Wire Industry

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Material savings in the cable industry using automatic measuring equipment

When I started in this industry, 26 years ago, it was generally thought that no-one could lose money by starting a cable factory. Well, think again.

Materials are, without doubt, the dominating cost factor in today's cables, comprising 50 to 75% of the total cost. One experienced production manager told me that every eighth truck shouldn't leave the company. He meant that their over-dimensional costs were a staggering 12.5%, and I believe this is no exaggeration – especially when we consider the total numbers of cables supplied that are over-dimensioned, over length and considered as scrap.

Clearly not enough time has been spent on the subject of material saving. I have continued to find production staff, including managers, devoting less than 10% of their time to material savings, despite the fact that this is, without doubt, the highest cost in our industry.

I find that, in many cases, people are more interested in new sophisticated production lines, and reducing costs by minimising the number of operators. But this may only amount to 4–6% of the cable cost; why do we continue to ignore potential savings on material dimensions?

Could it be that such an issue is considered as simply the responsibility of quality assurance (QA), and not considered as a potential saving? In fact, quality control can be an excellent cost saver.

How, then, does the production team look at the quality assurance department? As a helper, as a problem, or as a challenge? If industry is to go forward, all sections must be working together as a team, with the same aim.

I believe that modern specialist equipment, already used by international standards authorities, can not only assist QA, but can save manufacturers vast sums of money, while at the same time harmonising the entire working environment.

The various reasons for material over-usage are:

- Start and stop scrap (much work has already been done here)
- Incorrect length (mainly over-length)
- Process variations
- Wrong conductivity, mainly due to conductor over-dimension
- Over-dimensions, mainly due to radial over-thickness.

The potential saving of insulation material is considerable, and can be assisted and improved using modern, repeatable and accurate offline methods of measurement.

This will, of course, be combined with in-line measuring, securing the stable process. Considering the thickness of the radial wall, I will illustrate the problems with using old style manual methods.

We can consider the offline measuring unit as a calibrator for the inline measuring. There are two main obstacles to using online measuring in isolation: the specifications normally demand offline measuring, and both the cable and the centre hole have to be perfectly round, which I have not yet seen in my experience.

The most common method to measure cables offline is to use shadow graphs and measuring microscopes, which have been employed by the industry for over 25 years (Figure 1).

If you try to measure a cable with such a unit, it will be influenced by a range of factors:

- Where you believe the minimum wall is
- Where you think the wall starts and ends – just by moving your head you will get a different reading
- Measuring in the correct line so that you genuinely find the minimum wall
- How the sample is located on the measuring table

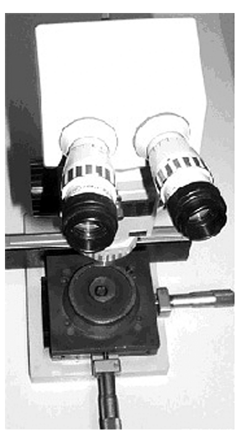


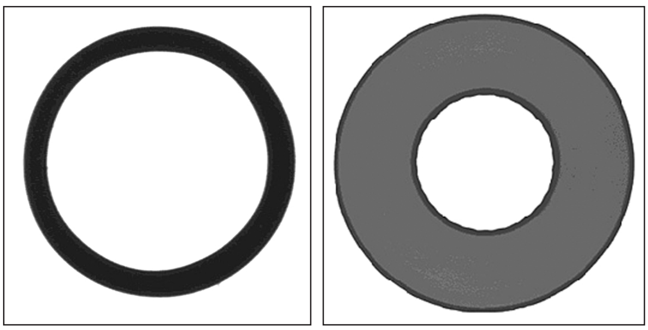
Figure 1 (left). Measuring microscope commonly used to measure cables

• Reading the micrometer screw position correctly
• Noting this reading correctly.

Human influence naturally results in divergent readings, and the divergence, or 'spread', has often proved to be as much as 5 – 9 %.

Looking at Figure 2a (below), we can understand the difficulties in measuring this sample manually. It is even more difficult to locate the minimum wall thickness in Figure 2b. We can expect that re-measuring will produce a rather large spread.

As previously mentioned, the current measuring spread using manual methods is 5–9%. This spread will have to be added to a manufacturer's process parameters to ensure that it makes a cable that will be approved.



Figures 2a (left) and 2b. Samples of cable walls

Using imaging technology

Now is the time when we must continue to reduce material costs, while, at the same time, improving quality. To achieve this, we can use equipment based on imaging technology in measuring offline.

The KSM imaging system, manufactured by ACM, has an optic/camera combination that observes samples in a similar way to the human eye/brain combination. This is the same principle used in profile projectors (shadow graphs). The image seen by the camera is then digitised and stored on a PC, where a Windows-based program calculates the measurements of the cable under test.

The big difference is in the evaluation. With imaging technology, the PC program performs the same operation repeatedly in a very short time.

Figure 2a shows how the camera sees the cable sample. The PC program has first to find the minimum wall. To do this, the program makes about 250,000 calculations. Then, depending on specification, the other minimum and maximum walls from previous calculations and measurements are included.

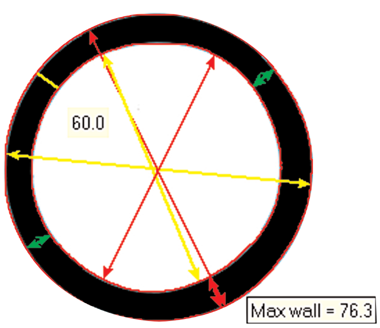


Figure 3a. Measuring using USA specifications

Figure 3a shows the results of offline measuring using the USA specifications. Initially, the minimum wall is located in the same way as for the European specifications (indicated by yellow line). Then the maximum wall is located (red line). Between these, two more minimum walls are located (marked green). The average of these four measurements determines the average wall.

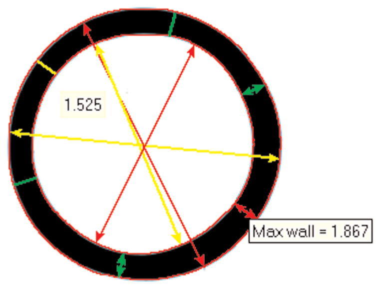


Figure 3b. Measuring using European specifications

Figure 3b shows the results of measuring using the European specifications, where, in the same way as with the USA specifications, the minimum wall is located first. Then the cable is split into six equal sections, and within these sections the other walls are located (marked with green lines). The red line is the largest minimum. The average of these six measurements is the calculated average wall.

The PC software then measures the cable diameters, both outside and inside, again using approximately 250,000 calculations to determine the measurements. From these, we find what is normally specified as the minimum, maximum and average.

The area is measured. It is not an estimation, but rather a true measurement, which is achievable due to the use of CCD cameras. This determines your insulation cost, because it is not only the walls that determine how much insulation material is needed, but also the cable body or strand form.

If we use an objective and independent method such as imaging technology, we know that we measure equally inaccurately each time, which is actually a very good background for statistical evaluations. When you know what you are doing, you can do something about it. You know that not only do you have to measure, buy you also have to measure with better accuracy than the process variation that you want to analyse. And we have seen that the manual methods unfortunately vary too much.

Now we have an available method for making it possible to know what we are doing, which is, after all, the basis for improvements. Experience shows a spread of approximately 0.2%.

Development of the KSM imaging system

The KSM offline imaging system was developed during a management course in Sweden in 1986.

The owner of an imaging company met a young production manager from a small Swedish cable factory. He knew that improved accuracy in offline measurement would give him a better basis for reducing material costs. The owner of the imaging company believed it was easily possible to develop such a measuring unit.

At that time, all quality control was overseen in the laboratory by skilled personnel, who only carried out sample and random control. Getting statistics for work on material consumption required an increased number of measurements at a greater rate. This could only be achieved by fully automatic measuring, made by the extruder operator directly after the start of production. Data also needed to be stored in a way that statistical data could be processed.It was then decided that such a unit should be developed.

Figure 4a. The KSM offline measuring system from ACM

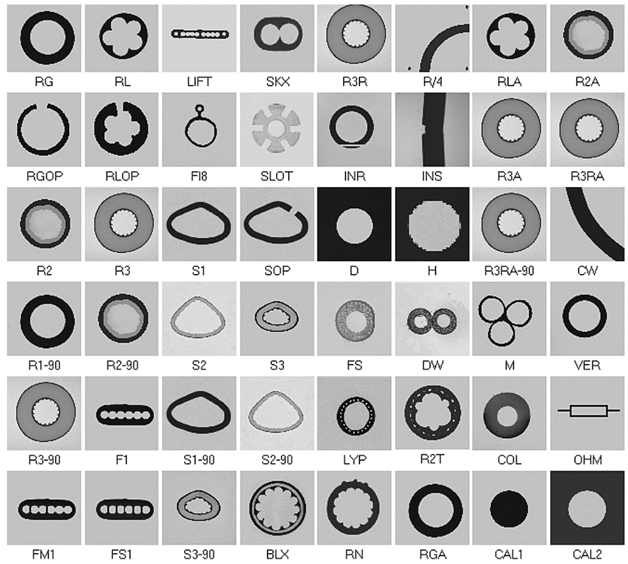


Figure 4b. A range of the different cable measuring programs available

After a long period of testing in the cable factory, ACM eventually secured cooperation to complete the project. The development involved a lot more work then anyone could have imagined, but today, after more than 14 years of improvements, we can honestly say it has been a successful project. As a result, today there is a modern, easy to use KSM Windows-based system available with a wide range of programs (Figures 4a, 4b.)

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