Ultrasonic Equipment Manufacturers Use MTI-2100 Fotonic™ Sensor for Precise and Repeatable Vibration Measurements

Introduction


Figure 1

Take a look around and you'll be surprised to see how many products you come in contact with everyday that use ultrasonics for assembly. Diapers, plastic toys, bags and packages, to name a few, all rely on a process called ultrasonic welding.

Ultrasonics is defined as acoustic frequencies above the range audible to the human ear, or above approximately 20,000 Hertz. When a part is excited at a frequency it generates energy. The amount of energy is proportional to the frequency and amplitude at which the part moves. The higher the amplitude and frequency, the greater the energy generated. To create this motion typically a high voltage, high frequency electrical signal is supplied to a piezo-electric crystal stack. As the crystals are excited they expand and contract at the same rate as the excitation signal. The amplitude, or peak-to-peak travel distance, depends on the piezo stack length and voltage applied. Typical frequencies range from 20 to 60 kHz with amplitudes from 100 micro-inches (2.5 microns) to over 0.002" (50 microns).

An "ultrasonic horn" is the device which concentrates this energy and applies it to a process. They come in many different sizes and configurations depending on the task for which they are designed. Figure 1 shows several different horn configurations. As the tip of the horn (or contraction area) is brought in contact with a part at a certain pressure, frictional heat is generated causing the material to plasticize locally, creating an insoluble connection between two parts within a very short period of time. As the energy is removed, the part will cure, creating the bond. An example of a typical bond is the seam of a plastic bag as shown in Figure 2.

The Problem

In order to create a consistent bond or weld the ultrasonic horn must produce a specified amount of uniform energy. Varying energy distribution across the face of a horn or varying frequency will result in an inconsistent process. It is important for the operator to precisely control the motion characteristics of the horn in order to maintain product consistency and integrity. Periodic measurements of horn frequency and amplitude are therefore required.

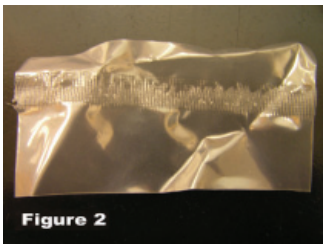
Figure 2

MTI Instruments, Inc.
325 Washington Avenue Extension
Albany, NY 12205
PH: +1-518-218-2550
OR USA TOLL FREE: 1-800-342-2203
FX: +1-518-218-2506
sales@mtiinstruments.com
www.mtiinstruments.com

The Solution

For this measurement MTI Instruments offers a unique non-contact fiber optic vibration sensor, the MTI-2100 Fotonic Sensor (see figure 3). It features advanced fiber optic and electronic technologies for precise measurements of displacement, position and vibration. Being non-contact, it does not affect or influence the target motion or dampen the vibration amplitude.

Figure 3

A fiber optic probe contains a set of light transmit and light receive fibers, available in several different configurations. A tungsten halogen lamp feeds light down the transmit fibers, where it exits the probe tip and hits the ultrasonic horn. Light that is reflected from the horn is captured by the receive fibers and transmitted to the MTI-2100. The light intensity is monitored, which is proportional to the distance between the probe tip and the target being measured. The LCD display provides peak to peak amplitude measurements of the horn in both English and metric units while and a rear panel BNC connector provides "real-time" output waveform data. This waveform can be analyzed to determine frequency, amplitude and consistency of the horn output, which is helpful in analyzing new horn designs as well as detecting horn defects.

The Equipment

The MTI-2100 Fotonic Sensor mainframe is available with a wide variety of interchangeable probe modules for maximum application flexibility. A general purpose probe module, such as the MTI-2062R, offers a frequency response of 150 kHz, a small target footprint of 1.2 mm and an output resolution of 2.5 nano-meters. For horn applications where the tip is thin or tapered MTII offers a unique "Edge" probe. It creates a "curtain" of light that is projected onto the horn tip. As vibration occurs, the amount of light received modulates and the MTI-2100 converts this modulation to a peak-to-peak displacement.

If you have a difficult application to solve, contact MTII's experienced team of application specialists who will thoroughly analyze your requirements and guide you to a practical, cost-effective solution.

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sales@mtiinstruments.com • www.mtiinstruments.com