inter·noise 96
25th Anniversary Congress – Liverpool

INCE: 34.2

ANALYSIS OF THE ACOUSTIC PERFORMANCE OF RECIPROCATING COMPRESSOR MUFFLERS WITH SOUND INTENSITY

C Öztürk & A Acikgoz

Turk Elektrik Endustrisi AS, Research & Development Department, Davutpasa, Litros yolu 1, Topkapi 34020, Istanbul, Turkey

1. INTRODUCTION

This paper based on a case study performed to understand the acoustic features of mufflers developed for the reciprocating, refrigeration compressors. Experimental studies that include results of the Acoustic holography and sound intensity measurements are, all compared to figure out the acoustic perfomance of developed prototype mufflers in reciprocating refrigeration compressors. Results of the study indicate that muffler that gives better attenuation during the FEA analysis can also provide better efficiency in the reciprocating refrigeration compressors.

2. FEATURES OF THE MUFFLERS

Muffling devices are commonly used to reduce noise associated with internal combustion engine exhausts, high pressure gas or steam vents, compressor and fans. Muffling devices allows the passage of fluid while at the same time restricting the free passage of sound.

Suction and/or discharge mufflers are installed in the refrigerant lines to reduce the cylinder pressure pulsations that can propogate back along the suction line or forward through the discharge line to cause pressure pulsations in the shell cavity . These refrigerant gas mufflers are installed as close to the suction and/or discharge valves as possible. Mufling devices may suppress the generation of noise and attenuate the noise already generated and may carry or direct the noise away from sensitive areas (1).

Because of the pure tone characteristics (Pressure pumping harmonics) and the small space available, compressor mufflers are reactive type mufflers. Since they are composed only of chambers and passages, they can be fabricated at low cost and require no maintenance (2). A reactive muffler reduces the sound power entering the muffler by altering the acoustic impedance at the enterance of the muffler (3).

3. PERFORMANCE PARAMETERS

Mufflers are generally classifed according to their mechanism, effective frequency range, critical dimensions and dependence of performance on end conditions.

Prototype mufflers
Two different type of mufflers are tested and compared to evaluate the acoustic efficiency respectively. when the results become available, then further consideration about the suitability to the numerical analysis results are sought.

Predicting the attenuation at FEA
Attenatuations that were predicted with these prototype mufflers are shown at figures 1 and 2.

4.ACOUSTIC HOLOGRAPHY

The acoustic radiation mapping obtained by the acoustic holography techniques on the left side of compressor casing. Twelve microphones were mounted on the line of array. At each position of microphone sound pressure was captured. During this measurements BK 3551 front ends and number of microphone arrays were used together with the LMS Acoustic Holography software. Figures 3 and 4 illustrate the pressure distribution in dB at the frequency of 3600 Hz . Results clearly indicate the function of the prototype muffler.

The results of the Acoustic holography also provide knowledge on the radiation charancteristics that vary depending on the acoustic features of prototype mufflers.

5. SOUND INTENSITY MEASUREMENTS

Sound intensity measurements has been applied to determine the characteristics of the noise generation and radiation that comes through the reciprocating refrigeration compressors that works with protoype mufflers. Figures 5 and 6 illustrate sound field measured on the surface of hemisphere. Intensity measurements provided sufficient information on the radiated sound energy and source mechanism. The measurements clearly reveal the relationship between sound energy radiation and mechanical events in the cycle of pumping harmonics.

Results of the intensity measurements have been integrated with the information obtained from the two dimensional, spatial frequency spectrum with similar information content, i.e direction and magnitude as the single axis case.

In Small cross sectional areas of the prototype mufflers , sound propogates in the form of plane waves over most of the freqency ranges, Generated data for

behavior of the mufflers do not provide confidence. Results of the field measurements suit to the results of directivity analysis when calculated during the studies.

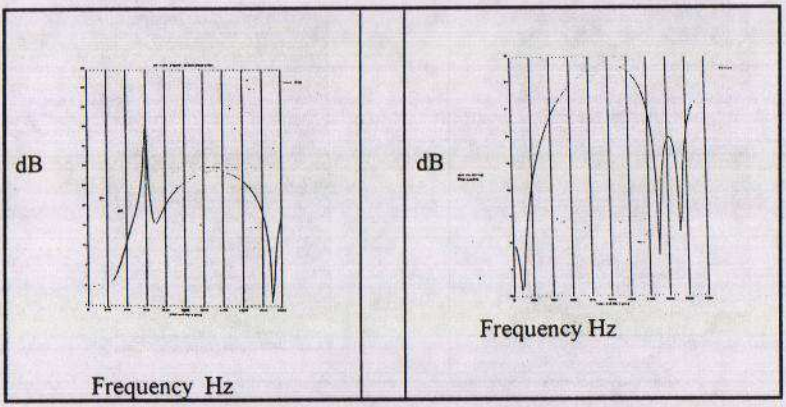
6. CONCLUSION

The conclusion of our studies indicated that by using the acoustical holograhy and intensity techniques it could be possible to have sufficient information on acoustic performance of prototype mufflers. The outcome of these studies suits to previous findings of FEA analysis that specifies attenuation in the frequency range of interest.

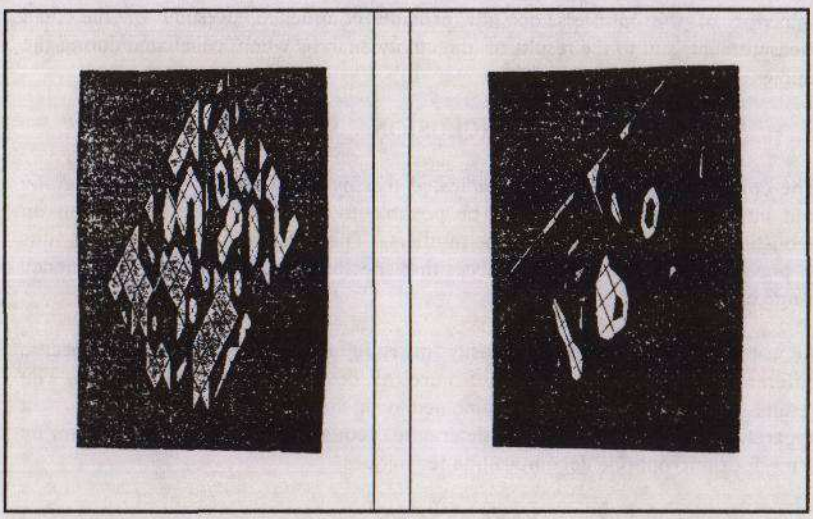
Acoustic holography and intensity measurements have shown the specific differences exists on the acoustical features of developed prototype mufflers. The results of these studies will be combined with the findings, obtained from test apparatus that were designed to determine acoustic performance of mufflers by using four microphone decomposition techniques.

REFERENCES

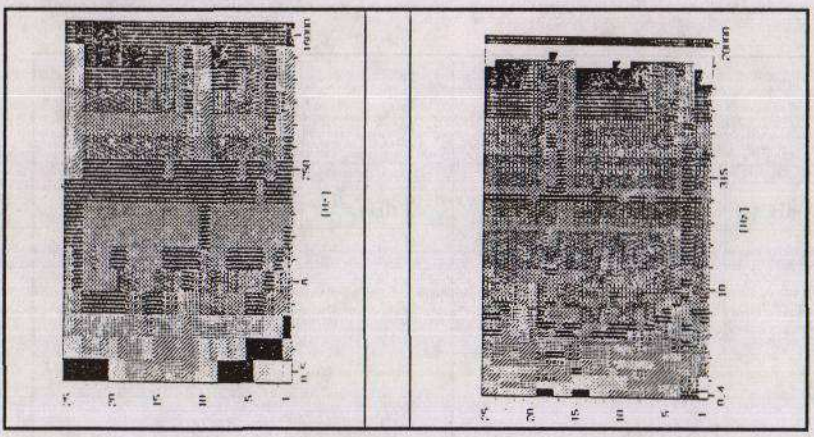
(1) J. F. Hamilton, Measurement and Control of Compressor Noise (Purdue University, (1988)
(2) P.O.A.L Davies, Practical Flow of Ducts , Journal of Sound and Vibration 124-1, 91-115 (1988)
(3) M.L.Munjal, Acoustic of Ducts and Mufflers, (John Wiley and Sons, 1987)



Figures 1 and 2 , Attenuation provided by the prototype mufflers within the frequency range of interest. They were predicted during FEA analysis. (Left muffler no : 1 "existing " , right muffler no:2 "new prototype")



Figures 3 and 4 , Acoustic radiation at 3600 Hz on the surface of acoustic field when different type of muffler protoypes located in the reciprocating refrigeration compressors. (Left muffler no: 1 "existing " and right muffler no: 2 "new prototype")



Figures 5 and 6 , Intensity on the surface of the noise field when different type of muffler protoypes located in the reciprocating refrigeration compressors. (Left muffler no: 1 "existing " and right muffler no: 2 "new ptotype")