Five Developments in Laser Cutting Technology

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Laser die cutting advancements have been made rapidly over the last several years. Design engineers who are not maintaining close watch of this industry may not be aware of some of the more recent benefits that are being realized. This article reviews five developments in laser die cutting of which design engineers must be aware before specifying components for their next project.

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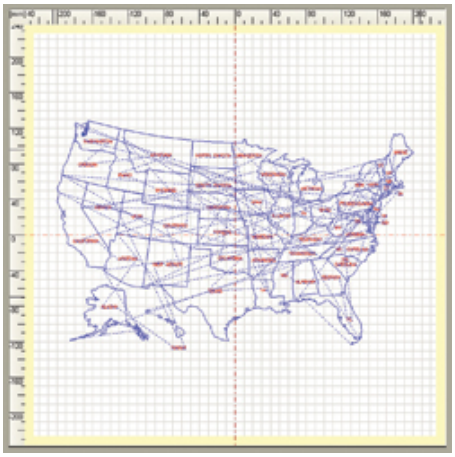
Fabrication of membrane switches, faceplates, and other medical device components where small angle cuts are required, is newly possible with the latest generation laser cutting machines (a.k.a. digital die cutters). Best-in-class laser cutting machines can achieve web speeds of 100 meters/minute, while maintaining precision cut patterns practically limited only by the width of the laser beam, typically 210 microns. Those who investigated laser die cutting technology as recently as two years ago are likely in need of an update on what laser cutting can and cannot achieve.

1. Evolution of the "Soft Marking" Standard



[2]

Laser cutting systems that were engineered just a few years ago were often not up to the challenges of cutting complex designs, especially when there were many sharp angles in the artwork geometry. Antiquated laser cutting was plagued by pinholes at the start and stop of cutting sequences, burnthroughs, and rounded corners where sharp angle geometries were required. These problems were accentuated at faster cutting speeds and especially with more complex part designs.

Today's best-in-class laser cutters avoid these problems. This is not because better lasers are used, but rather because more sophisticated algorithms and software engineering improve control of the movement of the mirrors that point the laser beam.

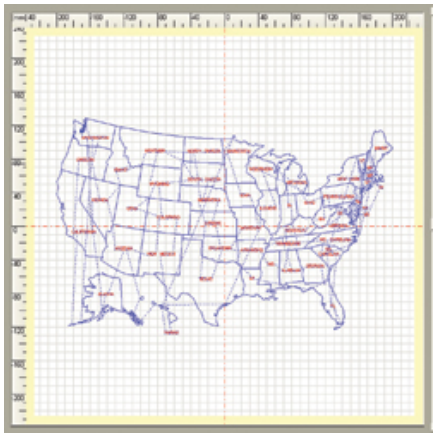
Note that soft marking is no small feat for the control software of laser cutting systems to achieve, and it is only the manufacturers of laser cutting technology that have made significant R&D investments in better software engineering that can deliver the defect-free soft marking that most medical device design engineering applications require.

2. Optimized for Web Speed, Not Cutting Speed Alone

Formerly regarded as slower cutting systems more appropriate to small run prototype work, today's better laser die cutters can now achieve web speeds of 100 meters/minute and, in many instances, are competitive with rotary die cutters for full-scale production.

Here too, it is the smarter algorithms in best-in-class systems that make digital die cutters competitive with rotary die cutters–in this case, by using algorithms that streamline cutting for maximum web speeds. Figure 1 offers an example of this. It shows a cutting sequence for a U.S. map that is not optimized in any manner vs. Figure 2 which shows the same artwork being cut by a laser die cutter in a cutting sequence that is optimized for web speed.

In Figure 1's non-optimized cutting, the path follows the lines of how the vector drawn image was first created in SolidWorks or equivalent software. This non-optimized cutting sequence is so slow that the web would only be able to advance intermittently. This was how antiquated laser cutters worked.



[3]

In Figure 2, a significant improvement in web speed has been realized–a 17% gain. This version is programmed automatically by the sophisticated algorithms in the control software during the setup of the job before it is run. Here, the single image of the U.S. map is split up into two separate images, and optimized to cut the split image. The software can tell the operator whether it is best to cut the

geometry as a single image, two images, four, etc., and will then seamlessly stitch the multiple images together (either to maximize web speed or to allow for cutting a design with dimensions longer than the width of the laser cutter's working field). For example, if the web is moving from right to left, this means that the geometry details on the far left need to be cut first and the way in which the scan heads are moved will depend on the web speed being used.

Be aware, however, that one can still find inferior laser cutting machines in the marketplace without software engineering that can achieve soft marking standards or optimize for web speeds. Design engineers sourcing digital die cutters that will be able to transition from prototype development to full-scale production need to investigate a machine's software engineering in great detail to ensure modern software engineering is the underpinning of the selected technology. Also, don't be confused by a manufacturer's claims of cutting speed. Web speed determines production outputs and cutting speeds, *per se*, are not as relevant.

3. Systems Integration for Ease-of-Operation

"User-friendliness" is an almost cliché term, but it is not hyberbole to say that this is one of the clearer contrasts between old vs. new (or inferior vs. superior) laser die cutters. Systems integration of all input and output modules in newer systems means that operators can reload jobs in seconds, recalling all previous job data, including laser settings, web control, pre-set values for registration, etc. Systems integration also "thinks" for the operator, providing real-time error feedbacks on system status, fault conditions, and corrective actions.

The same algorithms that will optimize cutting sequences also provide quick and accurate projections of production rates (maximum web speed and cut time per part) such that design engineers can accurately predict production costs involved in the finishing of various component and medical device designs.

The better quality laser die cutting systems with full integration of all systems components are the only laser cutting machines one can find in the market today that work seamlessly with variable images from digital printers. These better quality laser cutters allow one to create laser jobs with multiple pictures with different geometries and different step-ups. This is only possible in today's fully integrated laser cutters where there is ongoing communication between the PLC and the camera system.

A quick way of sorting out the systems integration underpinning a particular brand/model of laser cutting system is to ask if it can work in line with digital printers and if it can integrate cameras with machine controllers to automatically compensate for variations in prints, such as those that are created by shrinking as inks dry. Better laser cutters automatically account for variations in step-ups from one part design to the next and can only do so because of that ability for the machine controller to communicate with the camera system.

4. Flexible Systems Design

No two medical device applications are identical in terms of the part geometries to be cut, the substrates to be used, or the required production outputs. That is why engineers of better laser cutting systems will source components worldwide to best match the laser cutting machine configuration to the medical device/component finishing application at hand. If the aforementioned software engineering expertise underpins a laser cutting system, it may be possible to lower costs 20%+ with use of lower cost scan heads or laser sources, and/or by eliminating high-end camera systems.

5. Laser Cutting Machine Engineers as Part of Design Team

Reputable manufacturers of laser cutting systems provide contract manufacturing services that will take on the task of optimizing laser cutting systems to application requirements. Such services can be used as proof of concept for various prototyping projects by medical device design engineering teams, and as a means to evaluating the depth and breadth of the engineering talent that the manufacturer of the laser cutting system brings to bear on project success.

Online

For additional information on the technologies and products discussed in this article, see *MDT* online at www.mdtmag.com [4] and the following websites:

- www.spartanics.com [5]
- www.solidworks.com [6]

Links:
[1] mailto:pdirienzo@spartanics.com
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