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TEST AND EVALUATION REPORT

STATINTL

[redacted]

AUTOMATIC 4x5 INCH FILM PROCESSOR

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[redacted]

4 X 5-INCH FILM PROCESSOR

by

[redacted]

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FOREWORD

The purpose of this test and evaluation was to establish the parameters for acceptance of the 4 x 5-inch Film Chip Processor and to evaluate the design and operation by use of continuous belt operation from a specially designed magazine capable of holding thirty-five chip holders. The magazine is designed to receive holders and exposed film from a prototype printer. After the magazine is loaded on the processor, the exposed chips are fed into the processor at rates up to ten chips per minute. The magazine was originally designed to hold thirty-six chip holders, but, because the holders were redesigned, it will now accept no more than thirty-five.

CONTENTS

SECTION I

INTRODUCTION

This report is concerned with an objective evaluation of the [redacted] Automatic 4 x 5-inch Film Processor which was designed and manufactured by [redacted] a division of the [redacted] The evaluation considered such factors as design, workmanship, materials utilized in the fabrication of the processor, and, in general, engineering practices and principles. All systems were checked in accordance with the supplied manual.

SECTION II

GENERAL DESCRIPTION

A. DESIGN

A preliminary examination of the processor, after uncrating, revealed that both ends of the lower outer surface of the machine were slightly damaged; the tank interiors contained dried chemicals, miscellaneous parts, and film chips; and the filters and their containers in both the circulation and injector systems were contaminated because the liquid had not been drained. In an attempt to align the injector mechanism in a lateral position, IBM cards had been used as shims, along with a PVC rod. Later tests revealed that neither of these were required if correct water pressure was used. All water, power, and air connections were checked and found to meet specifications.

B. WORKMANSHIP AND MATERIALS

Stainless steel, PVC, Delrin, and other plastic work is acceptable and, in general, all of the fabrications are considered to be good. The wiring is clearly coded, and the workmanship is excellent. Installation of the processor was accomplished with no difficulties.

SECTION III

TEST PROCEDURES AND RESULTS

A. MECHANICAL TESTING

All testing of the machine was accomplished using only parts and film supplied by the contracting agency. Type SO-250 [redacted] film, coated on a 7-mil base STATINTL especially for the machine, was used. This film is similar to type 8430, which is coated on a 5.6-mil base. The heavier SO-250 film base was used because the other is too thin to stay in the holders, due to developing turbulation within the processor plenums.

Complete testing of the water supply, both for washing with tempered water and the use of cold water (55° F) for the injector and cooling systems, resulted in the following operations:

1. Tempered water in the wash section was found to be acceptable. It is recommended, however, that a support, or heavy duty diverting handle, replace the present handle and rod between the hypo eliminator – first wash – and the final wash tanks.

2. The testing was done with a relief outlet in the line. Opening of the outlet, causing a pressure drop, definitely improves the injector operation, as high pressure causes "chattering" in the solenoid valve.

3. The original mechanical testing was done with all tanks filled with water to protect the heating system and pumps. Later temperature testing was accomplished with photographic chemistry.

Room ambient temperatures remained at 72-74° F, with 50% (±3%) relative humidity.

B. SENSITOMETRIC TESTING

Sensitometric testing was accomplished with DK-60A, diluted 1:1. Although limited in scope due to the lack of temperature control, the following results indicate the probable acceptance of the processor if the recommended modifications are adopted.

1. There was good replication, both inter-magazine and intra-magazine, over a three-day period.

2. The turbulation pattern was generally good.

3. Gamma control was linear, with transport control from 2 through 10 chips per minute.

NOTE

All sensitometric step wedges were exposed on the [redacted] IB sensitometer within two hours of processing. STATINTL

SECTION IV

CONCLUSIONS

[redacted] Automatic 4 x 5-inch Film Processor is not totally acceptable in its present design, but, with certain changes and/or modifications, it can be utilized in the processing of 4 x 5-inch film chips as originally intended. The following observations, along with suggested improvements, are the result of this evaluation:

1. Temperature Control

The temperature control system was found to be unacceptable. Although the information supplied by the manufacturer indicates that the temperature of the supply water (to the exchanger and ejector line) must be "at least 5 degrees below the chosen processing temperature", it was established that, even with 55° F water at 55 psi, the developer temperature could not be controlled at any temperature below 83° F. Even though the minimum controllable temperature was somewhat lower, the same problem exists with the short stop and fix tanks. The heat exchanger system is incapable of maintaining a lower temperature because of the heat created within the processor by the pumps and dryer, the inadequate removal of this heat to an outside area— away from the processor, and the small size of the heat exchanger units in the tanks. The air temperature within the space containing the circulation pumps climbed very rapidly, after start-up, and stabilized at approximately 140-145° F.

To remedy this, it is recommended that:

a. Reflective thermal insulation be installed between tanks, dryer, and pump sections.

b. The equipment be modified to provide external force-venting of the processor interior to an outside area.

c. The heat exchanger units in the tanks be enlarged, or another unit for a larger area of exchange be added.

2. Air Supply

The air supply pressure, filtration, and operation were found to be acceptable. Since there was no control for the air squeegee as an integral part of the machine controls, the external pressure was regulated to make this procedure adequate.

3. Transport System

The film chip transport system, by means of Mylar belts, is well-adapted to this particular requirement, although there is a minor deficiency in the guide pins for the belts. The pins are imbedded in holes in the guide rollers in the four quadrants. Changes in temperature, particularly in the dryer section, cause the PVC guide roller to expand more rapidly than the stainless steel metal pin. The result is that the pins loosen and become dislodged from the retaining holes. Our recommendations are:

a. Replace the present tension roller guide wheels with a spring-loaded guide set and use threaded pins.

b. Use a pin that is serrated or grooved and place into retaining hole with a suitable cement.

4. Chip Holders

Chip holders, though adequate, have deficiencies that should be corrected. The chip holder should be machined to a smoother surface finish for one thing. A coating of silicone sprayed onto contact surfaces greatly reduced frictional forces within the magazine. The resultant ease of magazine loading and ejection into the processor was quite evident. The transport pick-off carrier hooks performed their function acceptably, after removal of roughness from the groove hole. What may well be considered the major problem with the holders involves the film retaining grooves on both sides of the holder. The edge of the film within these grooves is not adequately dried. Therefore, it is recommended that the holder be modified or air jets installed in the drying section to direct higher velocity air at these points of water retention. Tests of the holders in the processor indicate that it is necessary for the film to be secure under the three film-end retaining pins. Also recommended in the modification of the chip holders is that the depth of the grooves be increased by approximately 1 mm to eliminate the excessive "bow" in the film. It was found that the bow caused the film surface to extend beyond the plane of the holder surface, causing film damage and displacement within the film magazine and during the ejection cycle. To adequately dry the film chips, it was necessary to use 130° F - 140° F dryer temperatures. With the modification of the holders, 110° F - 120° F should be adequate at 10 chips per minute.

5. Replenishment System

The replenishment system is not only inaccurate but has no correlation with the amount of film being processed. Fed into the tanks by tubing, the processing chemistry replenisher enters within a few inches of the overflow drain. It is recommended that the position of the replenishment flow be relocated to a more acceptable position or fed into the turbulation pump tubing.

In its present design, the replenishment flow is constant while processing at 2 through 10 chips per minute, or with no film. After the rate is established for chips per minute, a solenoid liquid switch should be installed and timed with each chip ejected by the timing cam.

Also, support of the existing replenishment tubing at the gauges, as well as recalibration of the present gauges, or replacement of the "percentage" type gauge by one reading in cc/min., is recommended. The present controls are completely inaccurate. For example, the flow meters read in percentages based on a full flow rate of 580 cc/min.; at a 50% flow rate, the developer was replenished at a rate of 726 cc/min., indicating measurement inaccuracy.

6. Injector-Ejector System

The injector-ejector system was critical in regards to water pressure because correlation between the injector stroke and the return stroke is dependent upon water pressure. Injector operation was examined at water pressures ranging from 40-50 psi to 180 psi, in 5-psi increments. At 100 psi, the return was quite erratic. Optimum pressure range is 55-65 psi. All subsequent tests were run at 55 psi; this was found to be the minimum pressure adequate for an even and smooth injector piston stroke in both directions.

Ejection of the holders into the chute and transport take-off slot was checked, and, after retiming the microswitch cam that actuates the ejector, the ejection system worked satisfactorily. The retiming, accomplished by drilling and tapping a new screw-hole in the cam, resulted in earlier actuation of the ejector so that the holder is seated in its slot before the take-off arm comes into position to remove the holder.

Thus, the recommendations for this system are:

a. Install a pressure gauge, preferably on the control console. The gauge should be in line between the water filter and ejector solenoid, and the dial face should indicate control limits.

b. Replace the present enclosed filter with a transparent type (i.e., Cuno or Full–Flo). This is optional if the previous recommendation is adopted, because the gauge will show a pressure drop if the filter becomes contaminated.

7. Electrical System

The electrical system and schematics are acceptable and no modifications are needed.

8. Stacking Operation

The "take-out" stacking operation is satisfactory, except that the warning buzzer is actuated at thirty-six holders and the magazine only accepts thirty-five. Relocation of the microswitch trip can easily correct this deficiency.

9. Turbulation Plenums

Turbulation plenums have no access to facilitate cleaning. Small access holes and redesigning the turbulation pattern, or extension baffle, at "turn arounds" are recommended. The present pattern causes the chip holders to move in a pendulum-type motion which sometimes dislodges the film from the holder. The chip holders can also become wedged against a rough edge of the plenum.

An integral part of the turbulation system is a series of five 1/4-inch holes located at the bottom of the chip holder "take-out" in the developer section. The high pressure used to aid the "take-out" of the chip holder by the transport system causes higher densities along the longitudinal axis of the film. Numerous tests have shown that the central three holes of these five are not required.

10. Processing Tanks

Drain cocks on the bottom rear of the tanks are approximately one inch above the actual tank bottom and prevent full drainage. Thus, sediment is allowed to settle in the tanks, resulting in contamination. It is recommended that larger bottom drain cocks be used, with access from the front (tank end) of the machine.

Occasional loss of film chips, or any foreign particle falling into the tank creates the necessity, in most cases, of dismantling that section (i.e., removal of the transport system, tanks, replenishment and circulation systems). It is recommended that access panels be cut in the tank not only for removal of foreign objects, but also for easier threading of the transport belt in the event of a break. The panel would also allow necessary cleaning of tank sections which are not accessible at the present time.