CURTIS INDUSTRIES

A division of Powers Holdings, Inc.

Helping Patients with Cystic Fibrosis

Curtis – Helping Patients with Cystic Fibrosis

ABSTRACT

The maker of a popular Airway Clearance Technology (ACT) vest found that their pump produced excessive levels of conducted emissions. In addition, each vest contained two filters from two different suppliers, Curtis Industries, Inc. and another provider.

The manufacturer decided to consolidate to one supplier. They asked Curtis to provide a single filter in a limited space that would replace the two existing filters.

Curtis engineers modified an existing standard filter to one that performs better than the two previous filters combined, fits in the narrow space, and meets conducted emissions requirements.

This whitepaper examines:

- The Challenge
- The Solution
- The Process
- The Result

"Try to Breathe Through a Soda Straw Sometime"

That is how every breath feels for someone with cystic fibrosis.

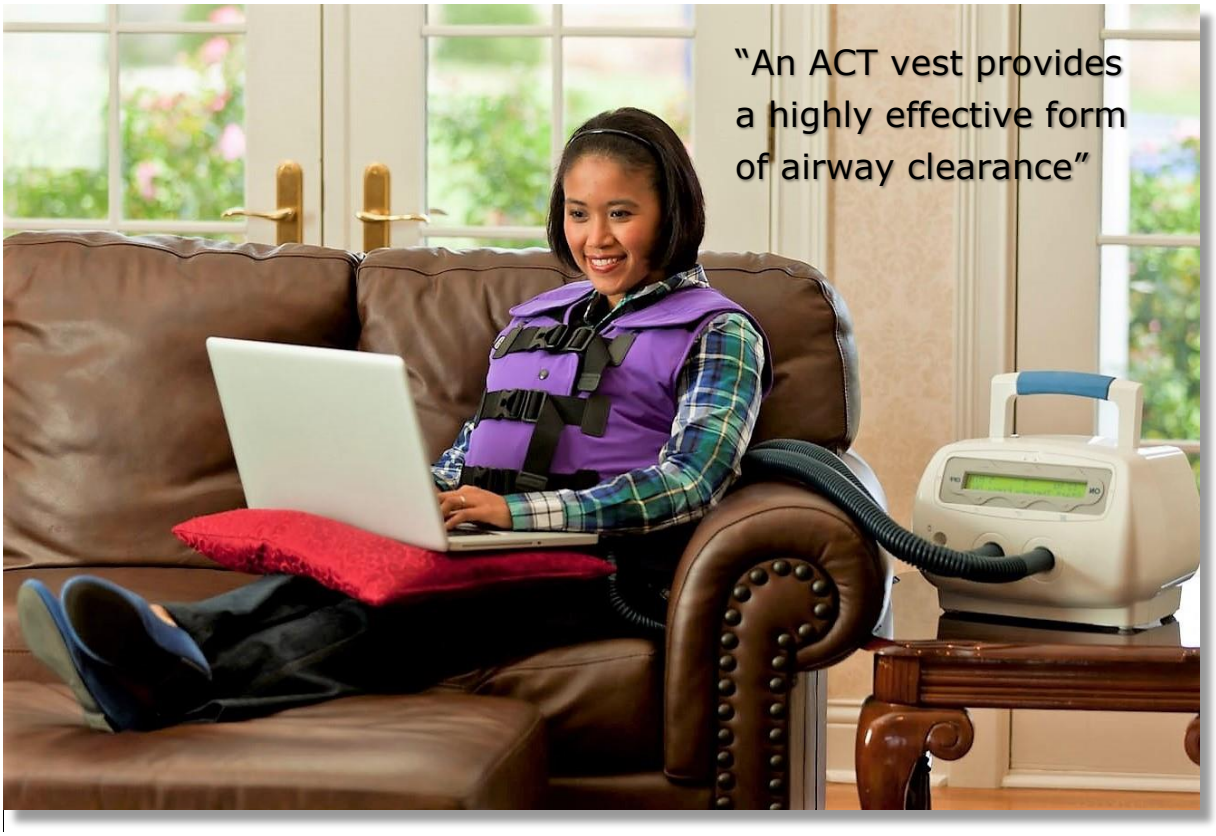
It used to be that a caregiver might massage, or slap, or even pound on the patient's chest or back to help break up mucus in the lungs.

Known as chest percussion therapy (CPT), that is what they did for as long as the arms of the person doing the slapping, or the pounding, held out.

But the Airway Clearance Therapy (ACT) vest changed all that.

Vest therapy (also referred to as high frequency chest compression/high frequency chest wall oscillation) is a safe, FDA-approved (and highly effective) form of Airway Clearance Therapy.

It has been prescribed for more than 120,000 people in the U.S. for a variety of respiratory ailments, including bronchiectasis, chronic bronchitis, and COPD, as well as cystic fibrosis.



Airway Clearance Therapy (ACT) vest

Research shows that an ACT vest provides a highly effective form of airway clearance.

It's simple to use – no special skills are necessary – and can be administered with little or no caregiver assistance.

Patient equipment consists of an inflatable vest, two interconnecting hoses, and a pulsating therapy unit (PTU).

The therapy works by administering rapid, but gentle, air pulses to the chest to help clear airways. These pulses help to:

- Loosen mucus lodged in the airways
- Thin dense and sticky secretions
- Produce airflow to help move secretions out of the lungs allowing for clearance by coughing, swallowing or suctioning
- Accelerate clearance time
- Increase the amount of mucus removed

The Challenge

The manufacturer found that their ACT pump produced conducted emissions levels that did not comply with regulations, not an uncommon occurrence when using motors, pumps, fans, ultrasonic frequencies, switching technologies, or any components that generate electrical noise.

The regulatory requirements are in place to prevent electrical interference with other equipment nearby (e.g., without the proper filter, your vacuum cleaner could cause static on your old analog TV), or with other components using the same power source.

To reduce emissions levels, each ACT unit contained two filters from two different suppliers, Curtis and a competitor. Together, both filters had to fit in a narrow space between the motor and the chassis.

The company decided to consolidate to one supplier for both filters. They asked Curtis Industries to provide a single filter that would replace the two existing filters, and still keep conducted emissions below acceptable limits. To complicate matters, that single filter had to fit in the cramped space.

The Solution

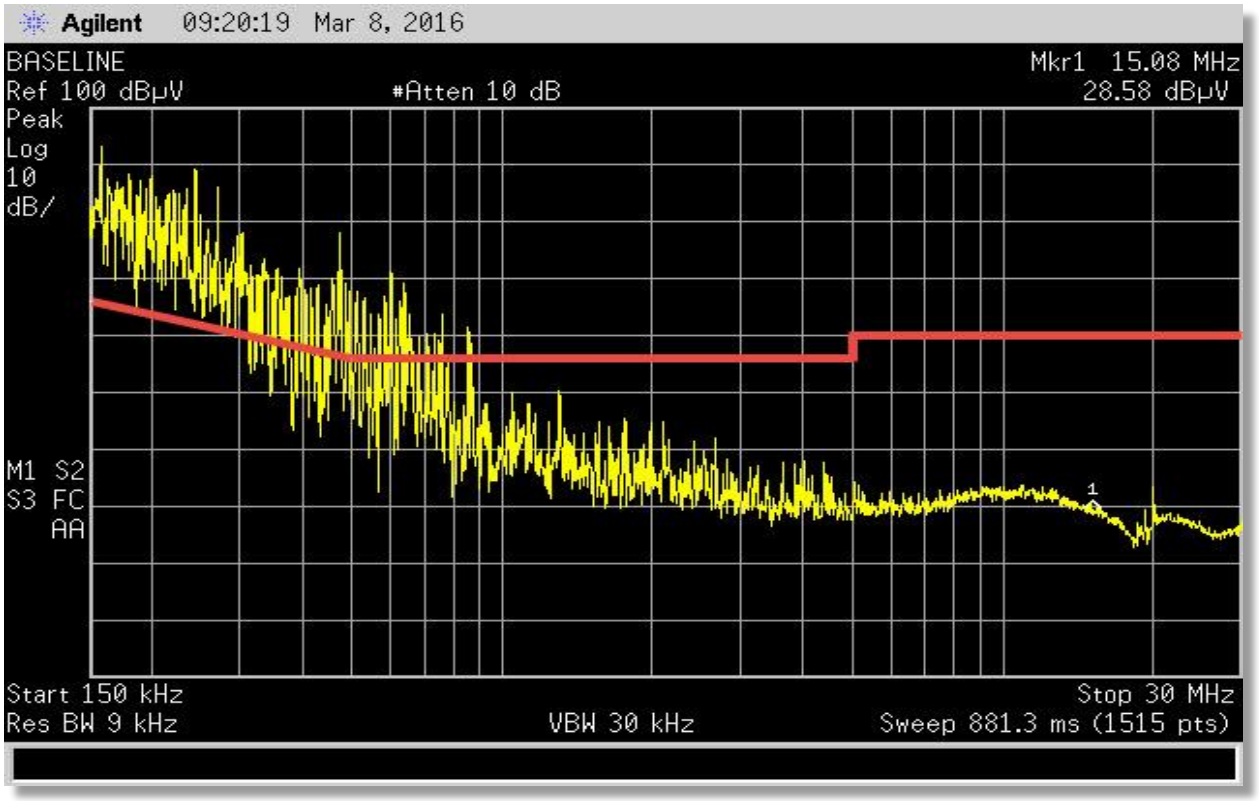
A standard filter that already carried safety agency approvals would have been the easiest solution. It would also have sped up the project timeline.

So Curtis engineers tried using several different standard EMI filters in the ACT unit. But unfortunately, none of them offered sufficient attenuation to reduce conducted emissions to acceptable limits.

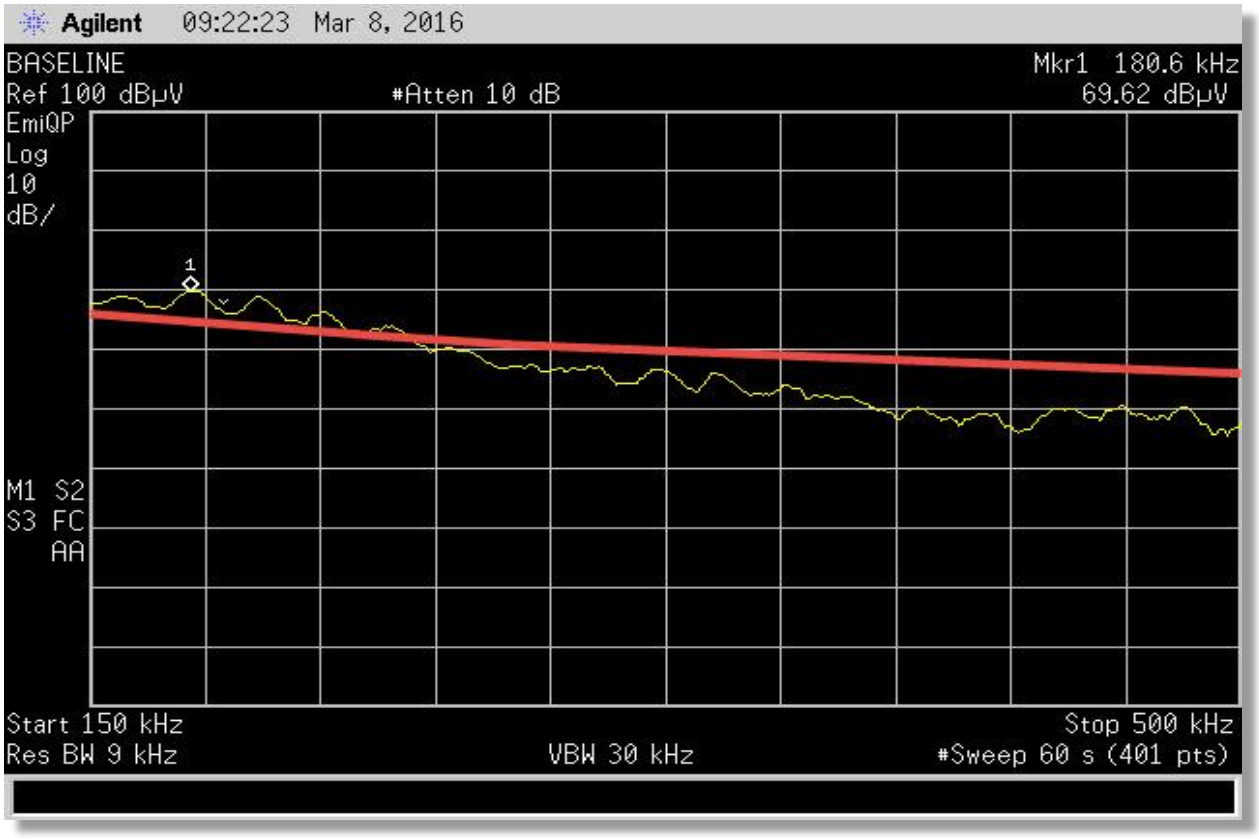
The next step was to develop a custom-designed filter.

Based on its testing of standard filter products, the Curtis engineers knew that neither Common Mode (line-to-ground) attenuation alone nor Differential Mode (line-to-neutral) attenuation alone would reduce the levels of conducted emissions significantly.

The challenge, therefore, was to produce an EMI Filter small enough to fit in the confined space of the ACT unit while maintaining high levels of performance in both Common and Differential modes.



No Filter Installed, Peak Plot



No Filter Installed, Quasi-Peak Plot

The Process

Although not a certified test lab, Curtis does perform pre-compliance testing for its clients.

Curtis engineers needed to determine if the new filter was likely to meet the appropriate emissions standards, so they tested the filters in the ACT units for conducted emissions results.

Equipment

- Airway Clearance Therapy (ACT) unit with hose (provided by customer)
- Spectrum Analyzer Agilent E7402A (valid calibration)
- (4X) LISNs
- Screen rooms

The manufacturer required that the custom filter meet the conducted emissions requirements listed in the CISPR11 Standard, Class-B.

Curtis engineers set up the ACT pump and prepared the lab for conducted emissions testing. With the unit powered and operating in a mode that generated the highest noise levels, test results were recorded and reviewed.

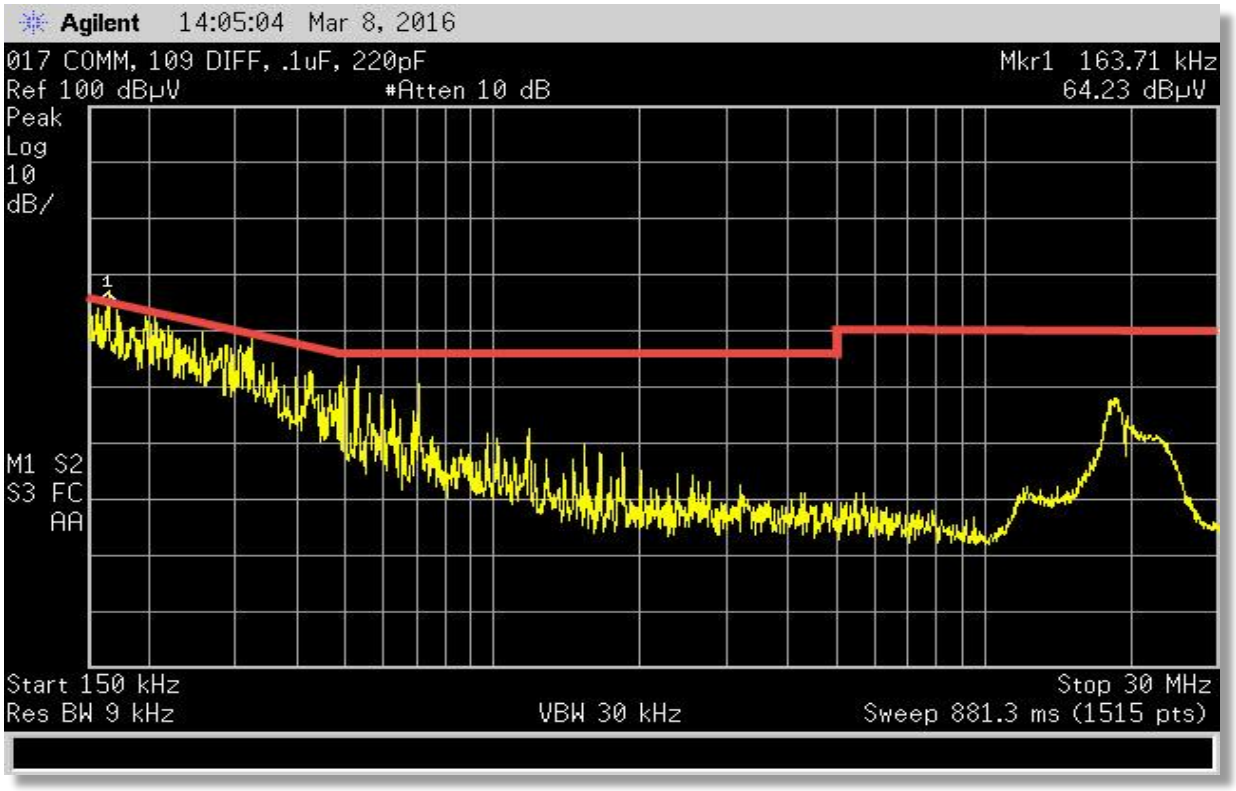
The Custom Filter Solution

First, Curtis engineers ran a baseline conducted emissions plot with no filter installed. This established the magnitude of conducted emissions (noise) present, and at what frequencies. Without any filter installed, the ACT pump did *not* comply with CISPR11 conducted emissions requirements governing medical equipment.

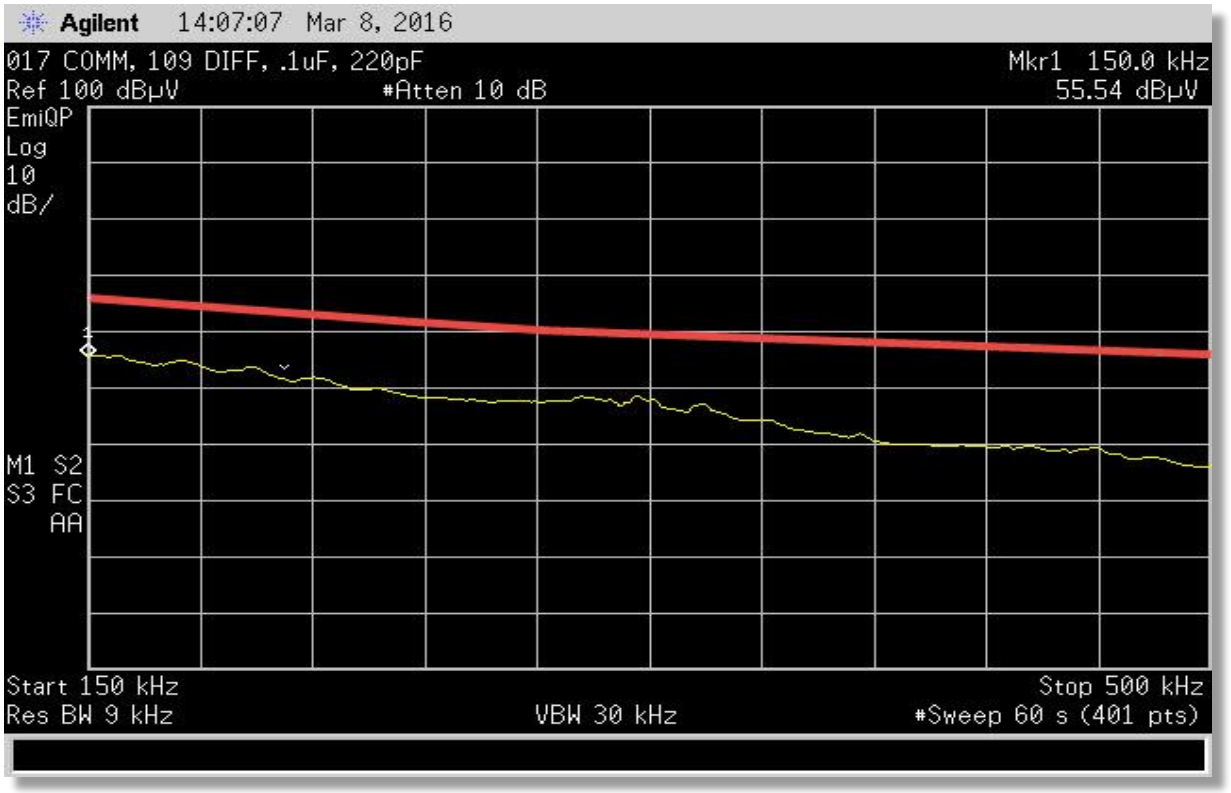
Next, they reviewed the noise profile and re-ran the test using standard Curtis filter samples of various configurations (single-stage, two-stage, common/differential stage, etc.).

When no standard filter was able to solve the problem, they entered the filter schematic into the company's circuit simulation software and ran filter circuit simulations. This showed them the best way to modify the circuit as needed (Inductor and Capacitor values) to produce what they believed would be acceptable results.

Lastly, Curtis engineers built a prototype of the final custom filter configuration, tested it in the customer's unit, and recorded the results.



Custom Curtis Filter Installed, Peak Plot



Custom Curtis Filter Installed, Quasi-Peak Plot

The Result

Good news.

Tests on the new filter designed by Curtis engineers indicated a high probability that the ACT vest would meet all applicable industry standards and pass all CISPR11 requirements when tested by a certified lab.

Best of all, the custom-designed filter fit into the narrow gap between the ACT vest pump's motor and the chassis.

The results were a resounding success, which made everyone at the manufacturing company very happy.

Patients with Cystic Fibrosis (as well as those with bronchiectasis, chronic bronchitis, and COPD) can all breathe a little easier.