



PRODUCT ENHANCEMENT SERIES

Cab Modification Guide for Sound

Maintenance and Repair	Application	Component Life Management	Component Renewal (CRC)	MARC Management	Product Enhancement Series
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1.0 Introduction

Improper machine and cab modifications can result in excess operator sound levels and noise exposure. Excess noise can be created by the introduction of additional noise sources into the operator environment or by changes to the original factory designs and noise controls that reduce the effectiveness of these controls. These additional noise sources or design changes can occur due to various field modifications inside the cab, to the cab, or surrounding the cab.

The purpose of this guide is to provide some basic understanding of field modifications that might affect operator noise and to illustrate some proper and improper modifications practices to avoid excess operator noise.

2.0 Product Enhancement Description

This section describes some general principles for controlling excess operator noise.

Useful Definitions

Sound is travelling waves in the air which can be perceived by human hearing. Sound can be useful – for communication, safety warning, or information about the machine condition or how it is operating. Excess or unwanted sound is noise. The amount of sound is the ‘sound pressure level’, which is typically measured in logarithmic units called decibels.

Operator Noise is the amount of sound at the ‘operator’s ear location’. Operator noise can be caused by the machine and its noise sources (diesel engine, fan, exhaust stack, transmission gears, hydraulic pumps, etc.) or from other noise at the worksite. The amount of operator noise can be measured in terms of sound pressure level in decibels. The amount of noise over a long period of time, such as an 8 or 12 hour period, is the noise exposure.

General Noise Control Principles

One purpose of the operator station or cab is to reduce noise reaching the operator. Caterpillar cabs are designed to block sound from entering the cab, absorb sound once it is inside the cab, and reduce vibrations that can result in sound.

Cab panels, glass, flooring, floor mats, and various covers are often chosen to block sound from entering the cab:

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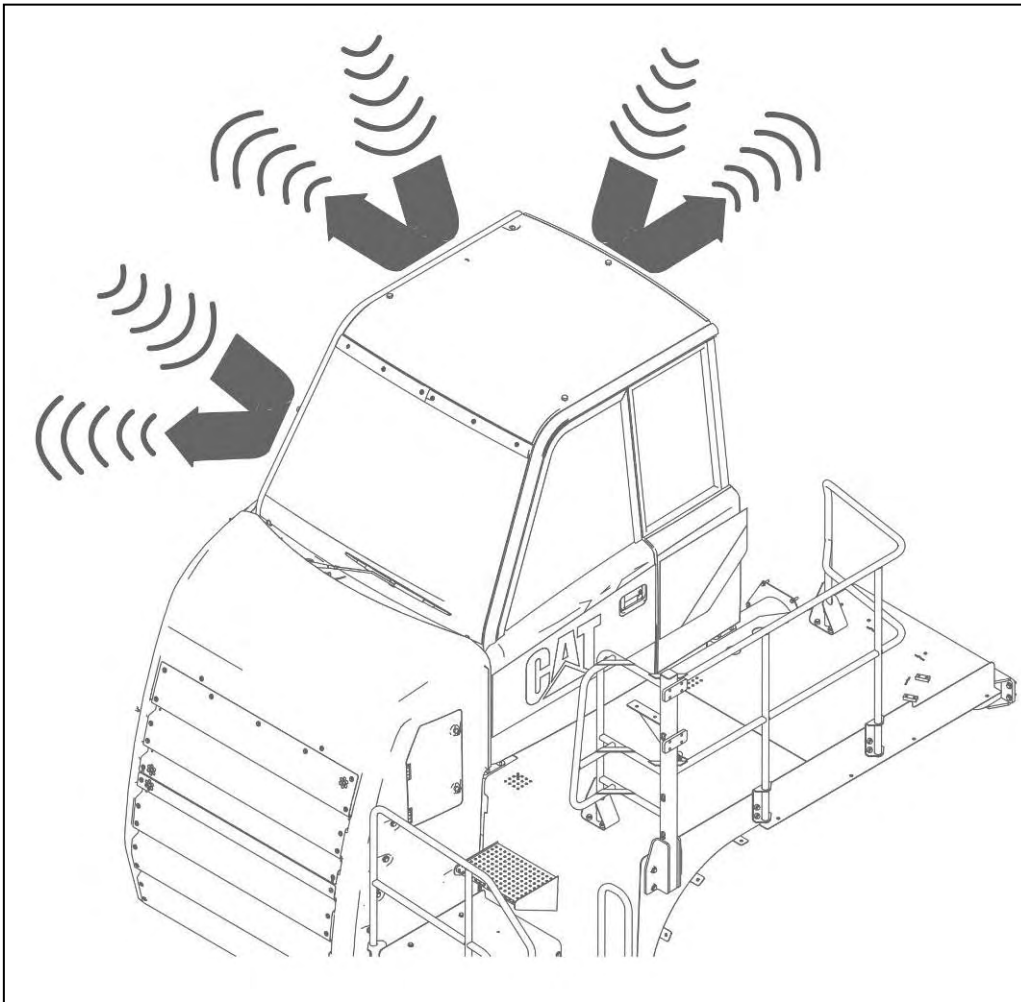


Illustration 1 – Cabs Block Sound

Cab interior components are added or chosen to absorb sound. These can include headliners, seats, floor mats, and sound absorbing trim applied to panels, covers, posts, etc.

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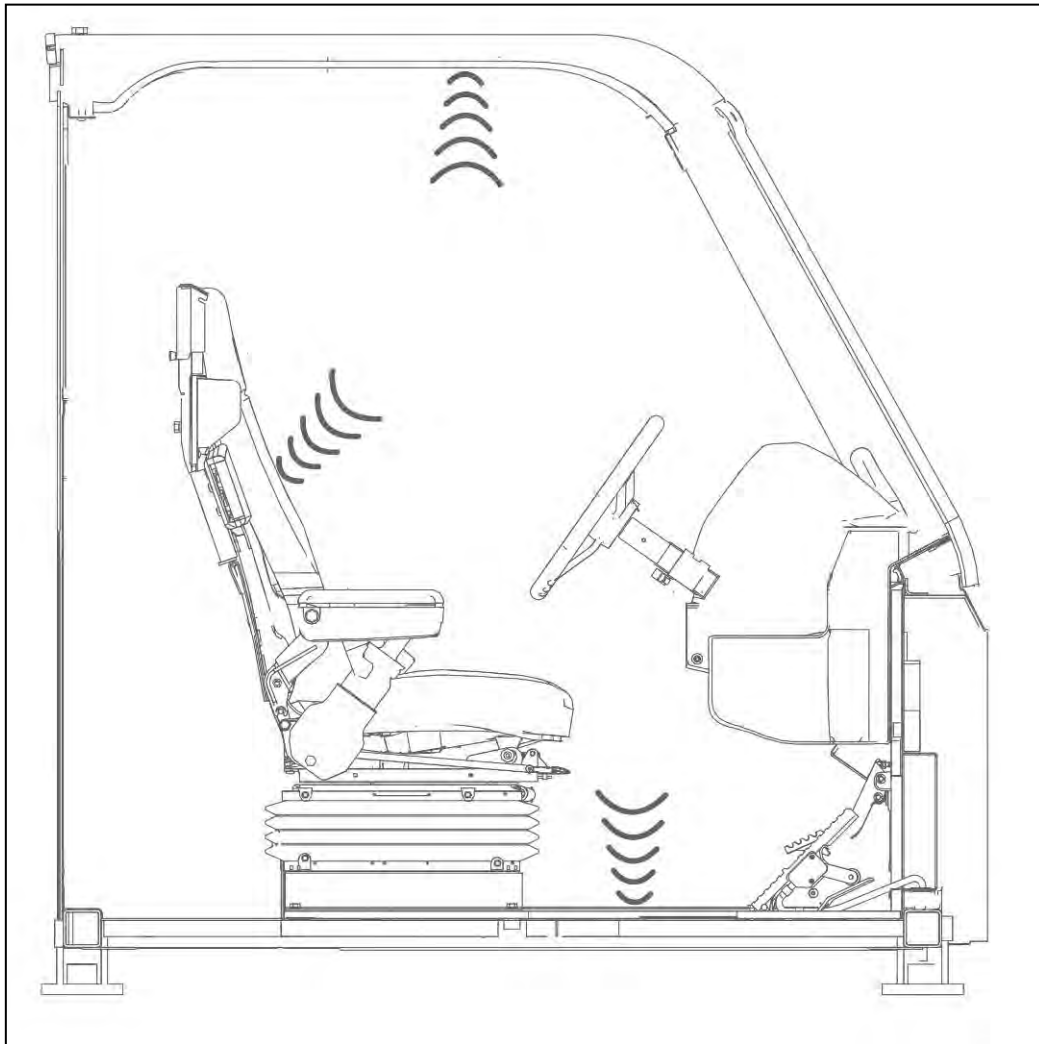


Illustration 2 – Cabs Absorb Sound

Cab structures and installations are designed to reduce vibrations that can cause sound inside the cab. This can include use of materials (panels, glass, etc.) that damp vibrations or use of isolators that prevent transmission of vibrations. For example, cabs are mounted on carefully selected rubber mounts to block vibrations from travelling from the machine to the cab.

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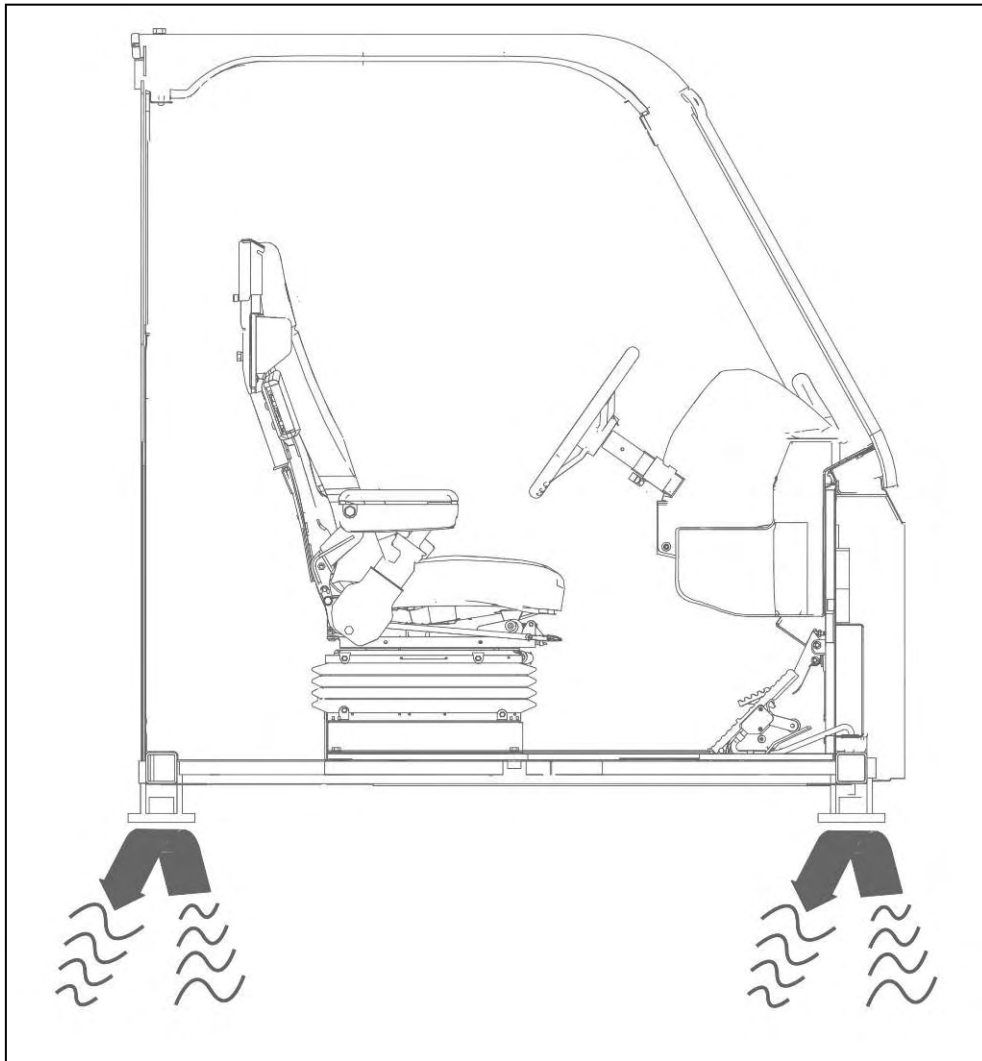


Illustration 3 – Cabs Block Vibrations

Cabs can create excess noise from buzzes, squeaks, and rattles (BSR). Parts that are in contact or come in contact can rub, scrape, or impact each other, etc. due to cab motion, vibration, or shock loads. This can create additional sound levels or annoying sounds. Cabs structures, construction, assembly, and attached components are designed to minimize motion and BSR. Loose parts are one source of rattles.

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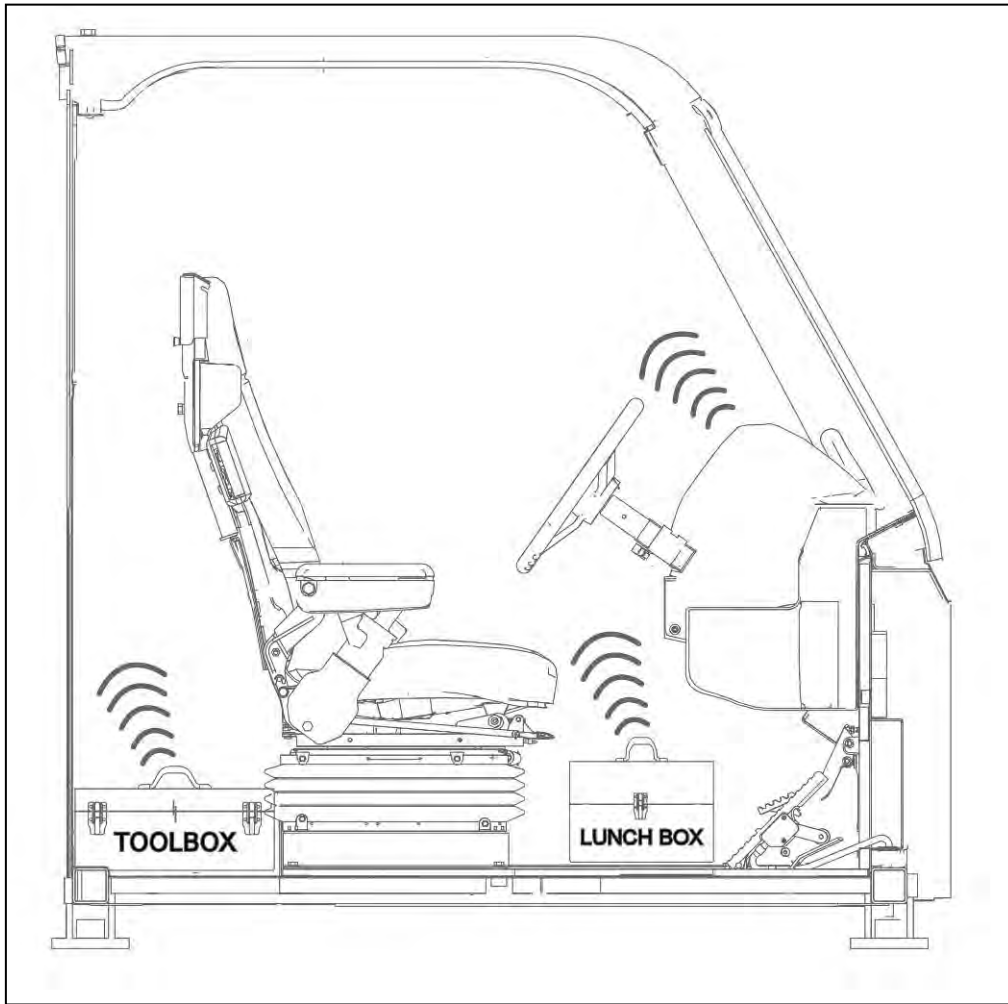


Illustration 4 – Cabs Can Create Buzzes/ Squeaks/ Rattles

Some cab accessories can create additional noise – such as HVAC fans, HVAC compressors, auxiliary fans, entertainment radios, communication radios, etc. Caterpillar designed HVAC systems, for example, are designed to contribute minimal noise when operated at typical, mid-level settings.

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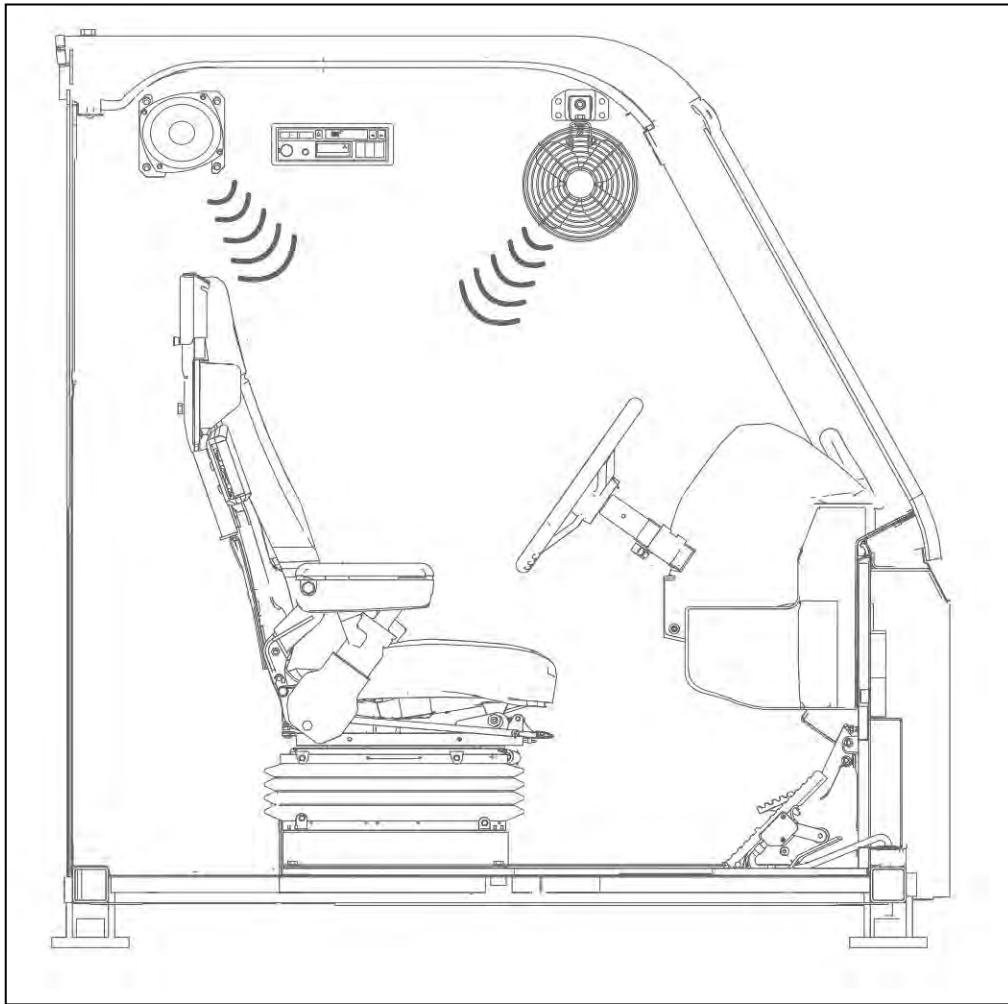


Illustration 5 – Cab Accessories Can Create Noise

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General Field Modification Noise Control Practices

A. Holes and Penetrations

Holes, leaks, gaps, or openings significantly reduce the ability of the cab to block sound. When mounting or installing new accessories or equipment:

- Avoid unnecessary holes or openings in cabs
- Cover an opening with materials at least as thick and heavy as the original panel
- Plug holes with heavy materials that are air tight
- Seal any leaks or gaps that are created due to installations or dis-assembly
- Seal any leaks or gaps around any penetrations created for cables, hoses, wiring, etc.; consider using grommets that are tight fitting and seal as necessary

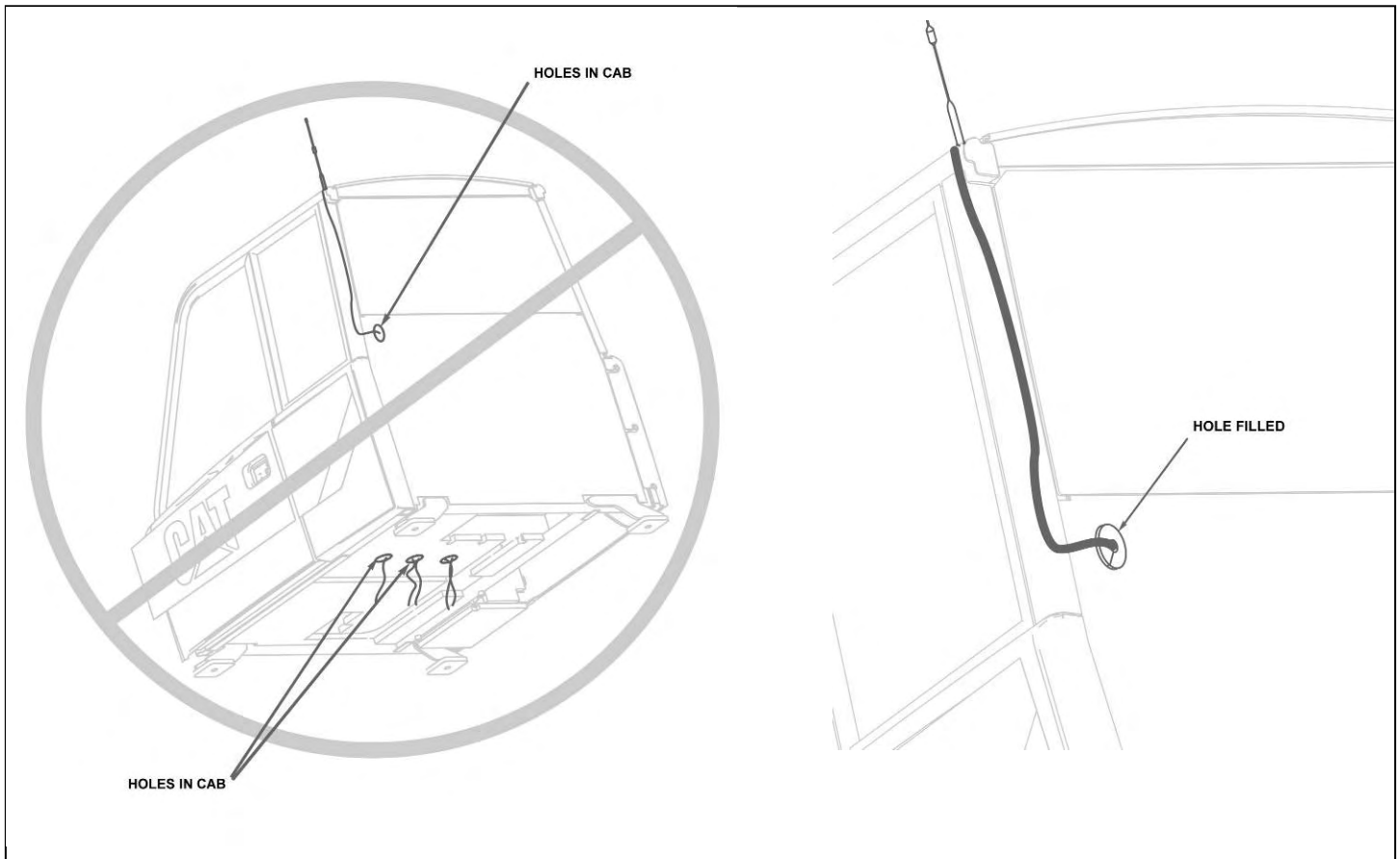


Illustration 6 – Plug holes with grommets

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B. Cab Structure

Changes in the cab structure may degrade the cab's ability to block sound or change the cab vibrations that can create sound. When mounting or installing equipment please reference SEHS6929, "Inspection, Maintenance, and Repair of ROPS and Attachment Installation Guidelines." It is also important to restore the original cab barrier system and understand the following key components:

- Replace an interior or exterior covers or panels
- Ensure proper sealing of doors and windows and any removed or replaced covers or panels
- Replace floor mat (barrier)
- Ensure floor mat is properly installed to avoid any sound leaks around the mat
- Replace any damaged structural elements – panels, glass, etc. – with original equipment with similar thickness, weight, or noise treatments
- Installation of heavy accessories may alter the cab vibration levels or result in 'resonances'

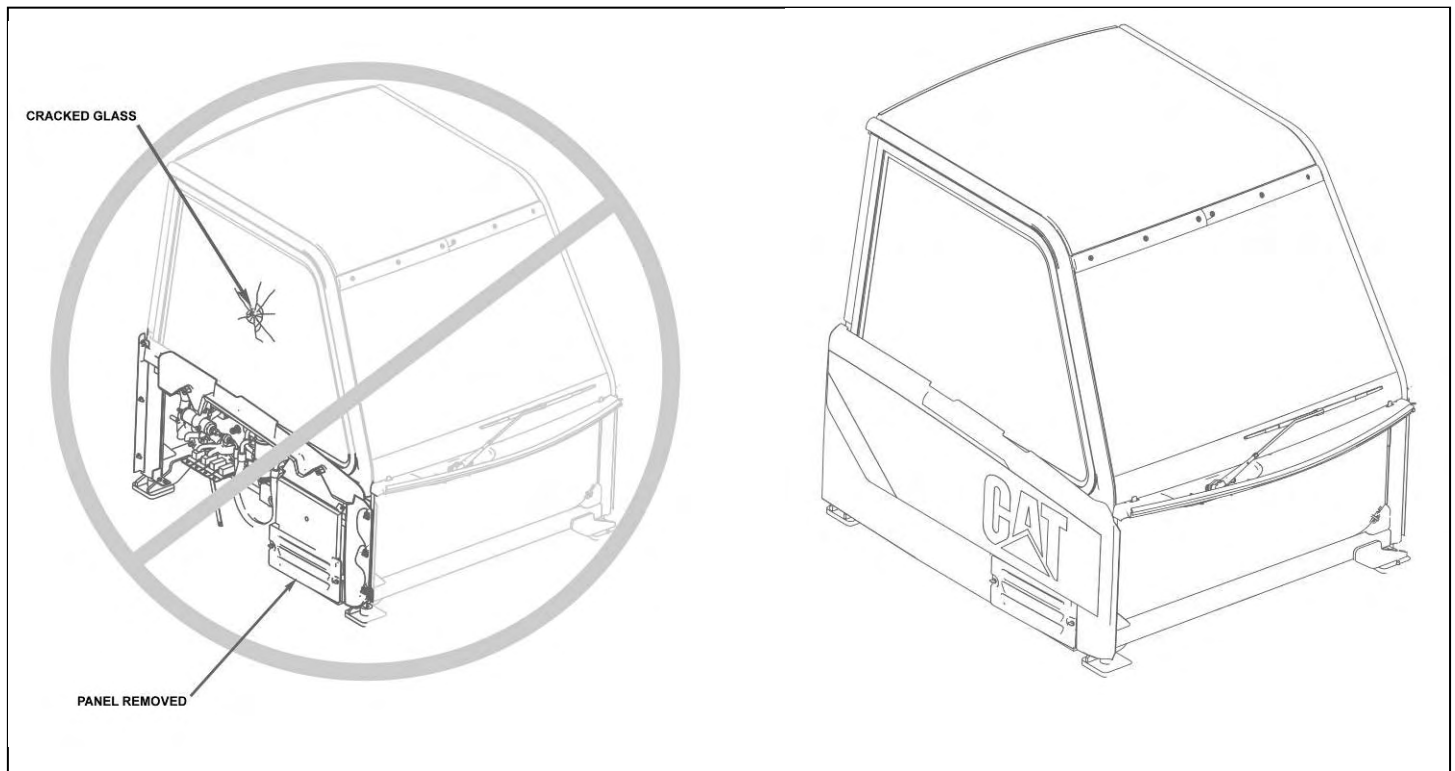


Illustration 7 – Properly Reinstall Cab Components & Repair Damage

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C. Interior Modifications

Changes that affect interior cab trim may degrade the cab’s ability to absorb sound. Make sure to:

- Replace any absorptive cab trim (mats, headliners, soft covers, etc.)
- Replace absorptive cloth seats with similar seats
- Ensure headliners are properly installed and headliner-to-roof gap is restored

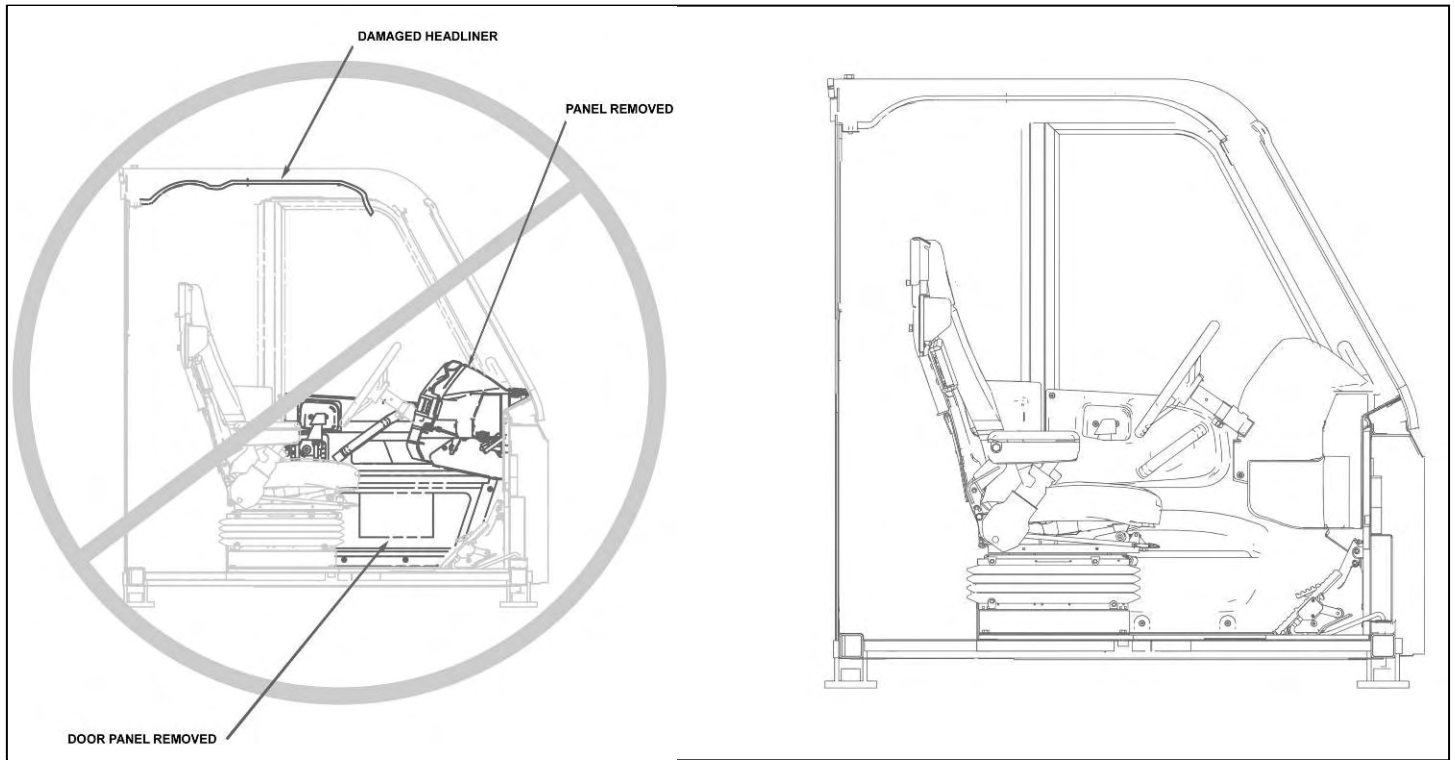


Illustration 8 – Do not replace Interior or Exterior panels

D. Interior Noise Sources

Added accessories can create additional operator sound levels and noise exposure. To avoid this consider:

- Select quiet auxiliary fans or multi-speed fans that can be operated with less noise
- Select radio equipment with maximum volume limiting features or auto-muting features than mute the entertainment radio when the communication radio is in use

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E. Exterior Mechanical Connections

Cabs use isolation mounts to block vibrations travelling from the machine frame to the cab and created excess noise. Added mechanical connections can transmit significant vibration and noise to the operator. To avoid this:

- Do not connect hydraulic hoses or accessories to the cab
- Ensure any stiff cables or wiring is isolated from the cab at the penetration point, such as with rubber grommets or washers
- Do not bridge the gaps between the machine and cab with any structure that can transmit vibration, motion, or forces
- If the cab is removed from its isolation system, ensure the cab is properly re-installed to avoid excess vibration transmission (by direct contact or by mis-aligned mounts or overly compressed or torqued mounts)

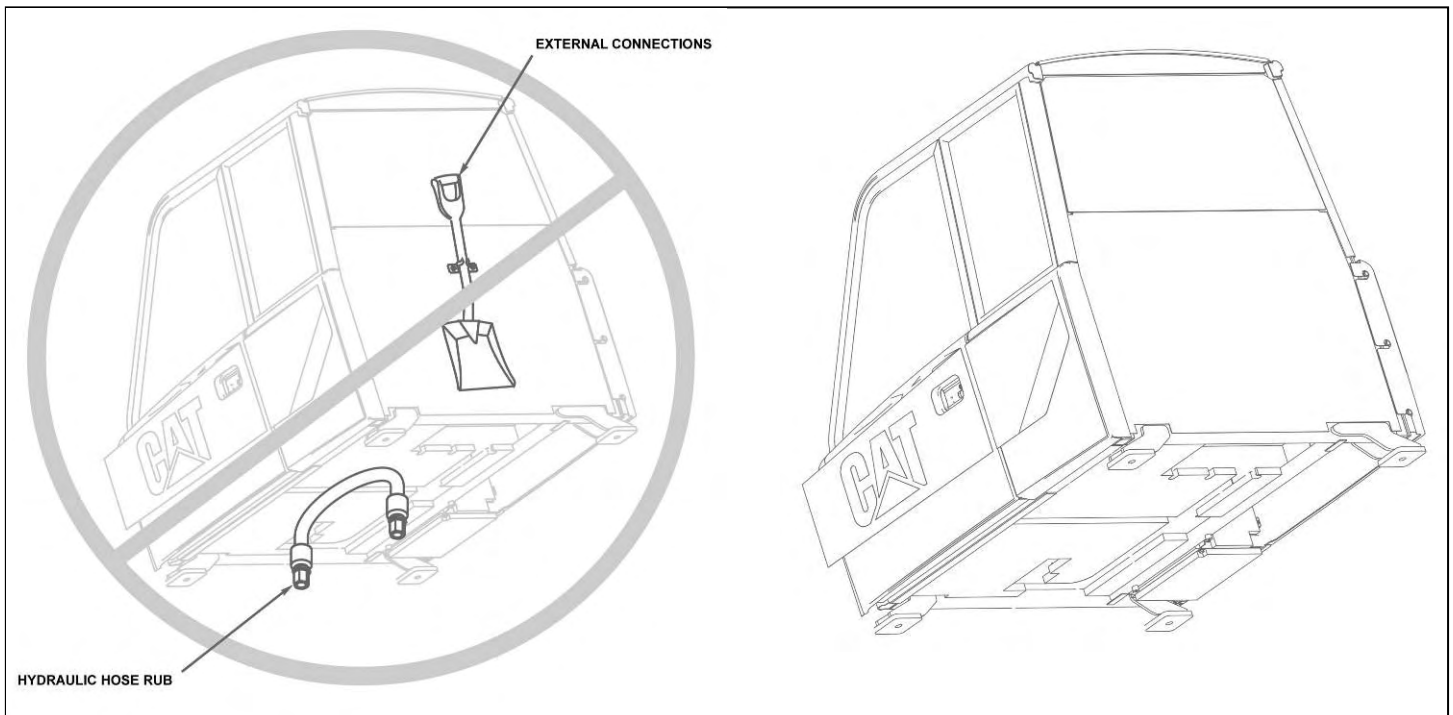


Illustration 9 – Do not connect hoses, accessories to the cab

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3.0 Implementation Steps

- Review modification potential to affect the ability of the cab to block sound, absorb sound, or block vibrations
- Review any powered component or accessory relative to potential noise generation
- Plan cab field modifications to avoid or fix openings, holes, gaps, leaks, or penetrations
- Plan cab field modifications to avoid isolate any new machine-to-cab connections
- Ensure any new hole, gaps, or leaks are sealed
- Ensure any cab absorption or barrier elements are replaced and properly installed with no leaks or gaps

4.0 Benefits

Minimizing operator sound levels to reduce operator noise exposure, improve productivity and reduce fatigue due to high noise levels, improve operator communications, generally minimize Health, Safety, and Environmental Control (HSEC) risks.

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