PURPOSE: Quick and accurate testing of voice coil thermal management.

SCOPE: This document is intended to be used in conjunction with the applicable ALMA International document(s) in which it is referenced. These referencing document(s) may contain general information not included in this document, but which applies to this document, thus it is not recommended to use this document outside of its intended context. In the event of conflict, information in this document supercedes information in the referencing document(s).

RESPONSIBILITY: ALMA International Component Standards Sub-Committee

RECORDS: This document will be maintained and kept on file by ALMA International. Measurement results shall be maintained by the entity performing the measurement.

RELATED DOCUMENTS:
ALMA International Nomenclature Prints (NP's)
ALMA International Dimensioning and Tolerancing Guidelines (DG's)
ALMA International Measurement Guidelines (MG's)
The Hisco Loudspeaker Voice Coil Handbook/Workbook

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1 Introduction

This elementary test allows quick and accurate testing of voice coil (VC) thermal management, under controlled static conditions, with a minimum of equipment. The results are highly repeatable, and relate directly to the thermal power handling of the coil, in that a coil that survives to a higher temperature in this test will survive at higher power in a loudspeaker. However, in a loudspeaker, there are several additional cooling mechanisms at work, such as forced air pumping, direct heat radiation into the steel, and heat conduction into attached parts. This test quantifies only thermal failures, and it is presumed that the mechanical modes, and the cooling effects of the surrounding steel would be a constant. If a new voice coil material or winding technique demonstrated superior performance in this test than the standard or reference type, then it deserves a full-scale evaluation and power test.

The measurement protocol is simply to apply a known amount of power from a variable voltage DC power supply to the static voice coil, and observe the steady-state current demand. From the ratio between the voltage and current, the DC resistance is easily calculated. From the change in the DC resistance, the temperature change in the coil can be calculated. Once the ambient temperature is added to this figure, the actual maximum operating temperature of the coil is determined. The test should be repeated at least six times, to establish an average result.

2 Required Equipment

- At least 6 samples of each type of VC to be tested
- DC power supply, capable of at least 50 volts and at least 8 amperes
- DC voltage/current/resistance meter, with indication to at least 2 decimal places
- Fireproof test bench covering

3 Method

Do not perform these tests in a small or closed environment, or in areas not protected by automatic fire fighting systems. The coils are subjected to thermal examination to the point of failure, and may produce unpleasant or irritating smoke and fumes.

Measure and record the direct-current resistance (DCR) of all of the VCs at room temperature, and the ambient temperature (T_A), which should be 23 ± 3 ºC.

Connect the first VC under test to the power supply, and place it on the fireproof surface, ensuring that there is no significant airflow around the Device Under Test (DUT).

Apply a moderate voltage, typically 12 volts, and allow the current to stabilize at a constant value, and record the voltage (V) and current (I). The time period required for the value to stabilize will typically be in the 30- to 60-second range.

Raise the applied voltage in 1 or 2 volt increments, and allow the VC to stabilize for 5 minutes, and then record the current. Repeat this routine until the VC fails, and ignore the final (failure point) increment.

Test the remaining VC samples, starting at 10 volts lower than the final value (of the previous test), and log the data for later use. After testing is completed, calculate the final DCR for each coil (in Ohms).

Calculate the ratio (K) of the new DCR to the original DCR, typically ranging from 1.5 to 3.2.

From the table, read the differential temperature (T_X), and add the ambient temperature (T_A) to this value to obtain the actual VC maximum operating temperature (T_{MO}). The values for Copper Clad Aluminum Wire can be calculated with a weighted (by percent composition by volume) average of the Copper and Aluminum values.

Copper Resistance K_C = 3.80e-3*T_X +1	Temperature Difference (T_X) ºC	Aluminum Resistance K_A = 3.93e-3*T_X +1
1.000	0	1.000
1.076	20	1.078
1.152	40	1.157
1.228	60	1.236
1.304	80	1.314
1.380	100	1.393
1.456	120	1.472
1.532	140	1.550
1.608	160	1.629
1.684	180	1.707
1.760	200	1.786
1.836	220	1.865
1.912	240	1.943
1.988	260	2.022
2.064	280	2.100
2.140	300	2.179
2.216	320	2.258
2.292	340	2.336
2.368	360	2.414
2.444	380	2.493
2.520	400	2.572
2.596	420	2.650
2.672	440	2.729
2.748	460	2.808
2.824	480	2.885
2.900	500	2.965
2.976	520	3.044
3.052	540	3.122
3.128	560	3.201
3.204	580	3.279

Revision History

Rev Level	Description of Change	Prepared/ Changed By/ Date	Approved By/ Date
DRAFT	Create document	John Busenitz 2/17/05	