

# SHAWFLEX

A SHAWCOR COMPANY

## Jacket Thickness Control

by Jeff State

ShawFlex manufactures custom, low voltage utility, instrumentation, thermocouple, control, marine and robotic cables for the petrochemical, pulp/paper, mining, automation and automotive industries in North America. The manufacture of these cables almost always involves the application of a “final jacket” of plastic which protects and electrically isolates the cable.

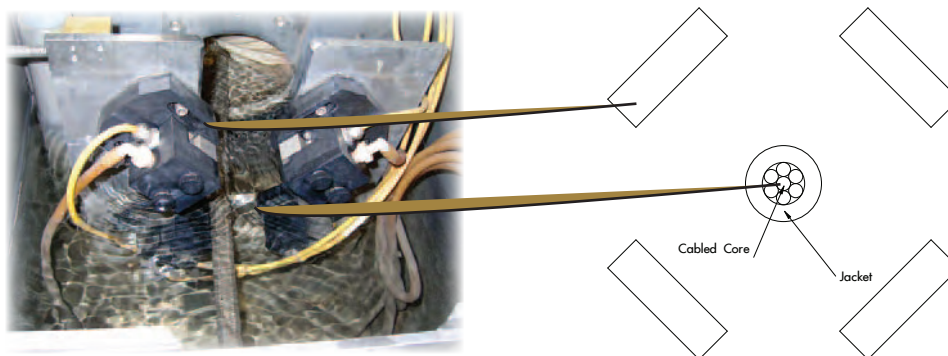
The final jacket is important in cable design because it is this protective covering which provides abrasion, tear and flame resistance, and acts as a moisture barrier. Because of this importance, the thickness of the jacket is specified by safety organizations such as UL (Underwriters Laboratories Inc.) and CSA (Canadian Standards Association).

As part of its ongoing quest to improve quality control, ShawFlex purchased a commercially available device that utilizes ultrasonics to measure wall thickness. The purpose of the unit is not only to ensure that the thickness of the plastic jacket meets the customer’s requirements, but that the centring of the cable within the jacket is improved.

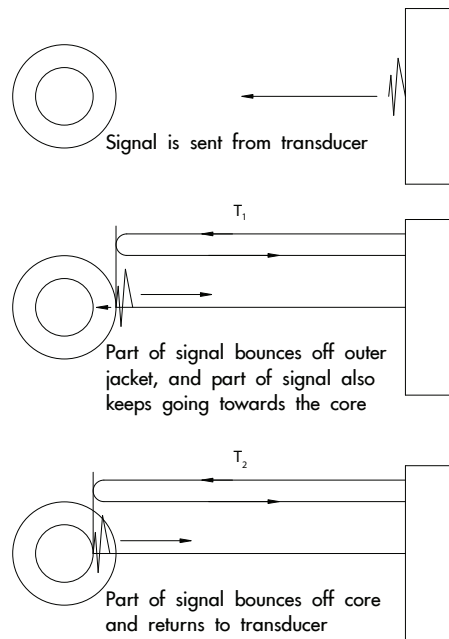


## How Ultrasonic Wall Thickness Measuring Works

The ultrasonic unit uses four transducers which send out a high frequency sound pulse towards the cable. The layout for the transducers is shown below.



The sound pulse is similar to the familiar sonar “ping” used by submarines. It moves towards the cable, reflects off the surface of the cable’s jacket, and also penetrates, then reflects off the cabled core.



$$(T_2 - T_1) / 2 = T_{\text{wall}} \text{ (time to pass once through the jacket wall)}$$

The time it takes the sound to penetrate the thickness of the jacket, along with the speed the sound is travelling in the jacket, can be used to determine the thickness of the jacket. (Note: sound travels at different speeds depending on the properties of the material it is travelling through.)

$$\text{Jacket Thickness} = \text{Speed of Sound in Jacket} * T_{\text{wall}}$$

As an example, if the speed that sound travels in a certain type of PVC running at a certain set of operating conditions is 40,000 in/sec, and the time it takes for that sound “ping” to pass once through the jacket wall is 0.0014 sec, the jacket thickness is calculated as follows:

$$\text{Jacket Thickness} = 40,000 * 0.0014 = 0.056 \text{ in (56 mils)}$$

By knowing the wall thickness at each of the four transducer positions, the operator is able to better centre the cabled core inside the jacket.

## The Problem

What is the speed of sound in the type of jacket being used at the conditions with which it is being applied? For wire and cable companies who make thousands of feet of the same cable, this is not so much of an issue as a sample can be cut from the start-up of the jacketing operation. By measuring this sample, the speed that the sound is travelling for those conditions can be determined and entered into the ultrasonic unit. ShawFlex’s focus on custom cables, short lead times and short production runs makes it impractical to calibrate in this manner, as an unacceptable amount of scrap would be produced in obtaining calibration samples.

## The Solution

ShawFlex came up with an innovative approach to determining wall thickness online without the need for this destructive sampling. Via a series of sensors and inputs, a computer using an in-house designed, customized program, is able to very accurately determine wall thickness based upon the diameter of the cable, the line speed and the output rate of the plastic jacket material. This computerized system then programs the ultrasonic unit to read the wall thickness as accurately as if a sample had been cut from the cable.



The ultrasonics screen (above right) is now calibrated and is displaying wall thickness accurately. The computer software (as shown on the left) continuously monitors the run and alerts the operator of any change in the process. In this manner, ShawFlex has substantially improved its quality and increased its cost control capability.