



CTRL WHITE PAPER

# NON-PRESSURIZED CABIN TESTING

IN AIRCRAFT, AUTOMOBILES, RAILCARS,  
AND HEAVY EQUIPMENT

*JEREMY WATTS , CTRL SYSTEMS | FEB 2017*

CTRL Systems  
1004 Littlestown Pike, Suite H Westminster, MD 21157 USA  
+1 (877) 287.5797 | +1 (410) 876.5676 | [www.ctrlsys.com](http://www.ctrlsys.com)



## Introduction

This paper will explore the use of acoustic ultrasound to perform quality control inspections and end user maintenance on non-pressurized cabins in the aviation, automotive, and heavy equipment industries. Vehicles as varied as F-35 Joint Strike Fighters, compactors, railcars, and 4-door sedans can all be tested using a similar procedure. This paper will address four major categories of vehicle testing (Automotive, Railcar, Heavy Equipment, Aviation), outlining test procedures using the CTRL Systems UL101 and UT2000. In each instance, the discussion will include a description of more cumbersome procedures already in place, and the advantages of using ultrasound as an alternative testing method.

## Automotive / Heavy Equipment Cabin Testing

Most automotive manufacturers use some variation of “rain” or watershed testing to verify the integrity of gaskets and seals around windshields, doors, and passenger windows of their vehicles. Current methods used by most manufacturers are unnecessarily cumbersome and time-consuming.

Once a vehicle has progressed far enough through the assembly process for all glass fixtures and doors to be completely sealed, the cabin of the vehicle is tested for leaks in the gaskets around windshields, door frames, and door windows. This is typically accomplished with a watershed test station. A member of the manufacturing team is seated inside the vehicle, as the chassis is processed through the rain test stand.

## Automotive / Heavy Equipment Cabin Testing (*continued*)

The watershed is turned on for 8-12 minutes, and the person inside the vehicle visually inspects all seals for signs of leakage. If a leak is located, it will be marked for repair. In some instances, immediate clean-up of the water is required after the vehicle is removed from the watershed in order to comply with safety regulations.

If no leaks are located, the vehicle is returned to a previous station for repair and must be tested again. The likelihood of a failed test varies between manufacturers and depending on the vehicle being tested, but it can be as high as 12%. The average in the automotive industry is approximately 1.2%, while the average for heavy equipment manufacture is approximately 3%. In all, the process requires at least two members of the manufacturing team to execute each inspection and consumes around 10-15 minutes of time per vehicle. Depending on the volume of the plant and the size of the vehicles it produces, the square footage of the assembly area dedicated to watershed testing can range from 500 to 5,000 square feet.

Ultrasonic cab testing is faster and safer than watershed testing. The UT200 ultrasonic transmitter is turned on and placed inside the cab on the dashboard. In larger vehicles, a second transmitter is placed in the rear of the cabin, as well. All doors are closed. The UL101 ultrasound receiver is turned on and utilized by the tester to scan all window gaskets, welds, and door seals. The entire procedure on a heavy equipment cab takes about two minutes. On an automobile, SUV, or truck, the procedure takes approximately five minutes. If there is no leak, the vehicle is moved on to the next station. If there is a leak, the vehicle is moved to a previous station for repair.

## Automotive / Heavy Equipment Cabin Testing (*continued*)

Ultrasonic testing of non-pressurized automotive and heavy equipment cabins has proven to be a better alternative to watershed testing. (1) Less time and manpower is required to execute a successful test. A single person can execute a successful test in approximately five minutes. One large heavy equipment manufacturer has reported that previous testing methods took two employees 80-90 minutes per day, plus the time required to blow off cabs and clean up excess water. Use of the UL101 and UT2000 takes one employee approximately 12 minutes per day.

(2) Ultrasound generally provides better results than watershed testing. Manufacturers of heavy equipment have reported fewer customer complaining of leaking cabins. While many manufacturers use ultrasound as a primary form of testing and merely run fewer units through a watershed, at least one heavy equipment manufacturer has reported moving completely to ultrasonic methods and has sold their watershed test stand. (3) The cost is far less prohibitive. A single CTRL-manufactured ultrasonic detector (UL101) and transmitter (UT2000) can be purchased for less than \$5,000. (4) The UL101 and UT2000 are a much safer alternative to the watershed method. Eliminating water on floors also eliminates the potential for injury related to slippage.



## Aircraft Cabin Testing

Whether testing an F-35 Joint Fighter or a small private aircraft, the accepted practice has typically been to pressurize the cabin and check for escaping air, using a combination of visual inspection, soap and water, sniffers, or ultrasound. This is a cumbersome process that requires time for pressurization and de-pressurization. Alternatively, ultrasound detection using an ultrasonic transmitter such as the UT2000 has proven to be a simpler method which requires less time and energy.

Similar to the automotive applications listed above, the UT2000 is turned on and placed within the cabin. In the case of larger aircraft such as the C-130, multiple transmitters can be used and spaced evenly throughout the cabin. The operator scans along all gaskets and seams with the UL101 receiver, listening for escaping ultrasound. As leaks are located, the operator marks them for repair. Once initial inspection and requisite repairs have been completed, the operator repeats the process to confirm repairs, paying special attention to the marked segments. Depending on the size of the aircraft, an entire cabin can be tested by one operator in 15-35 minutes.

## Railcar Testing

Manufacturers of cover hopper cars that carry grain, cement, or other granular products must inspect their products for leaks in hatches and discharge gates. In some cases, the gates are provided by a third party, so a thorough inspection is particularly necessary. The typical method for many manufacturers is extremely rudimentary: typically, an inspection is strictly visual, aided only by a flashlight. In some cases, soap and water and light pressurization is used, as well.

## Railcar Testing (*continued*)

Testing with ultrasound is much faster and more effective than visual inspection methods. Depending on the size of the railcar (typically 1600-1900 cubic feet), one UT2000 is turned on and placed within each “pocket” of the car. A single car typically has two or three pockets; with multiple transmitters, the whole car can be tested at one time. A single operator turns on the UL101 receiver and scans all seals, hatches, and discharge gates for sound. If no sound is heard, the car is passed on to the next station. If sound is heard, the car is returned to a previous station for tightening and repair. The entire testing process takes approximately ten minutes per car, and can be performed by a single operator.

## Conclusion

The use of ultrasonic transmitter/receiver testing is preferable to other methods. In the case of watershed tests, ultrasound is more cost effective, more accurate, safer, and less time-consuming. In the case of visual inspection techniques (including soap and water), ultrasound testing methods produce superior results in less time. In the case of pressurization testing, ultrasonic transmitter testing is equally effective while being less time-consuming and more energy-efficient.

*CTRL Systems has more than 25 years supplying the civil and military industry with the lightest, sensitive, enduring and friendly Airborne Ultrasound Receivers, if you wish to receive more information about this and other applications do not hesitate in contacting us.*

Call: +1 (877) 287.5797 | +1 (410) 876.5676  
Visit: [www.ctrlsys.com](http://www.ctrlsys.com)