EFI™ WHITE PAPER SERIES

Keeping an eye on energy consumption

DATE OF ISSUE:
JUNE, 2016

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1. Introduction

Have you ever heard of ISO 20690? Currently under development, ISO 20690 specifies how to measure in watts and kilowatts the electricity small and large format digital presses use. Why do we need this?

Electricity management is not part of the printing industry's collective mindset. However, unit electricity costs make a substantial contribution to the prices of raw materials and the cost of print media production. Whether the production unit is defined as 1000 A4s or 15 square metres of substrate, printers can use ISO 20690 as a guide for their technology investment planning.

The digital printing industry is embracing lean and green production. Lean operations make for less wasteful, more profitable businesses because they are based on concepts of resource management efficiency, process control and reducing any type of waste throughout the supply chain. Lower electricity usage can increase margins without compromising production values. Energy efficiency can add value to the printing machine, lowering a printing company's overall cost of ownership. Recognising this, manufacturers are introducing new digital printing devices with reduced electricity requirements and improved performance.

Performance is about more than the printing heads or media handling, since many factors contribute to the energy footprint of a printing system. The machine's size and output format, imaging technology, requirements for primers and coatings, ink types, the number of colours, overall system configuration and drying or curing technology, can all affect electricity requirements and usage. This is another reason why ISO 20690 is so important.

The white paper also addresses how newer technologies are responding to the call for greater energy efficiency. Curing UV inks with LED technology is one example.

The LED example shows us that low energy technologies play a major role in improving the environmental impact of print. They help reduce costs because using low energy components helps to bring down a printing system's electricity needs.

2. Guidelines for lowering power consumption

Printing companies are on a constant quest to improve cost management. Energy is a major expense, so awareness of the contribution power consumption makes to the cost of production is rising. Many buyers of production presses are starting to consider electricity consumption and replaceable component costs as part of their investment planning.

Printers must deliver the best results possible, while meeting ever more demanding customer expectations and complying with environmental regulations. But the balance between the cost of production and acceptable margins can be fragile. Reducing electricity usage is means of lowering production costs and improving margins. It's also central to lean and green business models.

3. Lean and green

The digital printing industry and its markets are embracing lean and green production. Lean operations make for less wasteful, more profitable businesses because they are based on concepts of resource management efficiency, process control and reducing any type of waste throughout the supply chain. Lower electricity usage can increase margins, without compromising production values. Energy efficiency can add value to the printing machine, lowering a printing company's overall cost of ownership. Recognising this, manufacturers are introducing new digital printing devices with reduced electricity requirements and improved performance.

Performance is about more than the printing heads or media handling, since many factors contribute to the energy footprint of a printing system. The machine's size and output format, imaging technology, requirements for primers and coatings, ink types, the number of colours, overall system configuration and drying or curing technology, can all affect electricity requirements and usage. The use of LEDs to cure UV inks and coatings for instance, requires much less electricity than the mercury arc lamps traditionally use for UV curing.

4. UV curing inks

Rapid output technology advances, often using UV curable inks, are encouraging shorter runs with higher unit values for each piece of print in the print run. UV curing inks contain photoinitiators that respond to specific wavelengths of UV light. They are formulated to rapidly respond to the UV energy without compromising the printed colour vibrancy, adhesion, durability and flexibility. The latest digital printing technologies can print on textiles, ceramics and 3-D objects as well as exotic substrates such as thin films and metals. Print buyers and their service providers love the idea of printing anywhere on any surface using these technologies and can be confident that the results will be excellent.

UV ink characteristics should not compromise the printing system's performance. UV curing inks used in digital printing systems must be formulated to perform well on all sorts of surfaces, and not run the risk of causing damage to the printhead. It is also important to achieve full curing of the inks, or there might be health implications. Meeting all of these requirements places considerable demands on the technology, particularly if it is also to follow the principles of lean and green production.

Rather than drying as conventional inks do, UV curing inks are cured using thermal energy. This energy has traditionally been provided by mercury arc lamps. But manufacturers keen to lower the cost of ownership for their customers, are opting to cure their inks using Light Emitting Diodes (LED) which are gaining in popularity. As the technology evolves and improves, it is gradually supplanting mercury arc curing for a growing range of applications.

5. LED-ing the way

Energy consumption is probably the biggest driver for the move to this technology, but both consumables and performance costs are also factors. LED curing requires far less energy than the mercury arc lamps traditionally used for UV curing and so create less heat. The gas discharge lamps rely on an electric arc that passes through vapourised mercury to generate intense light in the UV areas of the spectrum. It can take four to seven minutes for these lamps to fully warm up, so they generally stay on when the printer is switched on, even though the printing machine may not actually be running. This incurs an electricity cost to the printing company and cuts the productive lifespans of the lamps. They last around 24,000 hours, compared to LEDs which are only on when needed and can last at least twice as long.

LEDs require no warm-up time and use around 20% of the energy required by high powered mercury arc lamps. This makes LEDs very attractive as a means of reducing the overall electricity requirement of a production printing system. The choice of LEDs over arc vapour lamps can also have a positive impact on indirect costs, because LEDs are far kinder to sensitive substrates than conventional lamps. This can mean reduced waste and remakes, all of which positively impacts the electricity bill.

Depending on how they are configured, LEDs, which can be tuned to produce specific wavelengths of UV light, produce little, if any, heat so there are very few substrate constraints. Even extremely delicate lightweight films survive the LED curing process, because LEDs generate insufficient thermal energy to damage or distort them. The heat mercury arc lamps produce severely constrains the range of delicate substrate options a designer can consider for print media projects. And thermal energy produced as a by-product of curing with mercury arc lamps is wasted energy. This needlessly increases energy costs and emissions for the print producer, so using LEDs for UV curing reduces energy usage and lowers the cost of ownership especially, in the short run wide format digital printing sector.

6. Taking control of energy consumption

Despite the recent fall in the price of oil, energy consumption still makes a substantial contribution to print media production costs. It also has a negative effect on a company's environmental footprint, so it makes sense to improve device and component performance. The LED example shows us that low energy technologies play a major role in improving the environmental impact of print. They help reduce costs because using low energy components helps to bring down a printing system's electricity needs.

In order to make fair comparisons of the energy consumption of different devices, buyers need a common reference for measuring the energy usage of a printing system. This is especially important for the production digital printers used in a wide variety of on demand applications. Many projects printed digitally are produced in very short runs and as the run length falls, so the electricity cost required to produce each copy rises. A quantification of unit costs must factor in electricity usage calculations. But without a standardised way of quantifying electricity usage, it is almost impossible to accurately compare the energy performance of different digital printing technologies.

Fogra, the German graphic arts research association, has recognised this. In 2014 Fogra established the Fogra Energy Efficiency project to develop a means of quantifying the electricity usage of digital production printing machines. Fogra has passed this work to the International Standards Organisation (ISO) which is in the process of completing and publishing it. ISO 20690 is expected to be available in 2017.

7. What's in ISO 20690?

ISO 20690, currently under development, specifies how to measure in watts and kilowatts the electricity small and large format digital presses use. The standard does not apply to digital presses designed to print on substrates other than paper, but it is anticipated that standards for other substrates will be forthcoming.

The standard defines a typical printing configuration as including the Digital Front End (DFE), the printing unit itself, the paper feeder (sheet or web), paper delivery unit, external cooling units necessary for the printing system, curing and drying units, and so on. For the purposes of ISO 20690 a digital printing system includes the DFE with colour management functions, Raster Image Processing (RIP) and the press settings. This is where the output resolution, speed, colours, number of passes, substrate width, drying, curing and print mode are specified.

The printing system may also include additional equipment, such as finishing technology, which will contribute to the power consumption measurements. To comply with ISO 20690, measurements must be done with a power line analyser with a storage function. The device should be able to capture voltage values across a range of measures and within plus or minus one per cent accuracy. The sampling rate must be at least five kilohertz. The measurements are made over a period of time that is suitable for the printing engine speed and application. This can vary substantially across devices and applications, so the measurement time has to be fully documented. Measurements only start once the machine is stable and fully warmed up, and ready to run at operating temperature. Measurements are based on production of a specified number of square metres per hour, or on a specified number of A4 sheets. For ISO 20690, details of the reference measurement unit are still being worked out but these are the basic details.

8. Printing modes

One of the difficult things about taking measurements, is making sure that they are representative of the production situation. In stand-by mode the printing engine is switched on, but not running so no printing is taking place. In print ready mode a printing engine will switched on, fully warmed up and ready to run immediately, but still no printing is taking place. Production mode, which is the mode we care about for electricity usage, is when the machine is printing. It must be printing in a way that can be considered to be typical for the business sector or application. The printing engine must be producing work that is representative and in this condition the power consumption is expected to be stable with no peaks or ramps. This is the consumption rate that is measured for both quality and productivity modes.

The electricity consumption of a digital printing device depends on many factors. These include the age type and age of the printing machine, the print mode, printer settings, drying and curing settings, ambient conditions including room temperature and humidity. According to ISO 20690 and the Fogra recommendations, measurements should be based on a defined production unit such as fifty B3 sheets or one hundred square metres. Energy use should be measured for both the most productive machine configuration and for the configuration that delivers the highest quality, because the electricity usage may differ for each.

Quality mode requires printing a reference test print, such as the Altona test suite from the European Colour Initiative, a user group working with bvdm, the German print industry association. The same test form can be used for measurements in Productivity mode, and doing so will also demonstrate that the device is fit for purpose. The colour values of the output should be measured and must meet professional expectations.

9. The importance of documentation

If the measurements are to comply with ISO 20690 and in order to make fair and equitable comparisons of energy quantifications, full documentation of the testing process is required for both production and quality modes. The documentation should report the printing device manufacturer and model, the output format, ink or toner type, the printing mode (productivity or quality) and its configuration, plus the power requirement and specific energy input. In addition to this information the documents must reference the substrate and its width, the number of colourants and passes, output resolution, print mode (single or bidirectional), drying and curing methods, the overall printed area size, and of course the details of the system's productivity. Other details such as the time to print, can also be noted in the documentation.

Documentation is key to ensuring transparency and comparability. It confirms the details of the printing configuration, such as for example simplex or duplex, the format size, the test form used and so on. Large format machines will need to impose a reference test form and how this is done must also be documented. Details of the measurement device along with proof that it is correctly calibrated, for instance with a test certificate, must also be included in the documentation.

10. Benefits

10.1 To printing companies

Companies with an eye to emissions and waste management, will be able to use this document to understand how to compare the energy management of digital printing systems. With ISO 20690, operating costs and carbon footprinting data are easier to calculate. This is useful for carbon offsetting and for calculating the carbon footprint of print media products according to ISO 16759 for the quantification and communication of the carbon footprint of print media products. It is also a useful support for compliance to ISO 14001 for energy management systems. ISO 20690 supports efforts towards greater process control and process accountability, and contributes directly to a printing company's bottom line. ISO 20690 allows buyers to compare production digital printing systems using a common reference.

10.2 To manufacturers

Using a standard method for measuring electricity usage establishes a common benchmark for manufacturers of digital printing systems.

ISO 20690 allows manufacturers to quantify and compare the electricity usage of their digital printing devices unambiguously and transparently. It will aid investment decisions for future developments and provide data for Life Cycle Analysis (LCA).

10.3 To the environment

Although quantifying electricity usage is not simple, it is a necessary part of calculating carbon footprints. It is also necessary as the graphic arts industry moves towards a circular economy. ISO 20690 can be used to track electricity efficiency improvements over time or with technology generations. It can be used in conjunction with ISO 16579 to accurately calculate the carbon footprint of print media, and as an aid to fulfill ISO 14001-compliant environmental policies. Improved quantification of the environmental impact of print, also encourages the use of printed matter.

11. Conclusion

Electricity management is not part of the printing industry's collective mindset. However, unit electricity costs make a substantial contribution to the prices of raw materials and the cost of print media production. Whether the production unit is defined as 1000 A4s or 15 square metres of substrate, printers can use ISO 20690 as a guide for their technology investment planning.

ISO 20690 can be used to benchmark energy performance for different machines over time. This is a useful indicator of technical progress in the printing industry and a means of evaluating possible improvements in future technology generations. A manufacturer who prioritises energy efficiency, will be able to demonstrate this commitment, using ISO 20690 test results as the reference.