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NASA TECH BRIEF

Design and Development Criteria for Metal Bellows

Flow-induced vibrations of metal bellows used in fluid ducting systems reduce the flow efficiency and have been known to cause fatigue failures. The inability to predict flow-induced failures is related to the lack of understanding of the flow mechanism which causes the bellows vibrations.

Experimental and theoretical research was performed for the purpose of understanding and improving flow conditions of gases and liquids by minimizing pressure drops, surge pressures, and vibration levels in the fluid duct system. Significant findings included: (1) The fluid-elastic mechanism causing bellows flow excitation (vortex shedding) has been observed and described. Analytical models have been developed to allow a designer to predict when flow excitation may occur, and to estimate the severity of the bellows vibrations. Pertinent data in the form of equations and curves are presented. (2) A limited amount of information is presented to aid in the design of a conventional bellows liner which suppresses flow-induced vibrations. (3) Available data have been compiled which gives bellows pressure loss for various convolution geometries, various sizes, and various flow media. Existing bellows pressure loss correlation methods have been reviewed and future recommendations have been made. (4) A new elbow design has been conceived which results in a significant reduction in pressure loss. (5) Various bellows external damping devices have been tried as a means of suppressing bellows flow-induced vibrations. The results of these tests are presented to guide the designer in achieving vibration suppression.

Note:

Requests for further documentation may be directed to:

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No patent action is contemplated by NASA.

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