ACOUSTIC SYSTEMS

NS 8178 and ISO 23591

as Design References for Active Acoustics

A practical reference for consultants, system integrators and tender specifications

SIAP ACOUSTICS BV

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1. Purpose and key message

This document explains how NS 8178:2023 and ISO 23591:2021 can be used as practical acoustic quality references for music performance spaces, multipurpose halls and rehearsal-related applications. It is intended for acoustic consultants, theatre consultants, system integrators, venue owners and tender writers who need to define clear and defensible acoustic performance requirements.

NS 8178:2023 and ISO 23591:2021 provide independent reference frameworks for defining acoustic quality in music spaces. ISO 23591:2021 covers acoustic quality criteria for music rehearsal rooms and spaces, while NS 8178:2023 focuses on performance halls and multipurpose halls with an audience present, up to a volume of 6500 m^3.

For consultants, these standards are useful because they move the discussion beyond general descriptions such as “good acoustics”, “variable reverberation” or “suitable for multipurpose use”. They provide a structured way to define acoustic requirements that differ according to room type, musical use and performance condition, including RT, EDT, Sound Strength (G), frequency balance, background noise, stage-audience interaction, acoustic coupling, spatial consistency, variable acoustics, measurement and documentation. This helps consultants ask for the right acoustic outcomes in tender specifications and evaluate whether proposed systems actually address the required performance, including performer support on stage, acoustic coupling between stage and hall, consistency across the audience area, and challenging listening zones such as rear seating areas, side seating areas and areas around balconies.

In tender documentation, this can save time and reduce ambiguity. Instead of creating a fully bespoke acoustic performance framework for every project, consultants can refer to recognised standards and then add project-specific requirements where needed. This helps make the consultant’s specification more objective, easier to defend and less dependent on supplier-specific claims.

The practical value is that NS 8178 and ISO 23591 allow a tender to remain open and technology-neutral while still defining the acoustic outcome that the project requires. This is particularly useful for projects involving Active Acoustic Systems, where the difference between a complete acoustic system and a basic electronic reverberation system may not be clear from equipment lists alone.

Key message:
NS 8178 and ISO 23591 help consultants specify acoustic quality in an independent, measurable and defensible way. They provide a practical framework for defining the acoustic outcome a music space should achieve, while leaving room for project-specific design solutions.

2. Relationship between NS 8178 and ISO 23591

The relationship between NS 8178 and ISO 23591 is important because the scope of the Norwegian standard changed after the 2014 edition.

The earlier NS 8178:2014 covered acoustic criteria for both music rehearsal and music performance spaces. This edition formed the basis for the later international standard ISO 23591:2021, which has been adopted in Norway as NS-ISO 23591:2021.

In the current structure, NS 8178:2023 and NS-ISO 23591:2021 together replace NS 8178:2014. ISO 23591 now covers music rehearsal rooms and spaces, while NS 8178:2023 covers performance halls and multipurpose halls with an audience present.

Application	Relevant standard	Main focus
Music rehearsal rooms and spaces	ISO 23591 / NS-ISO 23591	Practice, teaching, ensemble rooms and rehearsal use
Music performance halls	NS 8178:2023	Performances with an audience present
Combined rehearsal and performance use	Both standards	Rehearsal criteria plus performance hall criteria
Multipurpose halls with music as a prioritised use	Primarily NS 8178:2023, with ISO 23591 where rehearsal is relevant	Acoustic flexibility, stage/audience conditions and variable acoustics

This distinction is useful for consultants and tender writers. A tender can refer to NS 8178:2023 when specifying acoustic quality for a performance hall, and to ISO 23591 when rehearsal use is also part of the project brief.

3. Why NS 8178 matters for Active Acoustic Systems

NS 8178:2023 recognises that acoustic quality in a performance hall is not only determined by fixed architectural conditions. In many modern venues, especially multipurpose halls, the acoustic response must be adaptable. A hall may need to support speech, amplified music, acoustic ensembles, choir, orchestra, theatre, conferences and other uses. These functions often require different acoustic conditions.

Traditional architectural acoustics can provide a strong foundation, but fixed physical measures cannot always provide the required flexibility. Curtains, banners, variable absorbers and transformable elements can change the acoustic response of a room, but they may be limited in range, frequency balance, spatial distribution or operational practicality.

Active Acoustic Systems can therefore be used as an alternative or supplement to structural solutions. In NS 8178-oriented design, an AAS may contribute to:

- increasing or shaping reverberation time;
- adding early reflections;
- supporting acoustic coupling between stage and audience area;
- improving the acoustic response experienced by performers on stage;
- creating different acoustic presets for different musical uses;
- helping a multipurpose hall support wider acoustic flexibility;

- compensating, within limits, for architectural constraints such as limited volume or low ceiling height.

This is an important distinction. An Active Acoustic System should not be understood only as a system that adds reverberation. In a performance hall context, it may also be expected to support stage-audience interaction, early acoustic response, spatial distribution, clarity, background noise control, acoustic presets and measurable behaviour in different configurations.

Early Decay Time and "running reverberation"

Reverberation time alone does not fully describe the perceived quality of an active acoustic response. RT describes the overall decay of sound energy in the room, but listeners and performers are strongly influenced by the early part of the decay. This is commonly described by Early Decay Time (EDT).

EDT can be understood as the **"running reverberation"** of the room: the reverberant impression that is present while music is being played, and the parameter that most directly relates to the listener's perceived acoustic experience of the space. In other words, EDT helps describe whether the room actually feels alive, supportive and connected during musical performance, rather than only having a long reverberant tail after the sound has stopped.

In some project specifications based on NS 8178-oriented acoustic criteria, additional requirements may be set for the relationship between EDT and RT. For example, a project may require the EDT to reach at least 90% of the RT value. This is a demanding and musically relevant criterion. A system may be able to increase the measured RT by adding late reverberant energy, while still failing to provide a strong and natural early acoustic response (EDT).

This distinction is important in tender evaluation. A specification that includes both RT and EDT-related criteria helps distinguish a complete Active Acoustic System from a system that mainly adds late reverberation.

A good result with AAS also depends on the underlying acoustic conditions of the hall. The room acoustic conditions should be balanced in frequency and in the distribution of reflections. Low noise levels from service equipment and technical installations are necessary because an AAS will capture and amplify the background noise in the hall. Microphone positions, loudspeaker locations, stage masking, ceiling design, technical rigging, background noise and acoustic treatment must therefore be considered together.

4. Tender specification and project assessment checklist

For consultants, theatre planners and system integrators, one of the main advantages of NS 8178 and ISO 23591 is that they provide independent acoustic quality references. This is valuable in tender documentation because it allows the project team to describe the required acoustic performance without relying on vague descriptions such as "good acoustics", "high-quality reverberation" or "suitable for multipurpose use".

A tender that only asks for an "electronic reverberation system" or a "variable acoustic system" may be interpreted in very different ways. One supplier may propose a complete active acoustic system with microphones, distributed loudspeakers, acoustic presets, performer support, measurement and tuning.

Another may propose a simpler system that mainly adds late reverberation through loudspeakers. Both may appear to meet the wording of a weak specification, but they will not deliver the same musical result.

A stronger tender specification should define the expected acoustic outcome, not only the system components. Relevant requirements may include:

- acoustic conditions for both performers and audience;
- acoustic coupling between stage and hall;
- variable acoustic presets for different music types;
- suitable RT, EDT, EDT/RT relationship and frequency balance;
- appropriate Sound Strength (G) and controlled increase in sound strength per preset;
- early reflections, stage support and performer interaction;
- clarity parameters where relevant, such as C50 for speech and C80 for music;
- consistent acoustic response across the audience area, including challenging zones such as under balconies, rear seating areas and side seating areas;
- maximum background noise level in the hall, for example 25 dB(A) for acoustic music applications, including ventilation, HVAC and other mechanical or technical noise sources;
- coordinated microphone and loudspeaker placement;
- measurement in relevant system layouts or presets;
- operation and maintenance documentation.

This approach allows a tender to remain open and technology-neutral while still requiring the functional qualities that a serious Active Acoustic System should provide.

For project assessment, the following information is typically required:

Information	Why it matters
Room function and intended uses	Determines which acoustic modes and presets are required
Prioritised music types	Links the project to quiet acoustic, loud acoustic and/or amplified music criteria
Audience capacity and performer count	Affects room volume, stage support and system coverage
Room volume, plans and sections	Needed to understand geometry, stage-audience relationship and loudspeaker locations
Ceiling height and rigging layout	Important for microphone and loudspeaker placement
Stage and audience layout	Determines performer support and acoustic coupling
Natural reverberation time	Defines the basis for active enhancement
Background noise data	Critical because AAS microphones capture and amplify background noise

Information	Why it matters
Existing or proposed acoustic treatment	Determines whether the room is balanced enough for AAS
Technical systems in use during performances	Lighting, projectors, ventilation, stage machinery and racks may affect the noise floor
AV and network infrastructure	Needed for integration with Dante, MADI, amplifiers, control and monitoring
3D model / IFC model	Useful for design coordination and acoustic review
Tender or consultant acoustic requirements	Allows the system proposal to be aligned with project-specific criteria

A useful project assessment should result in a clear design direction. It should define what the AAS is expected to do, what the natural room must provide, what physical or technical constraints must be addressed, and how the final system will be tuned and documented.

5. How SIAP supports NS 8178-oriented projects

NS 8178 and ISO 23591 provide the acoustic quality framework, but they do not design the hall or deliver the active acoustic system. A successful project still requires translation from acoustic criteria into a practical system design. This is where SIAP adds value.

SIAP welcomes NS 8178 and ISO 23591 because they provide independent recognition of acoustic principles that are central to SIAP's own approach. Developed by acousticians, the SIAP Active Acoustic System is based on the understanding that musical acoustic quality requires more than added reverberation. It depends on early reflections, stage-audience interaction, appropriate reverberation, controlled background noise, spatial distribution, variable acoustic conditions, tuning, measurement and documentation.

This aligns closely with the working principle of SIAP. By using microphones, AVA processing and distributed loudspeakers to create reflections and reverberation in addition to the room's natural sound field, SIAP supports the key active acoustic functions described in NS 8178: acoustic flexibility, increased reverberation time, early reflections from stage to audience and improved interaction for performers on stage.

SIAP supports NS 8178-oriented projects by combining room acoustic understanding, Active Acoustic System design, processing technology, third-party hardware integration, commissioning, tuning and documentation.

The starting point is always the intended use of the space. Before designing an AAS, the project team needs to define which uses are primary, which are secondary, and which acoustic presets are required. Typical use cases may include speech, amplified music, semi-acoustic music, choir, chamber music, brass or wind ensembles, orchestra, theatre and rehearsal use.

For each use, SIAP can define an appropriate active acoustic response. This may include changes in reverberation level, decay character, early reflection support, stage support, envelopment, spatial impression and overall acoustic balance. In a multipurpose hall, these conditions can be made available as presets, allowing the venue to move between different acoustic modes without changing the physical room setup.

The SIAP system design typically includes:

Design area	SIAP contribution
Acoustic concept	Definition of intended acoustic modes and AAS objectives
Microphone strategy	Placement and selection of microphones to capture the room and stage sound field
Processing	AVA-based active acoustic processing, routing, delay, reverberation and reflection control
Loudspeaker strategy	Distribution and zoning for natural spatial response and stable operation
Integration	Coordination with Dante/MADI infrastructure, amplifiers, loudspeakers and control systems
Control	Presets, user interface, CP04 control panel and optional configured iPad control
Tuning	On-site adjustment of acoustic presets, balance, stability and musical response
Measurement	Documentation of relevant acoustic parameters and system behaviour
Handover	User instructions, preset explanation, operation and maintenance documentation

SIAP's working principle is particularly relevant where project specifications include not only RT, but also EDT, early reflections, Sound Strength (G), clarity parameters and consistency across the audience area. Within SIAP's design philosophy, EDT can be understood as the "running reverberation" of the room: the reverberant impression that is present while music is being played, and the parameter that most directly relates to the listener's perceived acoustic experience of the space.

This is where SIAP's approach can be particularly valuable. The system does not only extend the reverberant tail; it can also contribute to the early part of the room response, stage support and the perceived acoustic connection between performers and audience. This helps distinguish a complete Active Acoustic System from a system that mainly adds late reverberation.

The placement of microphones and loudspeakers is not only a technical installation issue. It is part of the acoustic design. Microphones must capture useful acoustic information without excessive noise, coloration or instability. Loudspeakers must be distributed so that the active field feels natural, spatially integrated and musically supportive. The processor must then create the desired response while maintaining feedback stability and avoiding audible localisation of individual loudspeakers.

The best results are achieved when SIAP is involved early enough to coordinate with the acoustic consultant, architect, theatre consultant, AV designer and system integrator. This allows active acoustics to be treated as part of the hall's acoustic concept rather than as a late-stage technical addition.

Final message:
NS 8178 and ISO 23591 help consultants specify acoustic quality in an independent and measurable way. SIAP helps translate those criteria into a practical Active Acoustic System, with the acoustic design, technology, tuning and documentation required to support real musical use.

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