SMPTE RP 2096-2:2017

SMPTE RECOMMENDED PRACTICE

Cinema Sound System Maintenance Calibration

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Forward

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Introduction

This introduction is informative and does not form an integral part of this Engineering Document.

SMPTE RP 2096-1:2017 Cinema Sound System Baseline Setup and Calibration expands on SMPTE ST 202:2010 and RP 200:2012 by providing a set of current 'best practices' methodology for calibrating a cinema sound system, emphasizing contemporary fast Fourier transform (FFT) technology that is capable of transfer function analysis. It codifies a single set of procedures culled from current practices by experienced technicians to rigorously troubleshoot, calibrate and create detailed documentation for a dubbing theater or cinema. This provides a baseline for that theater that can be used for future "Maintenance Calibrations" and troubleshooting.

This Recommended Practice proffers a simpler procedure for maintenance calibrations that depends on:

1. The "Baseline Calibration" having been performed per [RP 2096-1], and its data/report being available to the technician performing the maintenance calibration.
2. At least the most recent previous "Maintenance Calibration" report and data being available to the technician performing this maintenance calibration, as it might point to issues that require attention if not immediate action.
3. No substantial changes having been made to the sound system or to the theater that would affect its acoustics.

1 Scope

This document details a set of recommended practices for the maintenance calibration and documentation of sound systems in dubbing stages (mixing rooms), screening rooms, and commercial cinemas to determine, and hopefully verify, the consistency of reproduction of motion picture sound in these spaces over time — in other words to provide a means to maintain correct calibration of a given space in the future.

2 Conformance Notations

Normative text is text that describes elements of the design that are indispensable or contain the conformance language keywords: “shall”, “should”, or “may”. Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting this Engineering Document’s requirements, specifications, procedures, or interoperability with other SMPTE Engineering Documents. Informative text does not contain conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as “Informative”, or individual paragraphs that start with “Note”.

The keywords “shall” and “shall not” indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, “should” and “should not” indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords “might”, “may” and “need not” indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and might be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined.

A conformant implementation according to this document is one that complies with all mandatory provisions (“shall”) and, if implemented, all recommended provisions (“should”) as described. A conformant implementation need not implement optional provisions (“might” or “may”) and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition. Tables shall be next, followed by formal languages, then figures, and then any other language forms.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this engineering document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this engineering document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

1. SMPTE RP 2096-1:2017 “Cinema Sound System Baseline Setup and Calibration”.

4 Frequency Response Target Area and Tolerances

In [RP 2096-1] and in this recommended practice, electroacoustic response is specified as being within a calibration target 'area' rather than matching a target curve or line. See [RP 2096-1] section 6 “Electroacoustic Calibration: Frequency Response Target Area and Tolerances” for the specifications on the calibration target area for each loudspeaker channel.

5 Cinema Sound System Maintenance Calibration Procedures

This maintenance calibration procedure uses a single microphone in the primary reference location.

Refer to [RP 2096-1] for specifics regarding specific equipment, procedures, measurements or results obtained while performing a maintenance calibration.

5.1 Equipment Needed

The equipment requirements for a maintenance calibration on a given theater is the same as what is required for a baseline calibration with the below exceptions and additions. In order to achieve the best consistency, it is important to match the makes and models of the microphones, analyzers and meters that were used to perform the baseline calibration of that theater.

Note that if issues are found, a new calibration will likely be needed on the channel(s) in question. That will require the full equipment list in [RP 2096-1], so it is best to plan the equipment for the calibration day accordingly.

- Only one calibration microphone is needed. The type of microphone to be used shall be determined by referring to the Baseline Calibration report for the given theater, which will include a precise notation of the brand, serial number and type of microphone used at the primary reference location.
- Only one microphone preamp is needed, with specifications identical to the ones used during the baseline calibration.
- The Baseline Calibration Report and Data, and all previous maintenance calibration reports and data for the specific theater which is slated to receive a maintenance calibration, are needed.
    - It is critical that the technician have these on hand. If these reports and data are not available, this procedure cannot be followed, and either 1) a new Baseline Calibration will need to be performed, or 2) this activity must be postponed until the Baseline Calibration Report and Data, and at least the most recent maintenance calibration reports and data, are available for the technician’s use.

5.2 Measurement Equipment Setup and Calibration Procedure

1. Perform any scheduled and appropriate preventive maintenance prior to proceeding.
2. Conduct a physical inspection of the loudspeakers, amplifiers, and signal processing equipment. Refer to [RP 2096-1] for details.
3. Check that the temperature and humidity in areas where technical equipment is located are within the operating range as specified by the manufacturers of that equipment. Prior to making measurements, measure and log the temperature and humidity in the theater. It has been shown that these can affect measured responses, especially at higher frequencies.

4. Locate and set up the single measurement microphone for the primary reference location in this theater precisely as noted in the Baseline Calibration report.
5. Set up the analyzer and related equipment in the theater seating area, if possible.
6. Connect the analyzer, signal generator, and if necessary an audio playback device, to the cinema playback system as it was done during the Baseline Calibration. Check the details in the Baseline Calibration report to ensure the exact reference microphone positioning and aiming is used for each measurement.
7. The microphone and microphone preamplifier shall be calibrated with a certified NIST-traceable calibrator as specified in the Baseline Calibration recommended practice. If a separate SPL meter is to be used for verification of playback levels, its calibration must be verified as well.
8. Configure the analyzer measurement settings as documented in the Baseline Calibration report for the given theater.
9. Verify signal flow and gain structure through the analyzer by playing back [ST 2095-1] reference pink noise from the chosen source. At reduced level check playback of reference noise through each channel to verify signal routing. If using transfer-function measurement for maintenance verification, set the analyzer's transfer-function measurement delays for each measurement channel during this process. See [RP 2096-1] for details.
10. Restore the playback system level to reference level.
11. Conduct a basic listening test to verify system functionality, coverage and frequency response of each loudspeaker channel. See [RP 2096-1] for details.
12. Using a sine wave sweep over 20 Hz – 16 kHz at a level of -3 dB FS per screen channel and a level of -6 dB FS for each surround channel, verify that each loudspeaker or playback channel is free from distortion or rattles. For the LFE channel use a sine wave sweep of 20 Hz – 300 Hz at a level of -3 dB FS. If there are concerns regarding these levels, a level of -10 dB FS may be used. Also verify that there are no rattles in the room. If distortion or rattles are detected, document them (including stimulus and channel details and aurally perceived location and characteristics) and investigate; replace any damaged components and repair any causes if possible (such as loose fixtures, with assistance from theater maintenance personnel if available).
13. Play back [ST 2095-1] pink noise through each playback channel and verify the frequency response traces match the reference traces from the Baseline Calibration, and the traces from the most recent maintenance calibration, within ±1 dB. If the traces do not match the reference traces, refer to [RP 2096-1] for the steps to calibrate the playback channel in question.
14. Play back [ST 2095-1] pink noise through each playback channel and verify that the SPL matches the Baseline Calibration data at the designated microphone location. Repeat this SPL check for each playback format available for use in this auditorium. If system components have been replaced, check that the frequency response matches the Baseline Calibration data before adjusting the SPL to match the Baseline Calibration data. If it does not, a baseline calibration will need to be performed on that channel.
15. Verify overall picture and sound synchronization using playback media that has a white-frame flash aligned with a -20 dB FS 1 kHz sine wave that is one frame duration on the center channel playback track. The sync check should be made in the middle row of the audience seating in a cinema or screening room, and at the mixing position in a dubbing theater.
16. Conduct listening verification using known program material. See [RP 2096-1] for details.
17. Record and store all appropriate data per the attached forms.

Annex A Record Keeping and Stored Data

A.1 Maintenance Calibration Checklist Forms

Theater | **Date** | **Engineer** | **Maintenance report number**

Maintenance check report

1	All items of equipment are as originally fitted	Yes	No
	Items differing from original installation or alterations made from original installation		
2	All items are functioning correctly (no fault indicators)	Yes	No
3	All parts of the system are free from dangerous conditions *Check for electrical defects, mechanical defects, and fire risk*	Yes	No
4	The system is free from signs of interference or modification	Yes	No
5	All tamper proof seals are intact	Yes	No
6	Cooling fans are clean, working, and racks free of obstruction	Yes	No
7	All cables and connectors are correctly connected and identified	Yes	No
8	All safety warning notices and devices (including covers) are in place	Yes	No
9	All items connected to designated outlets, and no unauthorised items connected	Yes	No
10	All statutory safety devices (electrical, Mechanical, and acoustic) are functioning *Check local legal and regulatory requirements for required compliance, including certificates*	Yes	No
11	System checked for electrical safety	Yes	No
12	Equipment rooms are free from dampness, leaks, or other contamination	Yes	No
13	Equipment rooms are adequately cooled	Yes	No
14	Loudspeaker cabinets are securely mounted and remain in the original positions *Check fixings on cabinets over the public and presence of safety bonds if required (local codes may apply)*	Yes	No
15	All loudspeakers cover the required listening area and have not moved since fitted	Yes	No
16	All loudspeakers sound correct and exhibit no tonal abnormalities	Yes	No
17	Loudspeaker drivers free from rattles or distortion (all cabinets, all frequencies)	Yes	No
18	System analysed from ref positions and confirmed to resemble original traces *CAUTION differences in analysis system and microphone specification may be the cause of minor variations*	Yes	No
19	Copies of current analyzer traces attached to this report	Yes	No
20	Sound in sync with picture at sync ref position	Yes	No
21	Verify System processor settings and delays are as previously documented	Yes	No
22	Listening test from playback unit carried out (with picture) and no issues found *Test for tonal quality, noise, correct listening level and correct channel output*	Yes	No
23	The whole system is free from excessive background noise and interference *Test with all room systems running, sound source from picture replay device*	Yes	No

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This document along with all plots should be archived along with the original theater alignment test report

Advisory Comments	
TEST	COMMENT

Maintenance report number

CERTIFICATION

Sign and date the appropriate section and cross out the non-applicable sections

1 **The system has passed** all tests in a satisfactory manner and is in full working order

Date | Engineer (Signature) | Company

2 **The system has passed** the majority of tests and complies to applicable standards however

There are areas of concern outlined in the advisory section which need further attention and may be a source of future failure

Date | Engineer (Signature) | Company

3 **The system has been inspected** and is not in good working order and/or is unsafe

The items of concern have not been repaired within the scope of this visit and are noted below

Date | Engineer (Signature) | Company

Reason

Re-test date

See recommended test periodicity on the original installation test document

NEXT PERIODIC INSPECTION WILL BE DUE NO LATER THAN / / DATE

Test expiration date sticker should be affixed to the main equipment rack