SYNRAD Technical Bulletin

00003

Technical Issue: Determining Line Speed for FH Tracker Systems

Date: 05 June 2001

Description:

This Technical Bulletin describes the calculations required for determining approximate line speed when marking with a SYNRAD FH Series Tracker Marking Head. Use this Technical Bulletin as a supplement to the *FH Series Marking Head Operator's Manual* (version 2.0) released June 2000.

This Bulletin covers the following topics:

Definitions

Before calculating the approximate line speed that an FH Tracker is capable of for a given mark, several terms must be defined. To obtain the highest possible line speed and mark quality, please review these definitions carefully before designing your Tracking application.

Mark

The *Mark* is the object, or collection of objects, defined by the bounding box when all marking objects are selected in your .mkh mark file.

Drawing Canvas

WinMark Pro's *Drawing Canvas* displays the maximum marking field dimensions for the selected lens size. For example, with a 200 mm FH lens selected, the maximum *Drawing Canvas* dimensions are 134 mm × 165 mm. When using a 125 mm FH lens, the *Drawing Canvas* spans an 85.7 mm × 105.6 mm area. See the *FH Series Marking Head Operator's Manual* or the *Fenix Laser Marker Operator's Manual* for FH lens specifications.

Usable Field Size

Usable Field Size is the distance, in millimeters, from the downstream edge of *Mark* placement on the *Drawing Canvas* to the downstream edge of the *Drawing Canvas* in the axis of part motion. Figure 1 illustrates *Usable Field Size*.

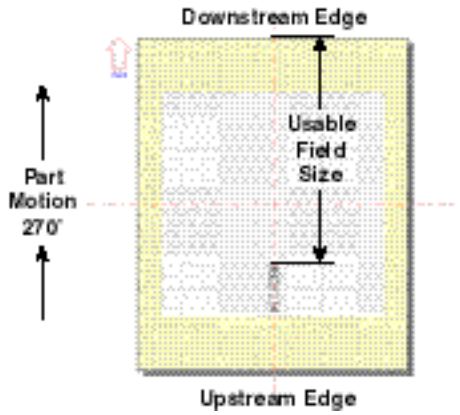

Figure 1 Usable Field Size

Mark Pitch

Mark Pitch is the distance, in the axis of part motion, from the leading edge of the *Mark* on one part to the leading edge of the *Mark* on the following part. **To achieve maximum line speed, *Mark Pitch* should <u>not</u> be less than the *Usable Field Size*.** See Figure 2.

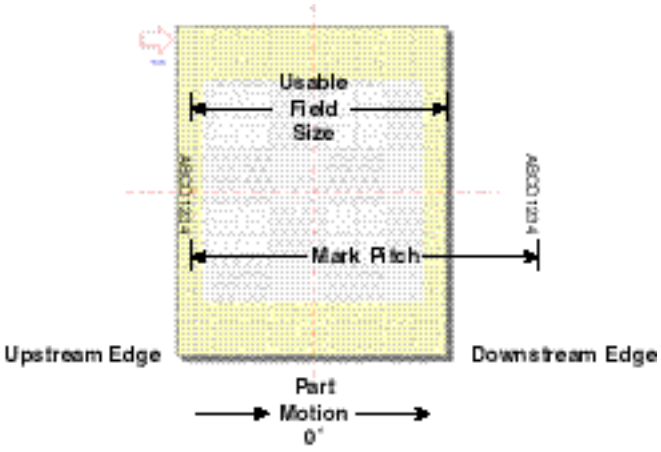

Figure 2 Mark Pitch greater than Usable Field Size

Cycle Time

The amount of time in seconds required to complete the *Mark* is the *Cycle Time*. Because cycle times for FH Index and Tracker Heads are the same, marks are first tested and optimized for speed and mark quality in Index mode.

Tracking Window

The *Tracking Window* is the fixed area beneath the Tracker Marking Head in which marking may be completed without error. The *Tracking Window* is defined as the smaller of either *Usable Field Size* OR *Mark Pitch*.

For example, Figure 3 shows an application using a 200 mm lens with a 0° *Motion Vector* giving a *Drawing Canvas* dimension of 134 mm. *Usable Field Size* measures 128 mm and *Mark Pitch* measures 90 mm. By definition, the *Tracking Window* is the smaller of *Usable Field Size*, 128 mm, or *Mark Pitch*, 90 mm. In this case the actual *Tracking Window* is limited to 90 mm.

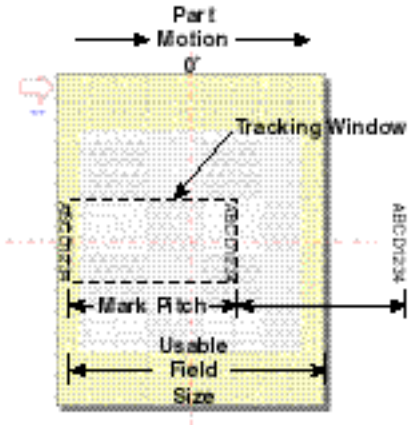

Figure 3 Tracking Window

Target Area

The *Target Area* is the area on the part, or array of parts, that will be lased with the *Mark* as parts move under the Tracker Head. See Figure 4.

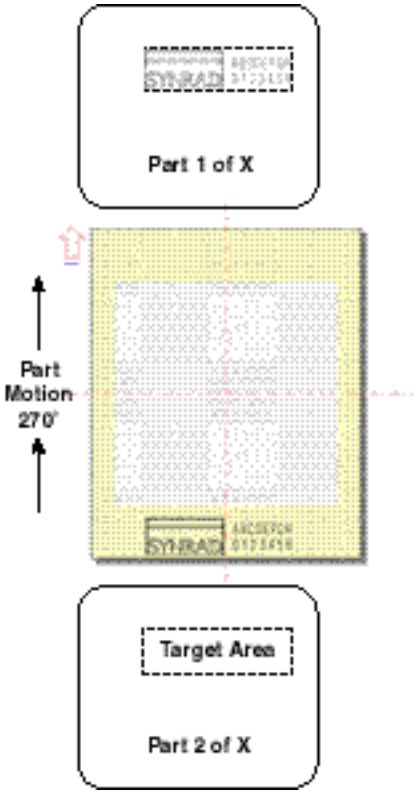

Figure 4 Target Area

Tracker Marking Criteria

- The entire *Target Area* of the part, or array of parts, to be marked must move completely within the *Tracking Window* before lasing will begin.

- Lasing must be completed on the part, or array of parts, before the next part, or array of parts, activates the part sensor. If lasing is not complete before the next part sensor input occurs, the next part, or array of parts, will not be marked and the mark log will display a "Line speed too fast – missed start" error.

  Depending upon *Sensor Distance* and *Mark Pitch*, FH Tracker Heads can buffer between 1 and 16 "start mark" signals. The number of start signals buffered by the Head equals the number of parts that pass the part sensor before the first part enters the *Tracking Window*. Note that when a "Line speed too fast – missed start" error occurs, the buffer is reset. In cases where more than one "start mark" signal is buffered, more than one piece will not be marked.

- *Encoder Resolution*, encoder pulses per millimeter of conveyor motion, must be properly set to prevent mark distortion or marking outside the *Target Area*. See the *FH Series Marking Head Operator's Manual* for details on calculating *Encoder Resolution*. After determining the correct value, open and run the *Linestack200.mkh* or *Linestack370.mkh* mark file to verify the calculated value (for 80 mm and 125 mm lenses, copy the linestack objects and paste into a New drawing created with the correct lens setting). If *Encoder Resolution* is correct, then short and long lines will appear as one long line as shown in Figure 5.

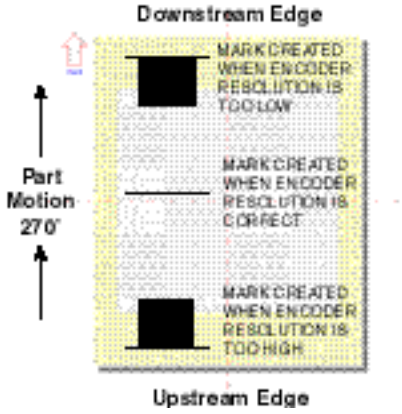

Figure 5 Checking Encoder Resolution

If the long line is ahead of the short lines in the direction of motion, then increase Encoder Resolution. If the long line is behind the short ones, decrease Encoder Resolution. Accuracy to the second decimal point may be required depending on the resolution of your encoder.

- *Mark* position and orientation make a substantial difference in Tracking speed because they change *Usable Field Size*. Maximum line speed is achieved when the *Mark* is positioned as close as possible to the upstream edge of the *Drawing Canvas*. Figure 6 shows how the same text positioned differently can give two very different values for *Usable Field Size*.

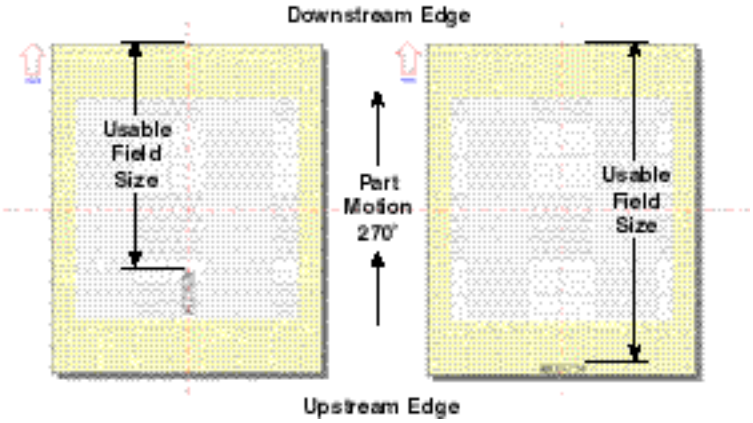

Figure 6 Mark length comparisons

- Marked portions of the *Target Area* may move beyond the upstream edge of the *Tracking Window* as the mark is progressing; however, lasing is disabled when any unmarked microvectors move outside the *Tracking Window*. If this occurs, the mark may be missing or incomplete and the mark log will display a “Line speed too fast to finish” error. In Figure 7, “Line 2” will mark unless any unmarked portions of the text object move outside the *Tracking Window*.

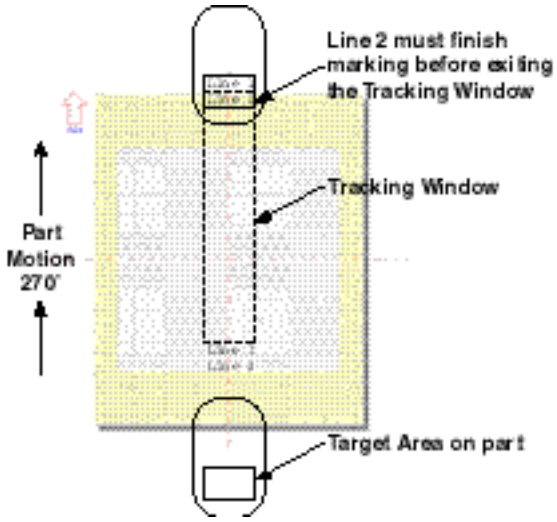

Figure 7 Maximum marking position in Tracking Window

Line Speed Formula

The formula below provides the approximate maximum line speed for a specific mark file using an FH Series Tracker Marking Head.

Line Speed = *Tracking Window* / *Cycle Time*

Note: To achieve maximum line speed, your mark file must first be optimized to meet mark speed and mark quality requirements for the specific material to be marked.

Sample Calculations

Sample Calculation #1 and Sample Calculation #2 guide you through the definitions described earlier so that the correct values for Tracking parameters can be determined and inserted into the Line Speed equation.

Sample Calculation #1

Refer to Figure 8 and read through the following sample line speed calculation.

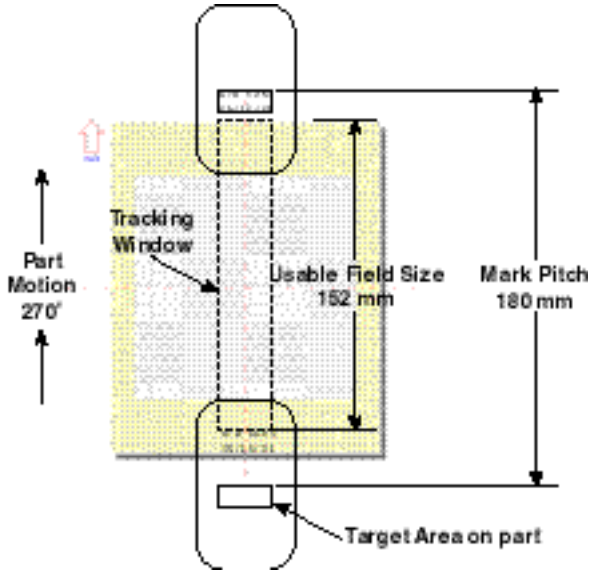

Figure 8 Tracker line speed calculation # 1

The mark is being made by an FH Tracker using a 200 mm FH lens; maximum lens field dimensions are 134 mm × 165 mm. A *Motion Vector* of 270° is set in WinMark on the *Tracking* tab due to the application's part motion requirements. *Mark* placement on the *Drawing Canvas* is such that the *Usable Field Size* is 152 mm.

The *Tracking Window* is defined as the smaller of either *Usable Field Size* OR *Mark Pitch*. *Usable Field Size* is 152 mm and *Mark Pitch* is 180 mm, so the *Tracking Window* is 152 mm.

Cycle Time for the mark (optimized in Index marking mode) is 0.32 seconds.

Line Speed = *Tracking Window* / *Cycle Time*

= 152 mm / 0.32 sec

Line Speed = 475 mm/sec = 28.5 m/min = 93.5 ft/min

Sample Calculation #2

Refer to Figure 9 and the following sample line speed calculation.

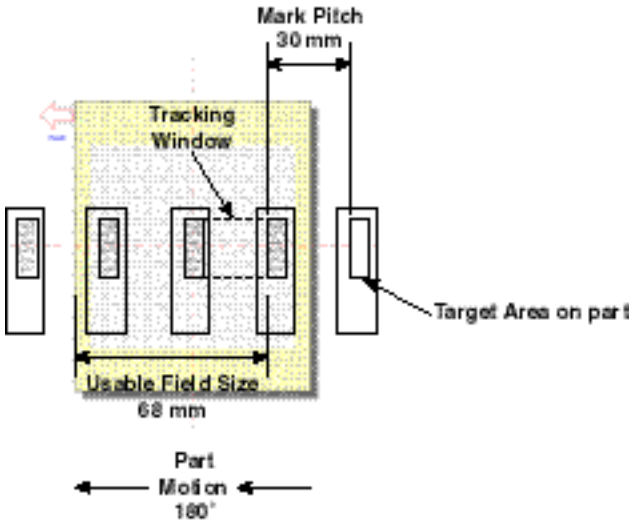

Figure 9 Tracker line speed calculation # 2

The mark is being made by an FH Tracker using a 125 mm FH lens; maximum lens field dimensions are 85.7 mm × 105.6 mm. A *Motion Vector* of 180° is set in WinMark on the *Tracking* tab due to the application's part motion requirements.

Usable Field Size is 68 mm and *Mark Pitch* measures 30 mm. The *Tracking Window,* the smaller of either *Usable Field Size* OR *Mark Pitch,* equals 30 mm.

Cycle Time for the mark is 0.20 seconds.

Line Speed = *Tracking Window* / *Cycle Time*

= 30 mm / 0.20 sec

Line Speed = 150 mm/sec = 9 m/min = 29.5 ft/min

Optimization

There are several variables related to the *Tracking Window* that can be optimized to increase throughput.

Usable Field Size can be lengthened by reducing *Mark* size, or in some cases, by rotating the *Mark*. Or position the *Mark* on the *Drawing Canvas* so that the upstream edge of the *Mark* is on the upstream edge of the *Drawing Canvas*.

If the *Tracking Window* is smaller than *Usable Field Size*, increase the *Mark Pitch* so that it is equal to, or greater than, the *Usable Field Size*. If this is not possible then consider adding a second marking head so that each head marks every other part, which effectively doubles *Mark Pitch*.

Cycle times of mark files are usually optimized, even in Index applications, to obtain the highest throughput speeds. In addition to increasing *Velocity* and reducing *Resolution*, try increasing *Off Vector Velocity* and reducing *Off Vector Resolution*. When rastering bitmap objects make sure that *Bi Directional Raster* is set to Yes. Refine the mark—use stroke text, not TrueType fonts; simplify line art; and, if possible, reduce the number of marking characters.

Summary

Line speed calculations do not take into account differences in computer speeds (for instance, if the mark's *Cycle Time* is optimized on a different system then the one running the actual marking application), or the time required for other automation processes (such as motion controllers or automation software) to complete their respective tasks between each mark. These factors must be accounted for when determining the actual throughput of your production line. As with any factory automation proposal, proof-of-concept testing is highly recommended.

For further information contact SYNRAD at: 1-800-796-7231 (in the U.S.) or 1-425-349-3500.