

Pre-registering print cylinders on press

MALCOLM G. KEIF

Those who study lean manufacturing know that waste comes in many forms. We must remind ourselves that anything that does not produce exactly what the customer values, when it is needed, is a wasteful operation. Makereadies, or press setups, are wasteful, at least in the eyes of our customers. Reducing press setup time is critical for improving customer value and making the printer more competitive on short-runs while increasing overall productivity. Even though makeready time is built into an estimate, the bottom line is that it isn't something a customer is delighted about paying for. Reducing makeready time, therefore, becomes a strategy that improves competitiveness in the marketplace.

Setup reduction

The process of reducing setup time includes several strategies and techniques. SHIGEO SHINGO introduced the process to the West in his 1985 book titled «A Revolution in Manufacturing: The SMED System». SMED or «Single Minute Exchange of Dies» was a process developed over several years at the *Toyota Motor Corporation* as a way of reducing setup time in the manufacturing of automobiles. By using a series of structured methodologies, *Toyota* and others have managed to reduce makeready times for stamping equipment by drastic amounts – in *Toyota's* case, from twelve or more hours to less than ten minutes. These drastic reductions result from fundamental changes and the accumulation of numerous subtle improvements. Removing 5 minutes

here and 2 minutes there can take an hour-long makeready and turn it into a 12-minute makeready.

There are several prerequisites to effectively reducing setup times. If the printer has not focused attention on implementing 5S (another *Toyota* tool), he will want to start there to maximize the benefits of setup reduction. Also, it is critical that the production employees understand and buy into lean principles. Without their support it will fail. But even with their cooperation, a critical resource will be lacking without their full commitment to the process: their creativity and ingenuity. If the company culture is centred on top-down decision-making, the printer may want to explore an empowerment philosophy, a critical part of *Toyota's* success.

One of the key tenets of setup reduction is to analyze and minimize adjustment time on machines. If a process needs adjustment, the setup team focuses on how to use jigs, fixtures, standard tools, standard processes, and the like to minimize the adjustment time. In printing, we have several adjustments that need to be made before saving product. These adjustments usually fall into one of the following categories:

- substrate handling, treatment and tension,
- impression adjustment,
- tooling registration,
- print registration,
- ink and colour adjustments,
- defect elimination.

Print cylinder pre-registration

A number of techniques have been employed to minimize adjustments for each of these areas. The purpose of this article is to discuss how to

reduce circumferential registration adjustment and particularly how to pre-register print cylinders by mounting them in the press so that only micro register adjustment is needed. The goal is to eliminate the necessity to disengage a cylinder and rotate it to the correct gear tooth before commencing on micro adjustment. Even with a 360-degree gearbox, placing the cylinder in the press at the correct circumferential starting position will cut valuable adjustment time out of the makeready process.

In most narrow-web pressrooms in the USA, it is common practice to put cylinders in the press with no regard to circumferential position. Instead, it is commonplace to insert the cylinders, print the first colour until the print is advanced entirely through all the required print stations. Then, one by one, each subsequent colour is printed. The gears of each cylinder are disengaged and rotated to the desired position for macro registration. Next, the colour is printed a second time and the macro registration process is repeated until the cylinder is within a gear tooth and ready for micro adjustments. These steps are repeated for each subsequent print station. In total, this could easily take 5 or more minutes, depending on the skill of the operator. This doesn't seem like much time to worry about but when combined with other improvement efforts, it can make a big difference to the total makeready time.

A better practice is to insert the print cylinders in the press in the correct gear position initially so that no gear disengagement and cylinder rotation are needed. In the case of a 360-degree gearbox no macro rotation is necessary. In other words, the cylinders are pre-registered so all that is needed is minor circumferential adjustment. Then all that is needed is simply fine-tun-

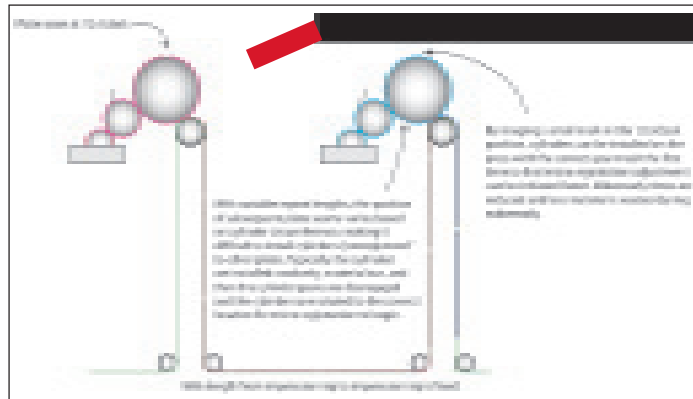
Associate Professor, *California Polytechnic State University*, San Luis Obispo, CA/USA. <http://grci.calpoly.edu>

ing of the image.

To install correctly the first time takes some thought. This process is more difficult than it sounds because the position of the cylinder relative to the plate seam will vary as cylinder circumference varies (repeat length). The position of the plate seams on one job will be different to the position on another unless they have identical repeat lengths.

It is relatively easy to calculate the seam location for each job. However, trying to accurately position the plate seam on press can be difficult with no scales for reference so additional adjustment is often needed. A better practice is to image a mark on each plate to indicate the 12 o'clock position so that the operator simply places that mark in the up position when inserting the cylinders.

To achieve this, a couple of variables must be identified. First, the plate or colour sequence must be



Print cylinder pre-register.

known. If that sequence later changes, the marks become invalid. Fortunately, it is not difficult to recalculate the mark position and to simply mark the plates with a pen. A second variable is the distance the web travels between print stations. This will vary between presses but usually doesn't vary between units (assuming no turn bars or other unusual situations).

The third item is the type of

gearing (1/4" cp, 10 dp, 1/8" cp, etc or even metric!). Many companies use one standard gearing - 1/8" cp being most common for narrow-web converters. Finally, the repeat length of the job must be known.

With those four bits of information, it is simple to determine where the marks should be imaged. Multiple repeats will fit into the web distance between print stations. If it happens to come out as a whole

Pre-registration mark location calculator.

Job Name	Flexo job 1	
Press	Mark Andy 2200 Press 1	
Web length between print stations under tension (inches)		110
Gearing (1/8"CP, 1/4"CP, [10DP enter .314])		1/8
Repeat (teeth)		96
Number of plates in job (exclude tint sleeve)		4
Colour Sequence		Mark Position
1	1st plate is positioned in print station w/ seam at 12 o'clock unless offset desired. Enter offset here:	0
2	Location of mark from lead edge of plate (in inches – to be positioned at 12 o'clock on station)	2,0000
3	Location of mark from lead edge of plate (in inches – to be positioned at 12 o'clock on station)	4,0000
4	Location of mark from lead edge of plate (in inches – to be positioned at 12 o'clock on station)	6,0000
<i>Note: Assumes specific press and color sequence is known and won't change and all units have equivalent web paths (i.e. no turn-bar, etc).</i>		

number (i.e. exactly ten repeats fit between the impression nip of station 1 and the impression nip of station 2) then put all the plate seams at 12 o'clock and the images are pre-registered. At that point the make-ready is initiated and only micro circumferential adjustment should be needed.

If, however, only 9.75 repeats fit in the web distance between the units, then a mark is imaged on the second plate at 75% of the repeat. In other words, on a 10" repeat, a mark is imaged at the 7.5" mark on the second plate. The operator installs

the first plate with the seam positioned at 12 o'clock. The second plate is then positioned with the pre-registration mark at 12 o'clock (seam will be at 3 o'clock). The pattern is repeated for each subsequent plate. The operator focuses at putting the seam of the first plate at 12 o'clock and the marks on subsequent plates at 12 o'clock.

A simple spreadsheet can be developed for the prepress operators to calculate mark position on any job. The operator simply types in the parameters and the location of the marks are calculated. A Magenta mark is positioned at 7.5" (from lead edge), a Cyan mark is positioned at 5.0", a Black mark is imaged at 2.5", and no Yellow mark is imaged (1st colour down positions seam at 12 o'clock). This example assumes a colour sequence of YMCK, 9.75 repeats between stations. 1/8" cp gearing, and a 10" repeat.

Pre-registering tooling

It is possible to do the same thing with the dies, though it is a little more complex because there is often no seam for reference. Magnetic dies have a seam and in these cases, there is a natural reference point to focus on. Either way, the principle is the same. If a die will run on a specific press all the time and there is no risk of the web distance changing, a mark can be routed or scribed into the die itself as a 12 o'clock reference point. It is more flexible to avoid permanent marks in the die and simply draw on it with a pen.

The relationship of the various die cavities will need to be considered. In other words, if the graphics

are 4-up (2 x 2) on the 10" repeat, then consideration should be given to how a single station fits into the web distance from the first plate seam. The question needed to be solved mathematically is what portion of a single die station will be positioned at 12 o'clock when the die is registered to the first down colour with its plate seam positioned at 12 o'clock. As an alternative, a simple set of protracted lines can be painted on the gear side-wall of the die station and align a mark on the die to the appropriately angled line. In this case, the mark is usually positioned between die cavities where the beginning of an image repeat would occur. Give it some thought and it will be surprising how tooling can also be pre-registered.

The little improvements matter

It is natural to scoff at these small improvements and discount them as too much work with too little payback. But in reality, the leaders in the narrow-web converting industries around the globe are focusing on customer value and doing everything possible to improve the things that customers want – printing high quality labels at good prices. That means focusing on the little improvements as well as the big ones. Try these techniques and see how even cutting five minutes out of every makeready will improve the bottom line. More importantly, teach employees the value of setup reduction and watch them come up with a million more improvements that will delight customers as well as the stakeholders. ■

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