PRECAUTIONS AND PROCEDURES FOR PRECISION PHASE MATCH OF MICROPHONES

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1. INTRODUCTION

Since the publication of the measurement data obtained with the NRC three-port coupler [1] for the precision phase match of condenser microphones, an effort has been made to extend the high frequency performance of the device to cover the phase response of 1/4 inch microphones. The aim here is to present our current research data, and to discuss some often encountered but less familiar aspects of precision measurement and instrumentation that are necessary to ensure precision phase match.

2. PRECAUTIONS

The theory of the phase match procedure had been described [1]. However, there are several important basic precautions :

Before any meaningful readings can be taken, and with the microphones inserted into the coupler, instruments for the phase match such as measuring amplifiers and preamplifier should be powered-on for several hours for temperature stabilization. It is essential that the microphones be at the same temperature as the acoustical coupler. With the microphones and the preamplifiers inserted into the microphone adaptors (or holders), the physical positions of the adaptors inside the coupler should be repeatable after the interchange of microphones. It is not realistic to expect precision phase match data when the measurements are performed during rapidly changing barometric pressure. It has been noticed that the small barometric pressure variation produced by opening doors of the laboratory has some influence on the level readings of the measuring amplifiers. Best results are usually obtained with the apparatus warmed-up over night.

3. PROCEDURES

The general measurement procedures are as follows :

With microphone (A) connected to Channel (A) of the measuring system, microphone (B) connected to the second channel (B), and with the driver of the coupler excited with sine waves over the one-third-octave frequency range of interest, the phase differences between the two channels were measured with a precision phase meter.

With microphone (A) connected to Channel (B), and microphone (B) connected to Channel (A), i.e. inter-changing the microphones, the phase readings were repeated, with special care given to repeat the measuring amplifier gain settings at each of the one-third-octave frequencies that had been used in the first measurement described above.

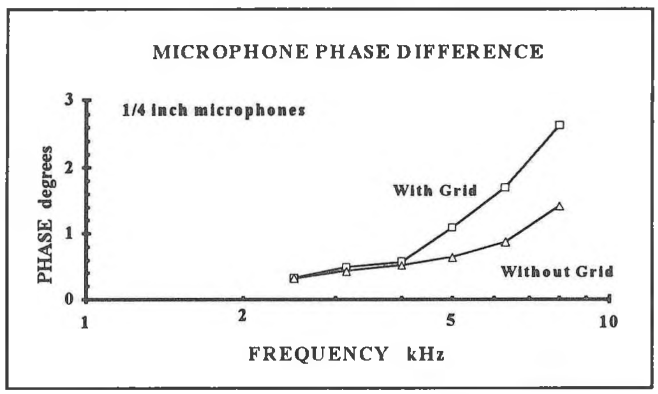
With the above two sets of phase measurements, it has been shown [1] that the phase difference of the microphones under test, and the phase difference between the instruments (preamplifiers, measuring amplifiers, one-third-octave filters) of the two channels can be deduced.

Since the phase between the instruments in the two channels (excluding the microphones), can be measured very precisely by applying a common electrical signal to both channels of the system, the performance of the coupler can be verified by comparing the phase difference of the measuring instrument channels calculated from information supplied by the coupler method, with the corresponding phase difference obtained with direct electrical measurements. In other words, the measuring method described above has a self checking mechanism.

4. PHASE MATCH OF 1/4 INCH CONDENSER MICROPHONES

With the Direct Method [2], the coupler arrangement has two independent electronic channels i.e. two preamplifiers, two measuring amplifiers and two one-third-octave filters (Brüel and Kjær 2639, 2636 and 1617, respectively). The test microphones (Brüel and Kjær 4136) were not matched in sensitivity or phase and they were selected at random from the existing measurement microphones of the laboratory. For this experiment, whether the microphones are of the free-field or the pressure type is irrelevant since the physical dimensions of both types of measuring microphones are identical.

The phase difference between two ¼ inch microphones over the high frequency region is shown here. The measurements were made with and without the protective grids. In the figure shown below, it can be seen that with the protective grids in place, the phase difference between the microphones is larger than the corresponding readings obtained without the protective grids. The difference between the two curves was approximately 0.01 degrees at 2500 Hz, and increased to approximately 1.2 degrees at 8000 Hz. Similar observations were obtained with ½ inch microphones : The corresponding phase difference increases were 0.2, 0.5 and 0.6 degrees at frequencies of 4000, 5000 and 6300 Hz, respectively.



5. CONCLUSION

Special precautions have to be taken during precision phase match of microphones. Depending on the applications of the matched microphones, the protective grids have some influence on the phase match data.

6. REFERENCES

[1] G. S. K. Wong, "Precision method for phase match of microphones," J. Acoust. Soc. Am. **90**, September (1991).

[2] G. S. K. Wong, "Microphone phase response measurement methods," Inter-noise91 Proceedings, **2**, 1045-1048, Sydney (1991).