Acoustic decoupling

Reducing noise in mobile hydraulics

Reducing the noise level was an important motivation as far back as the development of plastic clamps to fasten hydraulic lines in the 60s. The focus is once again on the hydraulics as a source of noise with the electrification of mobile operating machinery. The Stauff product range includes solutions for the targeted reduction of vibrations and noise.

Stauff has extended the range by a special clamp body version, type CHC, to fasten thermoplastic corrugated hoses, which are used to protect and bundle electrical cables.

Images: Stauff

In general, plastic clamps can also be used for the protection or routing of electrical cables and cable bundles.

In recent years, most manufacturers of compact and mini diggers have developed a range of machines with electric drive in parallel to their traditional product range. At the outset, these electric diggers were regarded sceptically, but have now captured their market despite their higher procurement prices. There are many reasons for this: Operating these machines produces neither exhaust gases nor noise emissions, and their performance is now almost equal to that of conventionally powered machines. This profile of properties is especially sought after on inner-city construction sites. It is therefore to be expected that electric drives will prevail in ever higher performance ranges, and not just on diggers. Noise reduction by acoustic decoupling is also an issue with other mobile and electrically driven machines – for example with municipal vehicles. In agriculture, the needs of the user are particularly important: it is easier to work with greater focus in an electric tractor with noise-reduced hydraulics.

Two sources of hydraulic noise emissions

With conventional diggers, the internal combustion engines (specifically: engine and exhaust noise) are the number one sources of noise. This is followed by operating noises that occur, for example, during excavation – for example, when the digger bucket hits stony ground. Generally, the hydraulics are only the third most common emitter of noise. The order is different with construction machinery fitted with electric drives. Their motors operate quietly, and the operating noises occur only occasionally. This places the focus back on the hydraulics as a source of noise.

Basically, a distinction is made between two sources of hydraulic noise emissions. The primary source is the operating noise of the pump. In addition to the noise of the drive itself, the movement of the hydraulic fluid, triggered by the pump, including the pressure pulses in the oil circuit, tends to dominate. The influence of this source can be reduced by low-pulsation or low-noise pumps, and further minimised by damping elements, such as rubber-coated metal rails. This addresses another important solution: acoustic decoupling. It concerns reducing the spread of structure-borne sound.

Acoustic decoupling

This approach addresses a noise source that contributes more to the sound level than the primary emission, especially in hydraulics. The pumps and the hydraulic fluid that moves or pulsates due to the actuators in the system cause surrounding components, such as lines and containers, to vibrate. This can be felt as vibrations and subsequently as sound emissions. These noises are not only propagated in the hydraulic system along the widely branched lines, but are also amplified by causing other system components and, if fixed, adjacent components to vibrate. Converted into airborne sound, they then reach the human ear as an unpleasant roar.

Plastic clamps to fasten hydraulic lines were developed by Stauff, the German developer and manufacturer of components for hydraulic line systems, some sixty years ago. Among other things, their aim was to dampen vibrations and noises in the hydraulic system, and they have significantly helped with sound decoupling. The basic version of these plastic clamps reduced

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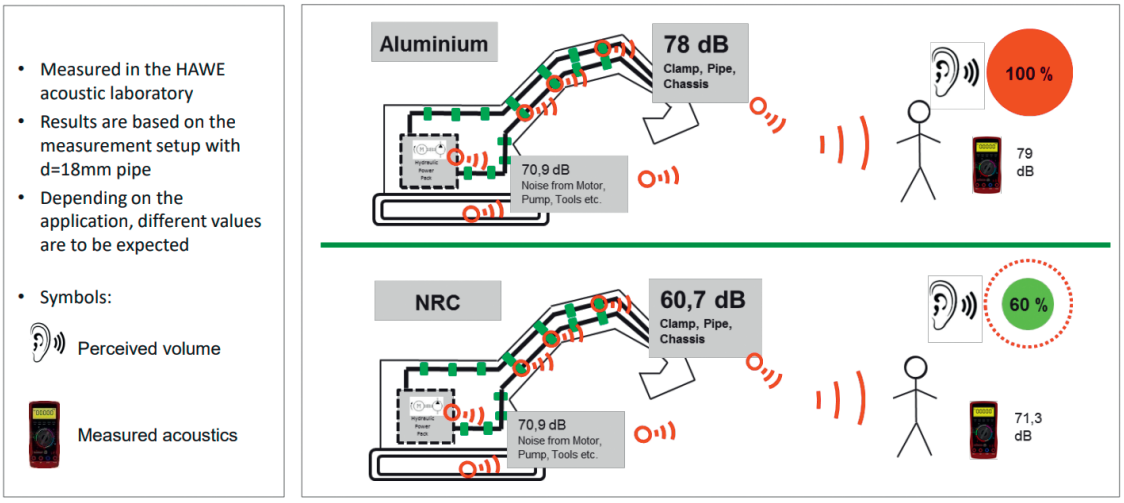


the transmission of vibrations and structure-borne noise. However, these clamps have been further developed over decades and with their differentiated property profiles thus fulfil varied applications in mobile and industrial hydraulics. An elastomer insert in STAUFF RI clamps guarantees an even greater damping effect.

Noise reduction with the NRC clamp

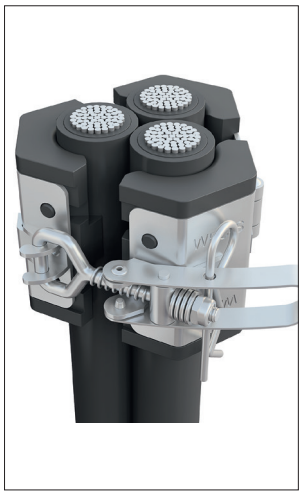
Stauff has developed the NRC clamp specifically for applications in which strong vibrations affect the hydraulic line system, and noise emissions affect the user. The "Noise Reduction Clamp" was originally developed for use in shipbuilding, where high demands are fundamentally placed on noise reduction, especially on passenger ships. This concept has been successfully transferred to other applications, with the result that manufacturers of electrically driven construction machinery have a product that has already been tried and tested under diverse loading.

NRC clamps guide tubes in a specially formed two-part elastomer insert that is integrated into the plastic polypropylene or polyamide clamp body. The contour of this insert, which was developed by Stauff Engineering in Werdohl, among other things, in the course of tests in its own sound laboratory, has a particularly small contact area to both the tube and the clamp body. This results in the mechanical damping of vibrations in the line and thus correspondingly reduces the noise level to a minimum. These clamps are compatible with the con-

Two questions to Dipl.-Ing. Oliver Wagner

What do OEMs need to consider if they want to expand their product range with electrically driven machines?
First of all, as with the development of construction machines with combustion engines, the hydraulic line system also needs to be included from the outset in electrically driven machines. This starts with the complete design and routing of the lines in the machine from the pump to the operating unit, and extends to the selection of the individual components, such as the tube and hose connections or the fastening elements. Our consulting services in this area are well known and used by many OEMs. Mobile hydraulics is now a particularly innovative sector and the machines have become increasingly complex in recent years, for instance in terms of equipment with sensors and actuators for automation processes or measuring technology for preventive maintenance. Accordingly, Stauff has already dealt extensively with the routing and fastening of electrical cables in recent years. Electrification of the drive is just one of the many requirements that OEMs approach us with.

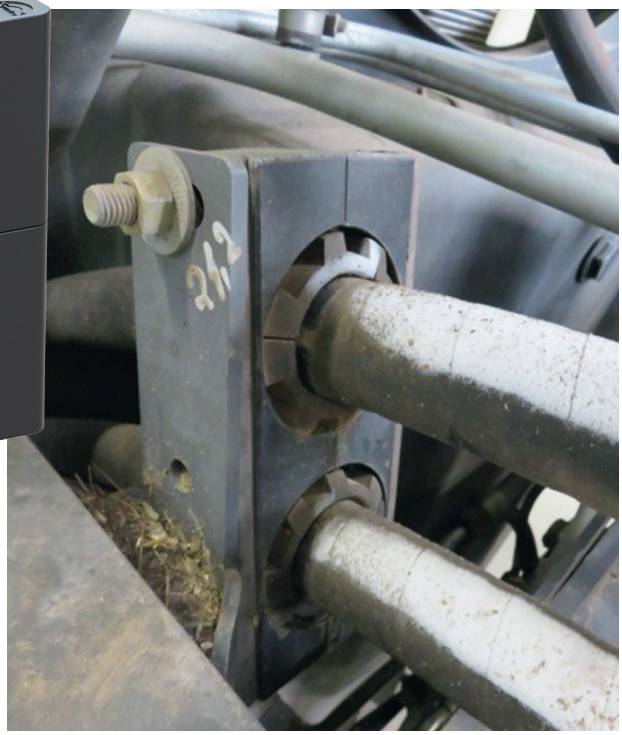
Has the Stauff product range been fundamentally expanded in recent years to include clamps for electrical and other supply lines?
JOne example of this is the CHC clamp, which we devel-oped to fasten corrugated hoses. It is now available in various sizes and is part of our standard range. However, we also design



special solutions, both for OEMs who are now developing electrically driven machines, and also for other innovative industries. For instance, our collaboration with a manufacturer of wind turbines resulted in the development of the WPC clamp (Wind Power Clamp). The requirements here are very specific: among other things, the retention forces have to be consistently high over a wide temperature range. The cables are protected by ultra-soft clamping jaws made of flame-retardant UL plastic. Straightforward, largely manual assembly is also critical in the special installation situation in the towers of wind turbines. Other sectors always benefit from our close cooperation with our customers' Engineering teams.

Dipl.-Ing. Oliver Wagner is a developer with a focus on electrical engineering in design and development at Stauff Germany.

In general, plastic clamps can also be used for the protection or routing of electrical cables and cable bundles.



The NRC clamp ensures the mechanical damping of vibrations in the line and correspondingly reduced noise levels.

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ventional, steel or stainless steel standard-compliant fastening accessories and can also be retrofitted if required.

Hose mounting version

An NRC clamp version, designated as the NRC-H, is available for fastening hydraulic hoses. Vibration reduction has a further benefit here: hose wear is minimised because constant micro-vibrations at the hose-clamp connections can cause melting at the contact ends, placing a heavy load on the hose material. This damage pattern is additionally prevented by the two-part elastomer insert protruding slightly beyond the clamp body at both sides. This aspect is often even more important for machine, plant and vehicle manufacturers than reducing operating noise. In principle, the contour of the insert for the NRC-H clamp has been adapted in such a way that it has the necessary clearance to change the outside diameter with pressure pulsations, and the hose remains securely fixed.

Also for electrical cables and cable bundles

In general, various models of plastic clamps can also be used for the protection or routing of electrical cables and cable bundles. This is a sensible (protective) measure in the conditions prevailing in mobile applications, e.g. on construction sites, and in view of the increasing equipping of electric diggers with sensors and actuators for automatic functions and preventive maintenance. For instance, Stauff has extended the range by a special clamp body version, type CHC, to fasten thermoplastic corrugated hoses, which are used to protect and bundle electrical cables. Last but not least, electrical cables can also be routed through tubes and thus are very well protected. The Australian company Safescape, for instance, uses this option in a high-performance vehicle with electric drive, specially designed for underground mining. Stauff Australia manufactured both the coolant lines and tubes to protect the electrical cables for the "Bortana EV" in its own Tube Bending Centre, and also supplied the appropriate fastening clamps.

Overall consideration and optimisation of the line system

It is not just the selection of the individual components, but, above all, consideration of the entire line system that helps to minimise vibrations and noise emissions. The movement of the hydraulic oil through lines and valves causes flow noises, which are amplified by turbulence, pressure fluctuations, and uneven flow conditions. The rapid opening and closing of valves and the associated pressure surges can cause noises that indicate that there is potential for improvement. The "quieter" the movement of the medium from the pump to the functional unit, the quieter the machine is. As part of its Stauff Line programme, STAUFF offers advice to OEMs at the initial concept and design phase and in the improvement of existing tube concepts – among other things with the aim of noise reduction. Pump manufacturers have also further developed their product range with the latest developments in mobile hydraulics and have reduced the volume of the loudest noise source after elimination of the combustion engine. *rso*