Material savings for the cable industry by the use of automatic measuring equipment

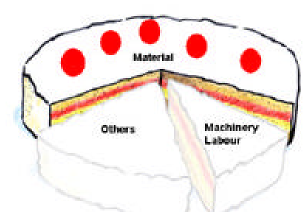
or WHY IS THE CABLE INDUSTRY GIVING AWAY SO MUCH MONEY?

Now is the time when we must continue to reduce material costs, whilst at the same time improving quality. So let's look how the imaging technology based measuring equipment can achieve this.

When I started in this Industry 26 years ago it was said that no one was so stupid that they could lose money by starting a cable factory.

Yes, I believe that this was once the case! But those days are long gone.

Materials are without doubt the dominating cost factor in a cable today. Their proportion is 50 to 75% of the total cost.



In spite of this the industry today is still giving material away, or to put it another way, **does the cable need all the material it has when it goes out of your factory gate?**

Every 8th Truck shall not leave

One very experienced production manager once told me when we where discussing this subject, that every eighth truck should not leave the company. He meant, their over dimensional cost was 12.5%!! According to what I have seen in real life he was not exaggerating. I believe that there is even more waste when we look at the total number of cables supplied, which are over dimensions and over length and we must also consider the cost of scrap as well.
But of course we cannot save everything.

Clearly not enough time is being spent on the subject of material saving. During my 26 years in this industry I have found, and continue to find production people (including managers) devoting less than 10% of their time to material savings.
Even if this is, without contradiction, the highest cost in our Industry.
I find that in many cases, people are more interested in new sophisticated production lines to reduce the cost by minimising the number of operators, even if this is only 4 - 6% of the cable cost, whilst they still ignore potential savings on material dimensions.
Why is this the case?

Could it be that quality is purely the responsibility of QA, and therefore not considered a potential saving? When in fact quality control can also be a great cost saver
How does the production team look at the QA department? As a helper, as a problem area, 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 save manufacturers vast sums of money, whilst also harmonising the total working environment.

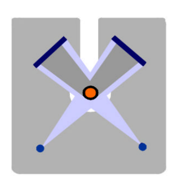
If we analyse the various reasons for material over usage today in our industry, they are, as most of you already know:
1) Start and stop scrap
2) Incorrect length, mainly over length!
3) Process variations
4) Wrong conductivity, mainly due to conductor over dimension.
5) Over dimensions mainly due to too high radial thickness.
I think that on point 1 much work has already been done.
Points 2 and 3 can be improved, but this is not the subject here.
For point 5, the radial wall, I will now show you the consequences of using old style manual methods.
As per point 4, I also like to mention the improvements available using accurate resistance measuring equipment, even, if this subject should be covered by my colleagues from AESA Cortaillod in Switzerland. We know that if we reduce the dimension of the wire we also need less insulation to cover it. The cable body will then be smaller and less jacketing material is needed

Photo showing wire measuring unit 7197 combined with KSM shown by the courtesy of AESA Cortaillod, Switzerland.

Potential saving of insulation material is great and can be helped and improved using modern repeatable accurate off-line methods of measuring.

Photo showing a measuring unit based upon image technology located in the production area.

This shall of course be combined with in-line measuring securing the stable process We can look at the off-line measuring unit as a calibrator for the in line measuring. In principle, it would be great if only on-line measuring could be used



There are two main obstacles to that:
1) The specifications normally demand off line measuring.
2) The cable has both to be perfectly round and also the centre hole has to be perfectly round, which I have not yet seen in my 26 Years in the Industry.

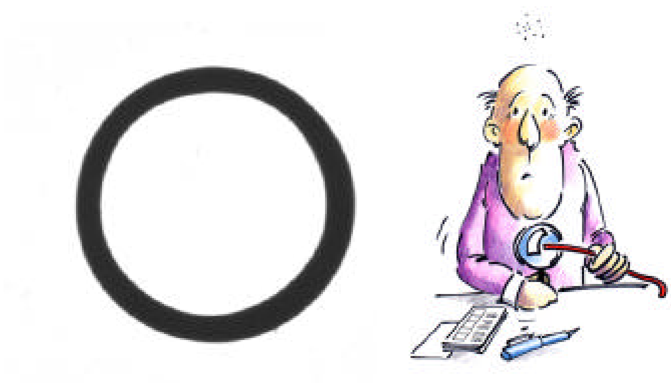
What is then today the most common method to measure cables off line?
It is shadow graphs and measuring Micro Scopes

Photo showing a measuring Micro Scope you often see used to measure cables

And how long has the industry been using these systems? I think well over 25 years!
If you take a unit like this and try to measure a cable, it will be influenced by many things.

If you look at this sample we can very well understand how difficult it is to measure manually.

Where do you believe the minimum wall is?
Where does the wall start and end?
Just by moving your head you will have a different reading.
To measure in the correct line so that you really find the minimum wall.
It depends how the sample is located on the measuring table.
To read the micrometer screw position correctly
Note the reading correctly

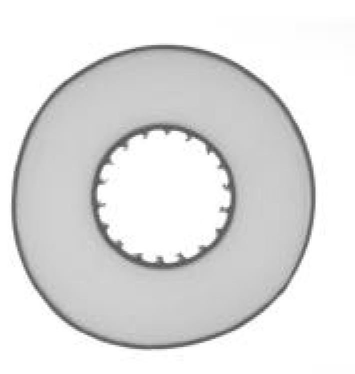


There must of course be a spread using those methods mainly due to the human influence.

Many studies have been made of the most commonly used manual methods, such as profile projectors and measuring microscopes. It has been proven that these give different results even on the same sample. Companies have used one sample, marking the top side to ensure measuring is made from the same side, then have it measured many times, (at least 20), over a period of time and by 2 to 3 people. It is amazing how big the spread then is!! In every case the variation was at least 5% and in some case up to 9%. These figures have been given to me by customers here in the US, as well as, other areas in the world.

And this case is even worse!
Where is the minimum wall thickness????

We can very well appreciate that the re-measuring will produce a rather high spread.

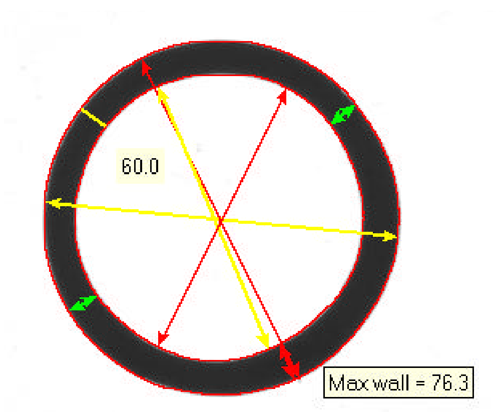


And as said in the introduction. the current measuring spread using manual methods is 5 - 9%. This spread will have to be added to your process parameters to ensure that you make a cable that will be approved.

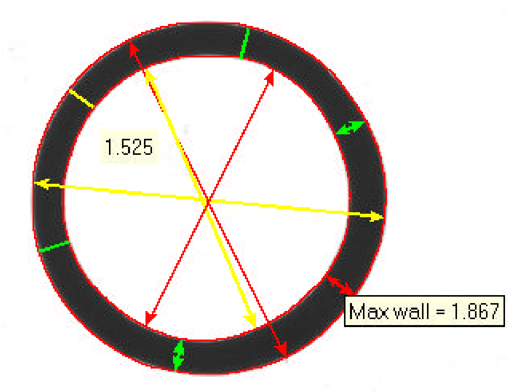
How do we use the imaging technology in measuring off line?

The system has an optic and camera combination looking at the sample, in the very same way as the human eye/brain combination. Which is the very same principle used in profile projectors (shadow graphs). The image seen by the camera is then digitised into the PC. We then measure this digitised image using a PC program especially developed for cable measurements, which can be compared to the human brain. The big difference is the evaluation. With the imaging technology the PC Program does the very same operation again and again and again, and in exactly the same way. It also does these operations many times in a very short time. The human brain, firstly makes a quick evaluation where it considers the minimum wall to and then it concentrates on that area alone.

This is how the camera sees the cable sample. The PC program firstly has to find the minimum wall. To do that the program must measure at the cable everywhere. It makes about one quarter of a million calculations to find the minimum walls. For this job a stupid computer is the very best thing to use, because as said previously, it does the very same thing again and again and again and…
Then depending on specification the other minimum and maximum walls are included from previous calculations and measurements.



This image shows the results of the measurements using the US spec, where firstly the min wall is located in the same way as for the European spec. It is marked with a yellow line. Then the max wall is located, indicated with a red line. Between those two more min walls are located and marked green. The average of these four measurements is the average wall.



This image shows the results of the measuring using the European spec where in the same way as with the US specification, you first locate the minimum wall. Then the cable is split into 6 equal sections and within those sections you locate the other walls. They are marked with green lines. The red line is the largest minimum.
The average of these six measurements is the calculated average wall thickness.

The PC program then measures the diameters. The outside and inside are measured. We again use approximately one quarter of a million calculations to determine the measurements to present those diameters. From these we find what is normally a specified min, max and average.
The area is measured. It is not an estimation, it is a true measurement which we can do, due to the use of CCD cameras. And this is your cost for insulation. Because it is not only the walls that determine how much insulation material that is needed, but also the cable body or strand form, has a big influence.

If we use a human independent method such as imaging technology we know that we measure equally badly each time. And this is of course a very good background for statistical evaluations. When you know what you are doing you can do something about it. To know you do not only have to measure, you 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.
This method is now available making it possible to know what you are doing, which is the basis for improvements. Experiences show a spread of the measurements to be as low as approximate 0,2%.
If we use 1% in a calculation we are on the safe side.

How and why was KSM developed?

It was actually on a management course in Sweden in 1986!
Then you will say, finally a management course that produced something.
Well in fact it was not me, the case was that at 11 o'clock in the evening in the bar an owner of an imaging company met a then young production manager from a small Swedish cable factory. He knew that improved accuracy of the off line measurement would give him a better background to reduce the material cost and the owner of the imaging company believed it would be easy to make such a measuring unit.

Today's comment from the very same person
"The main problem at that time in the cable business, and still is, is the waste of raw material due to over dimensions in wall thickness. At that time, all quality controls were made in the laboratory by skilled personnel, but they did only sample and random control. To get statistics for work on material consumption we needed faster and an increased number of measurements. This can only be achieved by fully automatic measuring, made by the extruder operator DIRECTLY after the production start. Data needs to be stored in a way that statistical data can be processed."

It was decided that such a unit was going to be built. But after a long time testing in the cable factory the measuring unit was not accepted (and not paid for).
We where, luckily for us, consulted and in co-operation the project was completed. It was a lot more work then any of us could have imagined, but today, after more than 14 years of improvements we can say it has been a success.

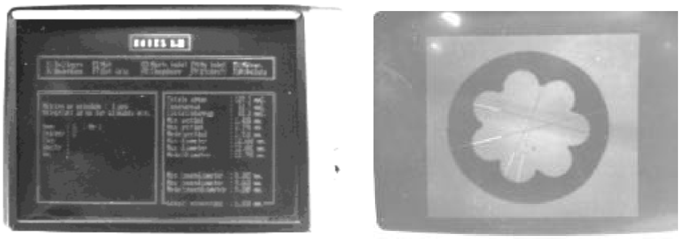


Photo showing the second generation Screens

After some years it started to look like a measuring unit, but still far from the level of today.

Photo showing the second generation KSM already then connected to AESA 7122

Today there is a modern easy to use Windows system available.

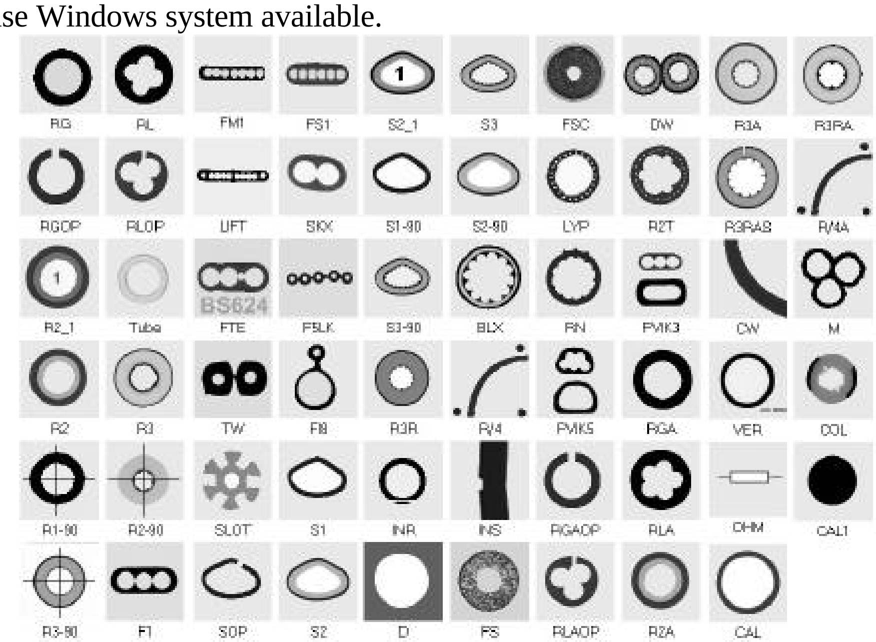


Photo showing today's modern KSM and some of the different programs available.

Economics

This is all very nice but how does it pay off?
It's rather simple. We all know (or should know!) that one extruder line "eats" material at a cost off something like 2 – 3 million US $/Year. Maybe down to 1 million for a low output line using low price material but even up to 5-6 million if we talk about HFFR.
And not to mention PA and FLUOR.
We have previously made it clear that manual measuring gives a spread of at least 5%.
If we measure automatically with 0,2% spread it is a difference of at least 4%.
Let say we can only save half of that. Which is 2%!
This is at least 20.000 US $/Year, and even up to well over 100.000 $/Year for one extrusion line. One installation can be located so that normally at least 3 extruder operators can use the same measuring unit. Saving potentially 60.000 $ to well over 300.000 US $/Year!! And as many of you know these figures are under estimated. To that, several more valuable advantages can be added using automated measuring principles. For example much less time needed to measure, avoiding wrong values being saved, better evaluation values for process optimising and so on.

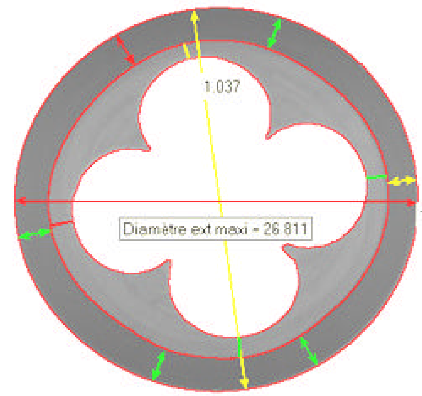
Conclusion

To be able to improve you must know what you are doing!!

and we must also wonder
WHY IS THE CABLE INDUSTRY GIVING AWAY SO MUCH MONEY?

References KSM   Sept 2001

Customer	*Pcs*	*Type*
ABB HV Cables - Karlskrona – S	1	KSM 80/120F
Alstermo Produktion - Alstermo - S	3	KSM DSM
AMO Kraft - Alstermo - S	1	KSM 23F
Berkenhoff & Drebes - Aßlar - D	1	KSM 10/30F
BSI Testing, Cables Lab. – London - GB	1	KSM 10/60F
Conductores Monterrey - Mexico	1	KSM 5/15F
DEMKO (UL) – Copenhagen - DK	1	KSM 8/28/70F
Draka Kabel i Sverige AB - Nässjö – S	2	KSM
Draka Kabel i Sverige AB - Ystad - S	3	KSM DSM
Draka Norsk Kabel - Drammen - N	3	KSM
Draka Norsk Kabel - Hokksund - N	2	KSM
Elektrim Kable Polskie -. Ozarow - PL	2	KSM
Ericsson Cables - Falun - S	6	KSM
Ericsson Cables - Hudiksvall - S	1	KSM 12/40F
EZU - Praha - CZ	1	KSM 12/85F
Fabryka Kabli Zalom - PL	1	KSM 14/65F
Helkama Kaapeli – Turku - FIN	1	KSM 10/50F
Helkama Kaapeli – Hanko - FIN	1	KSM 15/50F
Kabelwerke EHLERS - Hamburg - D	1	KSM 5/40F
Kabelwerke EUPEN - B	1	KSM 8/40/110F
Kablo Kladno - CZ	1	KSM 22/90F
Kablo Velke Mezirici - CZ	1	KSM 18Z/60F
Kablo Vrchlabi - CZ	1	KSM 5/25F
KIMA - Hässleholm - S	1	KSM 20Z
Krakowska Fabryka Kabli-. Krakow - PL	1	KSM 20/90F
LEONI Wiring Syst.- Newcastle-under-Lyme -	1	KSM 15F DSM
N K T – Power Cables - Asnæs - DK	1	KSM 40/90F
N K T – General Cables - Asnæs - DK	4	KSM
NEMKO – Oslo - N	1	KSM 23Z/100F
Nexans IKO Kabel, Power - S	5	KSM
Nexans Cable - Chester, NY - USA	1	KSM 12/32F
Nexans Irish Cable – Athlone - IE	1	KSM12/43/75F
Nexans Maroc – Mohammedia - MA	1	KSM4/15/40F
Nexans Norway - Halden - N	1	KSM 15/70F
Nexans Norway - Langhus - N	1	KSM 12/30F
Nexans Norway - Rognan - N	1	KSM 6/33/90F
NK Cables - Oulu – FIN (Draka)	3	KSM 12/35F
Pirelli Cables - Aberdare – Wales -UK	1	KSM 9/40F
Pirelli Cables - Bishopstoke – England	1	KSM 9/30F
Pirelli Cables – Bratislava - Slovakia	1	KSM11/60F
Pirelli Cables – Charvieu – France	1	KSM8/25F
Pirelli Cables - Pikkala - FIN	2	KSM
Pirelli Kabel - Schwerin - D	2	KSM
REKA Cables - Keuruu - FIN	1	KSM 9/40F
REKA Cables - Hyvinkää - FIN	1	KSM 30/90F
REKA Cables - Riihimäki - FIN	1	KSM 40/75F
SEMKO – Stockholm - S	**1**	**KSM 18Z/60F**
SEV – Fehraltorf - CH	**1**	**KSM 5/35/75F**



KSM, á system with multi layer measurements and automatic calculation of over dimensional costs.