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WHITE PAPER

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How to ensure high-quality, cost-effective product coding

in wire, cable, pipe and extruded profile applications

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With extremely tight margins, complex and varying regulations worldwide, and production which often cannot stop once started, getting extruded product coding right the first time, every time, is vital. This white paper outlines the factors manufacturers of wires, cables, pipes and extruded profiles should consider to ensure they achieve sufficient code permanence, legibility and compliance, while maximizing efficiency and profitability in these particularly challenging applications.

The market for extruded products is large and growing. To give a few examples, the global wire and cable market is expected to increase at a compound annual growth rate (CAGR) of 4.4% from 2021 to 2028,[1] while aluminum extrusion is predicted to deliver a healthy 3.7% CAGR between 2020-2027. [2]

Huge infrastructure improvement projects and investments in renewable energy dominate public policy, from US President Biden's push for a modern, more sustainable infrastructure[3], to China's ambitions to generate a fifth of its electricity consumption from non-fossil fuel sources.[4]

Every day, more and more products require electricity—even cars. China alone is expected to account for a 20% growth in electricity demand by 2040, not to mention needs arising from the continued urbanization of large parts of Latin America and Africa.[5]

Huge appetite for data and connectivity are also driving demand for extruded products through continued investments in fiber optics and 5G.

This is an era of great opportunity for extruded product manufacturers but, at the same time, they must cope with significant price increases in key raw materials such as copper. Accounting for 60-80% of a cable's cost, its price has more than doubled over the last year.

To address both the demand and supply-side challenges, plants are under intense pressure to produce more, faster, with improved line efficiency and without scrap or rework. Every element of manufacturing must be scrutinized and optimized at all levels. Extruded product manufacturing is such that every gain in time and quality, can make a big difference to profitability. 100% uptime with 100% quality is the goal. This white paper provides the questions and insights needed to ensure coding is as cost efficient and effective as possible.

The role and challenges of extrusion coding

Codes ensure the safe and efficient installation and usage of extruded products. For example, given the variety of cables and wires available, which can be crossed in various directions, confusion is possible. Connecting or disconnecting the wrong elements can have disastrous effects, such as inconvenient, yet costly, service outages, or even death. Good coding reduces initial installation and assembly errors while making follow-up maintenance, repair and usage considerably easier, quicker and less risky. Done correctly, such codes also impede the use of counterfeit or noncompliant products.

Given the importance of codes, requirements for adhesion and legibility are very high. In infrastructure projects, for example, codes marked today will need to remain readable 50 plus years from now. Even in the face of tough conditions such as being buried underground, located in the ocean or under the glare of strong, hot sunshine. They may also need to resist alteration in the face of vulcanization and chemical exposure, to name just a few more difficulties.

Even just 10 minutes of missing, illegible or incorrect prints could mean five kilometers of output having to be scrapped.

The data printed can include text, numbers, logos and barcodes. The content can be as simple as a few numbers on a single line several centimeters apart, or extremely long alphanumeric sequences which run across multiple lines, printed at longer intervals. The details coded are required to ensure traceability and relate to standards compliance and serial numbers, etc.

The messaging varies not only by product, but also by customer, application and geography. Within the same factory, manufacturers typically need to manage and print thousands of different codes on many colors and materials, depending on the standards set by multiple organizations nationally and internationally. The potential for human error is high. Furthermore, as regulations and standards commonly change over time, companies must ensure their coding technology and procedures are robust and flexible enough to cope.

Complicating matters even more, printing conditions are particularly intense. Lines usually run 24/7, often at high speed in hot and dusty environments.

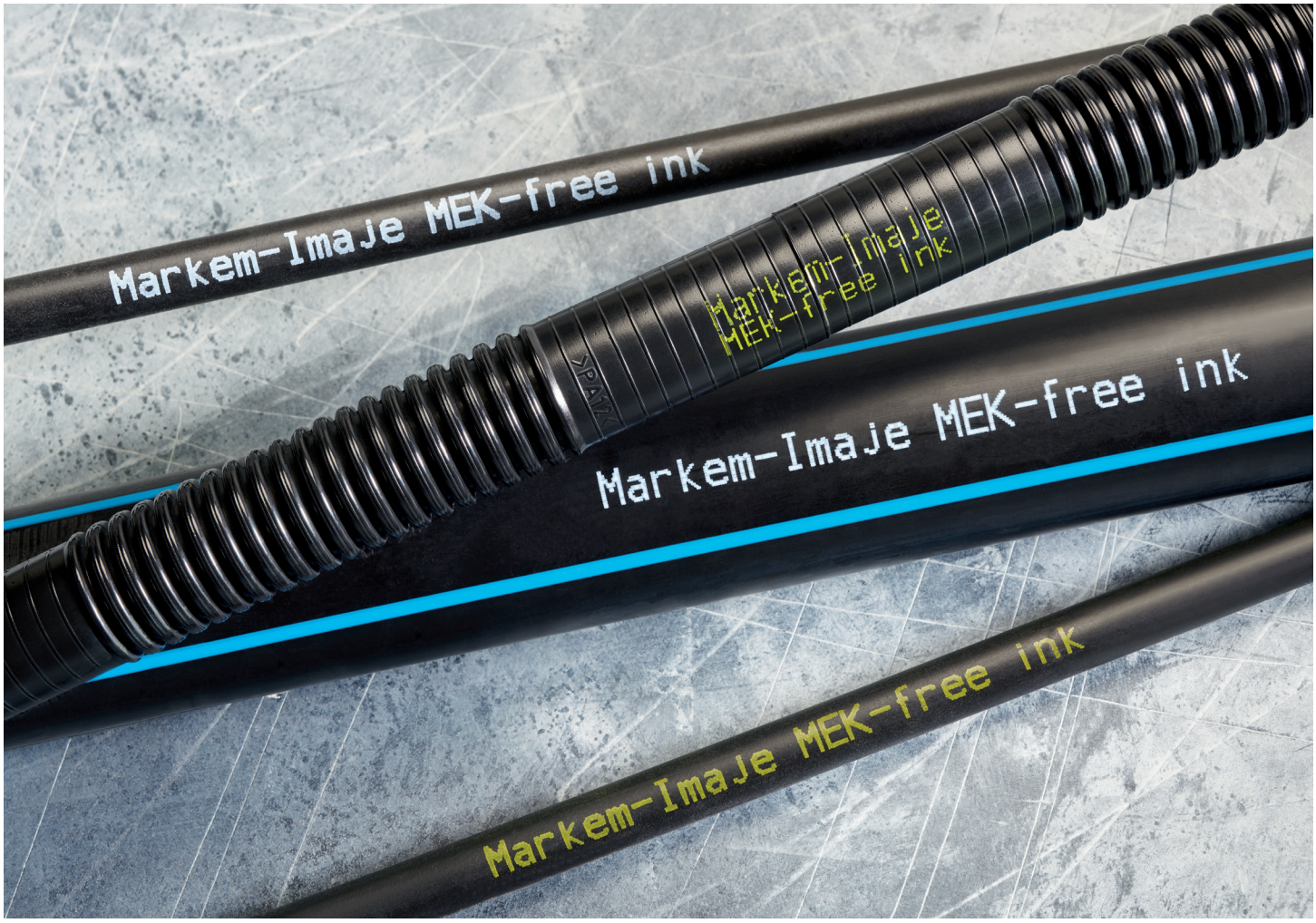
If problem prints are spotted mid-production, operators must often wait until completion before reloading the product and redoing the codes, delaying the next product run. This scenario assumes that the problem is addressable, and the output does not need to be scrapped. Consider the consequences of a line printing cable at 500 meters per minute. Even just 10 minutes of missing, illegible or incorrect prints could mean five kilometers of output having to be scrapped.

It is vital, therefore, to avoid setup mistakes and to use equipment that can reliably deliver perfect prints despite the arduous conditions.

Additionally, achieving the required code durability and quality is heavily material and technology dependent. An unsuitable combination for the specific application can lead to codes smearing, migrating, fading or being unable to withstand production and environmental conditions. In some cases, the codes may not even adhere at all, or the prints may be more susceptible to tampering. In addition to challenges arising from the substrates themselves, it can also prove difficult to get sufficient contrast and readability on various colors. Testing is key.

The surfaces to be marked can also be tiny. Ensuring that each print hits the fast-moving surface, every time, requires considerable precision.

Fortunately, by understanding the various options—and having a methodical way to assess suitability—manufacturers can overcome these many challenges and code their products cost-efficiently and with confidence.



A pioneering coding setup saves time and cuts errors for LAPP's Stuttgart plant

LAPP, is a global market leader in integrated cabling solutions for a range of sectors, including industrial machinery, plant engineering, transport, energy, food processing, etc. With 4,650 employees across the world, at 18 production sites and approximately 44 sales companies, its annual turnover is over €1.2 billion.

LAPP's Stuggart site sought to increase the accuracy and efficiency of its coding. To that end, its four production lines are now equipped with a pair of Markem-Imaje inkjet printers, a 9450 E and a 9450 Ec. The first uses a black ink for light-colored cables and the latter, high contrast model printing with a white ink for dark cables.

Michael Zahl, Operation Manager, LAPP, explains the benefits: "Installing the two printers side-by-side significantly reduces changeover time when we have to switch production. Another major advantage is that Markem-Imaje came up with one ink that adheres to all the different surfaces we have in production."

At production speeds ranging from 40 to 120 meters per minute, and handling 1,500 different possible messages, CoLOS® software (part of the Systech Packaging Intelligence Suite) controls the entire coding process, saving time and dramatically reducing errors. Message details which are specific to each cable include the brand name, where it was produced, temperature, wattage and compliance information for each market.

"Previously we had to manually upload every message into every single printer," notes Oliver Kast, Process Design Engineer, LAPP. "Now the operator just scans the barcode and the correct information is automatically sent from the central database to the printer."

The coding approach described here is pioneering for the cabling industry. "We challenged Markem-Imaje to help us develop this project. I've never seen a printing solution this advanced in any other plant," observes Zahl.

Front-of-line coding technologies

The complexity of extrusion coding is such that there is no single coding technology which works best in every situation. That said, some options are more flexible than others at a technology and/or supplier level. In this section, we focus on the benefits and limitations from a technological point of view.

By far, the most common coder is continuous inkjet (CIJ), due to its versatility and relatively low upfront cost. It is also the fastest coding option, capable of printing thousands of characters per second. Depending on the situation, some CIJs can code 1,000 meters of product per minute.

With this technology, a high-pressure pump directs liquid ink through to a nozzle which creates a continuous stream of ink droplets which generates letters, numbers or symbols made up of tiny dots. There is no contact between the printer and product. So long as the object moves in a straight line, the printhead can print on most anything, provided a suitable ink is chosen to deliver the desired adhesion and contrast.

LSZH

PP

PE

PVC

Continuous inkjet coders are the most versatile option for extrusion coding.

Given the challenges of extrusion coding described earlier, manufacturers typically need to use different colored inks, featuring application-specific formulations, to ensure codes are readable, non-migrating and provide resistance to harsh environments such as automotive fluids, sea water and UV. Indeed, the complexity of the chemistry involved is such that, to date, only Markem-Imaje has managed to develop an ink which can code all extruded surfaces equally well. Proven in numerous customer field trials, this silver ink called the MC469, was launched in February 2021.

In the absence of using a “one-ink-fits-all” consumable, choices include dye-based and pigmented options. Pigmented inks are especially fit for the extrusion sector. They offer a high level of non-migration which implies the code does not bleed or transfer onto another cable when rolled. Given that most cables are of dark color, pigmented inks, available in several colors including white, green, yellow, etc., guarantee the code is visible to the eye in all circumstances. Finally, the use of pigments implies that codes will not fade in time and will resist direct sunlight, often common during storage or when on a construction site.

Dye-based inks designed for extruded products require less maintenance and perform well in many situations. However, they are more likely to smear, migrate to other surfaces and/or fade from light exposure. Additionally, dye-based inks are less opaque and provide less contrast, making white, red or pastel prints hard to read on dark surfaces. An experienced coding supplier can provide situation-specific advice but, generally speaking, a good scenario for a dye-based ink would be black codes

on light-colored substrates, where migration or exposure to solvents, heat, etc. are not key issues.

A range of alcohol-resistant inks also exists, allowing manufacturers to code their products before or after being alcohol washed.

Finally, a line of UV-curing inks—for customers looking for extreme adhesion and resistance to harsh chemicals—is also an option, making them a good solution to prevent problems during production and in the field.

Markem-Imaje's MC469 silver ink reliably codes all extruded products.

Choosing between the various ink options usually involves a cost versus performance tradeoff and needs to be explored carefully, together with the supplier.

Lasers provide indelible marks which are tamper-proof and can withstand even the toughest conditions. Plus, since there is no ink involved, and thus no drying time needed, there is zero risk of smudging or migration. Lasers provide the ultimate performance in terms of code permanence, quality and traceability.

However, extraction and guarding packages are required to protect operators from the laser beams themselves and the fumes created when coding. All-in-all the initial capital expenditure is several times the cost of a CIJ system, with less flexibility in terms of moving the coder from line to line.

That said, lasers can end up being equivalent or cheaper over the life of the coder, particularly if producing output at the high end of the product spectrum. Why? Costs are offset by the fact lasers typically use no consumables and require no maintenance, apart from very occasional filter replacement or lens cleaning.

Another potentially limiting factor for laser coding is that it is not suitable for coding all materials. It often requires a strong underlying surface and a top layer which is responsive to the laser beam. To confirm that laser can code a particular extrusion product, manufacturers should send a sample of the material to the proposed supplier's lab, where laser coding experts should be able to determine with the utmost certainty if the material lends itself to high-quality laser coding at the customer's production speed.

In rare cases, it may be necessary to introduce additives to substrates to improve laser reactivity. However, this adds considerable cost, complexity and variability. It becomes hard to determine whether coding issues are due to problems with the laser, or incorrect amounts of the additive. In these rare cases manufacturers would usually be better off using a high contrast, high durability CIJ solution. If the 100% permanence and super-crisp codes of laser are required, managers should ensure that their raw material suppliers adhere to tight specifications for the percentage of additive added.

Today's lasers are also comparatively slower in extrusion applications. A good laser should be capable of reaching 300 meters per minute. Depending on material reactivity, font size and message content, faster laser coding is possible, though it is fair to say today's lasers are unlikely to match the fastest possible CIJ coding solution. It is expected, however, that within the next few years the speed gap between CIJ

and laser will narrow, as technological advancements deliver fiber lasers with greater power and improved processing speeds for graphics and messages.

Assuming a suitable material is involved, and the speed is sufficient, what are the laser options?

Capable of coding PVC and pipes, CO2 lasers work by removing the first layer of a product, sometimes revealing the second layer below. They would not be recommended for wire coding unless the marking depth could be tightly controlled, e.g., via cross-less fonts and consistent energy delivery to ensure the laser does not dwell too long in any one place. Any slight perforation to the wire's insulation covering could result in dangerous electric shocks and short circuiting.

Laser coding, particularly fiber, is increasingly popular.

By contrast, nothing is removed with a fiber laser; instead, there is a thermochemical modification to the surface. The particularly high reliability of these lasers and their ability to code many materials relevant to this market accounts for the growing popularity of this technology.

UV lasers are also non-abrasive and are used for materials not susceptible to CO2 or fiber coding. However, it is the most expensive option. The complexity of machine design results in a high upfront cost. Additionally, the crystal needed to convert the wavelength down to UV level, has a comparatively short lifespan and higher replacement cost than the laser sources of other technologies.

CIJ and laser are both "non-contact" technologies. This means they do not need to touch the item being coded, and so can easily print on products of varying sizes and contours. They are also digital technologies which mean messages can quickly and easily be changed whenever and however required—even without stopping the printer.

By contrast, hot stamping is a mechanical, "contact" technology. A hot mold is pressed against the product surface, transferring the code there via pigment or foil. It involves more downtime and more quality control checks at various stages. Messages, limited in length, are modified by manually changing the characters on the stamp, which is much more time consuming and prone to mistakes than the digital options. Frequent cleaning is needed. Additionally, the coding process itself risks damaging the material being coded, e.g., by burning through insulation. This leads to scrap if spotted at the plant or introduces a safety risk in the marketplace.

Given these disadvantages, why is hot stamping still used? Its setup costs are quite low, and the codes produced can be of a high quality. It is primarily used for printing logos and other marketing-related elements which some CIJ and lasers struggle with. It is not uncommon for it to be used in conjunction with CIJ or laser. Considering advancements in inkjet and laser technologies, however, our prediction is that hot stamping's decline will accelerate given the scale of its disadvantages.

With the above background in mind, this paper focuses on CIJ coders (which will continue to dominate the sector for many years to come) and lasers, particularly fiber (whose popularity has grown significantly in recent times).

Nexans: Using CIJ and fiber lasers across its plants to ensure high-quality, cost-effective coding for its cables

With 25,000 employees and an industrial footprint in 38 countries, Nexans is a market-leading provider of advanced cable technologies for power and data transmission. It designs solutions and services in three main business areas: Building & Territories (including utilities and e-mobility), High Voltage & Projects (covering offshore wind farms, subsea interconnections, land high voltage) and Industry & Solutions (including renewables, transportation, oil and gas, automation, and others). In 2020, the Group generated €5.7 billion in standard sales.

Nexans' Bohain-en-Vermandois site in France uses a leasing solution from Markem-Imaje to ensure error-free, high-quality and cutting-edge cable production using CIJ coding. This plant has 152 employees and produces 24,000 metric tons of cables per year, at a rate of around 200 meters per minute, for public buildings and for temporary installations.

"We produce more than one thousand types of cables, each with its own standards and specific marking requirements. We needed a reliable and clean solution to replace marking wheels, which carried an increased risk of error and did not produce a clear finish due to wear and tear and ink smudging," explains Guillaume Masse, Site Director.

The site now uses seven 9450 Ec CIJ printers operating with special inks, including a white ink, for colored or black cables. "The machines are reliable, robust and precise, providing a clean marking finish," notes Michel Bertrand, technician responsible for Nexans' inkjet equipment. CoLOS software also helps reduce marking errors. With CoLOS, operators have a dedicated program with a memory that is sufficient to store and manage the hundreds of messages required.

For greater flexibility Nexans opted for Markem-Imaje's SMILE program (which has recently been rebranded to Confidence 360). It includes the rental, maintenance contract and equipment replacement without investment. "Markem-Imaje also allows us to test new products. We sometimes suggest improvements based on our own needs," observes Bertrand.

In Sweden on the other hand, Nexans is using fiber laser technology to code on wires with sheathing made of HDPE with silicone at 200 meters per minute.

"Fiber laser coding is a relatively new option for the extrusion market. We were lucky enough to trial Markem-Imaje's fiber offering before its formal launch in 2019. We liked the trial so much, we actually refused to give back the equipment," jokes process engineer, Johnny Rydin. "The codes produced are easy to read and permanent. Plus, there's no maintenance. It's a win-win with less downtime for us and better traceability in market."

Picking the right coding solution: 10 key questions

Given the issues outlined earlier, the answer to "which coding solution is best?" is not straightforward. However, methodically answering these 10 questions will give manufacturers a full enough picture to identify the right technology, or combination, for their specific set of circumstances. Going through this checklist will also signpost issues to consider when they move onto evaluating supplier-specific offerings.

1 What level of adhesion and readability is required?

For applications where there are extreme demands for code permanence or longevity and readability, and the financials make sense, such as subsea and fiber optics, fiber lasers are the best option, provided the material is responsive to the laser beam. Laser codes remain as printed, no matter the age of the part. And, assuming a high-quality laser is chosen and set up correctly, the codes will be impeccable.

For extreme longevity and readability, fiber lasers are usually the best choice.

CIJ coders can also offer an excellent, near permanent level of adhesion provided the right type and quality of ink is chosen. Pigmented inks are typically best since the codes produced are less likely to smear or migrate to other surfaces, as compared to dye-based alternatives. They are also highly resistant to other processes and situations which could damage the code, e.g., heat, chemicals and sunlight. Additionally, the exceptional contrast provided by pigmented inks enables excellent readability.

In applications where concerns about migration—and the need to withstand production and/or environmental conditions is not as high—dye-based inks might be suitable, cost-efficient options.

Pigmented inks provide excellent adhesion and legibility.

2 What materials will be coded and with what message?

Most extruded product factories make many products to suit a wide range of applications. Different materials will be chosen depending on the level of flexibility and durability needed as well as the moisture, heat and fire resistance requirements, etc. for a given situation. Not all inks or lasers will code all substrates and colors equally well, making production and inventory management particularly challenging. Testing is critical.

Before undertaking substrate changes, manufacturers should consider the potential coding impact. Most suppliers should be able to provide an alternative,

suitable ink for their CIJ coders. With laser, however, if the new material is unresponsive to the existing laser beam, expensive additives might be needed; or, in a worst-case scenario, the laser will need to be abandoned for that application and CIJ used instead. Sending a sample to a laser testing lab is recommended to determine whether the new material is a good candidate for laser coding.

Manufacturers should also consider a coder's capability to deliver the messaging required. Some are limited in the number of lines of text they can mark. They may also be unable to print barcodes and logos.

Choosing an experienced supplier with a comprehensive portfolio will increase a manufacturer's likelihood of finding a streamlined and adaptable solution—whether it be CIJ, laser or a combination thereof. The best solution minimizes inventory, cost and scope for human error, while reliably delivering output to the required standard for each substrate and color.

3 How will the quality, compliance and accuracy of codes be ensured?

Using the wrong ink for the material or application could lead to codes fading prematurely, resulting in waste or rework, if spotted at the factory, and fines, or worse, in the marketplace. Manufacturers should choose suppliers providing "smart" ink cartridges, which prevent such mistakes. They may also wish to consider a one-ink-fits-all solution, an option currently available through Markem-Imaje.

Companies should also plan to buy consumables from the coder manufacturer. Despite claims to the contrary, third-party inks are not as perfectly calibrated for the equipment. They often lead to problems such as clogged jets which then deliver smeared and illegible codes, not to mention extra cleaning and maintenance. Third-party inks may also fail to comply with global regulations or provide the expected marketplace performance.

Coders with automated printhead cleaning are also a good idea as they ensure the expected quality is delivered right from the very first print.

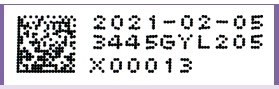
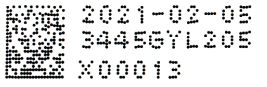
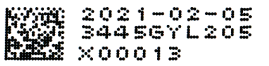
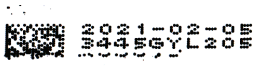
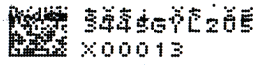
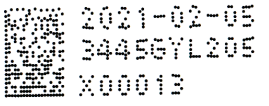
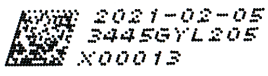
While laser coders do not face the same consumables issues as CIJ, particular care must be taken with the initial setup and support. An incorrect distance between the laser head and the surface to be marked can lead to prints which are not as precise as they should be. Expert installation and adequate training are similarly important for CIJ. See table for examples of coding errors which may arise due to these issues.

Assuming the printing method delivers the required quality, the other factor to consider is the message itself. As mentioned previously, extruded product manufacturers typically print thousands of different codes to accommodate customer and regulatory requirements. The potential

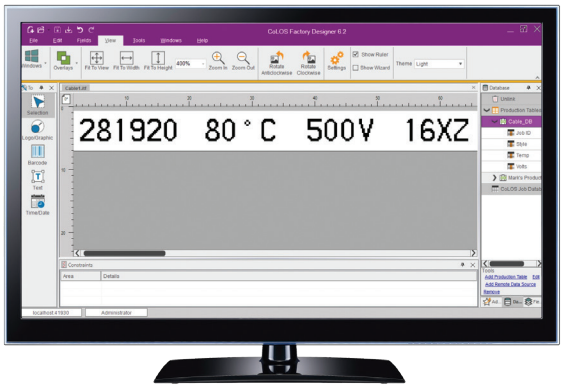
TROUBLESHOOTING

While training and supplier expertise will prevent many problems from happening in the first place, the below table illustrates some common issues and initial solutions to explore

Continuous Inkjet

 Reference	Reference
 Printhead too far from substrate	Poor viscosity management
 Printhead too close from substrate	Incorrect break-off phase
 Too low deflection voltage	 Incorrect break-off length
 Too high deflection voltage	 Poor printhead alignment with substrate

for operator error is enormous. To ensure codes are accurate and compliant, companies should seek solutions which simplify and minimize manual data entry.



The Systech Packaging Intelligence Suite by Markem-Imaje has improved data accuracy, line efficiency, compliance and traceability across many plants.

Most modern coders will design and store many messages locally and feature large touch screens which are as easy and familiar for operators to use as a tablet or smartphone. With codes saved in the system, even inexperienced operators can successfully change content between product runs. They need only pick from a list, preview the message and then send it to print. This is much faster and more accurate than manually entering multiple pieces of information each time.

For even greater accuracy, along with quicker line startups and changeovers, software applications can be connected to the coders, linking message fields to master product tables and automatically populating codes with Stock Keeping Unit (SKU) data. Verifying the code content after printing is feasible at low to medium speeds. However, advancements in technology will soon mean high-speed code checking will also be viable.

The caveat is to ensure the various elements have been proven to work together, as it is common to experience integration and operational issues when linking a patchwork of coders and software applications from various suppliers.

4 How large is the area to be marked?

The smaller the surface the bigger the coding challenge. Aircraft wires, for example, are especially tiny to help keep a plane's weight down. The CIJ printhead or the laser beam needs to be particularly precise with such wires, or they can easily miss the surface. Complicating matters, wires can easily jostle out of position given they are produced at such high speeds. A combination of coder features and supplier installation expertise can optimize results here.

For example, Markem-Imaje's 9450 E (CIJ) and SmartLase (laser) coders print characters as small as 1mm in most applications. And, having completed many wire installations, its engineers can provide advice on how best to set things up to mitigate against wire movement. Where the space available is a bit more generous, the 9450 E's dedicated brackets can assist with precision.

Looking at CIJ coding more generally, manufacturers should seek equipment with quick release brackets. CIJ coders need regular cleaning and maintenance. Coder misalignment can occur if operators need to screw the equipment back in place. They often struggle to put it back in the exact correct position, particularly since the screws can be in awkward places. In many applications this might not matter, but with wires, even a small deviation could be disastrous. The introduction of quick release brackets by various suppliers have made accurate repositioning easily achievable. With Markem-Imaje brackets, it can be done single-handedly, in one second, with 100% accuracy.

On the laser side, coder misalignment is not an issue, assuming the initial setup is correct, as lasers require no cleaning or maintenance apart from very occasional filter replacement and lens cleaning. Something else to look out for, however, is whether the laser comes with aiming diodes; these can greatly help with precision of code placement.

5 How can uptime and speed be maximized?

Typically a well-installed, good quality laser—requiring no consumables and no maintenance apart from very occasional filter replacement and lens cleaning—will provide the highest uptime, particularly when aiming diodes are used. The SmartLase F500 laser source has a meantime between failure of 100,000 hours, for example. However, as explained earlier in the technology description section, today's lasers may struggle to match the speeds achievable with CIJ, though the extent to which this matters depends heavily on material reactivity, font size and message content.

Where a particularly high line speed is the top priority, CIJ coders will often be the preferred option since they usually tend to print faster. For example, in wire extrusion applications, good CIJ can reach up to 1,000 meters per minute, a speed currently beyond the scope of laser.

Aside from ensuring good quality equipment is chosen, these are some uptime-enhancing features to look for in a CIJ coder:

The data needed to check message accuracy and optimize CIJ coding efficiency is visible on the 9450 E home screen.

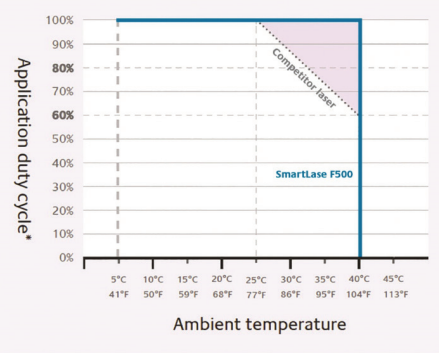
- **Quick and easy performance tracking** to monitor remaining prints, ink consumption and overall availability to avoid running out of consumables mid-production.
- **100% stainless steel enclosed printheads** as these will decrease the need for cleaning. Compared to printheads with plastic and/or exposed parts, stainless steel printheads are better protected and grounded so that less static builds up, helping them stay cleaner for longer.
- **Pressurized printheads** also cut cleaning. Debris, like the dust prevalent in extrusion plants, is less likely to get in.
- **Extended service intervals.** The 9450 E, for example, can code for 8,000 to 14,000 hours, depending on the ink type. Other coders under similar usage conditions might need their printheads changed three times to achieve the same print volume.
- **Quick release brackets.** In addition to making it quicker to put printheads back after cleaning and maintenance, they can also help printheads stay cleaner in the first place. Printheads are turned on in the service area before being moved back to the line, ink thus flows and builds in the nozzle. If the printhead gets jarred during repositioning, which is more likely the harder it is to put it back, the ink could spill. The printhead might need re-cleaning there and then, or it will require cleaning earlier than it would have otherwise.
- **User-friendly interfaces with internal message storage capacity, or the capability to link to company ERP systems** via an information management system, will increase uptime by accelerating changeover times through easier message design and data management along

Markem-Imaje's one-ink-fits-all helps streamline costs and minimizes downtime.

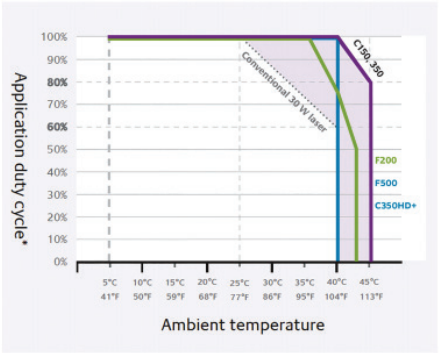
automated printer start-ups and management. Some suppliers even offer the ability for manufacturers to monitor and measure their overall equipment effectiveness (OEE) key performance indicators.

- **A one-ink-fits-all offering.** The particularly high cost of downtime means it has historically been most cost effective to have one printer per ink color. Unfortunately, this sometimes means that a line might be ready to code but the required printer is still finishing another job. The launch of the MC469 silver ink eliminates this problem as it can code all extruded products, whatever the color or application. No time is lost waiting or moving printers between lines. Also, downtime due to unplanned maintenance is likely to be lower; accidental damage during relocations is eliminated and line operators are typically more diligent in looking after equipment they consider "theirs".

Picking the right CIJ printer and then installing and maintaining it properly, are important in keeping production running smoothly. Despite best efforts, however, things may go wrong. Manufacturers should evaluate a supplier's ability to help them recover quickly from problems. The Markem-Imaje virtual assistant, Miva, for example, is an online self-support tool using artificial intelligence to empower printer users to resolve problems themselves, 24 hours a day, seven days a week. For more complicated issues, a helpdesk expert can provide remote support, or an engineer can be quickly dispatched to the factory. Markem-Imaje has a global presence with one of the market's largest group of service support staff.



*A duty rate cycle is the percentage of one period in which the laser is active. It is expressed as D = T/P (T is the time the laser is active and P is the total period).



Finally, environmental factors should also be considered carefully to prevent breakdowns and speed restrictions. Companies should look for coders with at least IP 55 ratings included as standard to ensure sufficient protection from dust and water ingress. And, if temperatures are likely to exceed 25 °C, those opting for lasers should scrutinize the system's cooling capabilities. Unlike the SmartLase® F Series fiber laser or the SmartLase C Series CO2 lasers, most conventional competitive lasers need to restrict application duty cycles above this temperature. This is because they only have a single fan at the end of the laser and insufficient scan head cooling.

6 How important is it to improve sustainability and easily export worldwide?

As in other sectors, sustainability is becoming an increasingly important priority for many wire, cable, pipe and extruded aluminum manufacturers.

Most inks used today are MEK-based and generate Volatile Organic Compound (VOC) emissions, contributors to greenhouse gases. And, given concerns about toxicity and its use in illegal drugs, MEK is regulated in many countries. Alternatively, a range of MEK-free inks exists and can cut import/export paperwork and reduce the need for costly ventilation systems and operator health checks.

The launch of Markem-Imaje's EW581 and EC582 inks have overcome the issues which have historically constrained MEK-free uptake in the extrusion sector.

Until recently, however, their use has not been feasible because the drying time and adhesion of MEK-free inks was unsuitable for most wires and cables. This has changed with the launch of Markem-Imaje's white EW581 and yellow EC582 inks. Not only have they been proven to deliver the required performance in extensive pre-launch customer trials, but they also cut VOCs and consumable cartridge waste by up to 40%, compared to standard MEK-based consumables used at 20 °C. The savings are even greater at higher temperatures as MEK-free consumables do not evaporate as quickly as MEK-based ones.

Fiber lasers are an even more sustainable option. The VOCs created when lasing materials are virtually eliminated with a properly constructed fume extraction system. And, with typically no consumable usage, waste is limited to the disposal of filters.

7 How adaptable is the chosen solution?

Regulatory changes could require additional coding to be applied to output or different materials to be used. Other market forces may drive demand for new or adapted products, leading to a change in a plant's product mix.

For example, there is currently a shift away from wires and cable that contain PVC insulation or sheathing materials.

- Halogen Free Flame Retardant (HFFR) materials are increasingly being specified for electrical wiring. Unlike PVC, which can propagate fires and emits toxic gases when burned, HFFR has inhibitory effect and generates smoke which is less harmful and less dense; fires spread less quickly, and occupants have a greater chance of survival. It also creates a safer environment for firefighters.
- Cross-linked polyethylene (XLPE) insulated cables safely handle a greater temperature range. They also last longer and have better resistance to corrosion, abrasion and impact forces. Installation is easier given XLPE's lighter weight, smaller bending radius, and the fact no special skills and equipment are needed for jointing and termination.

Manufacturers should consider to what extent their prospective coder can handle changes before being rendered obsolete. The larger its consumable portfolio, for example, the greater the chances of finding a suitable ink quickly. The ability to code multiple lines with a wide range of character sizes would also be useful. An experienced technical team to support the coder is also an advantage as it will accelerate the time to find an appropriate solution, whether existing or custom.

8 How unbiased, experienced and full service is the supplier?

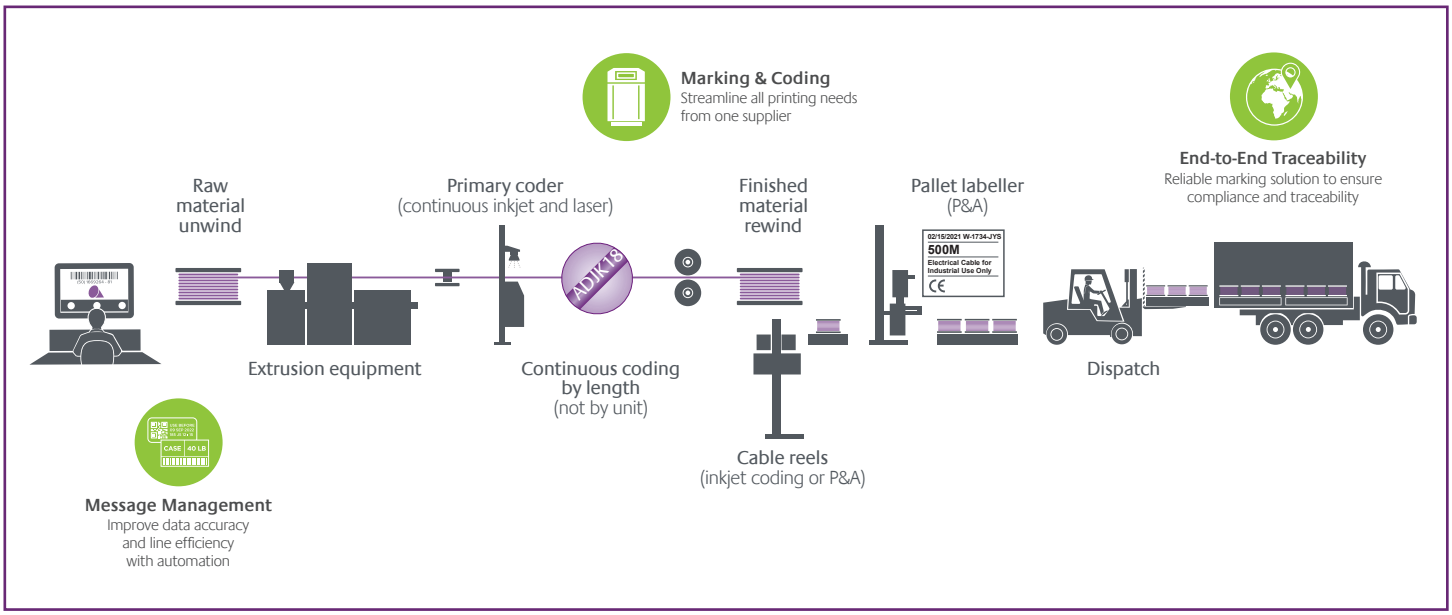
As conditions vary from plant to plant and according to application, manufacturers need a supplier who can address their diverse requirements. It is imperative that the chosen company has a proven track record in all key areas to ensure that a hassle-free, end-to-end, turnkey solution is provided.

Manufacturers should be wary of suppliers who focus on a single coding technology for extrusion. As the old saying goes, "when all you have is a hammer, everything looks like a nail." A company with access to all the main coding technologies is more likely to identify the solution that best suits a

plant's specific needs. And, in today's digital era, a supplier should be able to provide seamless integration with quality and efficiency-maximizing software applications.

Extrusion-specific experience with the various technologies is also vital. With the support of suppliers who fully understand this sector's particularly difficult challenges, manufacturers will deploy the required solution, or combination of technologies, in the most time- and cost-effective manner. Installations will be more hassle-free and optimized, as will the production itself. While true for all coding solutions, experience is even more important for laser given the extra safety measures required.

Companies may also find it useful to request a free demonstration to do a like-for-like comparison of how well the proposed coders deliver on the plant's actual production lines.



Expert training and support services should also be readily available. While this sounds obvious, suppliers are not equal in their ability to deliver. Operators need to know more than how to just hit print. They should feel comfortable scheduling jobs, changing consumables, doing basic cleaning and maintenance, and spotting potential problems before they impact production. The right supplier will empower operators to fix any issues quickly and back them up with fast, technical support when needed, usually through comprehensive service level agreements.

While this white paper has focused on front-of-line coding, it can be beneficial for the solution to also encompass end-of-line options such as Print & Apply (P&A), thermal inkjet, valvejet or large character resolution piezo.

Control over costs, throughput and reputation can be greatly enhanced by having a common coding solution along the line. A 'one-stop-shop' supplier delivers economies of scale and simplified invoicing, while optimizing maintenance and overall operations since all the equipment on the line has similar user interfaces. It also makes end-to-end traceability easier.

9 What is the relative importance between CAPEX and OPEX?

At a first glance, laser coders look more expensive than CIJ ones. The initial capital expenditure (CAPEX) required is higher due to the coder itself, as well as the need to install guarding and extraction equipment for safety. However, in the long run, they can often be less expensive, given that they have virtually no operating expenses (OPEX). Lasers hardly ever use consumables and maintenance is limited to very occasional filter replacement and lens cleaning. At Markem-Imaje we regularly supply both laser and CIJ coders and can help extruded product manufacturers calculate which option would be more cost-effective over a specific timeframe, given their specific circumstances.

It may also be the case that companies simply cannot afford the CAPEX required for a laser or to upgrade their CIJ coders for ones delivering better performance. Given competing business priorities, this is a common situation.

Fortunately, in recent years, leasing has become an increasingly attractive and viable option for manufacturers. For a fixed periodic fee, companies can choose the solution that best fits their needs without being hampered by the purchase price. This need not be limited just to the coder. Custom bundles of equipment, consumables, software and maintenance solutions can be consolidated into a fixed, periodic fee over a defined period, eliminating the need for a hefty upfront investment.

Rental programs give manufacturers simpler budgeting and operations, along with greater peace of mind. They know their equipment will be expertly maintained, thereby protecting quality and uptime, plus they face no unexpected coding-related costs.

10 What is the TOTAL cost of ownership of a given solution?

Having assessed the relative importance of CAPEX vs OPEX, as discussed in question 9, it is equally important to consider the total cost of ownership for prospective options within a technology category.

Many manufacturers make the mistake of focusing on the initial equipment costs and end up paying more overall in terms of greater operating expenses, downtime, rework and waste.

For reasons discussed earlier in the white paper, less expensive printers usually require more frequent cleaning and maintenance—both scheduled and unscheduled. For example, they will have shorter service intervals and less robust parts.

They are also less likely to have error-minimizing and productivity-enhancing features. Missing, illegible or incorrect prints will be more common due to suboptimal setup issues, greater nozzle clogging, too much manual data entry, etc.

Additionally, they may struggle to cope with changing regulatory and/or market demands.

Conclusion

While coding might seem like a small part of the overall process, the wrong marking choice can be extremely costly for wire, cable, pipe and extruded profile manufacturers. At plant level it results in increased downtime due to extra maintenance and slow changeovers, as well as waste and rework. In the marketplace miscoded or tampered with products can lead to significant fines, recalls and reputational damage. Such is the impact of these products, loss of life—potentially even on a mass scale—is possible, for example in the case of faulty wiring causing fires or catastrophic failures.

Fortunately, by answering the questions in this white paper, extruded product manufacturers can take the right steps to ensure coding-related quality, while still maximizing production efficiency and minimizing associated costs. They will be well positioned to profitably serve a market headed for significant growth for many years to come.

ENDNOTES

[1] https://www.grandviewresearch.com/industry-analysis/wire-and-cable-market-analysis-market

[2] https://www.mynewsdesk.com/dk/compounding-world/pressreleases/aluminum-extrusion-market-growth-scenario-operation-landscape-trends-and-competitive-analysis-2020-to-2027-3065980

[3] https://www.whitehouse.gov/briefing-room/statements-releases/2021/06/24/fact-sheet-president-biden-announces-support-for-the-bipartisan-infrastructure-framework/

[4] https://www.csis.org/east-green-chinas-global-leadership-renewable-energy

[5] https://www.mynewsdesk.com/dk/compounding-world/pressreleases/aluminum-extrusion-market-growth-scenario-operation-landscape-trends-and-competitive-analysis-2020-to-2027-3065980

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