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Cleaner environment through pure exhaust gases

Valves and dosing modules for SCR - Selective Catalytic Reduction - of NO_x exhaust gases from diesel engines

Valve assembly with plastic parts in the SCR aggregate.

Cleaner environment through pure exhaust gases

Bürkert's contribution for the clean use of diesel engines

Diesel aggregates have revolutionised the world and at the end of the 20th were made even more efficient. Today diesel engines are used in many areas. Whether in the air or on water, passenger car or ship, stationary for power generation or for propulsion of vehicles. The diesel engine shows its advantages in a wide variety of situations.

However, with the increasing number of diesel engines the emission values increase drastically. The nitrogen oxides that occur in the combustion of diesel fuel represent problems for our environment that are as significant as the problems associated with carbon dioxide. For example, nitrogen oxides, NO or NO_2, produce high concentrations of ozone on streets with heavy traffic.

A remedy is provided by a substance that reacts with the nitrogen oxides to form nitrogen and water - ammonia. This scientific reaction, SCR or selective catalytic reduction, points the way to a technology that ensures a cleaner environment. Only SCR catalytic converters reduce the nitrogen oxides to the degree now required by standards and directives. Ammonia (gaseous or liquid) is injected into the catalytic converter either in pure form as gas or in the form of a liquid urea solution (AdBlue). The higher the concentration the better.

The SCR technology is not new, it has been used for some time in power plants. The limit values for emissions that must be complied with in the future now ensure that this technology will also be used in construction machines, ships, power generators, transport vehicles and passenger vehicles. The important fact in this regard is that ammonia can be safely dosed with repeat accuracy. It is also important to keep dosing modules durable, compact and light. Bürkert is your single source for all technologies that enable these characteristics: Valves and sensors as well as plastics technology and system engineering.

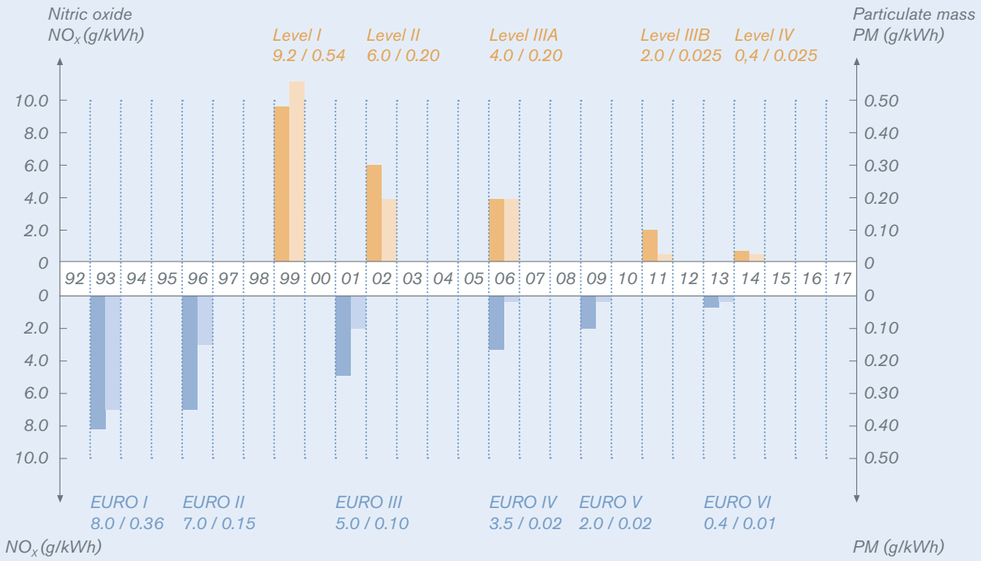
Reduction of pollutants in diesel engines

Diesel engines are powerful, reliable and efficient. Mobile commercial vehicles (on-road) such as trucks, buses, forklifts, excavators, ships, and stationary combined heat and power stations (off-road) for example are usually powered with diesel aggregates. Exhaust after-treatment measures that significantly reduce pollutants such as soot and nitrogen oxide emissions, in particular, through an optimised inner-engine combustion as well as in the exhaust, have contributed in this regard.

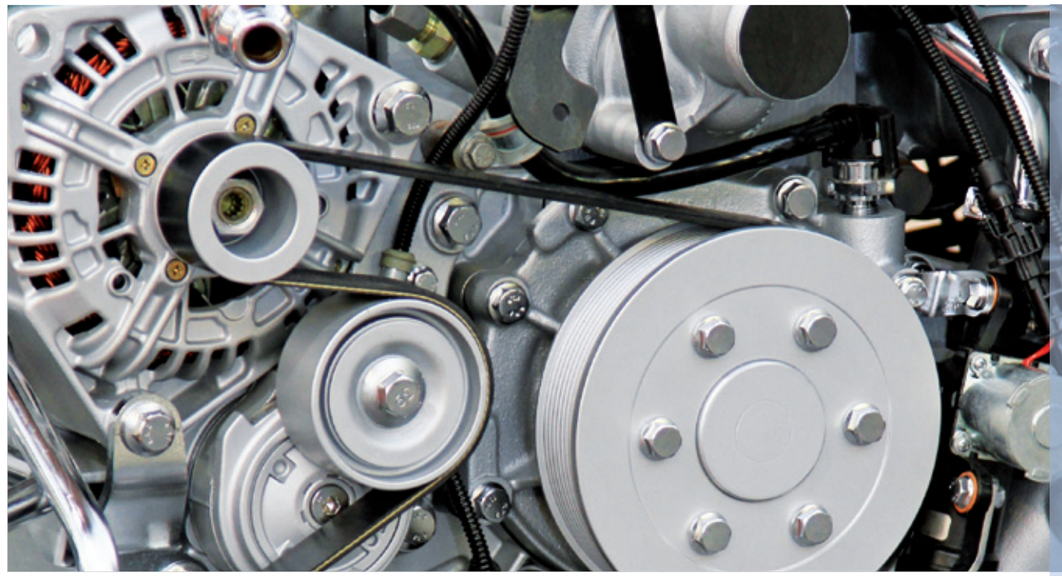
However the statutory regulations for further reduction of NO_x gases and particles, see graphic (level IV in the off-road area and Euro 6 in the on-road area), can only be achieved through additional emission reduction systems, uncoupled from engine operation. In this case, low-emission engines no longer conflict with general fuel savings.

Components, such as valves, sensors, or complete dosing modules in emission reduction systems with SCR technology, require a higher level of material resistance chemically and thermally, and a high level of physical leak tightness. Consequently, electromagnetic shut-off and control valves from Bürkert use specially encapsulated coils manufactured in-house. Bürkert engineers integrate these coils in dosing units of different capacity classes in a manner appropriate for the application. This guarantees an optimised, cost-efficient overall size, in addition to a significantly reduced variety of interfaces. Dosing modules increase the integrity and reduce installation and test complexity.

On-Road vs Off-Road



Jaussi / Liebherr, VDI conference for aftertreatment of exhaust gases in 2010

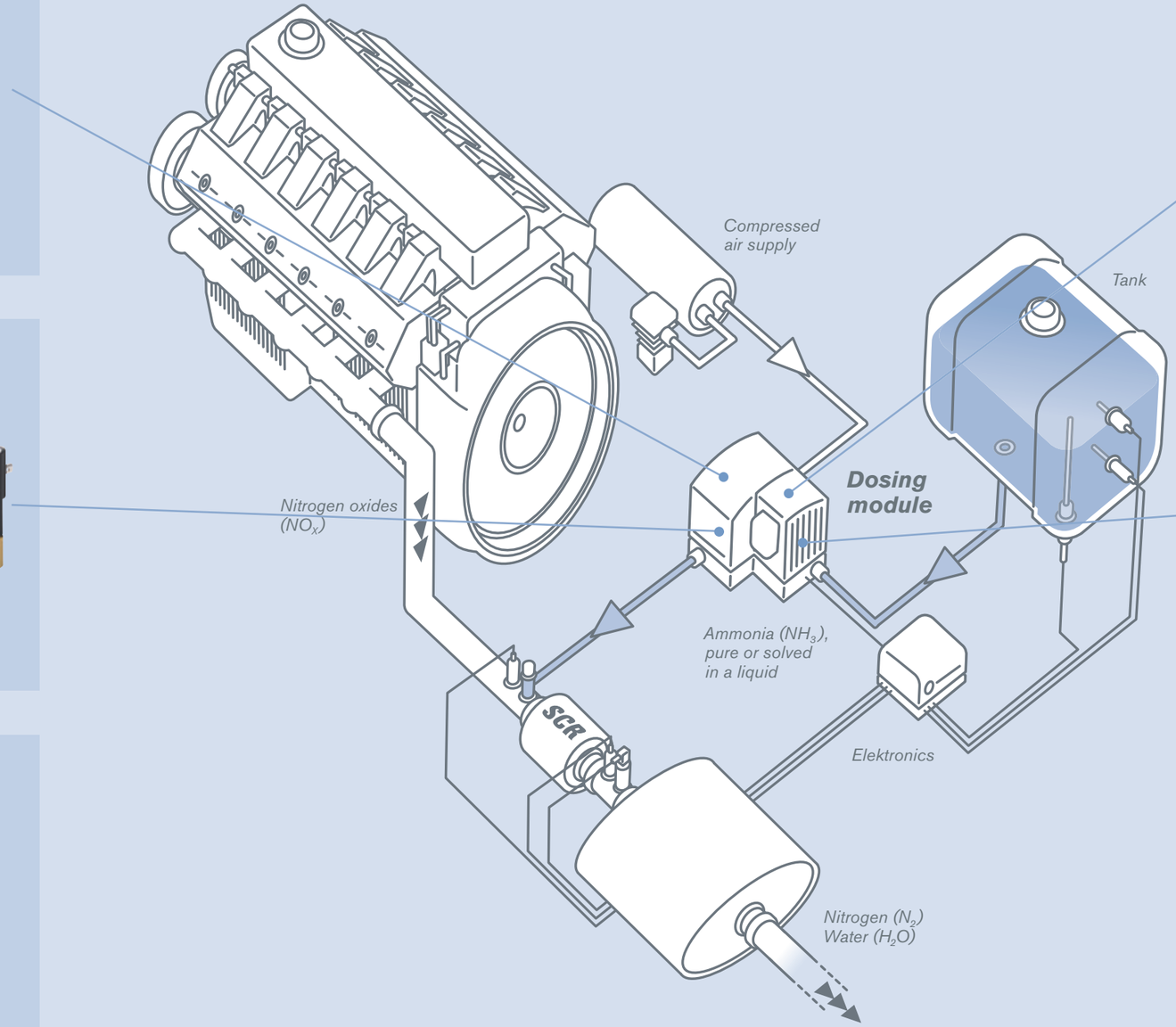


Fluid components for dosing gases and liquids

1 Electrical shut-off and safety valves

2 Control valves for dosing tasks

3 Mass flow controllers for air and ammonia



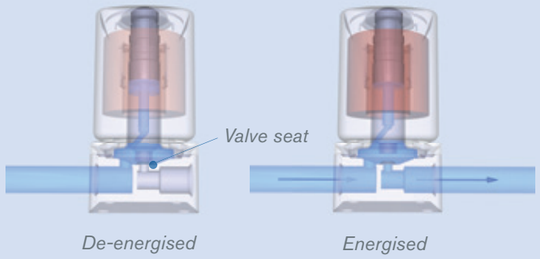
4 Integrated flow measurement unit for gases

5 Measurement of pressure, temperature and flow for liquids

6 System technology

Fluid components for dosing gases and liquids

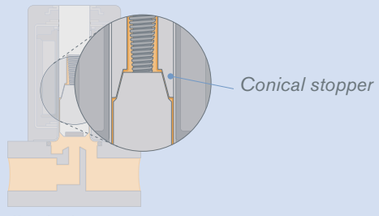
1



Electrical shut-off and safety valves

Dosing modules for gaseous ammonia or liquid urea, from which the ammonia for NO_x is obtained, require fast-switching electric valve technology. The task of the valve technology is to control the reactants (ammonia or urea), as well as the neutral nitrogen or compressed air that is used either for purging or conveying purposes. Use of two-way or three-way valves in flange versions enable a compact structure of the dosing unit. In addition to the technical control tasks, so-called solenoid valves switch off the reaction agents quickly and reliably, should this be required for safety reasons or as part of the dosing strategy. Specially qualified sealing materials ensure lasting and reliable leak tightness. Medium-separated solenoid valves enable an even longer service life. In this regard the valve's actuator is not in contact with the medium.

2

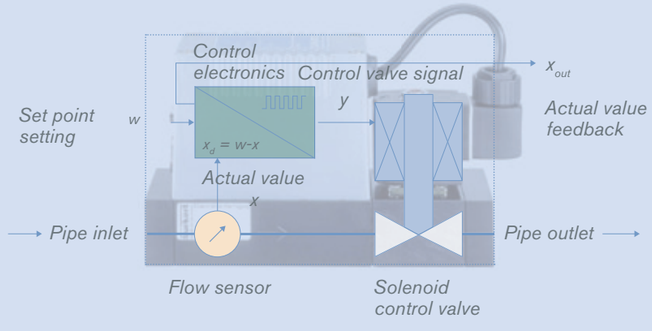


Conical stopper geometry (solenoid control valve)

Control valves for dosing tasks

The dosing strategy can be efficiently implemented with solenoid control valves that have an incomparably high control range (as much as 200:1). These valves have a lot to offer in a simple manner, consequently the costs remain minimal. Through PWM activation of the coil a moderate magnetic force is adjusted so that this force, counter to the return spring force, holds the plunger that activates the valve in a certain position. Friction-free guidance of the plunger is extremely important. The nominal diameter of the seat can be as small as 0.05 mm or as large as 8 mm. A sealing element is integrated in the plunger that acts on the valve seat. This means that such valves can also take over a shut-off function. Such valves can compensate for the non-linearity of the injectors, when they are used as control valves for the forced air. Variants that are resistant to ammonia and urea are also available.

3



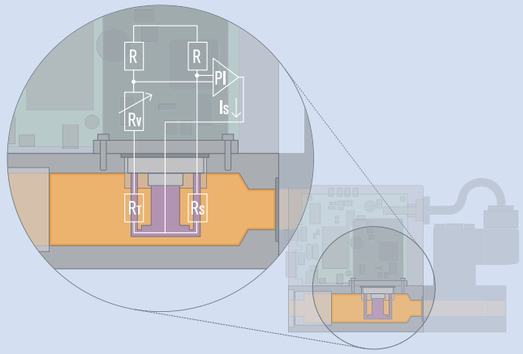
Mass flow controllers (MFC) for air and ammonia

Temperature-independent and gas pressure independent mass flow control of gases, such as air or ammonia, with a control range greater than 50:1 (2-100%) requires a reliable, precise and also chemically resistant sensor system with a long service life, as well as precise control valves. MFCs with thermal flow sensors, solenoid control valves and a sophisticated flow mechanism form a control loop and are outstanding at handling the task. These devices receive a flow setpoint, controls it and signal back an actual flow value, with analogue or digital signal technology. They are calibrated to the required full scale value and the desired flow unit (mass or volume).

Fluid components for dosing gases and liquids

Integrated flow measurement unit for gases

For the flow measurement, also of the gaseous ammonia, sensors are qualified in accordance with the thermal flow measurement, but also differential pressure principle. The thermal flow sensors offer an outstanding price/performance ratio, they are compact and ideally can be integrated in dosing modules. Due to its MFC portfolio, Bürkert has the required flow mechanics competence that ensures that the fluid-engineering efforts can be kept at a minimum. The sensors available for the dosing modules offer a high span, short response time, and the possibility of temperature compensation. These sensors are integrated exclusively in customer-specific Bürkert systems. The measuring span for differential pressure sensors is significantly smaller than it is for thermal flow sensors. By detecting the differential pressure via an orifice, the flow rate can be determined.



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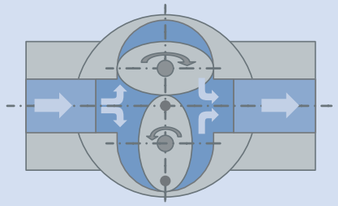
Measurement of pressure, temperature and flow (liquid)

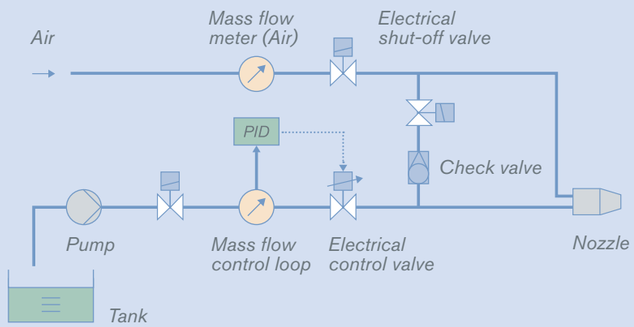
Fluidical dosing modules in SCR systems contain pressure sensors and temperature sensors. For example, the pressure monitoring indicates a required minimum pressure of the ammonia gas. If the temperature is also detected, then it can be ensured with certainty that gaseous ammonia is present, as required. In the gaseous state the materials of system components are subject to less stress. For liquid urea, temperature detection ensures that the system is above freezing. If the air pressure in AdBlue systems is right, then the suction mechanism of the injector is ensured. If AdBlue is conveyed out of the tank, via a pump, flow sensors detect the flow rate and thus enable the required dosing in the SCR catalytic converter, appropriate to the engine strategy. Moreover, as is the case for gaseous media, the differential pressure measurement technology is also available.



5

System technology

In addition to development of standard products, such as MFCs (Mass Flow Controllers) customers profit from Bürkert's system solutions that are developed on a customer-specific basis. The valve repertoire and product portfolio is the basis for customer-specific system solutions. Thus customers profit from complete assemblies that are tailored to the application-specific task. In a system development all specific requirements are taken into consideration, whether vibration resistance, temperature range, reliable flow measurement, selection of materials, plastic design or other requirements.



6

Welcome to the Fascinating World of Fluid Control Systems

Measurement and control: When it comes to working with liquids and gases, we are at your side – as a manufacturer of sophisticated products, as a problem-solver with an eye for the big picture, and as a partner offering you reliable advice. Since we started in 1946, we have developed into one of the world's leading suppliers of Fluid Control Systems. At the same time we have kept our status as a family-owned business with a foundation of strong basic values to highlight the way we think and act.

EXPERIENCE

There are things which are not inherently yours. You have to gather them bit by bit. You receive them from others. And you constantly have to acquire them anew. That is what makes them so valuable. Experience is one of those things. For instance, because of our many years of experience with metering, controlling and analysing of fluids, we can provide our extensive services to you – from consulting, development, and 3D CAD simulating to testing and after-sales service. Whether individual product solutions or a pioneering new system for the entire control process: Benefit from our experience!

COURAGE

Those who only work toward optimizing things that already exist will eventually reach the limits – technically, financially, or personally. In order to overcome these limits, courage is needed: The courage to be different and trust one's own ideas; the courage to venture into the unknown, searching for new ways to develop products that have never existed before. We have this courage. By pooling and utilizing our competencies across all sectors, you benefit from our cumulative knowledge in metering of fluids – whether it is in water treatment, cooling or hygienic processing applications.

CLOSENESS

There are things we simply take for granted. Only when they are gone, do we realize how important these things really were. This applies in particular to closeness. Without closeness, it is very difficult to build relationships and a good understanding of one another. As an established medium-sized company, we know that. And that is why we are always there for you. Working with you, we develop the best possible solutions for your projects. Our global presence in 35 locations enables us to press ahead with sensor innovations for our customers around the world.

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