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Subjects 464 (1480, 1638, 1971)
 (In reply, refer to Subject 464)

333 Pfingsten Road
 Northbrook, IL 60062
 December 7, 1995

Electrical Council of Underwriters Laboratories Inc.,
 Fire Council of Underwriters Laboratories Inc.,
 Subscribers to UL's Standards Service for
 Audible Signal Appliances
 Speakers and Amplifiers for Fire Protective Signaling Systems
 Visual Signaling Appliances – Private Mode Emergency and General Utility
 Signaling
 Signal Appliances and Equipment for the Hearing Impaired

SUBJECT: Report of the Meeting of the Combined Industry Advisory Conference of UL for
 Notification Appliances; Request for Comments

SUMMARY OF TOPICS

The following topics were discussed at the meeting:

1. Structure of the Subject 464 IAC
2. Length of Audible Signal Marking – UL 464
3. Rating – UL 464, 1480, 1638, 1971
4. Maximum Temperature Rises – UL 1480
5. Wave Form Analysis and Harmonic Distortion – UL 1480
6. Frequency Response and Audibility – UL 1480
7. Frequency Response Limits – UL 1480
8. Speaker Burnout Test – UL 1480

(Continued)

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SUMMARY OF TOPICS (Cont'd)

9. Impact Test – UL 1480
10. Audibility Test – UL 1480
11. Product Safety Markings – ANSI Z535.4-1991
12. Terminology of Visible vs. Visual - UL 1638, UL 1971
13. ADA and Synchronization - UL 1971
14. Colored Lenses – UL 1971
15. Polar Light Distribution – UL 1971
16. Standardization and Electrical Ratings – UL 1638 and UL 1971
17. Uncontrolled Environments – UL 1971
18. General Purpose Loudspeakers

COMMENTS DUE: February 7, 1996

A meeting of the Industry Advisory Conferences (IAC) of UL for Notification Appliances was held on November 6 and 7 at UL's Northbrook office. The purpose of the meeting was to discuss the items indicated in the "Summary of Topics".

Attached as Appendix A is a list of those who attended the meeting. Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix B of this bulletin regarding designated responsibility for the subject product categories. Attached as Appendices C - H are details of the items that were discussed. Appendices C - H are provided for information only. These items are NOT being proposed as revisions to the standards at this time.

Please note that proposed requirements were not developed at the meeting. Proposed requirements may be developed after UL reviews the comments received in response to this meeting report.

* * * * *

The following report is not intended to be a verbatim transcript of the discussions at the meeting, but is intended to record the significant features of those discussions.

DISCUSSION

1. Structure of the Subject 464 Industry Advisory Conference (IAC)

The IAC chairman, Isaac Papier, opened the meeting by introducing those present to each other and explaining the purpose of the IAC. He then discussed the makeup of this IAC and whether it was the proper forum for the subject standards. Multiple standards were being combined into a single IAC because of overlapping issues and manufacturing for products in these categories. All those present concurred that the IAC had the proper mix of representatives from the various factions of the industries covered to provide the necessary expertise and advice for the standards under review:

UL 464, Audible Signal Appliances

UL 1480, Speakers for Fire Protected Signaling Systems

UL 1638, Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling.

UL 1971, Signaling Devices for the Hearing Impaired

2. Length of Audible Signal Marking – UL 464

Currently, in addition to the Listing Mark text, audible signals are required to be marked with the wording outlined in Item E of paragraph 40.1.

1. "FIRE ALARM SERVICE" or,
2. "FIRE ALARM SERVICE" -- "PRIVATE MODE ONLY PER NFPA 72G" or,
3. "GENERAL SIGNALING (NONFIRE ALARM) USE."

UL suggested that the length of the text be reduced and that Item E of paragraph 40.1 be revised to indicate:

"An audible signal shall be marked for its type of service as defined in Section 3 (of Standard UL 464)"

UL would also revise Section 3 of UL 464 to include the definitions for Public and Private mode use as per NFPA 72. These definitions are included below:

3.1 "Audible signals not intended to be connected to a fire alarm system shall be considered for general signaling service.

3.2 Audible signals intended for fire protective signaling service are classified by operation for Public or Private Mode use. Audible signals for Public Mode operation are intended to notify occupants or inhabitants in the area covered by the fire protective signaling system. Audible signals for Private Mode use are intended to notify only those persons directly concerned with the implementation and direction of emergency action initiation and procedure in the area protected by the fire protective signaling system.

An example of how this would be implemented is as follows:

Current Requirements	Proposed
Audible Signaling Appliance for Fire Alarm Service	Fire Alarm Audible Signal
Audible Signaling Appliance for Fire Alarm Service, Private Mode only per NFPA 72G	Fire Alarm Audible Signal for Private Mode only
Audible Signaling Appliance for General Signaling (Non fire alarm) Use	Product name (Bell, Horn,...)

Unless marked, an audible signal for fire alarm service shall be considered for public use.

The representatives from industry were unable to come to a consensus on the subject. Various issues discussed involved how the continued texts could be combined with visual signal devices and speakers, how the fire alarm service notation should be included in the Listing Mark text, and coordination with NFPA and ADA. Further input from industry is requested.

On a separate marking issue, it was agreed that there should be the option of including the electrical rating information in the installation instructions manual.

3. Rating – UL 464, 1480, 1638, 1971

Currently manufacturers may add their own audibility ratings to the product or the installation manual. These ratings are always higher than UL's ratings because of the measurement method. In addition there is no consistency among the measurement methods employed. The majority of these methods are not based upon nationally recognized test methods and the measurements have not been substantiated by UL. The end result has been confusion in the field.

UL suggested that only the UL rating be allowed on the product and in the installation manual.

The representatives of industry suggested other international/nationally Recognized standards such as ISO, IEC, ANSI, or OSHA be considered and that data be accepted by UL if it can be verified (by test, check equipment, etc.).

Some representatives recommended that sound power level, rather than sound pressure level, be utilized because the value would be the same regardless of the test method, if the test method is ISO/ANSI recognized.

A related issue to this discussion was agenda item 10.

For strobes there was agreement that the peak candle power rating should not be permitted to be marked on the product.

4. Maximum Temperature Rises – UL 1480

Due in part to improved test methods for determining change in resistance, higher voice coil temperatures are being recorded. The temperature recorded may exceed the Class 105 and 130 rating presently noted in the Standard. Since UL recognizes higher temperature classes, the higher temperature readings will be considered acceptable provided the class of insulation used exceeds the measured temperature.

It was suggested that higher temperature classes should be added to Table 30.1, Item 4, as follows:

c.	Class 155 insulated windings	°C	°F
	Thermocouple method	110	198
	Resistance method	120	216
d.	Class 180 insulated windings		
	Thermocouple method	125	225
	Resistance method	135	243
e.	Class 200 insulated windings		
	Thermocouple method	140	252
	Resistance method	150	270
f.	Class 220 insulated windings		
	Thermocouple method	155	279
	Resistance method	165	297

And the following footnote added to the table:

All surrounding and/or adjacent materials shall be adequately rated such that there is no manifestation of fire or electric shock, nor possibility of material distortion which would affect the normal signaling performance of the device.

Also, the temperature of the voice coil may not adversely affect the coil form or adjacent materials. The manufacturer may be required to supply information concerning the temperature ratings of the surrounding material that form the connection means of the coil form to the baffle of the speaker.

There were no objections from the representatives except as the suggested changes applied to the voice coil. There was concern that the material specifications would not include appropriate temperature ratings that have been verified by UL. It was recommended that UL use the other tests in UL 1480 to determine the reliability and performance of the voice coil and surrounding materials, and utilize the speaker burn out test (Agenda Item 8) to determine fire and safety related concerns. Further input is requested from industry.

As an adjunct to this discussion one of the representatives of industry introduced another agenda item. The discussion is covered in Item 18.

5. Wave Form Analysis and Harmonic Distortion – UL 1480

The Wave Form Analysis test provides a convenient way of determining if a speaker sample has been affected by testing. The test procedure uses a microphone and oscilloscope to monitor sample output. If the wave pattern of the signal has been distorted, the test operator is then instructed to proceed with the Frequency Response test in the reverberation room. The Wave Form Analysis test has been referred to as the referee test in that it is subjective in nature and serves only to determine whether additional action is required in the evaluation of the speaker.

Since this is not a voice intelligibility test, UL feels that the test does serve a purpose as a screening procedure to expedite the assignment and keep costs down to the client.

In addition to the Wave Form Analysis and Frequency Response tests, UL is considering adopting a Harmonic Distortions test. This action is being considered in order that we coordinate our requirements with UL of Canada. Copies of the Canadian test addressing harmonic distortion measurements were included. See Appendix C. This was reviewed and discussed by the IAC.

There was general consensus that the harmonic distortion test replace the wave form analysis test, and that the frequency response test be done as an initial test on representative samples and as a final test after all the applicable conditionings. It was agreed that the frequency range should be 400 - 4000 Hz rather than 60 Hz to 20 kHz.

It was also voiced that the 7% THD may be unrealistic. One representative indicated that there has been some research done on determining an acceptable level of intelligibility. Further input is sought regarding an acceptable THD level.

Representatives requested that UL review the THD limits in UL 1711 and determine whether a total end to end percent THD limit can be proposed.

6. Frequency Response and Audibility – UL 1480

Both the Frequency Response test and the Audibility test are conducted at the same time. The amplifier system of the sound lab is programmed to produce band limited pink noise. The resulting audible output from the test sample is plotted in 1/3 octave bands. The band limits for the UL test have historically been 400 to 4,000 Hz.

When evaluating the speaker for each of these tests, the same signal format is used. Therefore, in order to save cost and time, the test signal is produced once and the data extracted that is necessary for the parameters specified in each test. For the Frequency Response test, UL only examines the frequencies between 800 and 3,150 Hz. These frequency limits were chosen because the Industry indicated most of the distortion would occur within this window. On the other hand, the band limit of 400 to 4,000 Hz is used to determine the total sound power output detected by the human ear.

Since the same type of signal is used for both tests and the method of extracting the information does not interfere with the data of the other tests, there appears to be no reason to separate these tests. UL asked if discreet separate audibility and frequency response measurements should be obtained using different methods? UL provided suggested wording which reflect the methods used to conduct the test. The suggested changes are shown in Appendix D.

The representatives agreed with the concept of the proposal and recommended some modifications. These included that the standard indicate that the measurements are A weighted and that the limits should be expressed in bands rather than center frequencies.

7. Frequency Response Limits – UL 1480

The Frequency Response test is intended to determine if the output signal strength from the speaker is approximately the same throughout the voice frequency band. After discussions with the industry 15 to 20 years ago, UL adopted the frequency band limits of 400 to 4,000 Hz as the voice frequency band.

An accepted method for measuring sound power output is to use a pink noise source and measure the power output of 1/3 octave segments of the voice frequency band. The total power output is then calculated by summing the power measurements of each 1/3 octave and determining the average value.

During earlier discussions, UL and Industry agreed that the Frequency Response measurements would be used to profile the signal strength by plotting the power output measurements at each 1/3 octave. The data window shown in Figure 25.1 shows the limits each 1/3 octave point has to remain within, in order for the complete voice band to be considered relatively constant.

Over the past year, some of Industry has indicated that the window is too restrictive and may prohibit better designs. Because of this new input, the present limits were discussed to obtain a consensus on the proper limits. There was no clear consensus, UL plans to retain the present frequency response and maximum acceptable distortion pending further investigation.

8. Speaker Burnout Test – UL 1480

The present speaker burnout test in UL 1480 basically consists of applying a 1 kHz square wave tone at 130 percent of rated input until ultimate conditions are reached. In addition, UL also conducts an abnormal operation test in which the output of any impedance matching transformer is short circuited until ultimate conditions are achieved. While both of these test conditions represent realistic situations that the speaker could be subjected to, UL has not experienced a failure in either of these tests.

In late 1994, the Electronic Industry Associated (EIA) requested ANSI approval of IS-33 (ANSI/EIA 636), recommended Loud Speaker Safety Practices. This document was prepared and approved by the National Sound Contractors Association product safety committee. This document contains an "abnormal test, electrical ignition" which is much more extensive than the abnormal operation and speaker burnout test currently in UL 1480. The Abnormal Tests, Electrical Ignition requirements contained in this document are attached as Appendix E for your reference.

UL asked for input relative to the need to revise the current Abnormal Operation and Speaker Burnout test and the desire and appropriateness of adopting the abnormal test as specified in IS-33.

Some representatives indicated that the test could be used in lieu of verifying whether the speaker material characteristics were acceptable or at least be an option to providing specifications. Another suggested that a review of the speaker construction could be done to determine whether the test could be waived for smaller wattage speakers.

Also expressed was a concern regarding the time and cost of testing to the EIA document.

Other representatives requested that other test information be researched to corroborate the applicable extent that the test is needed. At this point further input from industry is sought.

9. Impact Test – UL 1480

At the present time, UL conducts an Impact test on all plastic enclosures regardless of mounting arrangements. To comply, the samples can not sustain damage that would expose live electrical parts or cause a fire hazard. The present requirements do not address installation differences. UL asked if the impact testing needs to be conducted on a speaker enclosure when the device is intended for ceiling installation only? Everyone felt the tests should remain unchanged with the exception that reference to the decorative glass panel in Par. 34.2.1 of the standard be deleted. The test is conducted on all nonmetallic products.

10. Audibility Test – UL 1480

UL suggested that Paragraph 27.3 of UL 1480 be revised to subtract 20.6 dB(A) from the measured sound power measurement to allow for no reflecting planes. This change would harmonize this test for UL 1480 and UL 464 for similar installations.

Current Listings would have to be revised to subtract an additional 6 dB(A) from the current audibility rating (the difference between the proposed 20.6, and the current requirement of 14.6 db).

The representatives expressed concern that dropping the one reflecting plane would cause an unreasonable hardship because most of the applications involve at least a single reflecting plane. It was proposed that zero reflecting plane be employed if the installation instructions specify such an application.

Several representatives also questioned the current method of rating the sound pressure level (SPL) output in three db(A) step increments. There was consensus that UL eliminate the 3 db(A) step rating and use the actual SPL rounded to the nearest 1 db(A) increment in both UL1480 and UL464.

The discussion also included the possible implementation of ratings regarding directionality and the addition of an appropriate directionality test.

There was agreement that the audibility test requirements of UL 1480 and UL 464 need to be consistent.

11. Product Safety Markings – ANSI Z535.4-1991

In UL 464 there is one "Caution" marking requirement with no specific details provided. Requirements for "Caution", "Warning", and "Danger" markings are provided in the American National Standards Institute publication ANSI Z535.4. Appendix F provides details of the ANSI Z535 requirements. UL asked the IAC if it would be worthwhile to incorporate the ANSI Z535 requirements into the subject UL standards. Most representatives of industry did not see a need for these additional requirements at this time. A suggestion was made that if harmonization is to be adopted it may be more appropriate to specify IEC symbol marking as this is more likely to become the global standard.

12. Terminology of Visible vs. Visual – UL 1638, UL 1971

There are two nomenclature differences between UL 1638/UL 1971 and NFPA 72. These involve the terms visible vs. visual and signal device vs. signal appliance. The term visible was adopted by NFPA because of the similarity to audible. Because NFPA 72 is an ANSI standard, UL plans to propose revisions to its standards to adopt the visible and appliance terminology. The representatives of industry concurred this would be appropriate as long as the effective date was sufficiently long to minimize changeover costs.

13. ADA and Synchronization – UL 1971

STANDARDS UL 1971/UL 1638

NFPA 72, ANSI A117.1 and the ADA (Americans with Disability Act) Guideline will all be adopting a flash rate of 1 to 2 Hz for a single device. UL is suggesting harmonizing with these documents.

The presently permitted 1/3 Hz is being increased to 1 Hz since alerting at 1/3 Hz was shown to take approximately twice as long as at 1 Hz. The presently permitted 3 Hz is being reduced to 2 Hz to further minimize the possibility of adversely affecting people with photosensitive epilepsy.

In addition, UL is suggesting that the flash rate at nominal input voltage not be marked on the product. These ratings have no degree of accuracy and are being used by installers and AHJs in inappropriate ways.

NFPA, ANSI and ADAAG also have adopted requirements concerning light synchronization. UL therefore plans to propose definition, performance and marking requirements.

The Epilepsy Foundation of Greater Chicago has recommended that flash rates between 5 and 100 Hz should be avoided. As applied to synchronization, the upper limit of 100 Hz is the predominant factor.

Accordingly, UL plans to propose that synchronization be defined as all visual appliances flashing in a time interval of 10 ms or less and at a repetition rate at not less than 1 Hz or more than 2 Hz.

For test purposes, UL plans to propose that the maximum number of appliances be interconnected to the synchronization circuit and the light output of each appliance be monitored by photodiodes for a period of 15 minutes. Any deviation from the definition of synchronization would be considered a failure. Testing for synchronization would be conducted in conjunction with the Voltage Variation test, Variable Ambients test and Corrosion tests.

Everyone supported the changes and the majority recommended that the synchronization be monitored for 2 hr rather than 15 minutes.

Since synchronization would be an option, UL requested industry input with regard to product marking or identification to distinguish products which have been tested and comply with synchronization as opposed to products which have not been tested but claim to have synchronization. The representatives of industry recommended that the identification be in the Directory but not on the Product.

14. Colored Lenses – UL 1971

Standard UL 1971 specifies that a visual notification appliance provide a white light output. The same requirement is presently in Chapter 6 of NFPA 72, ANSI A117.1 and the ADA guidelines. All of these documents are addressing fire alarm alerting and have established white as a standard fire alarm/evacuation color.

Some hearing impaired persons have expressed concern about the method of signaling for emergency conditions other than fire, in which evacuation of the premise would be inappropriate. Emergency conditions such as an approaching tornado or earthquakes are typical examples. Seeking shelter during these conditions, rather than evacuation of the premises, would be appropriate.

The desirability and feasibility of allowing different colored lenses on visual notification appliances for distinguishing the type of emergency being signaled was discussed. If color of the signal can not be used to identify the type of emergency condition, what other methods are practical? The consensus was that there was no uniform color standardization for particular emergency conditions. It was concurred that UL 1971 be modified to include colored lens for non-fire applications, without color standardization. UL confirmed that these products would need to comply with all the requirements of the standard and that the marking would need to identify that the product was not for fire alarm signaling use.

15 - Polar Light Distribution Requirements - UL 1971

The Signal Strength and Format test, currently in UL 1971, specifies a polar distribution of the light output from the visual appliance. This polar distribution, when coupled with the installation requirements in Chapter 6 of NFPA 72, is intended to provide uniform light intensity throughout the area to be alerted.

As currently stated in UL 1971, compliance with the signal strength rating is determined by taking measurements along both the horizontal and vertical axis relative to the mounting height of the appliance. No requirements currently exist and therefore no measurements have been made at positions which deviate from either the horizontal or vertical axis.

Several manufacturers have expressed concern that the current requirements would permit a manufacturer to design a product in which the majority of the light intensity would occur in a "cross" pattern. The unit would comply with the Standard but not provide full area dispersion of the light output as intended by the Standard. It is claimed that such devices would have a competitive advantage while at the same time not provide adequate alerting for the hearing impaired.

Input was solicited as to the completeness of the present requirements as well as any suggestion for improvements. The representatives of industry concurred that additional measurements should be taken in all four quadrants. The measurements would include one point in each quadrant taken along the 45° axis.

16. Standardization of Electrical Ratings – UL 1638 and UL 1971

At the present time, there is no standardization of electrical ratings for notification appliances which connect to a control unit. Because of this, manufacturers of control units and fire alarm devices have rated their products in unique electrical parameters making it virtually impossible to establish compatibility by anyone other than the control unit manufacturer.

In order to address compatibility, the control unit manufacturers identify, by manufacturer and model designation, those devices which are compatible with their control units. This is required unless the electrical characteristics of the circuit can be fully defined as a single voltage and current rating. While this has worked well on installations of new fire alarm systems, situations where this practice has not worked well are as follows:

1. At an ever increasing rate, UL is made aware of installed fire alarm systems having a notification appliance, smoke detector or even the control unit that must be replaced. On some of the older systems, direct replacement of the product cannot be achieved because the product is no longer being manufactured. Since there is no published information concerning electrical characteristics of the fire alarm equipment nor any standardization of the electrical characteristics, the building owner may have to replace the complete system.

2. When an addition to a fire alarm system is required, frequently the compatible devices called out in the control unit wiring diagram are obsolete and are no longer available or devices other than those specified (ADA strobe lights for example) have not been specified at all. The system designer, installer and authority having jurisdiction are then required to make compatibility decisions without adequate information.
3. Frequently an AHJ will require evidence that UL has evaluated the compatibility of the control unit with notification devices to which it is connected. They have typically used the installation wiring diagram of the control unit as evidence. However, if a manufacturer wishes to be compatible with new Listed devices, they will have to resubmit to UL for a compatibility evaluation. They will also have to revise their installation documentation.
4. While a specific control unit and notification appliance may be electrically compatible today, there is no mechanism to prevent either manufacturer from changing their electrical parameters. As a result, the compatibility of the products no longer exists. This may occur during a file review process in which only one of the manufacturers is involved.

The present program being used by manufacturers and UL is not user friendly relative to the installer or acceptance authority. As a result, UL is concerned that many systems will be installed using devices and control units which are not compatible and may not achieve the overall goal of a fire alarm system. UL discussed with industry members the feasibility and desirability of standardizing on a single set of electrical parameters. This would provide installers and inspection authorities the ability to adequately judge compatibility of system components.

For discussion purposes only, UL suggested three standard parameters as follows:

1. Operating Voltage - 16 to 33 V dc (24 V dc nominal system) unfiltered full wave rectified or DC or 8 to 17.5 V (nominal 12 V dc system) unfiltered full wave rectified or DC. Rated signal strength would be required throughout the operating voltage range and no Voltage Variation test would be required.
2. Transient Suppression - An appliance shall not produce a transient voltage having an amplitude greater than 2 V peak to peak for a duration not exceeding 50 μ s while connected to a filtered and regulated DC supply set at maximum rated input voltage.
3. Surges - An appliance shall not create a power surge greater than 2 amperes for a duration not exceeding 50 μ s. The surge shall not have a frequency greater than 2 Hz. The appliance shall comply with these requirements while connected to a filtered and regulated DC supply providing maximum rated operating voltage to the test sample.

The representatives of industry agreed with the concept and suggested that standardization of electrical ratings would be feasible at this time. However, the numbers suggested need to be further examined and input from industry is requested as to the specifics of these parameters.

It was requested that UL maintain a special grouping for the products that do not meet the standardized parameters. It was agreed that the implementation would have an extended effective date to minimize impact on products currently being produced.

Also discussed was the means for measuring these parameters. A consensus was not reached regarding the RMS vs Mean vs Averaging Methods. One representative supplied data that he had on this subject. This is included as Appendix G. UL requested additional input from industry.

17. Uncontrolled Environments – UL 1971

Manufacturers have indicated that there have been occasions when a UL 1971 light is requested for use outdoors or for installation in an area where no environmental controls exist and where the temperature may be outside the 0°C and 49°C testing limits.

UL elected to omit outdoor Listing under UL 1971 because the polar light output information determines the effectiveness of the light for the size of the room in which it is installed. Once the device is placed outdoors, the polar distribution of light may not produce the same effect since reflective surfaces are not controlled. The signaling device, when installed outdoors, can only be considered a direct view device.

Industry input was requested on the need and feasibility of Listing visual appliances for the hearing impaired as suitable for extended ambient use. The industry representatives supported the suggestion and further requested that UL 1971 lights be optionally investigated for more stringent environmental conditions.

18. General Purpose Loudspeakers

An additional agenda item to cover general purpose loud speakers for UL 1480 was suggested by one of the representatives of industry. It was suggested that a separate section be added to the standard for this purpose. EIA 636 could be used as a guideline. An ad hoc committee was formed for this purpose. The following volunteered to participate.

Scott Edwards, Jack Curran, Paul Graham, Bill Keezer, Bruce Langmuir, John Henly, Dan Skupien, Craig Sato.

Some members of the Ad Hoc Committee met on November 7. Refer to Appendix H for a summary of that discussion.

REQUESTS FOR COMMENTS

Please provide your comments concerning the meeting report.

Written comments should be sent to the attention of Leonard M. Cohen at UL's Northbrook office, 333 Pfingsten Road, Northbrook, IL 60062-2096. Please reference all correspondence to Subject 464.

All comments should be sent by February 7, 1996.

Unless specifically requested to do so, UL will not acknowledge comments indicating concurrence with this report.

UNDERWRITERS LABORATORIES INC.



LEONARD M. COHEN (Ext. 42692)
Standards Engineer
Standards Department

REVIEWED BY:



ISAAC PAPIER (Ext. 42686)
Managing Engineer
Engineering Services, 417

SR:JTM/AM

464MTR.V01

APPENDIX A

ATTENDANCE AT THE NOVEMBER 6/7, 1995 MEETING OF THE IAC FOR AUDIBLE SIGNAL APPLIANCES

Industry Representatives

*Howard M. Berke
Scott Edwards
Paul Graham
John Henley
Bruce Langmuir
David Mazur
*Luy Nguyen
Ed Thorpe
Tim Wertz

Whelen Engineering Co.
Gentex Corporation
Federal Signal Corporation
Fourjay Industries, Inc.
Bose Corporation
G.S. Building Systems Corporation
Wheelock, Inc
System Sensor Division of Pittway Corp.
Faraday, Inc

Invited Guests

Tom Blekasi
Substitute for Howard M. Berke
Jack Curran
Substitute for Luy Nguyen
Rudy Duris
Paul Fidlin
Tom Fredericks
Chris Golec
Robert Hoepfner
Bill Keezer
Ron Kirby
Hal Light
John Pacelli
Larry A. Salzwedel
Robert Wright

Whelen Engineering Co.
Wheelock, Inc
Audiosone, Inc.
Electro-Voice Inc.
Whelen Engineering Co.
Federal Signal Corporation
G.S. Building Systems Corporation
Bose Corporation
Simplex Time Recorder Co.
Federal Signal Corporation
Gentex Corporation
Quam-Nichols Co.
G.S. Building Systems Corporation

UL Staff

Isaac Papier
Doug Brunmeier
Len Cohen
Ferd DeVoss
Dan Grosch
Paul Patty
Larry Shudak
Dan Skupien

Chairman

*Not in attendance

APPENDIX B

DESIGNATED RESPONSIBILITY FOR UL PRODUCT CATEGORIES

UCST	AUDIBLE SIGNAL APPLIANCES, GENERAL SIGNAL
UCST2	AUDIBLE SIGNAL APPLIANCES
UEAY	SPEAKERS
UEAY2	SPEAKERS AND AMPLIFIERS - COMPONENT
ULSZ	AUDIBLE SIGNAL APPLIANCE
UUKC	SIGNAL APPLIANCES AND EQUIPMENT FOR HEARING IMPAIRED
UUKC2	SIGNAL APPLIANCES AND EQUIPMENT FOR HEARING IMPAIRED - COMPONENT
UUMW	SPEAKERS AND AMPLIFIERS FOR FIRE PROTECTIVE SIGNALING SYSTEMS
UUMW2	SPEAKERS - COMPONENT AMPLIFIERS FOR FIRE PROTECTIVE SIGNALING SYSTEMS

The individuals shown in the following tables are involved with the investigation of products covered under the subject categories. The Primary Designated Engineer (**shown in UPPERCASE letters**) coordinates the establishment and uniform interpretation of UL requirements applicable to the product categories. The Designated Engineers (**shown in lowercase letters**) work with the Primary Designated Engineer to interpret requirements and maintain standards.

Should you have questions regarding the interpretation of the requirements proposed in this bulletin or any adopted requirements that affect your product, you are encouraged to contact the individual at the office to which you normally submit your products.

The Industry Advisory Conference (IAC) Chairman for the subject categories is Isaac Papier at UL's Northbrook office. The IAC Chairman oversees the significant interpretations made by the Primary Designated Engineer and arbitrates any differences regarding interpretation of UL requirements.

CCN	Office/Subsidiary	Responsible Engineer	Extension
UCST	Melville	Al Gengler	22562
	Northbrook	PAUL PATTY	42752
	Santa Clara	Anil J. Patel	32411

CCN	Office/Subsidiary	Responsible Engineer	Extension
UCST2	Northbrook	PAUL PATTY	42752

CCN	Office/Subsidiary	Responsible Engineer	Extension
UEAY, UUMW	Melville	Al Gengler	22562
	Northbrook	DOUG BRUNMEIER	42773
	Santa Clara	William Barry	32084

CCN	Office/Subsidiary	Responsible Engineer	Extension
UEAY2	Melville	Al Gengler	22562
	Northbrook	PAUL PATTY	42752

CCN	Office/Subsidiary	Responsible Engineer	Extension
ULSZ	Melville	Al Gengler	22562
	Northbrook	PAUL PATTY	42752
	Santa Clara	Anil J. Patel	32411

CCN	Office/Subsidiary	Responsible Engineer	Extension
UUKC	Melville	Al Gengler	22562
	Northbrook	FERD DeVOSS	42614
	Santa Clara	Anil J. Patel	32411

CCN	Office/Subsidiary	Responsible Engineer	Extension
UUKC2	Northbrook	FERD DeVOSS	42614

CCN	Office/Subsidiary	Responsible Engineer	Extension
UUMW2	Melville	Al Gengler	22562
	Northbrook	DOUG BRUNMEIER	42773

PROPOSED REQUIREMENTS ARE OF A TENTATIVE AND EARLY NATURE AND ARE FOR REVIEW AND COMMENT ONLY. CURRENT REQUIREMENTS ARE TO BE USED TO JUDGE A PRODUCT UNTIL THESE REQUIREMENTS ARE PUBLISHED IN FINAL FORM.

APPENDIX C

CANADIAN TEST ADDRESSING HARMONIC DISTORTION MEASUREMENTS

See item 5

7.4 Harmonic Distortion

7.4.1 Prior to the Harmonic Distortion Test, the speaker shall be subjected to a listening test over its bandwidth to determine that there are no buzzes, cries or other noises that would render the speaker unsuitable for its intended purpose.

7.4.2 The total harmonic distortion (THD) of a speaker shall not exceed 7 percent over the 60 Hz to 20 kHz bandwidth, when driven at rated voltage by a sinusoidal wave form having a THD of less than 0.2 percent.

7.4.3 The amplitude of harmonics of fundamental frequencies outside the rated bandwidth (600 to 4000 Hz minimum) shall be adjusted by a value equal to the differences between the fundamental frequency SPL and the rated output SPL, in the calculation of THD.

7.4.4 The measurement shall be made with the speaker mounted and located as described in Clause 7.2.2, with the microphone located on the reference axis 1000 mm from the reference point.

PROPOSED REQUIREMENTS ARE OF A TENTATIVE AND EARLY NATURE AND ARE FOR REVIEW AND COMMENT ONLY. CURRENT REQUIREMENTS ARE TO BE USED TO JUDGE A PRODUCT UNTIL THESE REQUIREMENTS ARE PUBLISHED IN FINAL FORM.

APPENDIX D

Frequency and Audibility Tests

refer to agenda items 6 and 7.

For your convenience in review, suggested additions to existing requirements are shown underlined and suggested deletions are shown ~~lined-out~~.

25 Frequency Response Test

25.1 A speaker shall produce a total sound pressure output that is not less than its marked rated sound pressure level, and flat to within the limits shown in Figure 25.1 as measured to one-third octave bands, when powered from a source of band limited pink noise that is flat to within ± 1 decibel at an rms level of voltage or current that provides rated power. The pink noise is to be band-limited between the bands 26 and 36 whose center frequencies are 400 of 800 and 4000 2800 hertz, with a dropoff of at least 6 decibels per octave.

25.2 This test is to be conducted as indicated in Figures 21.1 – 21.4, 50.1, and 50.2.

25.3 The sound power output of the appliance is to be measured in a reverberant room qualified to the requirements of Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms, ANSI S12.31-1990, or Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms, ANSI S12.32-1990. The sound power in each 1/3-octave band is to be determined using the comparison method. The A-weighting factor is to be added to each 1/3-octave band. The total power is to be determined on the basis of actual power. The total power then is to be converted to an equivalent sound pressure level for a radius of 10 feet (3.05 m) using the following formula:

$$L_p = L_w - 20 \log_{10} R - 0.6$$

In which:

L_p is the converted sound pressure level,

L_w is the sound power level measured in the reverberation room, and

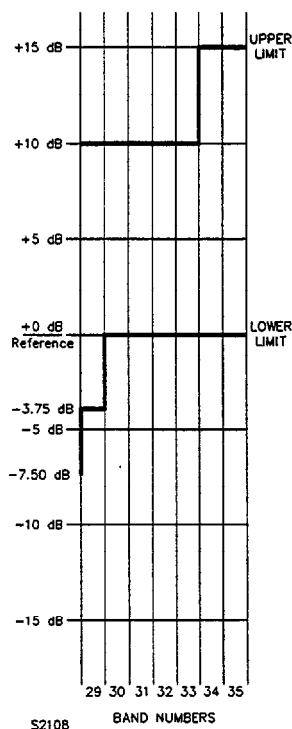
R is the radius for the converted sound pressure level (10 feet).

25.4 The sound power measurement is to be made in a reverberation room while the speaker sample is driven with a band limited pink noise signal at rated power. ~~The sound output is to be the overall weighted value over the bandwidth of 800-2800 hertz~~ The frequency response of the "A" weighted sound power of the speaker shall be within the limits shown in Figure 25.1.

25.5 The voltage applied to the speaker terminals is to be that required to produce rated rms power in the frequency range of ~~800 400~~ to ~~2800 4000~~ hertz and is to be measured with an average reading rms voltmeter.

25.6 In determining acceptability, the zero decibel reference line may be shifted vertically to determine whether the portion of the plot of one-third octave band power between ~~the bands 29 and 35 whose center frequencies of are~~ 800 to 2800 3150 hertz will fit between the upper and lower limits shown in Figure 25.1.

Figure 25.1
Frequency response limits



NOTE: Band number = $10 \log_{10}$ (center frequency)

Band number	Center frequency
29	800 Hz
30	1000
31	1250
32	1600
33	2000
34	2500
35	3150

26 Audibility Test

26.1 A speaker shall produce a total sound pressure output not less than its marked rated sound pressure level when powered from a source of band limited pink noise that is flat to within ± 1 decibel at an rms level of voltage or current that provides rated power. The pink noise is to be band limited between the bands 26 and 36 whose center frequencies of are 400 and 4000 hertz with a dropoff of at least 6 decibels per octave.

26.2 The test procedure is to be as specified in 25.3 – 25.6. Performance of the test is to coincide with initial performance of the Frequency Response Test, Section 25, on as-received samples, as illustrated in Figure 21.1.

26.3 The range of test frequencies may be extended below 400 or above 4000 hertz at the request of the manufacturer. Results of the test is to be used as the basis for the frequency range marked on the speaker as specified in 42.1(d).

PROPOSED REQUIREMENTS ARE OF A TENTATIVE AND EARLY NATURE AND ARE FOR REVIEW AND COMMENT ONLY. CURRENT REQUIREMENTS ARE TO BE USED TO JUDGE A PRODUCT UNTIL THESE REQUIREMENTS ARE PUBLISHED IN FINAL FORM.

APPENDIX E

ELECTRONIC INDUSTRY ASSOCIATED (EIA) - IS-33

See agenda item 8

10.0 Abnormal Tests, Electrical Ignition

As stated in Section 1.0 Purpose, electrical ignition can be caused by an audio power amplifier failure, by **an audio amplifier** feeding more audio power into the product from the amplifier than the product was designed to handle, or by **defective part or assemblies within the product**. In all cases, the audio amplifier's continuous audio power output would have to be large enough for ignition to occur.

This Section attempts to simulate these three abnormal conditions, by the use of a large regulated d.c. power supply **and a high power audio amplifier**. The loudspeaker, loudspeaker assembly or loudspeaker system **could** be connected to a power amplifier with any level of power output by the **end** user (unless, these products are **assembled** by the manufacturer with the amplifier as a permanent part of the system). This section addresses the situation where a large amplifier would be used.

The tests in this section are for products which do not have additional manufacturing operations performed on them before they reach the end user. When a loudspeaker assembly or system is to be tested, it is suggested that the assembly or system be tested as the final product. A manufacturer may also wish to test the individual loudspeaker(s) or other components in the product.

10.1 Testing Options

(Option 3): If, in the final product, the loudspeaker components are housed in an enclosure, or if there are any passive electrical components (resistors, capacitors, inductors, etc.) included in the electrical circuit with the loudspeaker components, the assembly or system should be tested in the form of the final product as described in paragraphs 10.6-10.8. The final product must be capable of sustaining operation under the abnormal operating test conditions given in paragraphs 10.7 and 10.8 without causing the risk of fire.

(Option 4): If, in the final product, the loudspeaker components are not housed in an enclosure, and if there are no passive electrical components (resistors, capacitors, inductors, etc.) included in the electrical circuit with the loudspeaker components, the loudspeaker components may optionally be tested as described in paragraphs 10.6-10.7. The loudspeaker components must be capable of sustaining operation under the abnormal operating test conditions given in paragraphs 10.7 without causing the risk of fire.

10.2 The risk of fire is considered to exist if the tissue paper or cheesecloth indicators specified in the abnormal test, glow or flame.

10.3 Cheesecloth Indicators

Cheesecloth used as an indicator for abnormal tests should be untreated cotton running 14-15 square yards per pound (26-28 square meters per kilogram) and having what is known in the trade in North America as a count of 32 by 28 - that is, for any square inch, 32 threads in one direction and 28 threads in the other direction (for any square centimeter, 13 threads in one direction and 11 threads in the other direction).

10.4 Temperature and Humidity Conditions

All samples to be used for these tests should be conditioned at a temperature of $25\pm5^{\circ}\text{C}$ ($77\pm9^{\circ}\text{F}$) and a relative humidity of $50\pm10\%$ for at least 48 hours prior to conducting any test. All testing should take place under these same conditions of temperature and humidity.

10.5 Setup Conditions

All tests should be performed in a location which is draft free during the duration of the test. Air movement around the samples can significantly increase the likelihood of ignition and can make the test unrepeatable. The tester should protect himself from smoke. The product or component under test should be physically mounted in accordance with the appropriate conditions detailed in paragraphs 10.5.1, 10.5.2 and 10.5.3 below and physically oriented in the operating position producing the most severe results during the abnormal tests in this Section.

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10.5.1 Loudspeaker, Loudspeaker Assembly, or Individual Component in the Electrical System or Sub-Assemblies

The product or component(s) should be suspended in free air; the means of suspension being optional as long as it has little effect upon the tests. A soft wood surface, covered with white tissue paper, should be positioned about 75 mm (3 inches) beneath the lowest extremity of the product or component(s). The tissue paper covering the soft wood should extend at least 300 mm (12 inches) in all directions beyond the vertical projection of the product or component(s) onto that surface. A single layer of cheesecloth should be loosely draped over the product or components(s).

10.5.2 Loudspeaker System or Loudspeaker Assembly, Having Wall or Ceiling Mount Provisions

The product should be mounted onto a soft wood surface covered with white tissue paper. To establish the most severe orientation, the mounting surface should be positioned as to represent either a vertical wall or horizontal ceiling surface. A second tissue paper covered soft wood surface should then be horizontally placed about 75 mm beneath the product, as established in 10.5.1 above. Both wood surfaces should extend at least 300mm beyond the projections of the product.

10.5.3 Loudspeaker System Intended For Either Shelf Cabinet Top or Floor Mount

The loudspeaker system should be placed on top of a soft wood surface which has been covered with white tissue paper. The tissue paper should extend at least 300 mm beyond the vertical projections of the product, as established in 10.5.1 above; the soft wood should also extend at least 300 mm beyond the product in the same manner. The loudspeaker system should be loosely draped with cheesecloth.

10.6 Test Equipment for Abnormal Tests for Electrical Ignition

10.6.1 D-C Overload Abnormal Tests:

Power Supply: The electronically regulated d.c. power supply will have to be large enough in order to cause a component to fail, or a protective device to activate, within 3-15 seconds, as prescribed in Test Condition A in Section 10.7. The size of the power supply required will depend upon the actual power handling capability of the product or components. A power supply with a volt-ampere rating of about 3-4 times the power rating of the product would be typical. For example, some high-power speakers have been found to need up to a 30 amp, 60 v.d.c. power supply to perform the tests.

The product (includes component of sub-assembly hereafter in Section 10) under test shall be wired to a variable output, electronically regulated (#) d.c. supply that has a steady-state current rating which is not less than three times the current used to establish the base voltage from which Test Conditions B, C and D in paragraph 10.7 are calculated. If the product is not provided with an integral connection cord, electrical connections should be made with stranded wire with conductor size sufficiently large so as not to affect the test. The polarity of the power supply connections should be such that the voice coil of the loudspeaker (or low-frequency driver of a loudspeaker assembly or loudspeaker system) is repelled outward away from the motor structure.

Data Measurement: A record of the d.c. current flow to the product as a function of time will need to be obtained. The current flow will need to be measured over a period of at least 15 second (See Figures 10.1 and 10.2) This can be accomplished using a storage oscilloscope, data logging meter, digital data acquisition system or some other suitable instrumentation.

10.6.2 A-C Overload Abnormal Tests:

Power Amplifier: The audio power amplifier will have to be large enough to cause a component to fail, or a protective device to activate, within 3-15 seconds, as prescribed in Test Condition A in Section 10.8. The size of the power amplifier required will depend upon the actual power handling capability of the product or components. A power amplifier with a power rating of about 3-4 times the power rating of the product would be typical. For example, some high-power speakers have been found to need up to an 1,800-watt power amplifier to perform the tests. Step-up voltage transformers may be used, if necessary, to achieve the required power levels.

The product (includes component or sub-assembly hereafter in Section 10) under test shall be wired to a variable output, audio power amplifier that has a steady-state power rating which is capable of delivering not less than three times the current used to establish the base voltage from which Test Conditions B, C and D in paragraph 10.8 are calculated. If the product is not provided with an integral connection cord, electrical connections should be made with stranded wire with conductor size sufficiently large so as not to affect the test.

- (#) The regulating capabilities may be augmented by manual control during the course of testing.

Data Measurement: A record of the a.c. current flow to the product as a function of time will need to be obtained. the current flow will need to be measured over a period of at least 15 seconds. (See Figures 10.1 and 10.2) This can be accomplished using a storage oscilloscope, data logging meter, digital data acquisition system or some other suitable instrumentation.

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10.7 D-C Overload Abnormal Tests

The products set up under the conditions described in paragraphs 10.4, 10.5 and 10.6 should be subjected to the following D-C. overload tests in the sequence A, B, C and D. Except for the special parameters specified for in Test Condition A, and as noted otherwise in paragraph 10.8, operation should in each case be continued until 4 hours time has elapsed or one of the following results are observed.

1. A risk of fire develops (see 10.2 for definition).
2. A protective device (see 3.12 Glossary) has operated or a conductive circuit element has opened, and current flow has ceased.
3. A protective device has operated or a conductive circuit element has opened and current flow has stabilized at no more than 25% of the initial test value (of current) for at least one hour.
4. Operation of the test may be continued for less than 4 hours time, but not less than 2 hours, if the current has remained constant for one hour or more and it seems that further current change is unlikely.

Before doing any testing, see all of the curves in Figure 10.1, and their accompanying text for graphic explanation of the determination of Test Condition A.

Test Condition A

The purpose of Test Condition A is to find the voltage /current combination that results in a protective device operating, or ignition, or failure which occur under the criteria noted directly below.

The criteria of test condition A is to:

1. Apply a d.c. signal with a known fixed voltage to the input terminals of the loudspeaker product that causes a significant event to occur within the product (protective device operating, or ignition, or failure). A significant event is considered to occur when the magnitude of the current delivered to the product falls to 50% of the value just prior to the onset of that event.
2. The instant at which the input current falls to the value noted in 1 directly above, is not less than 3 or more than 15 seconds after the application of the test signal.
3. If the product under test fails to meet the criteria described in numbers 1 and 2 immediately above, the product must be restored to its original condition, the voltage of the test signal should be adjusted up or down as necessary (higher current for faster onset of event; lower current for slower onset of event), and the restored product should be retested.

See the curves in Figure 10.1 and their accompanying text for graphic explanation of the determination of Test Condition A. A detailed explanation of the test follows below.

A d.c. signal with a fixed voltage potential of known value shall be applied to the input terminals of the product of such magnitude that a protective device operates or some conductive element within the circuit under test opens, or ignition occurs, within the prescribed time. If the product is a multi-way loudspeaker system utilizing an internal passive crossover network, Test Condition A need only be applied to the system input terminals. If the product is a multi-way loudspeaker system utilizing an external (active or passive) crossover, Test Condition A must be individually applied to the input terminals for each frequency band in the system, the test is repeated for each band in the system.

The voltage and current must be recorded during the test with a storage oscilloscope, data logging meter, data acquisition system or some other suitable instrumentation. Analysis of the recorded current and voltage magnitude as a function of time will verify that Test Condition A has been completed correctly and provides a record of the base d.c. potential used to determine the test voltages for Test Conditions B C, and D. The onset of a significant event will usually be that point where a change of current flow (sudden or gradual, increase or decrease) can be observed which is not due solely to a change in resistance because of I^2R heating effects. See the curves in Figure 10.1 and their accompanying text for graphic explanation of the determination of Test Condition A.

Test Condition B

A d.c. potential shall be applied to the input terminals of the product at 75% of the known fixed potential in Test Condition A.

Test Condition C

A d.c. potential shall be applied to the input terminals of the product at 50% of the known fixed potential in Test Condition A.

Test Condition D

A d.c. potential shall be applied to the input terminals of the product at 25% of the known fixed potential in Test Condition A.

10.7.1 If a product sustains operation for 4 hours under Test Condition B or Test Condition C without any protective device operating or circuit element opening, and without any indication of a risk of fire, then the tests which follow that condition may be omitted.

10.7.2 Products providing a means for changing the input impedance shall be tested with the impedance selector switch or connections such that the most severe conditions result.

10.7.3 All operating controls provided on the product shall be positioned such that the most severe operating conditions result during the testing.

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10.7.4 If any elements of a loudspeaker, loudspeaker assembly or loudspeaker system are electrically coupled to the source connections by means of a crossover network employing an electrolytic type capacitor, then Test Conditions B, C and D should be repeated with the electrolytic capacitor short circuited (in one separate additional test). If more than one electrolytic capacitor is used in the product, all electrolytic capacitors may first be short circuited simultaneously for this additional test. Operations may be terminated or tests may be omitted under the same circumstances noted in paragraphs 10.7 and 10.7.1.

10.7.5 The tests described in paragraphs 10.7 and 10.7.4 shall be repeated with the polarity of the applied d.c. potential reversed if there is any likelihood that such a reversal might produce more severe results. Operation may be terminated or tests may be omitted under the same circumstances noted in paragraphs 10.7 and 10.7.1.

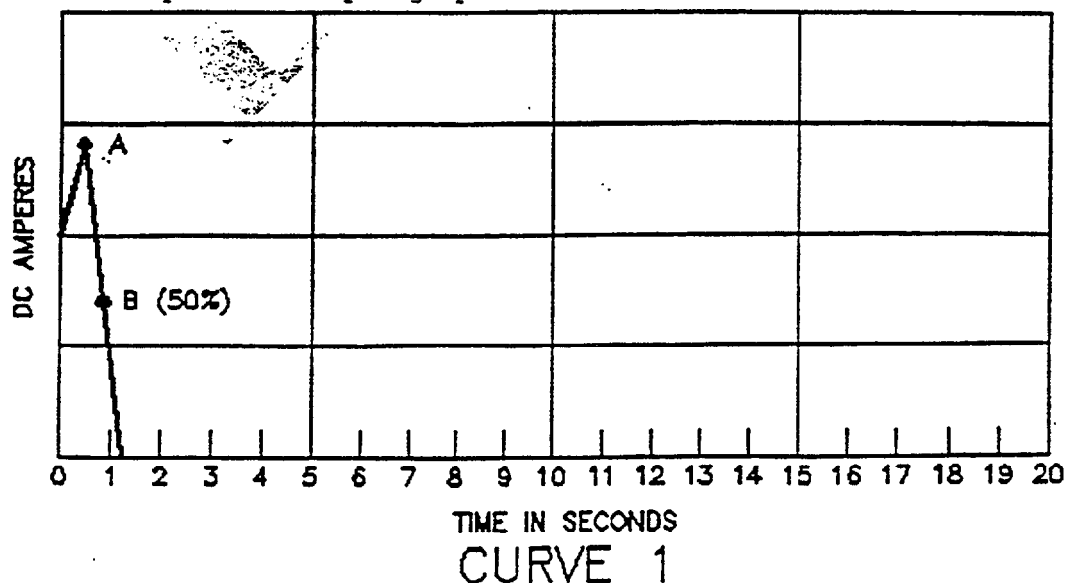
FIGURE 10.1

GRAPHIC EXPLANATION OF THE CRITERIA FOR TEST CONDITION A

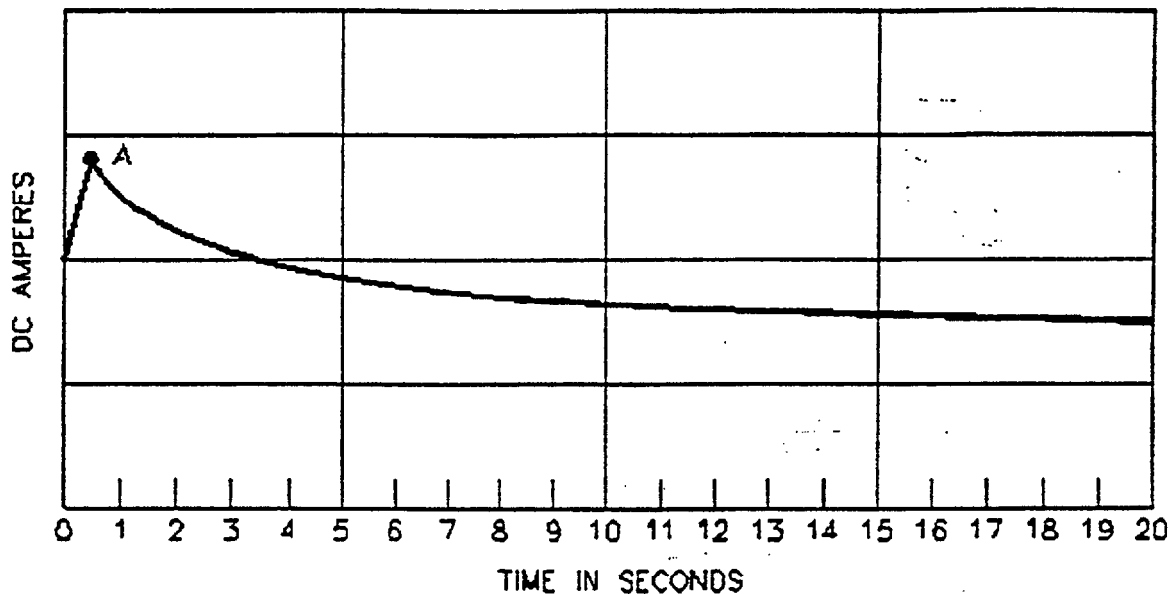
DESCRIBED IN PARAGRAPH 10.7

The following curves are provided only to explain the criteria for Test Condition A described in Paragraph 10.7. They are not actual scale representations of data obtained with a specific product, nor are the vertical ordinates of each curve to the same scale (that is, there is no direct relationship between the curves).

Curve No. 1 - This curve depicts a case in which a protective device or circuit element opens at point "a", and the input current falls rapidly to zero, passing the 50% level at point "b". However, the applied fixed potential was too high because the sought event occurs too rapidly, and the 50% point is reached before 3 seconds elapse after the application of the d.c. test potential. This waveform does not satisfy the criteria for Test Condition A expressed in paragraph 10.7.

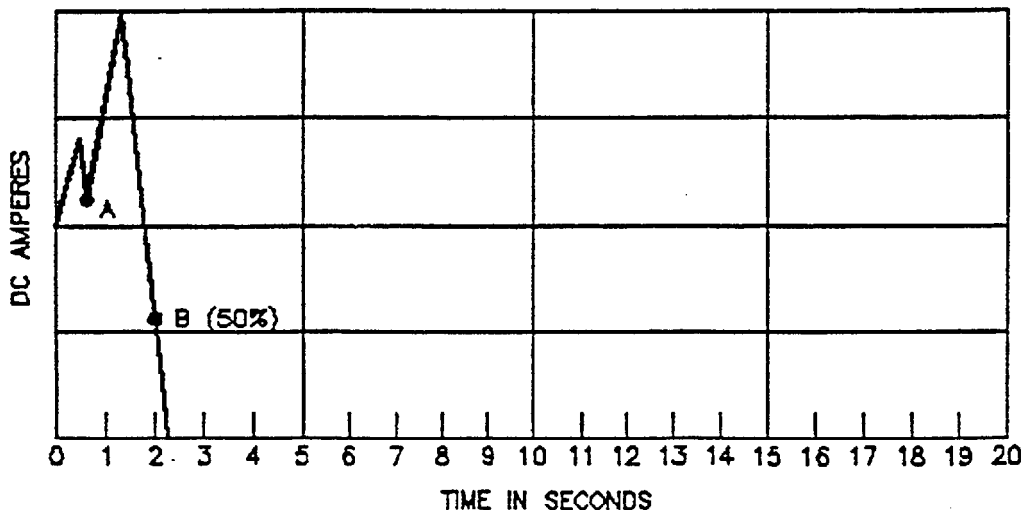


Curve No. 2 - This curve depicts a case in which the applied d.c. test potential was too low because the input current only diminishes due to the change of coil resistance caused by I^2R heating effects, and no protective device operates or circuit elements opens to cause the sought reduction in current even to occur within 15 seconds of the application of the potential. This waveform does not satisfy the criteria for Test Condition A expressed in paragraph 10.7.



CURVE 2

Curve No. 3 - This curve depicts a case in which the applied d.c. test potential was too high. After an initial decrease in the input current because of an increase in resistance resulting from I^2R heating effects, coil turns short at point "a", and the input current rapidly increases until a protective device operates or a circuit elements opens. The input current passes through the 50% level at point "b". However, point "b" occurs before 3 seconds elapse after the application of the potential. The waveform does not satisfy the criteria for Test Condition A expressed in paragraph 10.7.

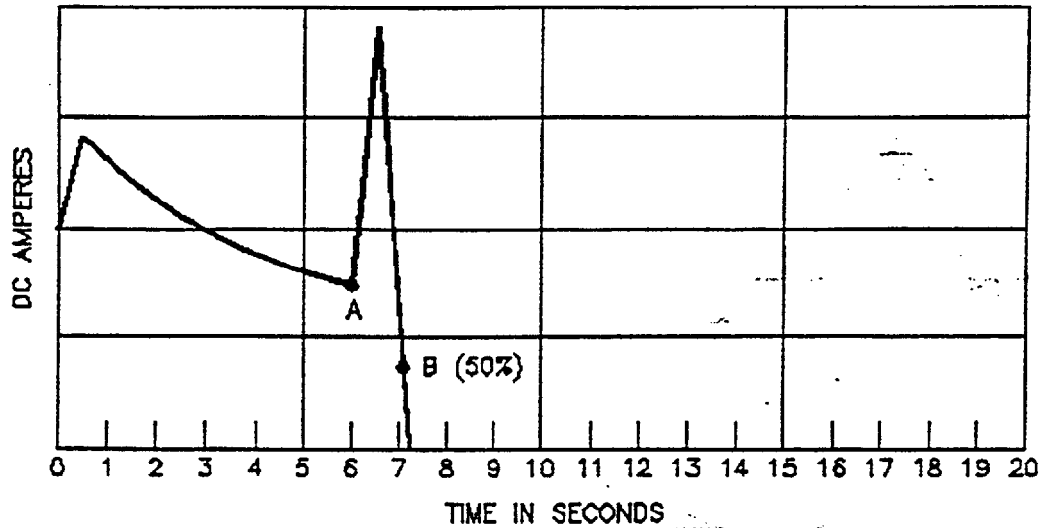


CURVE 3

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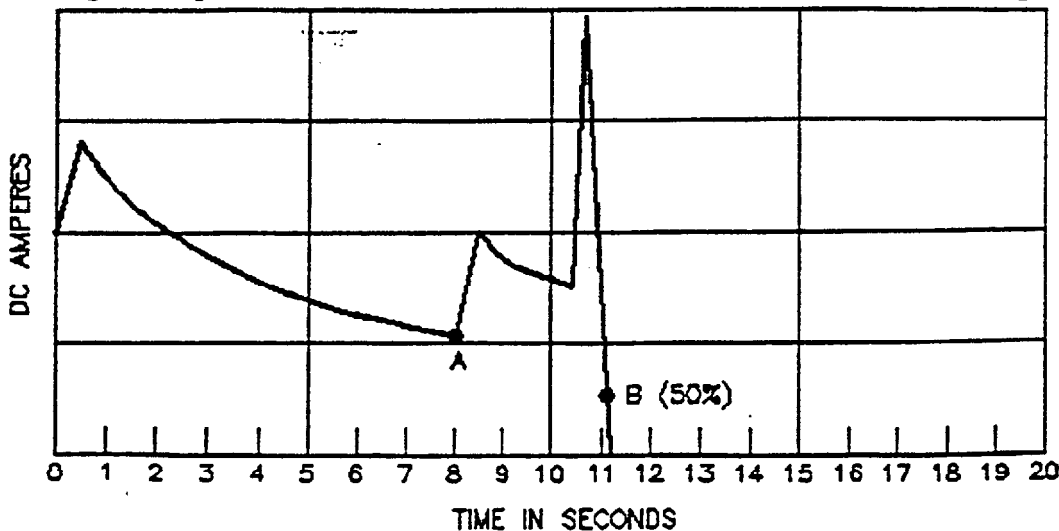
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Curve No. 4 - This curve depicts a case in which the applied d.c. test potential is of the required order of magnitude. After an initial decrease of current because of an increase in resistance resulting from I^2R heating effects, coil turns short at point "a" and the input current rapidly increases until a protective device operates or a circuit elements opens. The input current passes through the 50% level at point "b", more than 3 and less than 15 seconds after the application of the potential. The voltage used to fulfill this test condition shall be used in the determination of the 75, 50 and 25 percent test voltages required for Test Condition B, C and D, respectively.



CURVE 4

Curve No. 5 - This curve depicts a case in which the applied d.c. test potential is of required magnitude. After an initial decrease of current because of an increase of resistance resulting from I^2R heating effects, coil turns short at point "a" and the current rapidly increases. However, after an initial increase, the current again begins to decrease because of increasing resistance, until additional turns short. The current then increases rapidly again, until a protective device operates or a circuit element opens. The input current rapidly decreases, passing through the 50% value at point "b", more than 3 and less than 15 seconds after the application of the potential. This waveform satisfies the criteria for Test Condition A expressed in paragraph 10.7. The voltage used to fulfill this test condition shall be used in determination of the 75, 50 and 25 percent test voltages required for Test Conditions B, C, and D, respectively.



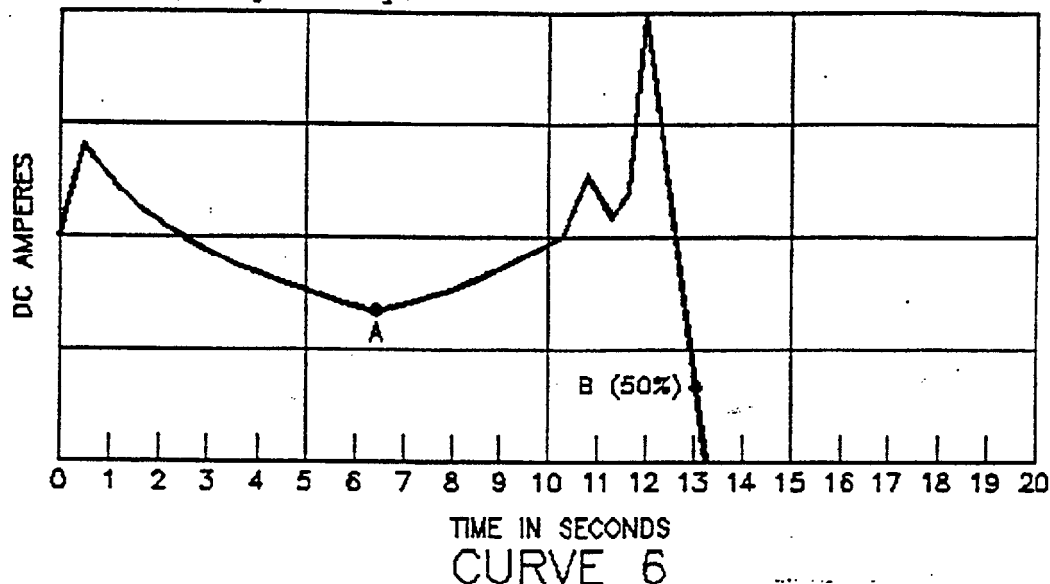
CURVE 5

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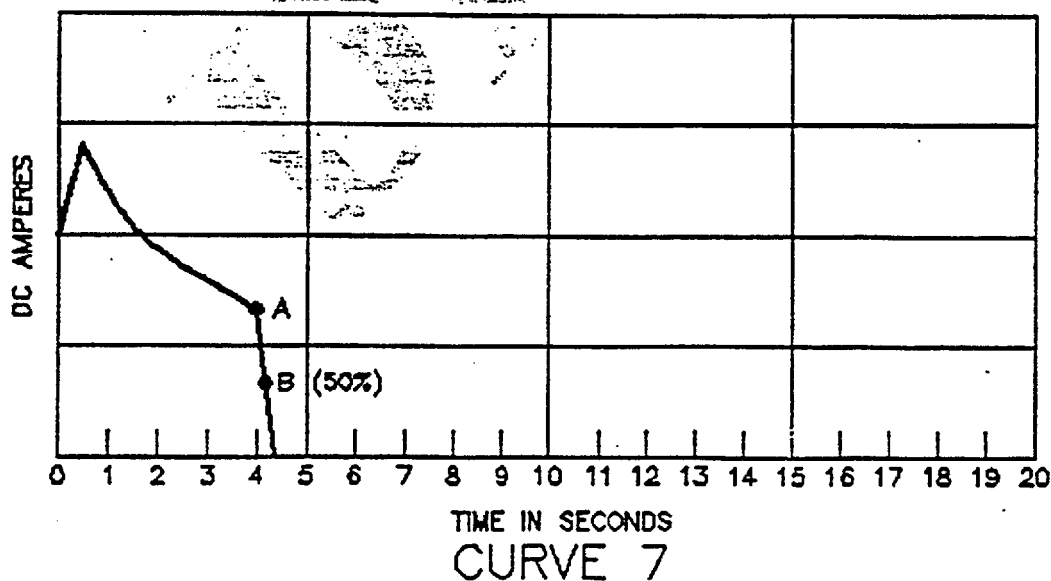
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Curve No. 6 - The analysis of curve No. 6 is similar to that of curve No. 5, except that the coil shorting takes place in a series of major and minor subevents. This waveform satisfies the criteria for Test Condition A expressed in paragraph 10.7. The voltage used to fulfill this test condition shall be used in the determination of the 75, 50 and 25 percent test voltages required for Test Conditions B, C and D, respectively.



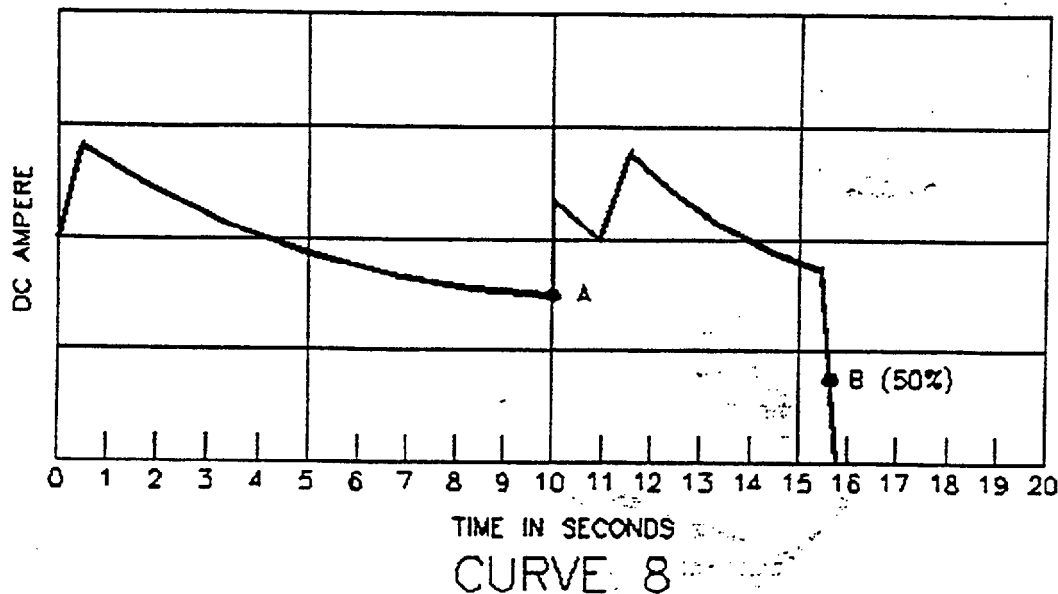
Curve No. 7 - This curve depicts a case in which the applied d.c. test potential is of the required order of magnitude. After an initial decrease of current because of an increase of resistance resulting from I^2R heating effects, a protective device operates or a circuit element opens at point 'a'. The input current passes through the 50% level at point 'b', more than 3 and less than 15 seconds after the application of the potential. This waveform satisfies the criteria of Test Condition A expressed in paragraph 10.7. The voltage used to fulfill this test condition shall be used in the determination of the 75, 50 and 25 percent test voltages required for Test Conditions B, C and D, respectively.



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Curve No. 8 - This curve depicts a case in which the applied d.c. test potential was too low. The sequence of events is much like that described for Curve No. 5, until sustained loading causes a protective device to operate or a circuit element to open. The input current passes through the 50% level at point "b". However, point "b" occurs more than 15 seconds after the application of the potential. This waveform does not satisfy the criteria for Test Condition A expressed in paragraph 10.7.



10.8 A-C Overload Abnormal Tests

Products that have any passive, frequency-dependent, electrical components (such as inductors and capacitors) included in the circuit along with the speaker components, must be tested for a.c. overload as outlined below in this section. If there are no frequency-dependent, electrical components included in the circuit along with the speaker components, the a.c. overload tests in this section may be omitted, because the d.c. overload tests performed in Section 10.7 are equivalent and sufficient. Products that have any passive electrical components included in the circuit along with the speaker components that are not frequency dependent (such as fuses, circuit breakers, light bulbs, switches, resistors, etc.), may also be omitted from the a.c. overload tests in this section, because the d.c. overload tests performed in Section 10.7 are equivalent and sufficient.

The products set up under the conditions described in paragraphs 10.4, 10.5 and 10.6.2 that require a.c. overload testing as defined in the above paragraph, should be subjected to the following a.c. overload tests in the sequence A, B, C and D. Except for the special parameters specified for in Test Condition A, and as noted otherwise in paragraph 10.8.1, operation should in each case be continued until 4 hours time has elapsed or one of the following results are observed.

1. A risk of fire develops (see 10.2 for definition).
2. A protective device (see 3.12 Glossary) has operated or a conductive circuit element has opened, and current flow has ceased.

3. A protective device has operated or a conductive circuit element has opened, and current flow has stabilized at no more than 25% of the initial test value(of current) for at least one hour.
4. Operation of the test may be continued for less than 4 hours time, but not less than 2 hours, if the current has remained constant for one hour or more and it seems that further current change is unlikely.

Before doing any testing, see all of the curves in Figure 10.2 and Figure 10.3, and their accompanying text for graphic explanation of the determination of Test Condition A.

Test Condition A

The purpose of Test Condition A is to find the voltage /current combination that results in a protective device operating, or ignition, or failure which occur which occur under the criteria noted directly below.

The criteria of test condition A is to:

1. Apply an a.c. signal with a known fixed voltage and frequency to the input terminals of the loudspeaker product that causes a significant event to occur within the product(protective device operating, or ignition, or failure). A significant event is considered to occur when the magnitude of the current delivered to the product falls to 50% of the value just prior to the onset of that event.
2. The instant at which the input current falls to the value noted in 1 directly above, is not less than 3 or more than 15 seconds after the application of the test signal.
3. If the product under test fails to meet the criteria described in numbers 1 and 2 immediately above, the product must be restored to its original condition, the voltage of the test signal should be adjusted up or down as necessary (higher current for faster onset of event; lower current for slower onset of event), and the restored product should be retested.

See the curves in Figure 10.2 and their accompanying text for a detailed graphic explanation of the determination of the a.c. test signal(s) used in Test Condition A. See the curves in Figure 10.3 and their accompanying text for graphic explanation of Test Condition A. A detailed explanation of the test follows below.

An a.c. signal with a fixed voltage potential of known value shall be applied to the input terminals of the product of such magnitude that a protective device operates or some conductive element within the circuit under test opens, or ignition occurs, within the prescribed time. The frequency of the a.c. signal shall be at the frequency of minimum impedance in the midband of the loudspeaker. If the product is a multi-way loudspeaker system (for example, a 2-way system with a woofer and tweeter), multiple tests would be performed, for each loudspeaker device in the system, with the a.c. signal applied to the input terminals of the system, and with the frequency of the a.c. signal set at the of minimum impedance in the midband of each speaker

device in the system. See the curves in figure 10.2 and their accompanying text for a detailed graphic explanation of the determination of the frequency of the a.c. signal(s) used in Test Condition A.

The voltage and current must be recorded during the test with a storage oscilloscope, data logging meter, data acquisition system or some other suitable instrumentation. Analysis of the recorded current and voltage magnitude as a function of time will verify that Test Condition A has been completed correctly and provides a record of the base a.c. potential used to determine the test voltages for Test Conditions B, C, and D. The onset of a significant event will usually be that point where a change of current flow (sudden or gradual, increase or decrease) can be observed which is not due solely to a change in resistance because of I^2R heating effects. See the curves in Figure 10.3 and their accompanying text for graphic explanation of the determination of Test Condition A.

Test Condition B

An a.c. signal shall be applied to the input terminals of the product at 75% of the known fixed signal at the known frequency in Test Condition A. For multi-way loudspeaker systems, Test Condition B must be applied to the input terminals for each speaker device in the product.

Test Condition C

An a.c. signal shall be applied to the input terminals of the product at 50% of the known fixed signal at the known frequency in Test Condition A. For multi-way loudspeaker systems, Test Condition C must be applied to the input terminals for each speaker device in the product.

Test Condition D

An a.c. signal shall be applied to the input terminals of the product at 25% of the known fixed signal at the known frequency in Test Condition A. For multi-way loudspeaker systems, Test Condition D must be applied to the input terminals for each speaker device in the product.

10.8.1.1 If a product sustains operation for 4 hours under Test Condition B or Test Condition C without any protective device operating or circuit element opening, and without any indication of a risk of fire, then the test conditions which follow that condition may be omitted. In the case of multi-way loudspeaker systems, only the speaker-device tests sustaining operation for 4 hours under Test Condition B or Test Condition C without any protective device operating or circuit element opening, and without any indication of a risk of fire, may have the following test conditions omitted.

10.8.2 Products providing a means for changing the input impedance shall be tested with the impedance selector switch or connections such that the most severe conditions result.

10.8.3 All operating controls provided on the product shall be positioned such that the most severe operating conditions result during the testing.