



# TECHNICAL TALK

by JULIAN D. HIRSCH



● **AMPLIFIER TESTING:** In the February 1964 "Technical Talk" I discussed the Institute of High Fidelity (IHF) standards for making tuner measurements. The Institute also has another standard, IHF-A-200, dated September 1959 and titled *Standard Methods of Measurement for Amplifiers*.

The IHF amplifier standard is, by and large, well thought out and quite comprehensive. It is unlikely that any industry-wide measurement standard will ever satisfy all parties concerned, but most manufacturers do adhere to portions of this one, and I follow it wherever it is in accordance with my personal testing philosophy and my test facilities—which is most of the time.

According to IHF-A-200, the power-line voltage fed to the amplifier under test should be exactly 117 volts rms. A deviation of only one or two volts can significantly modify the power-output capabilities of an amplifier, so I monitor line voltage with a laboratory voltmeter accurate to 0.75 per cent. Some amplifier manufacturers use 120 volts or even 125 volts as a basis for rating their products. When testing an amplifier rated under such conditions, I test it at 117 volts so that it can be compared to other makes, and then I check it at its rated line voltage to confirm the manufacturer's claims.

The IHF standard also requires that an amplifier be operated for at least one hour, at one-third of rated output, before measurements are made. This is because the transformer windings have more electrical resistance when they reach full operating temperature, and this may result in a loss of maximum power output by as much as 10 per cent (as compared to the maximum output when the amplifier is relatively cold). I suspect that manufacturers sometimes rate their amplifiers "cold," but I always allow an amplifier to reach its full operating temperature before making any power measurements.

The load resistor that replaces the loudspeaker during measurements must not only be an essentially pure resistance (that is, it should have no inductance), but

it must be able to dissipate the full output power of the amplifier while maintaining its rated resistance within  $\pm 1$  per cent. This calls for special cooling precautions, because as the resistance element absorbs the amplifier's power output, it gets hotter and tends to change value.

Another procedure I follow, although it is not a part of the IHF standard (which pre-dates wide use of stereo) is to drive both channels of an amplifier simultaneously. This is a severe test, but one I feel is more realistic (after all, the channels will be operated simultaneously in actual use) than either single-channel or music-power tests.

**C**ONTINUOUS-POWER output is measured as a function of frequency, from 20 to 20,000 cps, at a specific percentage of harmonic distortion. I use 2 per cent distortion as a criterion, increasing the drive to the amplifier at each test frequency until the output distortion measures 2 per cent, and recording the power output. The IHF standard requires that power be measured with an accuracy of  $\pm 0.5$  db, or 10 per cent. This requires careful calibration of test equipment, since an amplifier's power output is notoriously difficult to measure accurately.

The music-power-output test requires that at full power output all significant amplifier power-supply voltages be maintained at their no-signal level. In practice, this means that the normal amplifier power supply must be temporarily replaced with a laboratory-type regulated supply, or that such special techniques as tone-burst power tests must be used. In the first case, there is an increased possibility of damaging the output tubes or transistors, while the second method requires some fairly elaborate test instruments. But quite apart from measurement problems, I have never been convinced that the music-power rating does more than provide a higher power-output figure for amplifiers of unexceptional performance, while it has almost no effect on the rating of a really good amplifier. Hence I do not make this test. (Continued overleaf)

## REVIEWED THIS MONTH

Thorens TD-224 Record Player



Cipher 800 Tape Recorder

Amplifier sensitivity is defined by the input voltage required to develop the unit's rated voltage or power output. I deviate from the IHF standard slightly in this case, and prefer to rate the amplifier in terms of the input needed to develop a standard (rather than maximum) output, which I have arbitrarily selected to be 1 volt (from preamplifiers) or 10 watts. This gives an indication of the input voltage required for a given listening volume, rather than for a maximum level that differs from one amplifier to another and may never be reached in normal use.

The IHF standard requires that harmonic-distortion measurements be made only at a single frequency (1,000 cps) at rated output, half output, and one-hundredth of rated output. However, I make this measurement at a number of power levels and plot the results graphically. In addition, I measure the intermodulation distortion over the same power range. Any appreciable difference between the harmonic- and IM-distortion curves is usually an indication of limited low-frequency power-handling capacity.

The IHF standard specifies that hum and noise be measured at maximum amplifier gain, with inputs

open-circuited and short-circuited. These measurements are then repeated at gain settings of  $-20$  and  $-40$  db. Instead of the latter measurements, I set the amplifier control so that a 1-volt, 1,000-cps signal into a high-level input (or 10 millivolts into a phono input, or 3 millivolts into a tape-head input) will drive the amplifier to 10 watts output (or 1-volt output in the case of a preamplifier). All hum-and-noise figures are then expressed as so many decibels below the 1-volt or 10-watt standard output.

There are certain other measurements not covered by IHF-A-200 that I make as a matter of routine. These include checking the tracking of the two sections of a dual gain control, the balance-control range, crosstalk from one input to another, stereo crosstalk, stability under capacitive loads, square-wave response, loudness-compensation characteristics, and power-line leakage current. The latter condition sometimes exists to such an extent that an unpleasant shock can be received when touching any part of the music system while also touching a radiator or standing on a concrete basement floor. For some reason, this check is usually ignored in evaluations of hi-fi equipment.