REGISTRATION

PREFACE:

This document has been put together in an attempt to better educate both employee's at AGFA and our customers on the subject of registration. It is intended to be used as a reference by sales, technical support, and field service when the issue of registration arises.

- Processor

I. Definitions

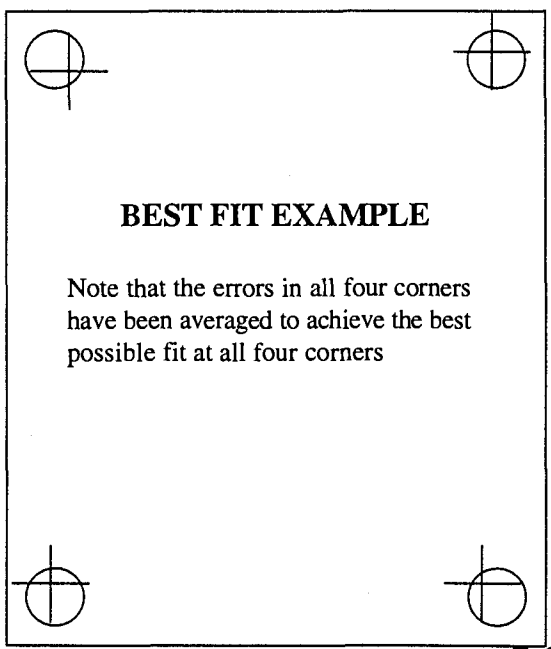
The following are definitions for the terms used throughout this document and how they apply to the applications described herein.

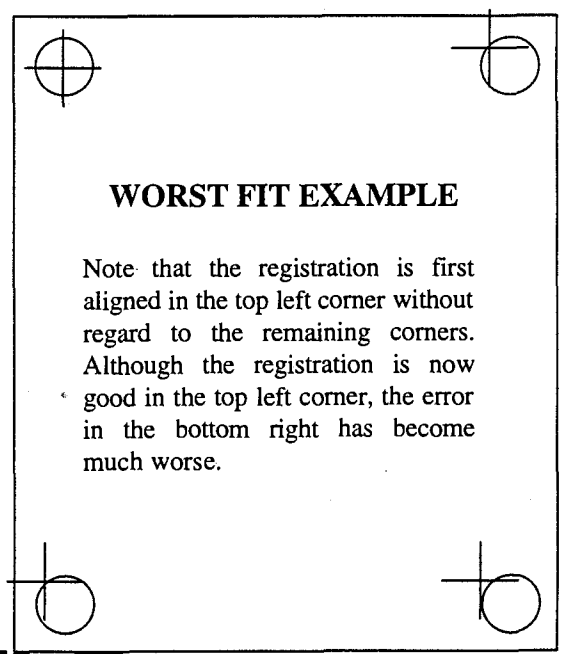
- **Repeatability** - The ability to reproduce multiple images, consecutively, which when overlaid and measured in a best fit mode, meet or exceed the imagesetter specification.
- **Accuracy** - The ability to align the image with an absolute scale. This is the absolute accuracy of a system and must be considered separately from repeatability.
- **Linearity** - Linearity is the measure of variability in the length of 1 inch segments across the entire fast scan and slow scan axis.
- **Parallelism** - This refers to the first scan line as compared with an imaginary line drawn through the center head punch and the tail punch.
- **Duplo/Quadro** - The taking of multiple images from within the same piece of film. This means the images are imaged on different areas of the drum.
- **Squareness (Perpendicularity and Aspect Ratio)** - This refers to the slope of the first and last, best fit, fast scan line as compared with the first and last, best fit, slow scan line. Ideally these should have angle of 90 degrees between them. The aspect ratio is the relationship between page length and page width.
- **Best Fit** - A method of registration in which all measurement point errors are averaged in such a manner as to achieve the best possible fit with the least amount of error at all measurement points.

II. Registration Methods

Best Fit vs. Worst Fit

If the system has no punch capability, the copy can be measured using a "Best Fit" method or "Worst Fit" method. In the case of the Best Fit method the errors between the images are averaged to achieve the best possible fit with the least amount of error at all the registration points. In the "Worst Fit" method, the images are aligned precisely at one given point and all errors are accumulated at the remaining registration points. This is best explained through example. Please refer to the diagrams below which attempt to show how "Best Fit" compares with that of "Worst Fit".





In the "E Note: Errors are exaggerated for purposes of example. ıe case of the "Worst I ıws the accumulated errors to appear at the other registration points.

All of AGFA's marketing specifications rely on the "Best Fit" method of measurement.

Press Operators vs. Strippers

It is important to note that the best fit method is the approach used by the press operator after the films are plated and placed on press. It would not be wise for the press operator to use a worst fit method as this would certainly produce the poorest final printed output.

In contrast, the strippers uses the worst fit method which doubles the repeatability error as measured by AGFA. This is mostly employed as the method for the stripper simply because it is easier and faster. This may mean that films will get rejected that would possibly have performed fine when at press where they would have been aligned in a best fit method.

On some newer presses they use an automated register system which has a custom target imaged with the files and is placed at one or two points on the plate. When the press operator uses this registration system they are effectively using a worst fit method and any errors in registration will be exaggerated. This is because the target is measured at only one or two points without regard to the rest of the press sheet. They typically have the ability to manually override the system, but may be reluctant to as this process is intended to reduce the need for manual registration.

Punch vs. No Punch

When the imagesetter has the ability to punch the film, and these are used for registering the films, the best fit method of registration is no longer in use. At this point the films are being registered using a worst fit method but the registration alignment point has been moved from a single point or target on the film to the punch holes. This does not allow for compromises and can be problematic. If the accuracy level achieved is acceptable, this is one of the fastest and most productive methods of registration. If however greater accuracy is required, then a best fit method should be used to register the films. Again, all AGFA marketing specifications rely on the best fit method and have increased specification when using punches.

Transfer Punch

Another common area which greatly influences registration is the transfer punch operation. In the case where films are punched by the imagesetter and then are placed on the transfer punch to make the appropriate press plate punches/notches, this operation can be a source of registration problems. The use of a transfer punch system with dual stage vacuum will greatly reduce the possibility of these added errors. The dual stage vacuum will draw down the film from the center first working in an outward fashion towards the edges of the film. This reduces or eliminates the inconsistencies and distortions which are common with single stage draw down systems. If the imagesetter has tail punch capability, the use of the tail punch will also help reduce errors which occur during the transfer punch operation.

III. Image Placement

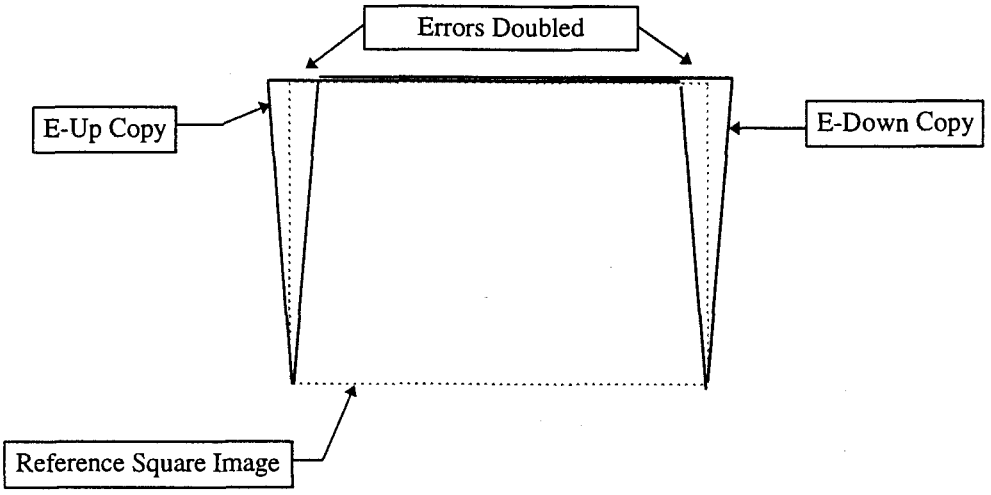
Duplo/Quadro

Duplo and Quadro is a method where multiple files imaged on the same sheet of film but on different areas of the drum are then registered together. The way these files are arranged on the film inside the drum can have big influences on the ability to have these files register. If for example the files are arranged on the film such that they are not all in the same orientation then

Emulsion to Emulsion

Some times customers application require the taking of two images and flipping one to place the two together emulsion to emulsion. Customers sometimes use this as a measure of system performance when in fact it may have little or no relevance to the registration accuracy which the customer can expect under the normal applications for which the equipment will be used.

When the films are placed E to E, the squareness error is doubled. This performance is controlled through the perpendicularity and aspect ratio specification. This is not to be confused with duplo/quadro discussed earlier and does not necessarily relate to the accuracy and repeatability of the system. Thus a system could fail a E to E test but still meet it's image quality specifications.



Software Applications

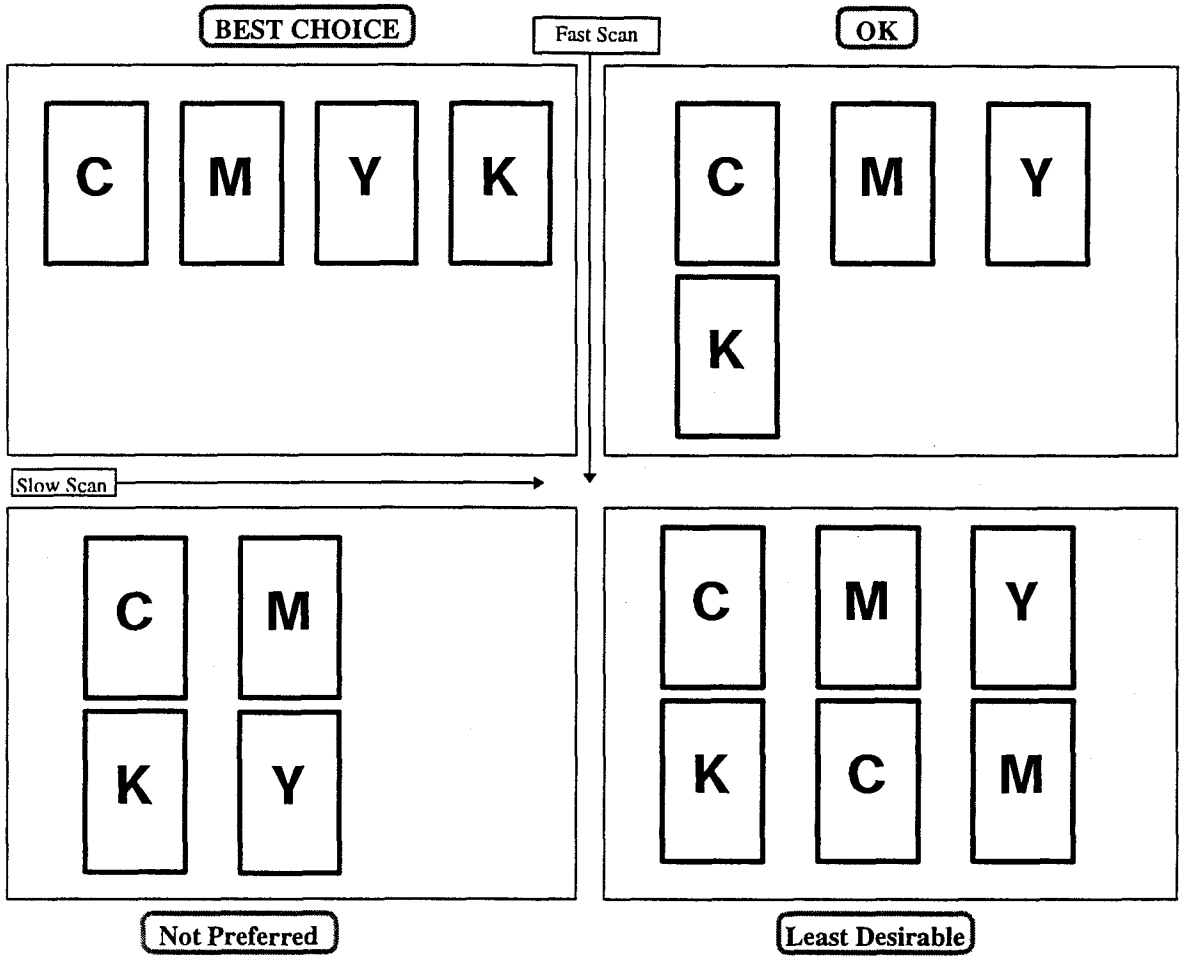
There have been documented cases which show some application software packages have also been the cause of registration problems. When an application has a bug that may generate inconsistent results it is very difficult to identify. Occasionally these errors will be present on only one of a standard set of separations. For example the CMY may all fit but the K could be off. In the case when application software is to blame it is often already documented as a bug and can be isolated to files which come from that application. If registration problems appear from multiple different applications it is not likely a application software problem. It is still important to keep this is mind as a potential cause and to look for any possible links between the problems and the application from which the films were generated.

IV. Dimensional Stability

Accuracy

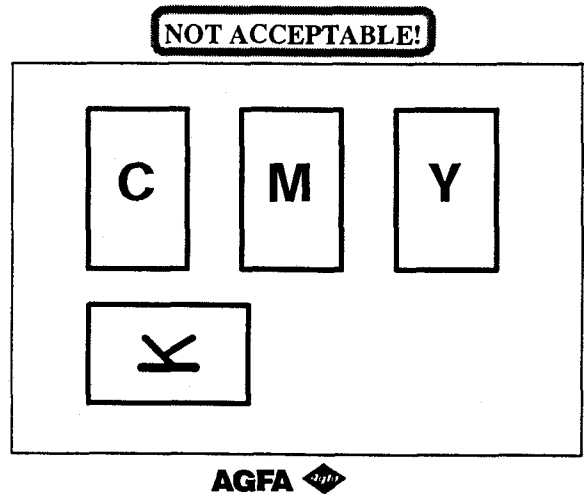
This measure is controlled by the scale adjustment measured in the X and Y coordinates and is set at the factory under the ideal environmental conditions. Once the system is installed at the customer these adjustments may require fine tuning to accommodate any environmental differences. Accuracy also includes the scale linearity which is the measure of 1 inch segments in the X and Y axis. It is possible to have the correct outside dimension with a varied linearity across the scale.

the result can be that the files will not register. Even having all the files in the same line on an X or Y coordinate can be a benefit. The following examples show different duplo/quadro layouts and which are best as well as those that must be avoided.



Ganging

Some film saving and ganging programs which are designed to make the best possible use of the film do so without regard to what disadvantages it may have to the registration of the images. For this reason it is critical to take into account what affects using ganging will have on image placement and to prevent such things as image rotations when the files are to be registered with each other.



Film Stability / Environment

All of the precision designed into AGFA's' imagesetters is rendered irrelevant when environmental control of the imagesetter work area is ignored. A leading cause of poor registration results from little or no consideration of the effect of the environment on the dimensional stability of film.

Alliance rolled film is packaged at 68 degrees F (20 degrees C) and a relative humidity (RH) of 50%. The film while still in the daylight package will maintain these RH conditions until opened. Even after opening and putting into a supply cassette the film remains at these packaged environmental conditions, except for the top couple layers. This is due to the fact that the media is wound very tightly on the core which seals in the RH condition. However, immediately after the film is unrolled it begins to adjust to the ambient environment. If this environment is identical to the original packaging environment (68 degrees F and 50% RH) then there is no change in the dimensions of the film. On the other hand, if the environment is different, then the film dimensions will change. This is a result of the properties of the base as well as the Gelatin layers of the film. The base is effected by temperature whereas the gelatin layers are effected by changes in relative humidity.

In the case of Alliance film, the dimensional sensitivity of film is .017mils per inch per % change in RH (17 microns per meter per % change in RH) and .01mils per inch per degree F (18 microns per meter per degree C). All of the film vendors' films have roughly the same properties. For example, the dimensional stability of Kodak film is identical to AGFA's Alliance film. To help put the dimensional stability into perspective, consider the Avantra 44. The length of the film in the 44.5 inch axis will shrink by 15 mils (380 microns) when placed in a relative humidity of 30%, not at all uncommon. A 10 degree F (5.6 degrees C) temperature increase, also not uncommon, will increase the 44.5 inch axis by .045 inches (115 microns).

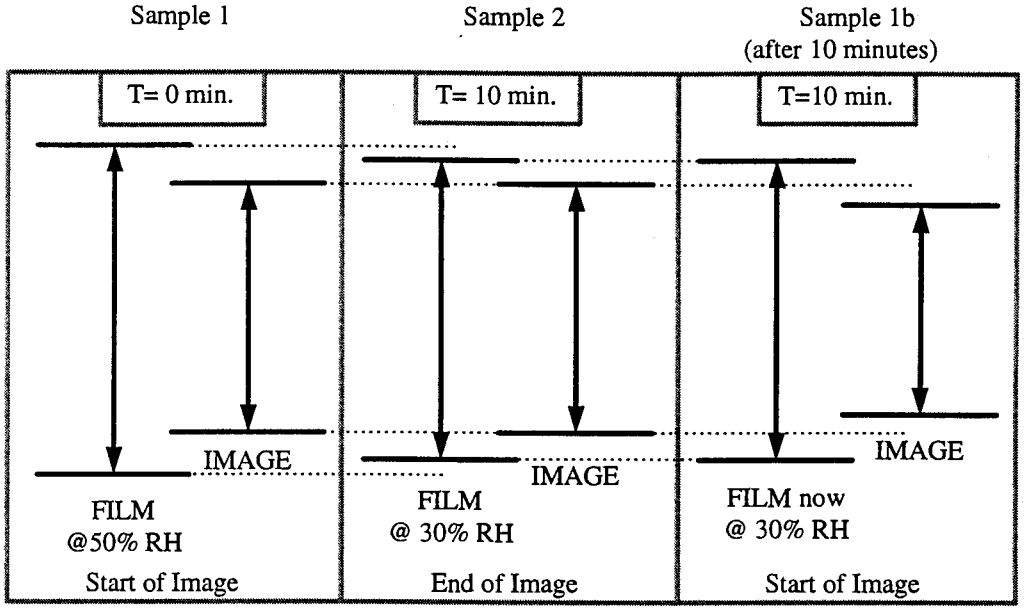
Compounding the issue of environmental sensitivity is the element of time effect on the film dimensions. This is especially significant when encountering a humidity environment other than 50% because the film responds rather slowly to RH. Temperature changes will also result in significant dimensional changes but the film will adjust to a new temperature in a far shorter period of time. This rapid adjustment prevents any image distortions as a result of the film adjusting during the imaging process.

The slow adjustment to RH is a major issue with applications which require registration between film imaged on the same portion of the drum as well as applications where the same piece of imaged film is cut and later stripped (duplo or quadro imaging).

In the first case, that of registration between films imaged on the same portion of the drum (typical when imaging imposed flats), registration problems result from film which has been in the drum having adequate time to adapt to the environment. When compared to subsequent films which did not have sufficient time to adapt, a registration error will result. For example, consider a piece of film which has been in the drum for 10 minutes before it is imaged with the first color of a separation in a 30% RH environment using the Avantra 44. Compared to the other separations which are run afterwards, the first separation will be imaged on a film <u>already</u> shortened by a lower RH. The remaining separations will then be shorter by 7.5 mils (190 microns) after adapting to the 30% RH environment.

In the case of films which are imaged in a Duplo or Quadro mode, during the imaging time the film will have changed dimensions from the beginning of the image to the end. For example, with an Avantra 44S running in a 30% RH environment, imaging a 36x44.5 inch area, at 3600 DPI (which takes approx. 6.5 minutes), the 44.5" film dimension will decrease by 40% of its ultimate dimensional change or -6 mils (-150 microns) during the imaging process. After the entire sheet adapts to the 30% RH this results in an image on film that is shorter on the

beginning then the end after processing. See the diagram below. This will clearly result in the machine failing to meet the duplo registration specifications.



T= Time of imaging
Start of Imaging = Area imaged while film at 50% RH
End of Imaging = Area imaged after film has adjusted to the 30% RH environment.
Note: In Sample 1b the image is smaller as a result of the film shrinkage after imaging on the film when it was still at 50% RH.

In this example if the film is now processed it will become completely relaxed. If after drying, the film is returned to the 30% RH environment, the "Start of Image" area will still be small. If the film is instead placed into a 50% RH environment, then the "End of Image" area will be large since the imaging took place while the film was in a shrunken state (30% RH) during imaging.

It should be noted that 7 mil and 4 mil thick film are equally sensitive to temperature. The thicker 7 mil film is only 18% less sensitive to humidity. It does take roughly twice as long for the 7 mil film to settle to changes in RH, so there may be some minor improvements in registration in duplo and quadro imaging with this film.

In conclusion, in order to get the registration performance out of the AGFA imagesetter that was designed into it, strict environmental controls must be adhered to. All of AGFA's marketing specifications assume an ideal environment of 70 degrees F (21.1 degrees C) and 50% RH. For example, to be within +/- 0.2 mil over a 1 meter distance the RH must be controlled to 0.25%! As a practical matter, control of RH to 50 +/- 2% and consistent temperature control within +/- 2 degrees will still yield more than adequate repeatability for even the most critical work. In addition to control of the environment for the imagesetter, the processing of all the films which are required to register should be completely consistent

Processing

The most critical point in the processing stage occurs in the last phases as it relates to dimensional stability. The water which is on and in the gelatin layers is removed by evaporation. This process takes place faster at higher temperatures. The optimal drying temperature in the processor dryer is from 104 -113degrees F (40-45 degrees C). Temperatures which are too high (max. 140F/60C) must be avoided because they have disadvantageous influence on dimensional stability.

Film Storage

Film storage is important factor both prior to use as well as after imaging and processing. Improper storage conditions of the film, prior to use, can result in poor performance in media transport both at the imagesetter and the processor. Poor transport of the media in the imagesetter can result is serious registration errors. Poor transport in the processor can result in the media being distorted or stretched that can affect the registration as well. The following are recommended storage conditions for all Alliance HN products.

Average temperature between 64.4 - 69.8 degrees F (18-21 degrees C)
max. 77 F (25 C) min. 39.2 F(4 C) An increase to 82.4F (28 C) is permitted for a limited period of 3 successive weeks per year.
No adjustments of relative humidity

After the films are output and processed, all films which are to be registered together should be allowed to adjust to the ambient environment for a minimum of 15-30 minutes before any attempts to register the copy is made. This allows all the films to normalize and take on the post processing dimensional size. Ideally these films should be suspended vertically during this period.

V. Troubleshooting

Imagesetter

Some of the influences that are imagesetter related are listed below and should be investigated. Some of these can be controlled by the user while others must be addressed by a qualified service engineer. All of the recommendations are generalized and should apply to all AGFA imagesetters.

- **Transport Rollers**
  - ⇒ All transport rollers should be inspected and cleaned regularly with the recommended cleaners (typically isopropyl alcohol 90% for AGFA imagesetters with neoprene or EPDM rubber rollers).
  - ⇒ Nip pressures should be checked for proper contact and even pressure.
- **Supply Cassettes**
  - ⇒ The internal parts of the supply cassette must be in good condition.
  - ⇒ The light seal must be checked for uneven wear and internal brakes or clutches (if equipped) must be functioning properly.
  - ⇒ The drive motor (if a driven supply cassette design) must be in good condition and the friction wheel surfaces clean and correctly adjusted. Regular "Motor Cleaning" procedures must be performed on some designs.
- **Take-up Cassettes**
  - ⇒ The light seal must be checked for uneven wear and release latches (if equipped) must be functioning properly.
  - ⇒ The internal scroll must be in good condition and the cassette must allow the media to enter smoothly without excessive resistance.
- **System Alignments**
  - ⇒ All media transport alignments must be verified and all parameters should be checked.
- **Environment**
  - ⇒ The environmental conditions must be within the required specifications for both the equipment location as well as all media storage areas.

Processor

- **Dryer**

  ⇒ Check dryer set temperatures as well as actual operational temperatures. The temperature must be stable with minimal fluctuations. The key to good dryer performance is consistency (always achieves the same temperature) and stability (has minimal fluctuations).

  ⇒ If external panels of the processor have been removed for better access, this can influence dryer performance. To much fresh air introduction may lower the RH. The panels may need to be re-installed to regain the proper fresh vs. re-cycled air mix.

- **Water Temperature**

  ⇒ If the processor is using fresh incoming water in the wash tank the water should be tempered. The water should be not more than 15 degrees F (9.4C) from the temperature of the fixer bath.

- **Hardener**

  ⇒ If the fixer is being mixed with hardener, it is important that the manufacturer's recommended amount is being used and not exceeded. Incorrect use of hardener will have adverse affects on the films drying properties.

A.2.3 Environmental Specifications

Temperature:

Operating: 60° to 80°F (15 to 30°C)

Shipping: 23° to 115°F (-5 to 45°C)

Relative Humidity: 35% to 85%, non-condensing

Altitude:

Operating: 9,842 ft. (3,000m)

Shipping: 42,650 ft. (13,000m)

A.2.4 Functional Specifications

Image Size:

Avantra 20: 13.7" x 20" (34.8 cm x 50.8 cm), max.

Avantra 25: 17.7" x 25.00" (44.96 cm x 63.5 cm), max.

Output Resolutions: 1200, 1800, 2400 or 3600 DPI

Spot Size:

0.00076" (20 microns) @ 1200

0.00057" (15 microns) @ 1800

0.00037" (9.5 microns) @ 2400

0.00031" (8.0 microns) @ 3600

Performance:
(Sq. in. per minute)

400 @ 1200 DPI

267 @ 1800

200 @ 2400

133 @ 3600

Screen Rulings:

Up to 300 LPI (288 shades of gray @ 3600)

Repeatability:
Best Fit: +/- 0.5 mils
To Punches: +/- 1 mil

Accuracy:

+/- 2.0 mils