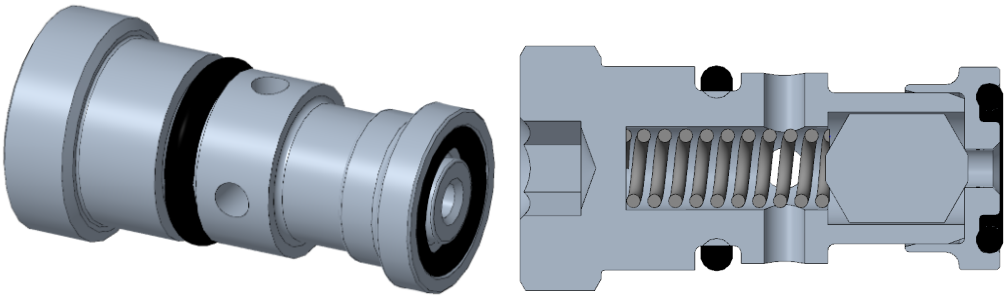
Making four-wheel-drive cars quieter and more efficient while improving performance

Most hydraulic systems are very negatively affected by air intrusion. One such system is the four-wheel-drive couplings of cars. When air enters the system the power distribution between wheels becomes difficult to control, since air is much more compressible than oil. A new type of valve has been designed that allows air to be removed more quietly and efficiently than before.

Traditionally an over-pressure valve, that opens when the system reaches a certain pressure, is used for letting air out. This is a simple and reliable solution. However, it is rather noisy and limits the pressure range that the coupling can use for torque transfer as the highest pressure has to be reserved for de-airing. By designing a valve that extracts air at lower pressures the noise is reduced and full potential of the coupling can be utilized.



Initially the valve is forced closed by a spring which prevents leakage. When the oil pressure (in the right side of the image) reaches a certain point, it will overcome the spring and transfer the cylindrical pin to the other side. Conversely, it will return to its original position when the spring overcomes the oil pressure on the other side. It is this small movement back and forth that allows air to escape past the small pin while keeping oil inside.

The design was developed by determining the most important criteria for a solution and then generating as many concepts as possible that could fulfill these. When the best concept had been found it was simulated and technical drawings were produced. These drawings will provide the basis for physical prototyping which will be the next step towards full scale production and implementation.

As the vehicle industry transitions to electric the demand for silent drivetrain components that can match the quietness of the electric motors increase. By having a silent coupling to provide four-wheel-drive the driving comfort of an electric vehicle can be maintained while contributing to better driving performance.

Fredrik Westling, *Automatic De-airing of a Hydraulically Actuated Torque Transfer System*