WHITEPAPER

KEYS TO SUCCESSFUL HVAC PRODUCTION TESTING

ABSTRACT

In order to sustain long-term success, many HVAC manufacturers are seeking ways to decrease cost and increase productivity. Automotive manufacturers are exerting pressure for longer warranties and improved quality. As a consequence, HVAC manufacturers must examine ways to improve their production process.

This document discusses several options for HVAC manufacturers to consider in leveraging their test and analysis systems to maximize productivity and quality.

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KEYS TO SUCCESSFUL HVAC PRODUCTION TESTING

Can HVAC manufacturers maintain or increase their profits given the challenges they are facing? On one hand, they are pressured by their automotive manufacturer customers who increase feature complexity and demand longer warranties, better quality and lower costs. On the other hand, they risk costly warranty chargebacks as end consumers have heightened expectations for precise control over the airflow and temperature in their vehicle, and have little or no tolerance for adverse noise.

HVAC manufacturers must constantly balance throughput demands with delivering a high quality product. Although one mandate often conflicts with the other, it is possible to achieve both. A successful testing process will enable you to improve cycle time and throughput while delivering quality units. The following seven steps outline how you can take the necessary actions to achieve this balance.

1. ELIMINATE BOTTLENECK TEST STATIONS

Traditional airflow tests are expensive, time consuming, difficult to calibrate and yield inconsistent results. In many cases a production line that has airflow testing may have to use multiple test stations to process the required throughput. Alternatives to traditional airflow tests do exist.

These alternate tests need to capture more than basic limit data; they should record the results of the entire test process. For example, the test should collect the waveform representing the current and time required to move an actuator from a fully open to a fully closed position (its span). Capturing the current used throughout the entire process yields much more detail than recording traditional PLC limit information. Statistical analysis of this data can allow you to identify any defect that is impeding the actuator from its normal full movement. Most defects would create a spike or anomaly in the results, due to a difference in either the duration of the movement or the current required to move the actuator. Simple limit information cannot identify the same degree of defect detection. Similar tests should be conducted on all actuators on the unit as well as the servo (if applicable) and blower motor.

In many cases time-consuming, high maintenance and inconsistent airflow tests can be replaced by the previously described tests. In some cases implementing a more rigorous set of tests resulted in a 50% reduction in the overall test time, with the entire test cycle completed in under 60 seconds per unit. In addition to realizing time savings, these tests will enable you to be more precise and find more defects. The result can be higher throughput and in some instances the requirement for fewer test stations.

2. TAKE CORRECTIVE ACTION BASED ON "ROOT/CAUSE" UNDERSTANDING

The comprehensiveness of the tests that are conducted and the resulting data can have a substantial impact on line management and production improvement capability. If production managers do not have data as to what defects are causing a part to fail, they are not equipped to take corrective action to repair the source of the defect. Ultimately, this means that the same defect will continue to be produced resulting in lower yields and ongoing quality issues.

Any manual inspection of defective units is time consuming, subjective and inconsistent in identifying key problem areas. Rather than investing the time required to isolate and fix a defect,

some production facilities opt to scrap the unit. If the production line is failing units without having insight as to why, the opportunity to take corrective/preventative action earlier in the process is forfeited. Any failed unit impacts throughput metrics and drives up the cost per unit.

Short-term pain results in long-term gain. Increasing the number and type of tests you conduct will have a short-term impact on first time yield results. However, as corrective action is taken, fewer defective units will be produced or passed on to the customer. Your yield will improve and the plant will experience ongoing savings from a reduction in warranty charge-backs and quarantines. As a result of implementing a more stringent test and analysis platform, some manufacturers have reduced their quarantine expenses from body and assembly plants by as much as 70%. The effects of increased customer satisfaction will magnify the impact of these savings.

3. MIRROR THE "ACTUAL" END WORKING CONDITIONS OF THE UNIT

If possible use the actual control panel or an accurate representation of the control panel to test the unit. Reproducing this interface as close as possible will allow you to simulate the working conditions in the vehicle. For example, control panel simulations will enable you to detect actuator defects that are masked by supplying a voltage to the actuator. As a result you will catch more defects at your facility and eliminate costly warranty claims.

4. COLLECT THE RIGHT DATA AND USE IT THE RIGHT WAY

Remember that collecting data is strictly a means to an end. Determine what information is required to understand how to improve your cycle time and yield results. Ensure that:

1. The optimal set of information is collected and archived for each test. Keep in mind that basic PLC limit information is not enough to help you identify defect trends and process improvements.
2. Data should be consolidated across multiple test stands to provide a full picture.
3. The data can be easily analyzed to help identify defect trends. Your test solution should be able to statistically learn your process limits in order to identify problem spots in production. You may also want access to historical snap-shots for a given time period or shift. Keep in mind that graphical representation of the information can facilitate and expedite the analysis process.
4. If you collect the right information you can use it to quantify your quality process and standards to prospective customers. Having this information may help you grow your business by closing sales with new customers.

5. IDENTIFY WAYS TO SHORTEN TEST CYCLE TIME AND IMPROVE YIELD

In addition to root/cause analysis, if possible conduct some form of "what-if" analysis on your data. You will require full waveform capture, as basic pass/fail data is not sufficient to conduct this type of analysis. Don't risk impacting a live production line to experiment with test limits. You should run scenarios through data previously collected from production to determine the impact increasing or decreasing a limit would have on throughput and quality. This kind of analysis will allow you to in some cases reduce limits and improve the testing process. You will also be able to reduce the number of false rejects resulting from limits that were set unnecessarily high and not impact overall quality. With this analysis you will be equipped to proactively

improve your test cycle time and first time yield. Using these techniques, some manufacturers have been able to reduce their rework expenses by up to 25%.

Before conducting this type of analysis ensure that you have a good understanding of the methodology and/or algorithms used to set the initial parameters.

6. MINIMIZE THE FINANCIAL IMPACT OF RECALLS AND WARRANTY CHARGE BACKS

Although first time yield and throughput are paramount concerns, recalls and warranty charge-backs can have a large negative impact on overall profit. In order to manage the warranty process, implement quality management solutions that provide birth history tracking of units. The ability to trace when a defect was introduced and what units were produced before the defect was addressed will help you minimize the impact of costly recalls and quarantines. The more thorough the test data you collect the more accurately you will be able to isolate the problem units.

Some manufacturers have experienced up to a 30% reduction in warranty associated costs by implementing a comprehensive test and analysis system.

7. CUSTOMER AND SUPPLIER COLLABORATION

You can enhance customer relationships and satisfaction by working with your customer to set test specifications. This collaboration is especially effective in setting parameters around defects that are subjective, such as with noise and vibration tolerances. Upon setting scientific parameters around previously subjective tests you will have some recourse when processing invalid warranty charge-backs. With thorough test data and flexible test solutions you will always be equipped to demonstrate to your customers that a unit met or exceeded the agreed upon specifications when it was shipped.

Similarly, if you outsource components for your HVAC units, you can work with your suppliers to request that they conduct thorough testing of their motors or compressors. This will help ensure that you are receiving quality parts and should reduce any defects relating to outsourced components during your end-of-line testing.

In determining the test solution that is best for your needs remember, you must weigh short term cost versus long term success. As OEM customers become more demanding, you will need to be able to demonstrate that you can meet their quality requirements. Vigorous testing processes will help you maintain existing contracts and can be a selling point to acquire new business. Improving your test process will result in faster cycle time, better yield, fewer quarantines and increased quality. Overall you will benefit from reduced warranty charge-backs and satisfied customers. When you evaluate the impact on your bottom line, comprehensive testing solutions will result in a favorable return on investment and can yield a payback of less than three months. Can you afford not to evaluate these options?

Created by: Sciemetric Instruments Inc.
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About Sciemetric® Instruments

Founded in 1981, Sciemetric® Instruments is a world leader in manufacturing defect detection and product quality management systems. Customers include leading automotive and industrial manufacturing companies with a focus on improving plant yield and customer satisfaction. Customers include Fortune 500 manufacturers such as Ford, General Motors, DaimlerChrysler, BMW, Delphi, Visteon, Behr, Cummins, John Deere, Caterpillar, Mazda and Saturn.

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