inter·noise 83

COMPENSATION OF PRESSURE AND VOLUME IMPULSES IN FLUIDS BY MEANS OF COMPENSATING CUSHIONS

Juval Mantel

Dr. Mantel & Partners GmbH / Acoustica GmbH
Simeonistrasse 11 Geula Street 12
8000 München 19, W.-Germany Haifa/Israel

Noise propagates in pipes along pipe walls and along the media in the pipes. In order to avoid body-borne noise, the insertion of elastic devices like expansion joints is used. In order to avoid propagation of noise along the fluid or other media in the pipes, sound attenuators or mufflers were used in the past /1/ + /2/. Investigation had shown that inserting elastic cushions in the media absorb the kinetic energy of volume or pressure pulses of the media. Thus the body-borne sound is attenuated in a way which is simplier and safer than the general use of elastic expansion joints which must be replaced from time to time /3/. The performance and capabilities of elastic fluid insertion will be shown and the analyses of the cushion as a lowpass filter will be made.

Controlling noise propagating along pipes and tubes is in general done by inserting expansion joints. However, practice has shown that these measures are not entirely satisfactory. Apart from the correct installment of the expansion joints into pipes (for the correct way to install expansion joints see figure 3), it is imperative to adhere to specific standards for dimensioning.

Since part of the energy is propagated in water (I_F) and part of the energy is propagated in the tube itself (I_K) a model has been developped which shows the attenuation of sound level in tubes:

$$D = -10 \log \left[(1 - a)\, 10^{-\frac{D_k}{10}} + a k^{-2} \right]$$

The key to the used symbols is:

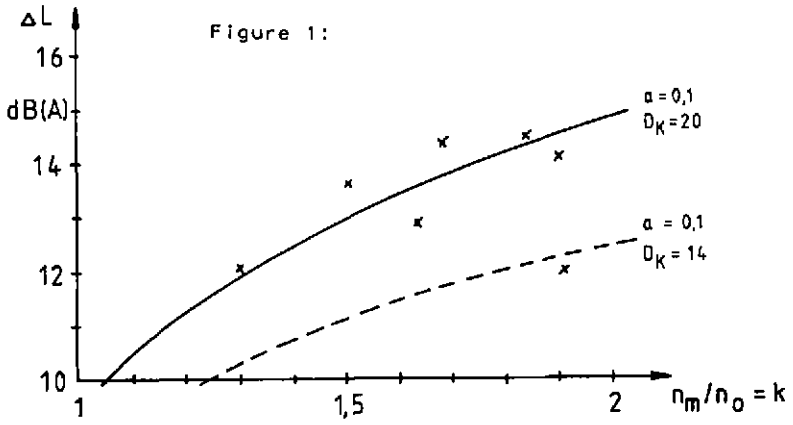
$$a = \frac{I_F}{I_F + I_K}$$

The relation between the compressibility of the pipe and liquid on the one hand and the attenuation of the sound level on the other hand depends on the attenuation of the "dry" expansion joint (this means the pipe is empty of water or fluid) and on the relation of the energy in fluid (I_F) and the total energy in pipe (see figure 1).

One can determine the insertion loss of the "dry" expansion joint with a shaker and can calculate the total insertion loss "A"- weighted for the spectrum of the used pump. This is done by the formula above. Comparison of the calculated insertion loss and measured insertion loss (figure 2) shows a good correlation except for the metal expansion joint.

In the lecture the planning standards for the practical use of expansion joints for water- or fluid-filled pipes will be shown as well as correct placing of the outer expansion joints and the cushion type, in the tube inserted expansion joint silencers.

Figure 1:



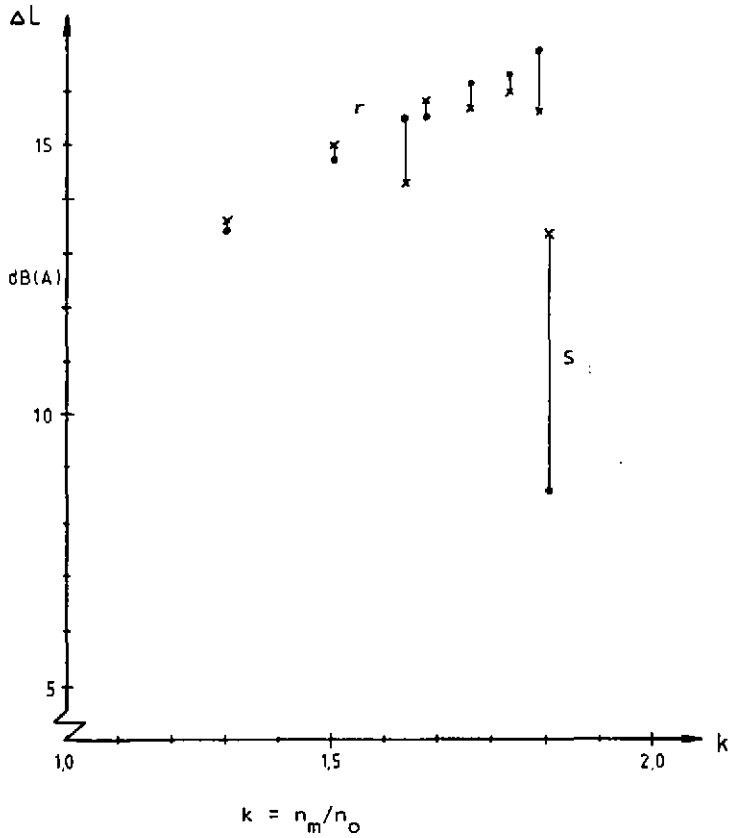


Figure 2: x measured
· calculated
r = rubber
s = steel

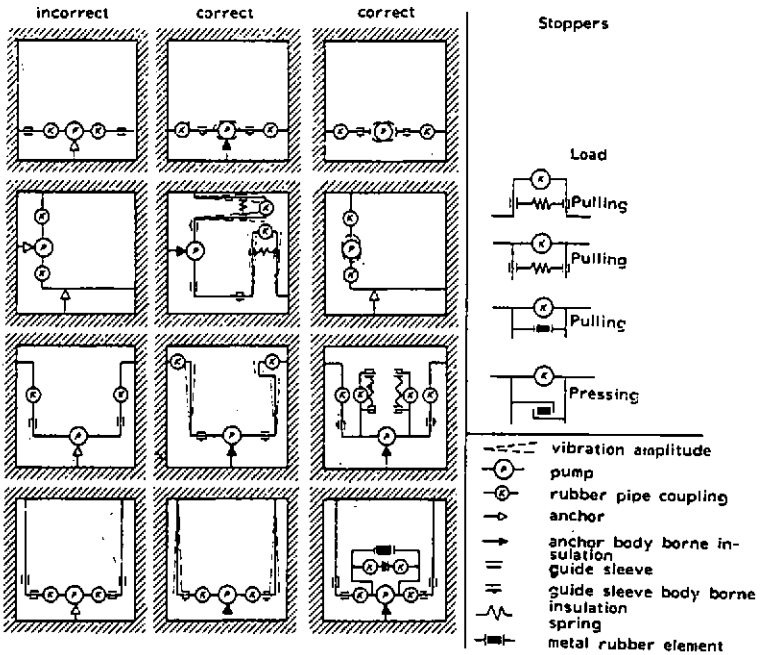


Figure 3: Example of incorrect and correct installation of expansion joints

References

/1/ J. Mantel Air-borne sound of presses, published in "VDI", 1975 June, pp. 575 - 577

/2/ J. Mantel Reduction of pumping noise by means of expansion joints, published in "HLH 28", 1977 No. 12, pp. 449 - 454

/3/ J. Mantel Investigation of the efficiency of expansion joints and similar devices for the reduction of water-borne sound in pipes (report for the Government of the Federal Republic of Germany (not yet published)