

TFX Debris Removal System
Beta Revision C

Airjet Artifacts and
Adjustment Procedure

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Revision History

Revision	Date	Author	Comments
Draft	April 25, 2000	Lauren Walker	
	May 05, 2000	Lauren Walker	Corrected set screw direction discrepancies
	Jun 19, 2000	Lauren Walker	Added microscope to tools list

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1. TOOLS REQUIRED

- Metric hex key set
- Measuring Calipers
- 0-10 SCFH Rotameter Flowmeter with ¼" hose fittings
- 0-20 SCFH Rotameter Flowmeter with ¼" hose fittings
- Approximately 1ft of ¼" Pisco pneumatic hose
- Microscope (50-100X, 60X recommended)

2. BACKGROUND INFORMATION

NOTE: Adjustability of both air jet position and flow rate will be reduced or eliminated in production versions of the debris removal system.

Digital Flexographic media (flexo) is ablative and hence generates debris during thermal imaging. When flexo is imaged, a certain amount of debris remains at the pixel borders. Due to the optical design of the TFX head, the banding resulting from this debris differs depending on the pixel number. More severe banding is generally seen at the end of every 4-pixel column, and at the end of the 64-pixel swath as shown in **Figure 1** below. When *escan 48* is used, the darker bands will also repeat every 16 pixels.

If the debris banding pattern is not minimized the following problems can result:

- The optical density (D_{min}) is too large, preventing proper dot formation during plate processing.
- The banding pattern is visible to the naked eye, and resolves on processed plates. This is often difficult to differentiate from weak pixel banding.
- The banding pattern interferes with screens and results in moiré.

NOTE: The severity of microbanding can also vary with media type.

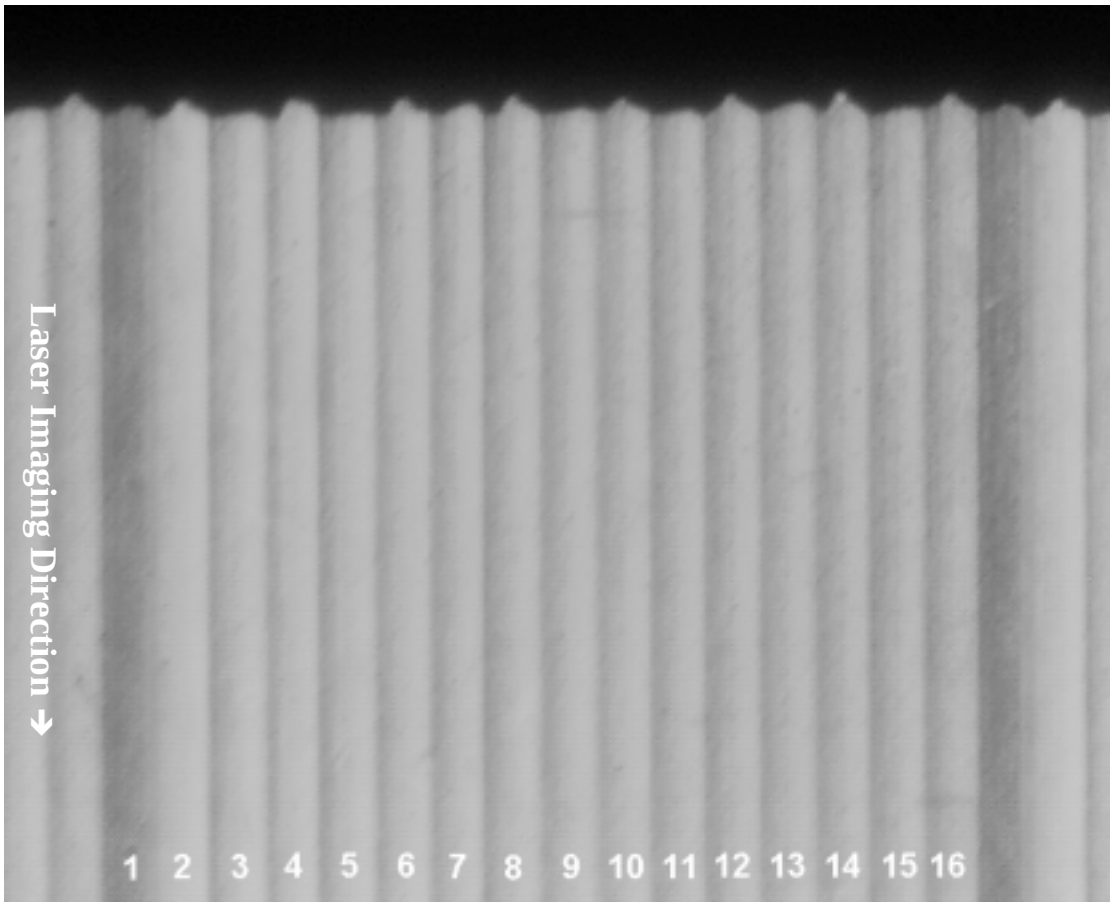


Figure 1 Solid plot banding with *escan 0*. Notice 4 and 64 pixel repeating patterns. Bands corresponding to the sixteen, 4-pixel columns in the diode array are labeled from 0 to 16. A plate produced from this image would be unsatisfactory.

Debris must be directed away from the laser and collected to avoid image artifacts and to prevent exposure of the operator to the airborne debris. The TFX debris removal system (DRS) consists of three major components: an air jet; three counter jets; a suction nozzle. See **Figure 2**. The purpose of each of these components is summarized below.

Air Jet: The Air Jet is directed at the write spot to blow debris rapidly away from the write and focus lasers. This reduces the effect of microbanding and directs the debris towards the suction nozzle. In the current Beta Revision C DRS, the Air Jet is adjustable horizontally and vertically. The flow rate is also adjustable by means of a throttle valve.

Counter Jets: The aforementioned air jet blows debris very quickly towards the suction nozzle. If not slowed, the jet will blow debris past the suction nozzle as the suction is not sufficient to slow the Air Jet on its own. To correct for this, three additional jets of air, termed the "counter jets" oppose the air jet and slow the blown debris in front of the suction nozzle. The counter jets are fixed with

respect to the suction nozzle and thus only the flow rate is adjustable in the current Beta Revision C DRS.

Suction Nozzle: The suction nozzle collects the debris blown by the air jet and slowed by the counterjets. The suction airstream then transports the debris to the filter cabinet. The suction nozzle position and flow rate are not adjustable.

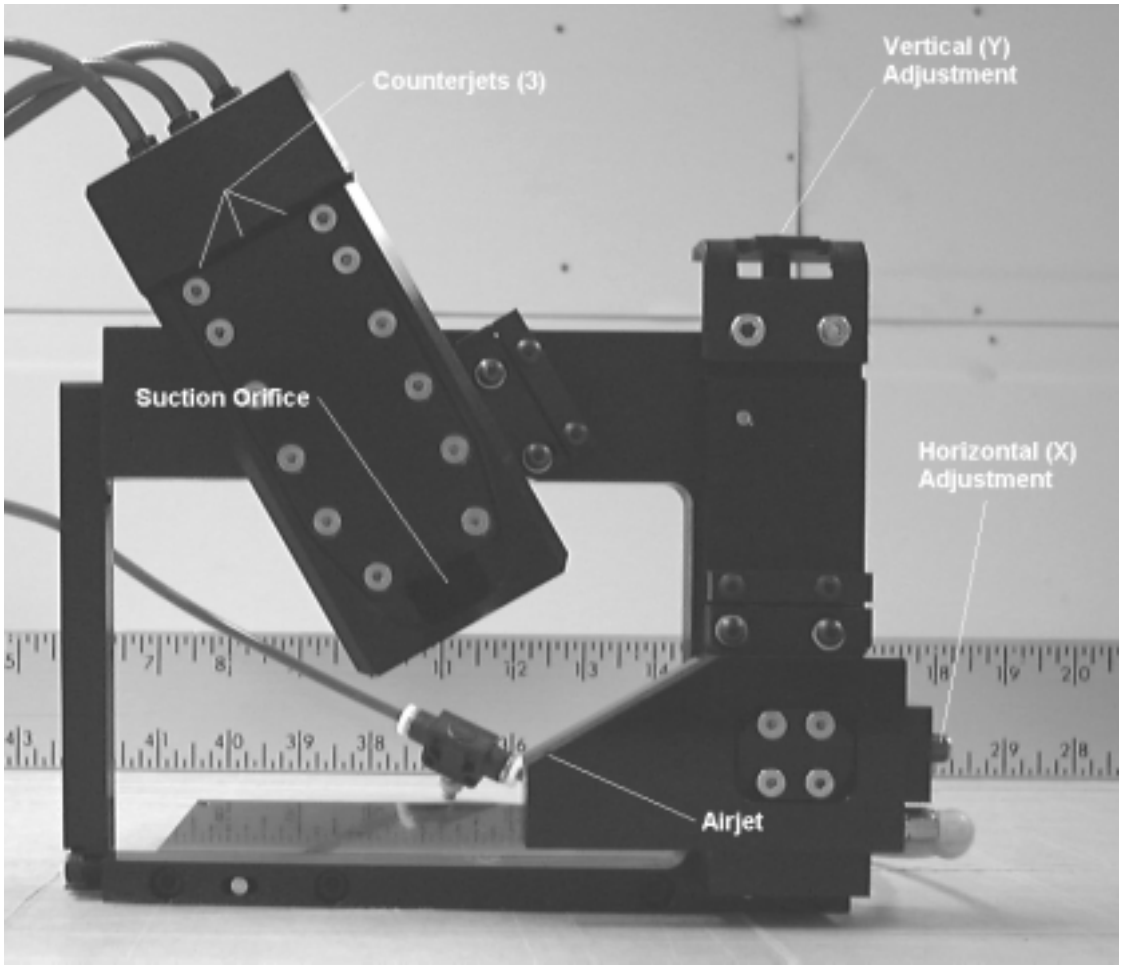


Figure 2 Revision C TFX Debris Removal Nozzle Fixture, View From Front.

Three characteristics of an imaged flexo plate are used to assess how well the air jets are positioned: The D_{min}, the uniformity of microbanding, and the direction of debris blown onto unimaged media by the air jet (*debris tails*).

***D_{min}*:** D_{min} is a measure of the transparency of the imaged flexo photomask. Reductions in the transparency of the imaged photomask resulting in an increase in the D_{min} can result from poor debris removal or underexposure. A large D_{min} is often indicative of improper positioning of the air jet, or insufficient air flow in the jet.

Microbanding: Microbanding results from variations in the D_{min} across imaged areas on flexo plates. This can result from improperly set pixel exposures, poor debris removal, or diode failures. In most cases, even with optimized exposure and debris removal, slight single pixel microbanding will remain – however, this is invisible to the naked eye, and will not affect final, processed plates. See **Figure 3** below and compare to what was shown in **Figure 1**. The uniformity of the microbanding provides an indication of how effective the *airjet* is in blowing debris quickly away from the imaging area.

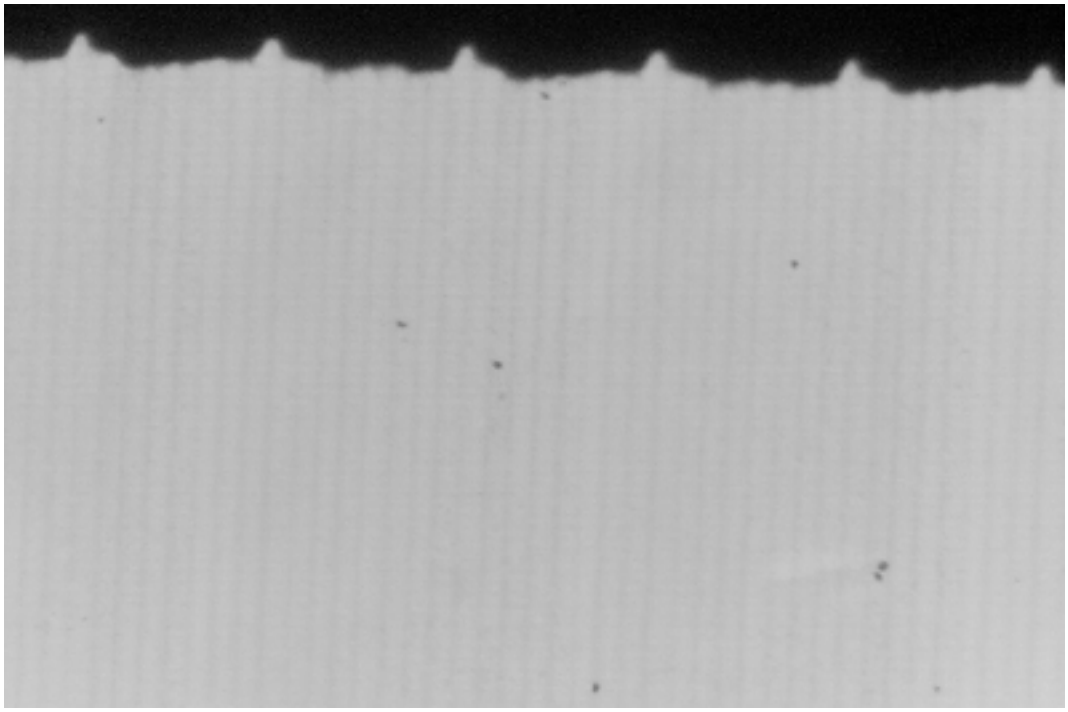


Figure 3 A solid plot showing light single pixel microbanding, visible at 100x magnification. This was plotted with optimal debris removal and exposure calibration and would produce good quality processed plates. The specks shown in the photo are a result of handling, not of poor debris removal.

Debris Tails: Debris Tails are the debris redeposition patterns seen on unimaged areas of the flexo photomask adjacent to imaged areas. Depending on how the debris removal system is adjusted, the debris tails can be found on the leading, trailing, home, and away sides of imaged areas. The location of debris tails, their direction, and their length are all indicators of whether or not the air jet is located properly.

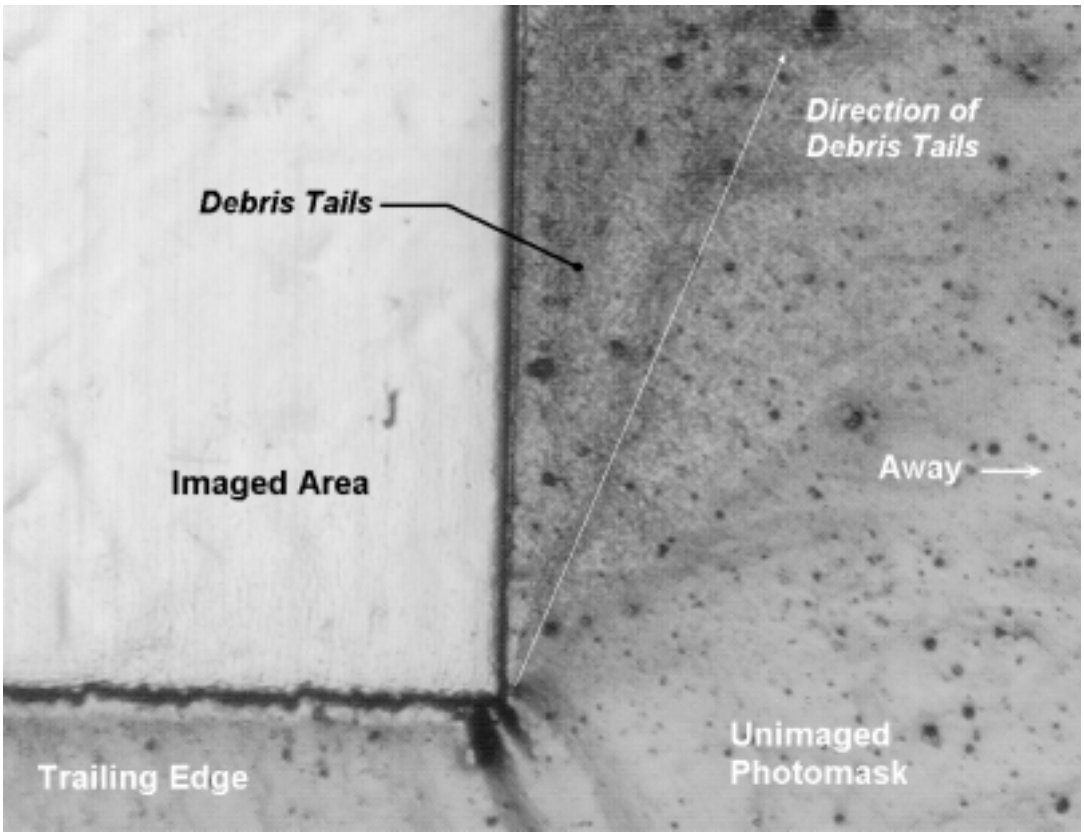


Figure 4 Debris tails are shown at the trailing and away edge of a solid plot. The plot was imaged with optimized air jet position. Debris tails are best seen in reflected light and are difficult to photograph.

3. ADJUSTMENT PROCEDURE

Example plots showing proper and improper DRS calibration are shown in Section 4.

NOTE: The following setup procedure was developed for drum speeds of 200-225 RPM. At significantly higher drum speeds, the final adjustment positions may be significantly different than those mentioned below due to the increased surface speed of the drum. The set-up procedure, however, should suffice for any drum speed.

1. Check that the exposure and media parameters have been set up properly (Ref. Document).
2. Check that the debris removal assembly and all hoses have been installed properly (Ref. Document).
3. See **Figure 5** for measurement and release screw locations. Using calipers, set the horizontal and vertical air jet starting positions by loosening the release screws, and turning the set-screws to give the desired position. Set X to ~5mm and Y to

~16mm. Note that the adjustments are not spring loaded. Apply pressure to the set-screws to ensure they are resting against the reference faces.

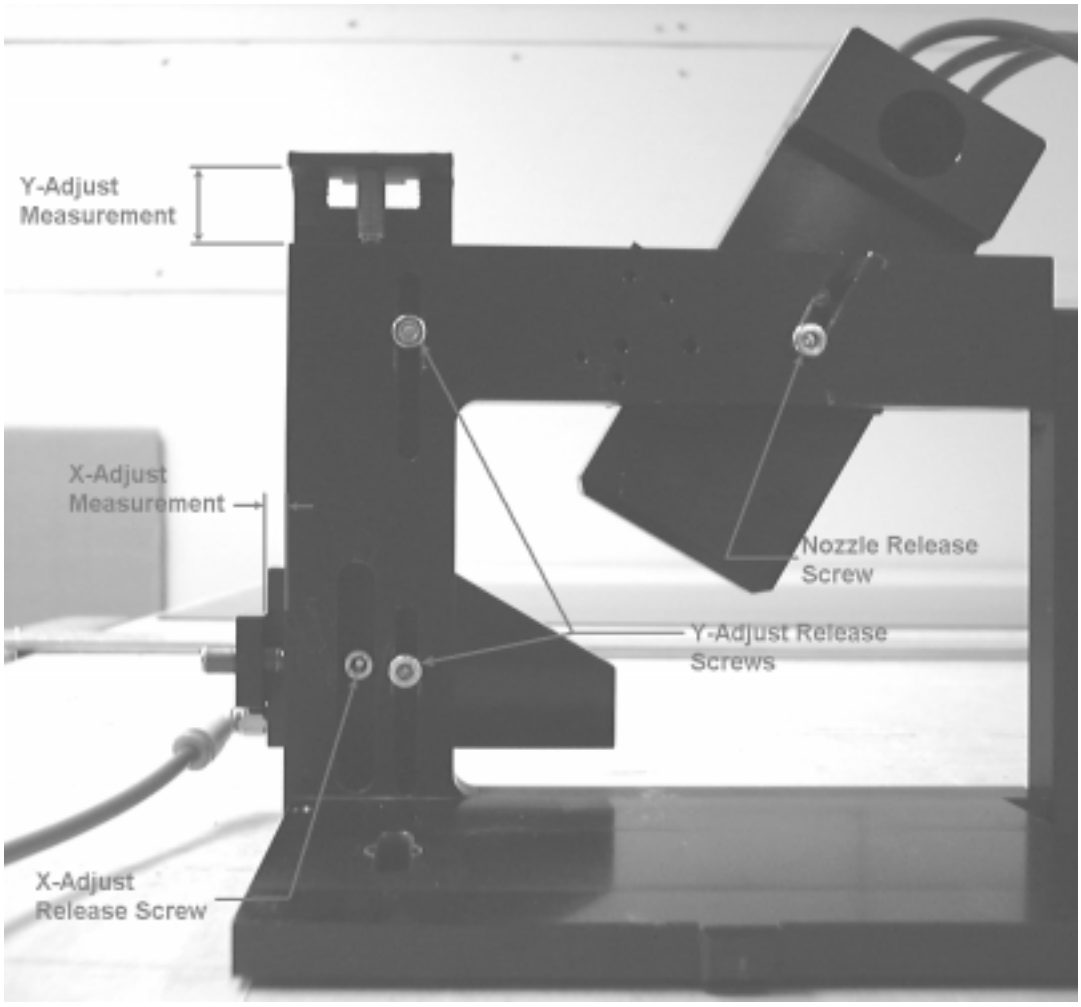


Figure 5 View From Rear, TFX Debris Removal Fixture, Revision C

4. Install the 10 SCFH flowmeter directly downstream of and inline with the *airjet* throttle valve.
5. Install the 20 SCFH flowmeter directly downstream of and inline with the *counterjet* throttle valve.
6. Turn both the *airjet* and *counterjets* on using the MPE command "*act dblow on*".
7. Adjust the *airjet* throttle valve to allow ~10 SCFH of flow, as indicated on the rotameter.
8. Adjust the *counterjet* throttle valve to allow a total of ~18 SCFH of air flow to the three *counterjets*.
9. Load Cyrel media on the ThermoFlex, execute *stage zero,* and prepare for imaging.

10. Set the vertical position of the *airjet* to ~12mm, (12 turns counter clockwise of the 80TPI locating set-screw, from the rough position set earlier). Plot a series of solid images (plot 12) raising the air jet by 2 turns of the set-screw (clockwise) per strip from –12 turns to +6 turns from the starting position (clockwise being positive). This range may be increased if necessary.

    NOTE: All calibration of the *airjets* should be done while imaging DuPont Cyrel DPS or, preferably, DuPont Cyrel DPH.

11. Inspect the leading and trailing edges of the imaged strips in reflected light. The best vertical setting is the highest position setting where *debris tails* are not seen on the trailing edge of the plot. Set the vertical position to this best setting.

    NOTE: A flashlight and magnifier may help to see very fine *debris tails*.

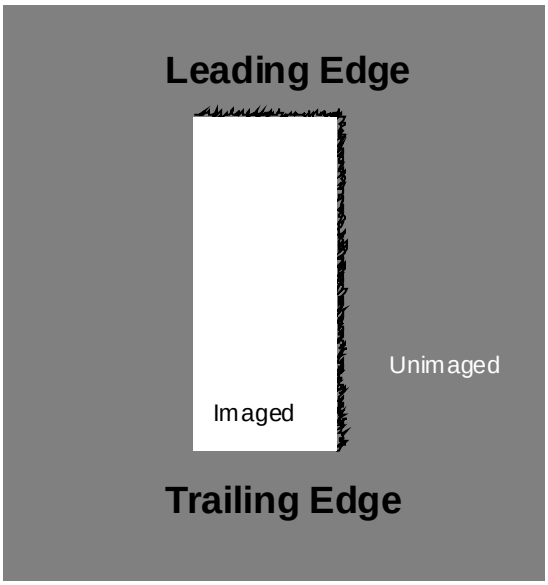


Figure 6 Desired debris tail location and direction

12. Set the horizontal position of the *airjet* to ~8mm, (9 turns clockwise of the 80TPI locating set-screw, from the rough position set earlier). Plot a series of solid images (plot 12) moving the *airjet* towards the *away* direction by 2 turns of the set-screw (counter-clockwise) per strip from 9 turns to -9 turns from the starting position (clockwise is positive). This range may be increased if necessary.
13. Inspect the *home* and *away* edges of the imaged strips. The best horizontal setting is the most *away* position setting where *debris tails* are not seen on the *home* edge of the plot. Set the horizontal position to this best setting.

14. Plot a series of solid strips (plot 12) starting at an *airjet* flow rate of ~10 SCFH as indicated on the 1-10 SCFH range rotameter flow meter. Reduce the flow rate by 1 SCFH per strip from 10 SCFH to 4 SCFH. Inspect the plots with a 60x microscope and light table. Select the least flow rate where quality has not been affected and set the throttle valve accordingly.
15. Confirm acceptable image quality and D_{min}<0.10 using an Orthochromatic transmission densitometer.
16. If possible, process a solid image (Plot 12) to confirm that 4 or 16 pixel banding is not reproduced on processed plates.

4. REFERENCE PLOTS

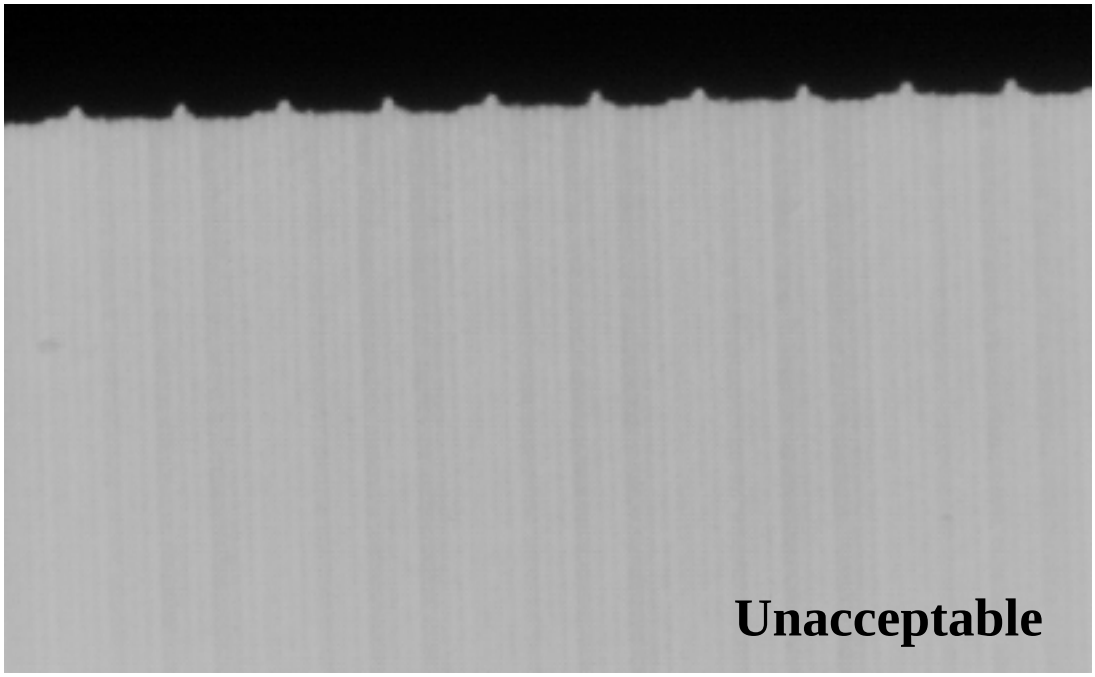


Figure 7 Solid plot with improper *airjet* adjustment. 40X magnification.

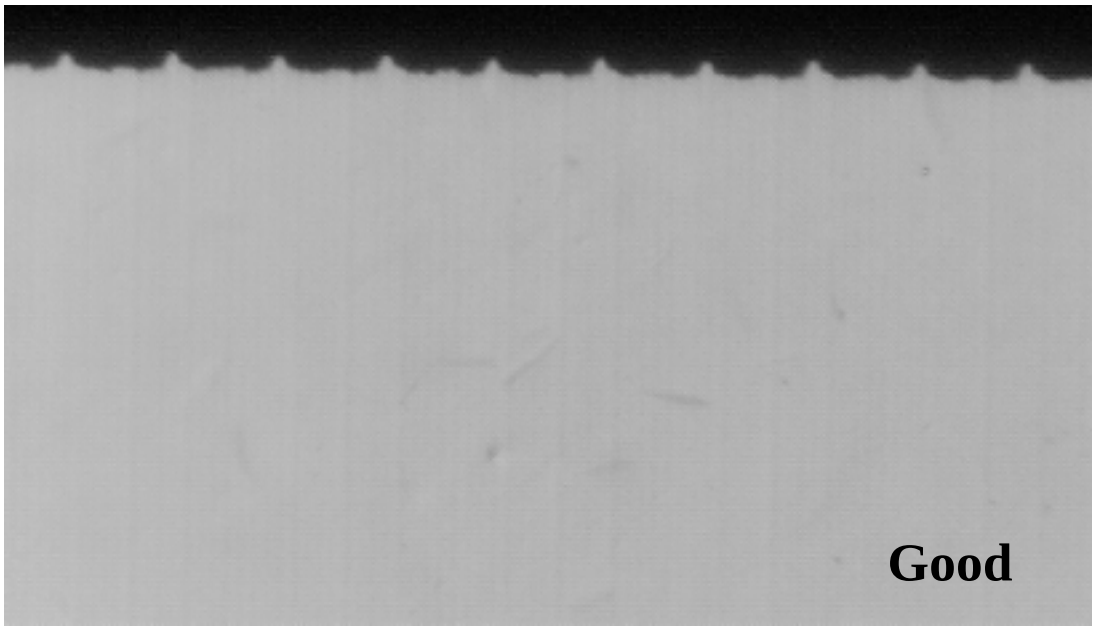


Figure 8 Solid plot with proper *airjet* adjustment. 40X magnification.

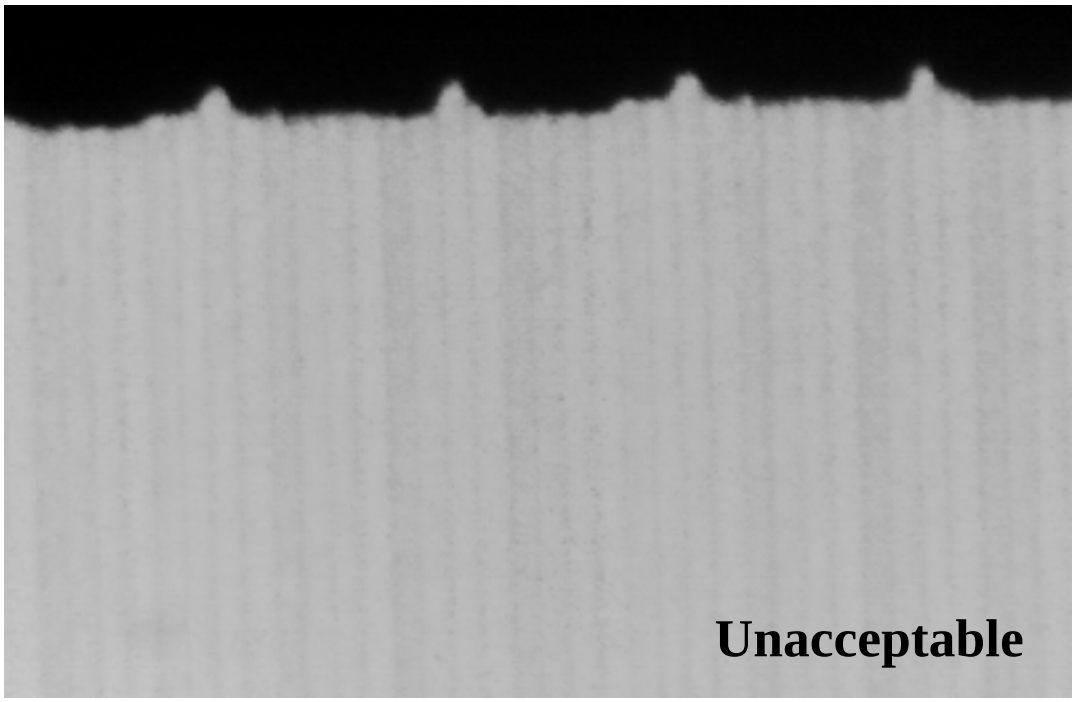


Figure 9 Solid plot with improper *airjet* adjustment. 100X magnification.

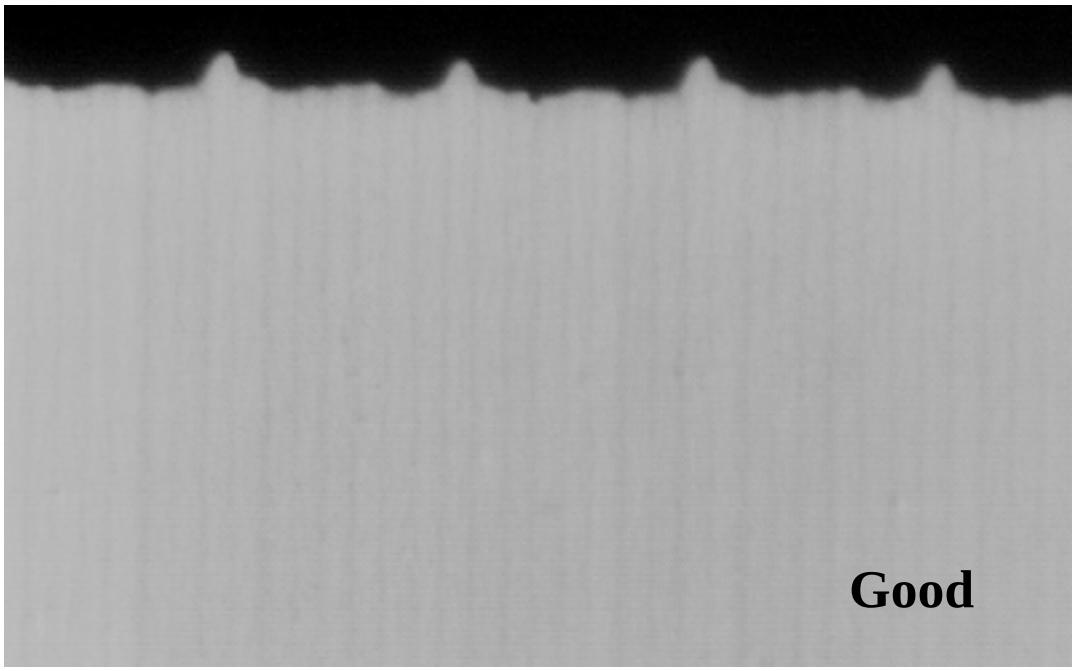


Figure 10 Solid plot with proper *airjet* adjustment. 100X magnification.

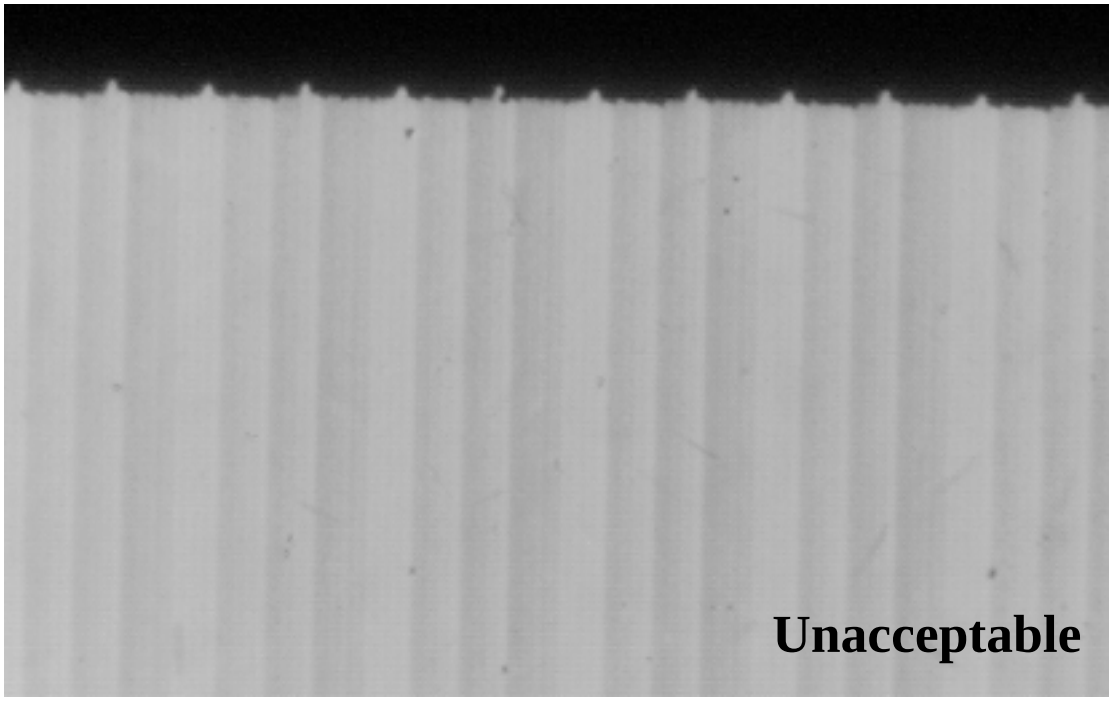


Figure 11 Solid plot with insufficient *airjet* flow rate. 40X magnification