inter·noise 83

DEDICATED COMPUTER CONTROL FOR ACOUSTICAL TESTING OF SMALL BUSINESS MACHINES

S.P. Cruickshank and M.J. McLaughlin

International Business Machines Corporation, 1000 Northwest 51st Street, Boca Raton, Florida.

INTRODUCTION

There is an increasing demand for noise measurements to be taken on small business machines and computers. Noise measurements are relatively time-consuming and can be made in several different ways. One way to streamline the procedures and maintain reliable test results is through dedicated computer control. The following is a description of a unique automated method of measuring, recording and reporting acoustical sound pressure and sound power levels emitted from small business machines and computers.

GENERAL OPERATING PROCEDURE

A machine or system to be acoustically tested is placed in the center of a semi-anechoic chamber. For sound pressure measurements, four Bruel and Kjaer 4165 microphones are positioned the standard one meter away from the machine to be tested. The microphones are calibrated daily with a Bruel and Kjaer 4230 calibrator.

Daily background noise levels are measured and compared to the corresponding sound pressure levels produced by the machine during a normal operational run. If the background noise levels are not at least ten decibels below the machine noise levels, then a correction factor is added to the results.

Sound power measurements are made on machines one cubic meter or smaller in size. Five Bruel and Kjaer 4165 microphones are situated on a rotating boom suspended from the ceiling. An acoustical hemisphere is defined as the boom rotates around the machine and measures

the sound power levels emitted.

An internal pink noise is applied to the acoustical instrumentation for weekly calibration of the General Radio 1566 bandwidth filters.

Impulse noise measurements are taken with a Bruel and Kjaer 4165 microphone connected to a Bruel and Kjaer 2636 measuring amplifier.

All of the acoustical instrumentation mentioned is interfaced to an IBM 5120 computer whose software was designed to automatically calculate, record and report sound pressure levels, sound power levels and impulse noise levels emitted from small business machines or systems under test.

CHAMBER CHARACTERISTICS

The semi-anechoic chamber working space is 6.1 meters by 7.3 meters with a ceiling height of 3.66 meters. The walls and ceiling are covered with sound absorptive wedges 66 centimeters in length. The floor is covered with an acoustically solid material.

The reflective floor is mounted on air bags designed to isolate noise and vibration interferences from other work areas. Springs are used to adjust or pull the room into position. With the use of this type of restraint, the basic integrity and efficiency of the isolation system is maintained.

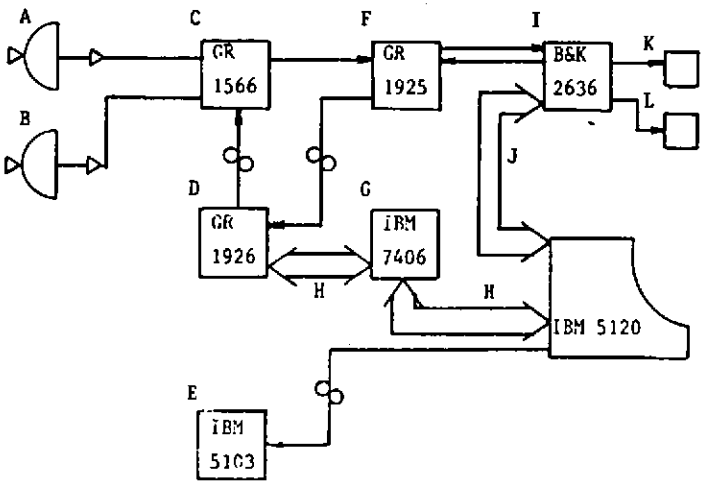
The semi-anechoic chamber is equipped with double doors. The inner door contains the same sound absorptive wedges as the ceiling and walls. Rubber seals are mounted to the outside edges to ensure an acoustic enclosure. The outer door has metal grounding fingers around its perimeter which sheild the room from any interfering radio frequencies.

Constant temperature and humidity control for the semi-anechoic chamber is accomplished through an acoustical reduction muffler duct system. The system makes use of two intake entrances and two exhaust air ducts.

EQUIPMENT CONTAINED IN THE RACK

The equipment and instrumentation (filters, multichannel amplifiers, etc.) are situated together in a rack and operated automatically through an IBM 5120 computer by way of an IEEE 488/GPIB bus and an IBM 7406 Device Coupler.

The following block diagram displays the instrumentation the system used:



A: Four standard microphones
B: Five microphones on boom
C: GR 1566 multichannel amplifier
D: GR 1926 multichannel RMS detector
E: IBM 5103 printer
F: GR 1925 1/3 octave multifilter
G: IBM 7406 Device Coupler
H: 8-Bit TTL I/O
I: B&K 2636 measuring amplifier
J: IEEE-488, 1978 bus
K: Rockland 512/S FFT
L: Monitor

SOFTWARE

A program was developed to measure, record and report noise levels emitted from machines or systems under test. The noise levels are reported for both 1/3 octave band frequencies and overall A-weighted sound levels. Once execution of the measurement procedures is completed via the 5120 computer host, the operator is free to extend his/her attention to other parameters of the test.

Sound pressure levels may be automatically measured once the microphones are situated in the four standard positions, one meter away from the machine to be tested. A fifth operator position may be reported optionally if required. Impulse data may also be collected per microphone position and separately reported on the final data sheet.

The software is designed to automatically check for puretones. If the system measures a decibel level greater than five from one octave band frequency to the next, the program will automatically identify the reading as a possible puretone. The operator will then analyze the readings with a Bruel and Kjaer 4165 microphone and a Bruel and Kjaer 2107 narrow band frequency analyzer. Once the puretone frequency and decibel level is defined, the program will prompt the operator for the puretone readings and will automatically correct the measurements for the puretone annoyance factor.

DATA REPORTING

Before beginning a test, the program will prompt the operator for information to be reported on a cover sheet. The cover sheet will contain such information as the date of test, the product name, model and serial number, and a description of the laboratory and equipment used to take measurements. Once the cover sheet is completed, automatic acoustical testing may begin.

At the end of each accoustical test run, a printout is generated containing the following information.

- Date and run number automatically chronologically listed
- Chart listing decibel levels per frequency band for each of the standard four microphone positions
- Chart listing decibel levels with standard correction factor for A-weighting reported per frequency band for each of the standard four microphone positions
- Description of run (i.e., machine at idle)
- Average A-weighted decibel levels per microphone position
- Maximum A-weighted decibel levels
- Overall average A-weighted decibel level
- Optional data: impulse, puretone correction factors and operator decibel levels.

SUMMARY

The dedicated-computer control system has many benefits other than significant time savings and reliability in data reporting. Consistent data is maintained from test to test. Full data reporting is automatically accomplished at the end of each test run. For systems or machines one cubic meter or smaller, sound power measurements are easily taken with minimal set up required. Most any combination of acoustical testing is available with the ease of entering a simple command into the IBM 5120 computer host.