8. Noise emissions of control valves

8.1 Overview of noise calculation standards

The calculation methods used today apply to sound development from turbulence, compression thrusts and cavitation. A perfect model is not known.

This chapter refers to the published standards and cannot go to details of the improvements of the modified standards by SAMSON, which are a part of SAMSON valve sizing software and published in its help system and special publication: Reprint WA112en from Valve World April 2003:

“Evaluating the calculation provided by the relevant noise prediction standards for control valves” and WA 195 EN from Hydrocarbon Processing January 2008 “Improvement of IEC 60534-8-3 standard for noise prediction in control valves” Authors: Dr. Ing. J.Kiesbauer/ Dipl. Ing D.Vnucec SAMSON AG

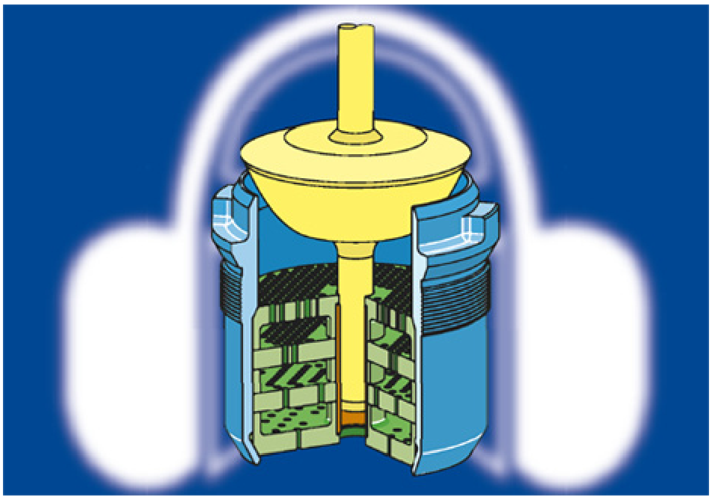

Figure 8.1.-1: AC-2 Trim

In the VDMA guideline 24422 (1979) a group of leading German control valve manufacturers and users from the chemical industry developed a simple, except for with limit ranges (relief into a vacuum or the open air, very small differential pressures) proven calculation method on an empirical basis for predicting the noise emission of control valves without particular sound reducing measures in the form of the sound pressure level to be indicated at 1 m away from the valve. Sound levels of low-noise versions calculated according to this can be corrected using the terms ΔL_G for gases and vapors and ΔL_F for liquids.

Planners of complex systems, however, frequently require the spectral distribution of the sound power converted in the valve and the connected system. As a result of this a completely revised version of the VDMA guideline was published in 1989 which starts with the internal sound power induced in the valve. The calculation of the frequency-dependent pipe for the sound Power emitted from the pipeline was taken from the VDI guideline 3733 (noises with pipelines).

This method was integrated for liquid flows in DIN IEC 534 part 8-4. In 1994 an American method also based on the internal sound power which was implemented for gas and vapor flows in DIN IEC 534 part 8-3. All of these methods have their weakness at certain points, however the VDMA guideline 24422 (1989) in conjunction with the VDMA sound measuring guideline 24423 (1993) (measurement of the internal sound output) was the best in the last decade.

This has been carried out by SAMSON AG due to extensive sound measurements (internal and external measurements with water, air and water vapor) over the last years. The following sound calculation standards are thus available in the valve sizing program. The

SAMSON standard method is always used first here. The necessary characteristic value suggestions in the program procedure are oriented with free entry; they are otherwise linked to the respective type when the SAMSON database is used.

The SAMSON standard calculation method is virtually the VDMA guideline 24422 (1989) with inlet characteristic values adapted to measurements and additional modifications to the original equations which plainly deviate from reality (e.g. G_2 differential pressure-dependent, frequency distribution above all with liquids). International only the liquid part of VDMA 24422 after some modifications became the first international IEC-standard 534-8-4 in 1994.

The vapor and gas standardized noise calculation method referred to the national US standard ISA 75.17 – 1989 and became first an IEC-standard 534-8-3 in 1996.

Improved accuracy are introduced with the actual new IEC Standard 60534-8-4 for liquids published in 2005-08 and IEC 60534-8-3 for gases published 2000-08 and a revised draft from 2008-08. International- and SAMSON experts develop the new standards. Reference measurements from SAMSON AG test rig are used.

8.1.1. List of major SAMSON AG modifications

Compressible flow media (gases and vapors)

- VDMA 24422 (1979)
- VDMA 24422 (1989) G_1 and G_2 load and differential ratio depended, a.o. G_2 modified for X < 0.2 for major SPL reduction because in case of smaller differential pressure ratios VDMA results are up to 20 dB(A) too high. Adding more frequencies 31.5 to 250 and 16000 Hz.
- DIN IEC 534 Part 8-3 SAMSON modified on the basis of VDMA 24422 (1989) and VDMA 24423 (1993): F_d from measurements not from geometric data.
- DIN IEC 60534 Part 8-3 2000-8; Draft 2008-08
  Include methods to calculate any low noise design by specific measurements e.g. SAMSON flow dividers St I; St II; and St III

Improved accuracy in IEC 60534-8-3 Draft 2008-08 by adapting the level coefficient $A\eta$, the acoustical efficiency factor r_w and the Strouhal number St_p to the measured data of several valve design- and size parameters (about 3000 measured points from SAMSON R&D). Improved calculation of the pipe transmission loss TL(f)

Non-compressible flow media (liquids)

- VDMA 24422 (1979) if $x_F > z$, ΔL_F correction for SPL reduction at higher x_F values. e.g. x_F=0.6 to 1; SPL prediction in case of flashing $x_F > 1$.
- VDMA 24422 (1989) nearly identical to DIN IEC 534 Part 8-4 1994.
- SAMSON modified on the basis of VDMA 24422 (1989) and VDMA 24423 (1993) for higher accuracy: F_1 reduced from -8 to (-6 to -7) and load depended f (load C_v/C_{v100}); ΔL_F from measurements; Improvements of the pipeline transmission loss. More impact of higher frequencies than 3 dB/Octave; modified Strouhal- and peak number.