

APPENDIX 3D

SOUND TRANSMISSION RATINGS

1.0 DEFINITIONS and ACRONYMS

In this Appendix, in addition to the definitions set out in Schedule 1 of this Agreement:

1. **ANSI** – American National Standards Institute
2. **ASHRAE** – American Society of Heating, Refrigerating and Air-Conditioning Engineers
3. **ASME** – American Society of Mechanical Engineers
4. **ASTC** – Apparent Sound Transmission Class
5. **ASTM** – American Society of Testing and Materials
6. **“Confidential Privacy”** rating is a level of speech privacy and is defined as follows: the sum of the composite STC and the A-weighted background noise level shall be at least 80.
7. **dB** – the Decibel is used to measure sound level.
8. **dBA** – A-Weighted sound pressure level
9. **IIC** – Impact Isolation Class
10. **Leq** – Energy average sound level
11. **NC** – Noise Criteria
12. **NIC** – Noise Isolation Class
13. **NRC** means Noise Reduction Coefficient. NRC is a single number rating of the sound absorbing properties of a material – derived by arithmetically averaging the Sabine absorption coefficients at 250 Hz, 1000 Hz, 2000 Hz and 4000 Hz. An NRC of 0.00 indicates zero absorption while; an NRC of 1.00 indicates 100% absorption.
14. **RT60** – Reverberation Time in seconds
15. **STC** – Sound Transmission Class

2.0 Acoustic Control

This Appendix will be read in conjunction with Appendix 3A [Functional Program].

3.0 Acoustic Performance

3.1 Project Co shall design the Facility applying the following overriding principles and covering the following concerns.

3.1.1 Appropriate acoustical performance is critical to specific areas within the Facility. Areas including private offices, conference rooms and classrooms/lecture theatres, and similar, with teleconferencing and including studios, edit suites, and similar, with recording ability all require acoustical treatments to limit disruption of occupants and processes. Furthermore, areas such as the mechanical and electrical rooms, and similar, all present unique challenges to minimize transmission of sound to adjoining spaces. Project Co. will take care throughout the Design and Construction to ensure that the level of design and workmanship achieves and maintains the desired room acoustic conditions (i.e. reverberation time, RT_{60}), sound isolation performance (i.e. Sound Transmission Class, STC) of the assemblies and appropriate background noise levels (i.e. Noise Criteria, NC) ratings.

- 3.1.2** Together with this Appendix, the Room Data Sheets indicate the requirements outlined in Section 2.1.1 for most spaces, either individually or as part of an element.
- 3.1.3** Where Appendix 3A [Functional Program] includes a number of spaces, or an entire element, the STC indicated applies to the perimeter of that grouping or element unless otherwise clarified. Where adjacent rooms have different STC requirements, the greater STC requirement shall be applied to the demising wall. The NC ratings apply to all spaces within the grouping or element unless indicated otherwise.
- 3.1.4** Project Co will develop assemblies in compliance with the Design and Construction Specifications in consultation with their acoustical consultant. The suitability of the proposed assembly will be reviewed throughout design development and the final constructed assembly may be subjected to in-situ testing to determine the Apparent Sound Transmission Class (ASTC) by an independent agency prior to or after occupancy in key spaces as agreed to with the Authority.
- 3.1.5** A sound insulating partition is defined as a partition that has been specified to be STC 45 or greater. The STC ratings specified in Table 1 - STC Adjacency Matrix is considered to be the minimum required. Where it is determined to be impractical to extend a partition to the underside of the structure, an alternative design may be used provided that the specified STC indicated in Table 1 - STC Adjacency Matrix is met. Detailing of acoustical assemblies must take into account structural, and assembly, short and long-term deflection. STC ratings shall apply to floor and ceiling construction, as well as walls.
- 3.1.6** Floor design will provide structure-borne noise isolation between critical spaces, and should address footfall sound where indicated.
- 3.1.7** Exterior glazing should be selected to sufficiently reduce exterior noise to meet the dBA requirement for the room, based on the 15 minute Leq of the predictable worst case hour of a typical 24 hour day; refer to Table 2 - Maximum NC ratings for general room types..
- 3.1.8** Where the STC rating for a partition, door or window is not sufficient to reduce intrusive noise to meet the NC rating, partitions should be designed to meet the NC rating.
- 3.1.9** Building services sound levels should not exceed the NC ratings specified in Table 3 - Maximum reverberation times. Audible sounds from building services should not contain any readily identifiable unusual traits including buzz, whine, and hiss, regardless of NC level. NC levels may be subjected to in-situ testing by an independent testing agency prior to or after occupancy to ensure compliance with acoustical design criteria.
- 3.1.10** Access flooring (if used) should not generate drumming or footfall noise when walked on. Sound isolating partitions should extend from the structural floor slab to underside of slab or deck above, interrupting access flooring. Where cables pass through such partitions at the underside of the partition, the pass-through should be detailed to maintain the sound integrity of the partition.
- 3.1.11** For sound recording rooms, video and teleconferencing rooms, and

meeting rooms larger than 15m², wall and ceiling sound absorbing finishes sufficient to provide high speech intelligibility shall be provided.

- 3.1.12** Vibration control and floating floor systems (if required) shall be provided for all major mechanical rooms located above critical spaces including
- 3.1.13** classrooms, lecture theatre, sound and edit suites, offices, meeting rooms, boardrooms or any other area where structure-borne noise would create negative acoustic effects in the occupied space. Proper vibration isolation mountings of any rotating or vibrating machinery or device shall be provided.
- 3.1.14** The exterior building envelope including glazed areas, shall be such as to meet the project dBA requirements as outlined in Table 2 - Maximum NC ratings for general room types.
- 3.1.15** Noise control measures should be applied to generators and other outdoor mechanical equipment to ensure that intrusive noise from the mechanical equipment does not exceed the dBA rating for any indoor spaces, and that sound levels emanating from the equipment does not exceed the requirements of the Noise Control Bylaw of the City of Vancouver in terms of adjacent occupied areas.

4.0 Scope of Work

4.1 The scope of acoustics, noise and vibration control Design shall include the following:

- 4.1.1** Sound Isolation – To ensure appropriate sound isolation between spaces
- 4.1.2** Noise Control – To control the impact of noise from noise sources to interior spaces and outdoor space
- 4.1.3** Vibration Control – To control the impact of vibration from equipment and activities to interior spaces
- 4.1.4** Room Acoustics – To ensure appropriate acoustic design for designated spaces
- 4.1.5** Environmental Noise Control – To ensure exterior noise sources meet the background noise requirements within the facility.
- 4.1.6** Environmental Impact Assessment – To ensure building noise sources comply with the City of Vancouver Noise Control Bylaw requirements.

5.0 References

- 5.1** STC (Sound Transmission Class) – ASTM E90
- 5.2** IIC (Impact Isolation Class) – ASTM E989
- 5.3** NRC (Noise Reduction Coefficient) – ASTM C423
- 5.4** L_{eq} (Time Weighted Equivalent Sound Level)
- 5.5** NC (Noise Criteria) – ASHRAE, 2011 ASHRAE Applications Handbook, Chapter 47.26

6.0 Design and Performance Requirements

- 6.1** Sound Isolation

6.1.1 Sound isolation shall be provided to ensure privacy and minimize intrusive noise from exterior sources.

6.1.2 STC ratings for specific rooms are provided in the Room Data Sheets. A guideline for general room types is provided in Table 1 - STC Adjacency Matrix.

Table 1 – STC Adjacency Matrix

	OFFICE/SESSIONAL RM	EXECUTIVE OFFICE	MEETING RM	CONFERENCE RM	CONFIDENTIAL/QUIET RM	SEMINAR RM	CLASSROOM	COMPUTER LAB	STUDIO/PROJECT RM/CRITIQUE RM	WORKSHOP	WASHOUT RM (PRINTMAKING)	SOUND STUDIO/RECORDING ROOM	SOUND STUDIO/CONTROL RM	EDITING SUITE	RADIO ANTE & BROADCAST RM	MOTION CAPTURE STUDIO	PRODUCTION/POST-PRODUCTION	BOOKSTORE	GALLERY	LOUNGE/INFORMAL NODES & PODS	LIBRARY	PUBLIC SPACE/WAITING AREAS	KITCHEN	SERVICE AREA	SHIPPING/RECEIVING
OFFICE/SESSIONAL RM	45	50	50	53	55	50	53	50	50	55	55	65	55	53	55	65	50	50	50	50	50	50	53	53	50
EXECUTIVE OFFICE		50	50	53	55	50	55	53	55	55	65	55	55	55	65	55	53	50	53	50	50	53	53	53	53
MEETING RM			50	53	55	50	50	50	50	55	55	65	55	55	55	65	55	50	50	50	50	50	53	53	50
CONFERENCE RM				53	55	53	53	53	53	55	55	65	55	55	65	65	55	53	50	53	53	53	55	55	55
CONFIDENTIAL/QUIET RM					55	55	55	55	55	55	55	65	55	55	57	65	55	53	50	55	55	55	55	55	55
SEMINAR RM						50	50	50	50	55	55	65	55	50	55	65	50	50	50	50	50	50	53	53	50
CLASSROOM							50	50	50	55	55	65	55	50	55	65	53	50	50	50	50	50	53	53	50
COMPUTER LAB								50	50	55	55	65	55	50	55	65	50	50	50	50	50	50	53	53	50
STUDIO/PROJECT RM/CRITIQUE RM									50	55	55	65	55	50	55	65	50	50	50	50	50	50	53	53	50
WORKSHOP										55	55	65	55	55	65	65	55	55	55	55	55	55	55	53	57
WASHOUT RM (PRINTMAKING)											55	65	55	55	65	65	55	55	55	55	55	53	53	55	55
SOUND STUDIO/RECORDING STUDIO												65	65	65	65	65	65	65	65	65	65	65	65	65	65
SOUND STUDIO/CONTROL RM													57	57	57	65	57	57	57	57	57	57	57	57	57
EDITING SUITE														53	55	65	53	55	55	55	55	55	55	55	57
RADIO ANTE & BROADCAST RM															55	65	55	55	55	55	55	55	55	55	55
MOTION CAPTURE STUDIO																65	65	65	65	65	65	65	65	65	65
PRODUCTION/POST-PRODUCTION																	53	50	55	50	55	50	55	53	50
BOOKSTORE																		45	50	45	50	45	53	53	50
GALLERY																				45	50	45	53	53	50
LOUNGE/INFORMAL STUDY NODES & PODS																					50	45	53	53	50
LIBRARY																						50	50	53	50
PUBLIC SPACE/WAITING AREAS																							45	53	50
KITCHEN																									53
SERVICE AREA																									
SHIPPING/RECEIVING																									

Table 1 - Notes:

- (a) “Public Space” includes lobbies, corridors, concourse, eating area, reception areas and similar spaces.
- (b) “Service Area” includes elevators, elevator machine rooms, server rooms, laundries, garages, maintenance rooms, mechanical and boiler rooms and similar spaces.
- (c) “Confidential Room” includes quiet rooms and confidential rooms and other spaces requiring private and confidential conversation. It should be noted that electronic sound masking may be required for these key rooms to ensure ‘confidential speech privacy’.
- (d) Operable walls (if used) dividing the lecture theatres, studios and/or classrooms will have a minimum STC 48-52 sound rating.

- 6.1.3** STC ratings shall be applied to the perimeter of the room and also through ceiling and floor constructions.
- 6.1.4** Where adjacent rooms have different STC ratings, the higher rating shall be applied to the demising partition, floor or ceiling.
- 6.1.5** Effort should be made to strategically locate rooms such that noise sensitive rooms are not adjacent to rooms that generate high noise levels.
- 6.1.6** A sound isolating partition is defined as a partition having an STC rating of 45, or greater. All such walls are considered to be full height and all single stud walls are assumed to include insulation and 25 ga. steel studs. Alternate constructions to achieve the STC rating for rooms with 'non-full height walls' must be verified by an acoustics engineer.
- 6.1.7** All perimeter joints should be tightly sealed.
- 6.1.8** Partitions containing windows and/or doors may not meet the STC requirements of Table 1 - STC Adjacency Matrix, as they will be limited by the STC of the applicable windows and doors specified. The composite rating of a partition including a door and/or a glazing panel shall be STC 35 (with the door closed) except where purpose-built acoustically rated STC 45 or STC 50 doors are required.
- 6.1.9** In general, well fitted solid core wood or filled metal doors (minimum weight of 20 kg/m²) should be used for all classrooms, meeting rooms, offices and similar rooms. Acoustically rated purpose-built doors rating at minimum STC 45 (or vestibules with acoustically sealed doors) shall be used for the 400-seat and 150-seat Lecture Theatres, sound studios and edit suites and similar high sound isolation spaces. The frames of all such doors must be grout-filled.
- 6.1.10** Glazing panels should not be included in acoustic walls unless specially required.
- 6.1.11** Penetrations of sound isolating partitions shall be sealed airtight to maintain specified STC ratings.
- 6.1.12** Ductwork shall be laid out to minimize penetrations through sound isolating partitions.
- 6.1.13** If post-construction testing is required, the measurement parameter will be the ASTC test method as outlined in the applicable ASTM standard. The results should be within 8 STC points of the stated STC requirement for acceptability. NIC measurement parameters should be used only where rooms being tested are too small to meet the ASTM requirements for room size.

6.2 Noise Control

- 6.2.1** Noise control shall be provided to minimize the impact of noise sources within the building.
- 6.2.2** NC ratings for specific rooms are in Table 2 - Maximum NC ratings for general room types. Rooms not listed should conform to the NC requirements outlined in the last edition of ASHRAE.

Table 2: Maximum NC ratings for general room types (assuming doors are closed re HVAC noise and windows are closed re exterior noise in dBA)

Room Type	NC Rating	Exterior Noise, dBA (15 minute, Leq)
Rooms with video-conferencing	25-30	35
Recording rooms and Studios	20-25	30
Large Lecture Theatres	25-30	35
Sound Studios	25-30	35
Edit Suites	20-25	30
Motion Capture Studio	20-25	30
Radio Broadcast	25-30	35
Classrooms/Seminar Rooms	30-35	45
Offices	30-35	45
Gallery	30-35	45
Meeting Rooms/Conference Rooms	30-35	45
Computer Labs	30-35	45
Laboratory Spaces	35-40	50
Lobby areas / Public Space	35-40	50
Open Office areas	35-40	50
Bookstore	35-40	50
Corridors	35-40	50
Kitchen	40-45	55

- 6.2.3** HVAC equipment shall be designed to meet the NC requirement for the space.
- 6.2.4** Silencers shall be located as close as possible to the air handling units (before the ducts exit the mechanical room).
- 6.2.5** Air velocities in main ducts should not exceed 8m/s (1500fpm). Ducts with air velocities greater than 5m/s (1000fpm) should not be located in the ceiling space of spaces that have a rating less than NC 40.
- 6.2.6** Duct elbows and branches shall be radiused.
- 6.2.7** Room air diffusers should be selected to have an NC rating that is five (5) points quieter than the NC rating for the room for rooms rated at NC 30-35 and ten (10) points quieter than the NC rating for rooms rated at NC 25-30 or lower.
- 6.2.8** Piping should be laid out to avoid wall cavities and ceilings of critical rooms.
- 6.2.9** Noise isolating supports should be used to support ducts and plumbing to the building structure.
- 6.2.10** Fluorescent lighting ballasts that are integral to fixtures must be low noise type.

6.2.11 Lighting ballasts for the communications centre, boardrooms, meeting rooms, and interview rooms must be mounted remotely in corridors or service spaces.

6.2.12 All transformers must be properly vibration isolated.

6.3 Vibration Control

6.3.1 Vibrating equipment shall be properly vibration isolated from the building structure

6.3.2 Vibration isolators shall be selected to provide minimum 95% vibration isolation.

6.3.3 Flexible connectors should be used for duct and pipe connections to vibrating equipment.

6.3.4 Vibration isolation shall be provided to meet the requirements for any vibration sensitive equipment, for example in Laboratory Spaces.

6.3.5 Vibration levels shall not exceed 0.1mm/s (RMS, frequency range 4Hz to 1000Hz) on the structure in all occupied spaces.

6.4 Room Acoustics

6.4.1 Acoustic treatment shall be provided to ensure acceptable speech intelligibility as well as overall noise control.

6.4.2 Reverberation times for specific rooms are provided in Table 3 - Maximum reverberation times..

Table 3: Maximum reverberation times, RT₆₀, for general room types

Room Type	Maximum RT₆₀ (Mid frequency Ave, Seconds)
Recording Rooms and Studios	0.3-0.4
Edit Suites	0.3-0.4
Radio Broadcasts	0.3-0.4
MOCAP	0.45-0.55
Rooms with video-conferencing	0.45-0.55
Large Lecture Theatres/V-C	0.45-0.55
Classrooms/Seminar Rooms	0.7
Offices	0.7
Gallery	0.7
Meeting Rooms/Conference Rooms	0.7
Computer Labs	0.8
Open Plan Office Areas	1.0

6.4.3 Except where otherwise indicated, acoustic ceilings shall provide minimum NRC 0.7 and CAC 35 ratings

6.4.4 Special attention shall be paid to acoustic treatment of the walls in the large lecture theatre, sound studios, edit suites and any rooms used for recording

rooms and/or video conferencing rooms and meeting rooms greater than 15m², a minimum of 20% of the sound absorptive materials.

6.5 Environmental Noise Control

6.5.1 Exterior glazing and walls shall be designed such that intrusive exterior noise does not exceed the dBA requirement for the space per Table 2 - Maximum NC ratings for general room types..

6.6 Environmental Impact Assessment

6.6.1 Noise generated by the facility should not exceed the requirements of the City of Vancouver Noise Bylaw.

6.6.2 Noise barriers or enclosures should be provided for outdoor mechanical equipment as necessary to meet the City of Vancouver Noise Bylaw requirements as well as the maximum re-entrant noise per the dBA requirements of Table 2 - Maximum NC ratings for general room types.

6.7 Impact Isolation (IIC)

6.7.1 For core learning spaces an IIC 45-50 rating should be achieved between vertically stacked rooms.

6.7.2 For key low noise rooms (i.e. NC 20-25, NC25-30) an IIC 65 rating is required for vertically stacked rooms.

6.8 Acoustics for Privacy/Confidentiality Enhancement

6.8.1 There is a requirement to maintain Confidential Privacy (a level of speech privacy) for some of the key areas of the Facility.

6.8.2 The following spaces in the Facility will be designed with increased sound proofing in order to achieve Confidential Privacy rating:

Rating	Confidentiality Rating
Quiet rooms	• Confidential Privacy
Confidential rooms	• Confidential Privacy

- These spaces may be measured post construction to ensure they fall into this category at the Authority’s request.

6.8.3 Speech privacy is based on the level of speech, the acoustical properties of the partition systems, the level of acoustic finishes in a space and the background noise. This will need to be evaluated and where sufficient ambient noise is not provided by the HVAC system, consideration must be given to the use of an electronic background sound masking system (refer to Sections 5.9 and 5.10 of this Appendix).

6.9 Enclosed Room Speech Privacy Design Guidance

6.9.1 Speech privacy can be achieved with proper space planning, partitions, room finishes and effective use of sound masking systems.

6.10 Sound Masking

6.10.1 A digital centralized, dual networked sound masking system shall be provided in all spaces requiring Confidential Privacy and which is not reasonably obtainable by sound proofing and adequate background

noise from the building services systems. The system will be as approved by the Authority.

6.10.2 The sound masking system will include the following:

6.10.2.1.1 Strategically located speaker assemblies installed above conventional suspended acoustic tile ceiling or flush to the ceiling; and

6.10.2.1.2 Speaker assemblies generating unique, diffuse and unobtrusive sound with spatial and temporal uniformity, and having a spectrum shape designed to mask speech and low level unwanted noise.

6.10.3 Sound masking system details and locations will reviewed by the Authority as part of the Design review process.