Evaluation of Inking Roller Temperature Transients
Afton, Inc.

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Executive Summary

A press trial was conducted at PIA/GATF to evaluate the performance of different compounds used to produce inking rollers for a web offset lithographic printing press. The primary objective was to evaluate temperature transients of the different compounds over a specified period of time. Any distortion of the concentric nature of the rollers was also evaluated. To achieve these objectives, the press trial was segmented into two parts. The first section involved applying a lubricant to the roller train and running at a speed of 50,000 imps/hr, without printing. The second section of the trial involved running the press at the same speed while printing. The MAN Roland Rotoman heatset web press at PIA/GATF was utilized in the execution of these objectives.

Results

The press trials were successfully conducted to observe temperature transients of various inking roller compounds. The major findings can be summarized as follows:

- The compounds provided by Afton, Inc. generated significantly less heat during section 1 than the rubber house rollers used as the control. This finding is applicable to all roller sizes evaluated; typical temperature transients for the 140mm ink transfer roller are shown in Figure 1.
    - On average the control rollers finished section 1 15˚F warmer.

- The data indicates the temperature variations between the three compounds provided by Afton, Inc were small with respect to the 150mm and 140mm rollers. The largest variations in temperature were measured on the 87mm form roller, with approximately a 5˚F between compounds in section 1 and 15˚F between compounds in section 2.
    - The rate of temperature increase between the different compounds varied, with the compound in unit 4 (EXP2) appearing to have the fastest temperature increase rate.

- The data indicates that the durometer of the control rollers was slightly more stable during the trial than the rollers provided by Afton, Inc. However, the difference in durometer readings of the cold rollers before and after the trial was found to be nominal.

- Any distortion of the rollers was considered to be nominal and insignificant.

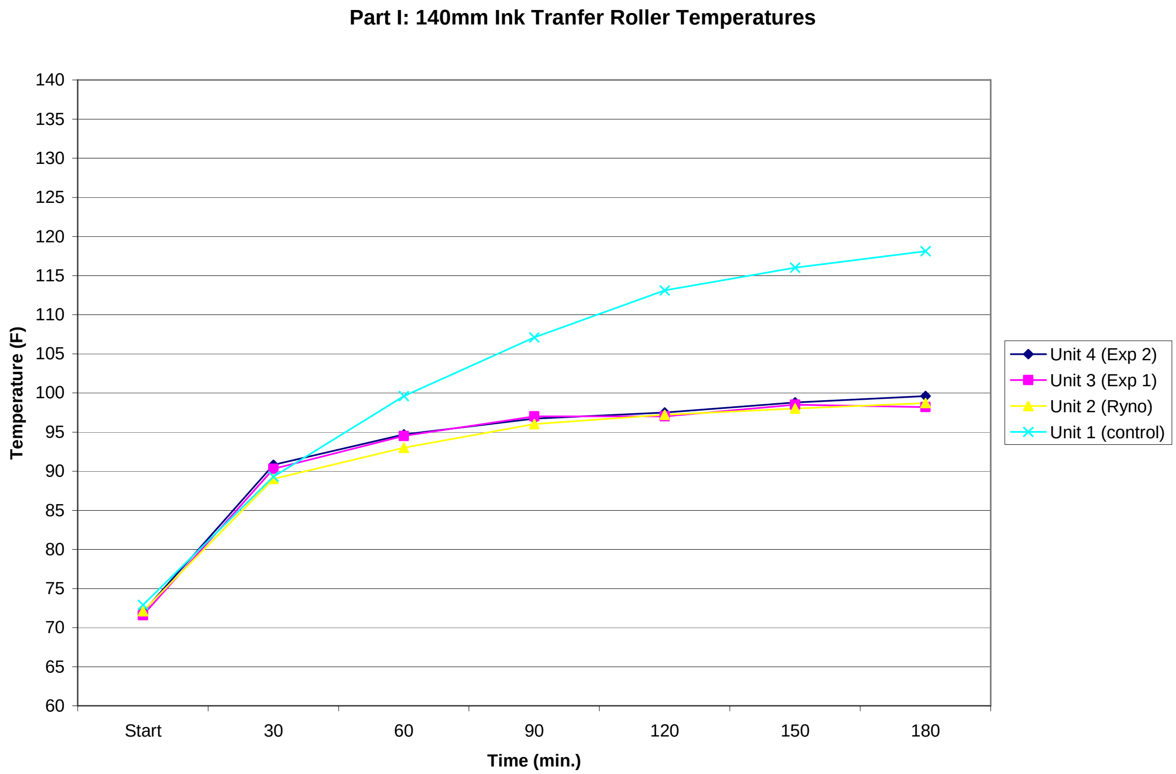


Figure 1: Temperature transients during section 1 of the press trial

Conclusions

The trial performed at PIA/GATF indicates that all of the compounds tested are capable of being used on a web offset printing press. The rollers were tested at much higher temperatures than would be typical operating temperatures of a web press ink train. Under these extreme conditions there was no abnormal swelling or distortion of the rollers. Theoretically, a cooler inking system is advantageous for lithographic printing. For every 1˚C the ink changes in temperature, there is approximately a 10% reduction in viscosity. When considering the image is comprised of many small dots, viscosity becomes a very important property in lithographic printing. The process is dependent on a rapid rise in viscosity of a printed ink film to maintain a sharp dot. The less viscous the ink film is, the higher the propensity for excessive dot gain. Although there was no exploration into longevity/durability of the rollers, our testing indicates that all of the compounds used in this trial are suitable for a web offset printing press, with respect to temperature.

Objective

The primary objective of the press trial was to evaluate temperature transients of various compounds used in the production of inking rollers on a lithographic web press. There were also secondary objectives that included observation of change in durometer and concentricity of the rollers. To achieve these objectives the MAN Roland Rotoman web press at PIA/GATF was utilized.

Experimental Procedure

Prior to the start of the trial, the rollers were assembled and installed by PIA/GATF press operators. The three rollers that were evaluated are highlighted in Figure 1.

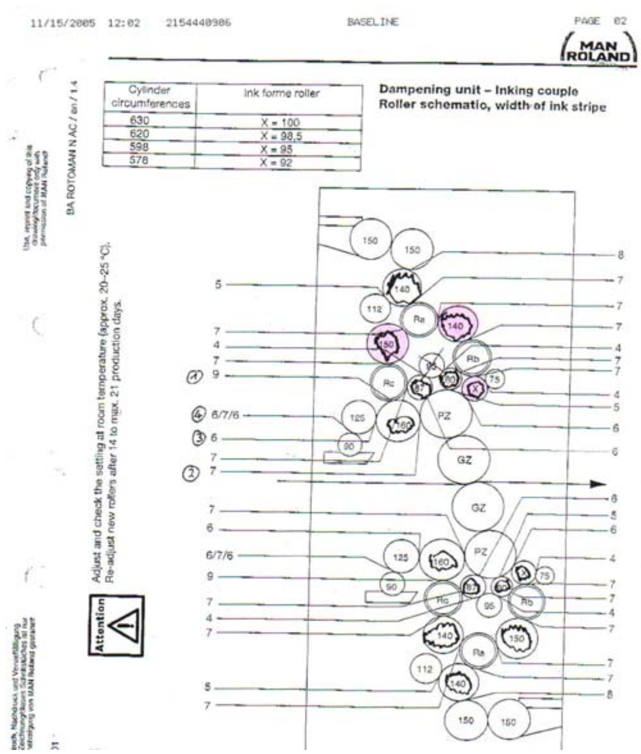


Figure 1: Schematic roller train for PIA/GATF MAN Roland Rotoman web press

These rollers were; 87mm ink form rollers, 140mm ink transfer rollers, and 150mm ink transfer rollers. These were specifically selected due to accessibility for temperature measurement. A different compound was evaluated in each of the four printing units. The location of the compounds that were evaluated are shown in Table 1.

Printing Unit	Rubber Compound Reference
1	Control (house rollers)
2	Ryno
3	Exp 1
4	Exp 2

Table 1: Roller compounds evaluated

Prior to the installation of the trial rollers, the diameter and durometer were measured. Durometer was measured using a Type A durometer according to ASTM Method D 2240.

During the pre-trial measurements it was found that the ink form rollers for the evaluation were 87mm, rather than the specified 92mm. As a result, the protocol was adjusted to obtain the most data from the smaller roller. This particular ink form roller normally has 3 roller nips that include the plate, a vibrator roller, and a 75mm rider roller. Due to the roller being smaller than the specification it was only able to contact two of the nips. Upon consultation with Afton Inc. it was decided that this roller would be set to the vibrator and rider roller, but not contact the plate. All the rollers that were evaluated were striped prior to the trial 1mm heavier than the press manufacturers' specification. This was done to provide greater compression, thus facilitating the generation of heat. The rollers were also striped at the conclusion of the trial to determine if there was any swelling of the compound. The press was configured to provide a clear optical path for measurement of the 150mm transfer rollers. This enabled measurements of the 150mm roller during the trial. For safety purposes the press is equipped with guards covering the 140mm and 87 mm rollers. It was not possible to obtain a clear optical path, therefore the press was periodically stopped to measure these rollers.

With the exception of the rollers being evaluated, all of the consumable were provided by PIA/GATF. A summary of the consumables used in the trial is shown in Table 3.

Ink	Sun Ultraprint
Fountain Solution	Prisco 225E (5oz./gal conc.)
Paper	MeadWestvaco 60# Focus Gloss Text Web Plus
Plates	Kodak Sword (150 lpi PIA/GATF Standard 21x34 Test Form)
Blankets	Kinyo S7620V
Roller Lubricant	Lub-a-Roll

Table 3: Press Consumables

The image used for the trial is shown in Figure 2. A new set of plates were used for each section of the trial.

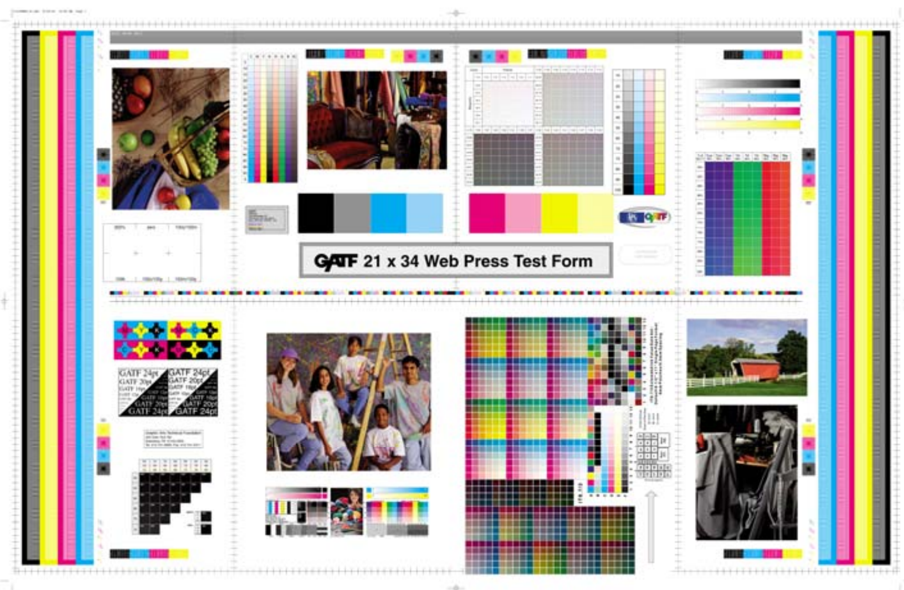


Figure 2: Test form used for trial

The trial was divided into two sections. The first section involved applying a lubricant to the roller train and running at a speed of 50,000 imps/hr, without printing. The second section of the trial involved running the press at the same speed while printing.

In a normal production environment the ink going through the roller train also serves as a lubricant and aids the rollers in the dissipating the heat generated by roller compression, shear and friction. Pre-trial research indicated 0.100 lbs was an adequate amount of lubricant to be applied to each upper printing couple. This amount was pre-weighed and applied to each upper couple. A printing couple is defined as one half of a printing unit of a web press. To limit the amount of rollers that needed to be provided, the investigation focuses exclusively on the upper printing couples. The lower printing couples were de-clutched, the dampening system disengaged, and the units placed under impression. With the exception of the lower plate and blanket, this isolated the upper inking systems. After the lubricant was applied to the upper couples the starting temperature readings were taken using a non-contact pyrometer. To ensure accurate, consistent measurements, the units were marked where the measurements were to be taken. Additionally, all of the temperature measurements were taken by the same PIA/GATF staff member. The units were always measured in the same sequence; 4, 3, 2, 1, 4. The first measurement is repeated to observe any change in temperature that may occur after the press is stopped.

The press was started at a speed of 50,000 impressions per hour. The press is equipped with a roller temperature control system called PINPOINT. This system allows the press operator to control the temperature of the roller train via an IR air sensor or internal water temperature. For this trial, the

PINPOINT system was utilized using the internal water control. The temperature was set at 80˚F for the duration of the trial.

Temperature measurements of the 150mm rollers were taken at the start, 5, 10, 15, 30, 45, 60, 90, 120, 150 minutes, and end of this three hour section of the trial. These measurements were taken while the press was running. The press was stopped at 30, 60, 90, 120, 150 minutes to facilitate optical access of the 140mm and 87mm rollers. During the stops for temperature measurements the durometer of the rollers was also measured by an Afton Inc. representative. The durometer measurements were taken using Type A durometer, but not in accordance with ASTM Method D 2240. Due to the position of the rollers in the press it was impossible to use a dead weight, therefore rendering the measurements subjective.

On completion of the first section of the trial, the roller train was automatically washed twice. The blankets were also automatically washed twice. The blankets were then manually cleaned and wiped dry. A new set of plates were mounted in preparation of the second section of the trial which involved printing. Due to time constraints, we were unable to allow the press to re-acclimate to room temperature prior to starting the second section of the trial. Prior research indicates to do so could take in excess of 6 hours.

The second section of the trial involved printing substrate at a press speed of 50,000 imps/hr for a period of one hour. The 150mm rollers were measured at the start, 5, 10, 15, 30, 45, 60 minute (end) increments. The press was stopped half way through the run to measure the temperature of the 140mm and 87mm rollers. Unlike the first section of the trial, durometer measurements were not taken when the press was stopped. To do so would involve severing the web causing additional down time that would allow heat to dissipate from the rollers. Upon completion of the trial the rollers being evaluated were re-stripped and compared to original stripe specifications. The objective for this is that if any swelling of the compound occurred during the run it should be reflected in the change of stripe width. The rollers were then removed from the press and examined for concentricity.

Results and Discussion

The press trial was successfully completed to evaluate temperature transients of different roller compounds used to manufacture web offset inking rollers. The objective of the manufacturer was to determine if the compounds used to produce these rollers are feasible to use in a full-size web offset press. The results of this press trial indicate that all of the rollers evaluated are capable of running on a web offset press with respect to temperature.

The roller temperature transient results from the first section of the trial can be found in Appendix 1. All of the experimental compounds performed similarly for this section of the trial, typical results from the 140mm roller are shown in Figure 3.

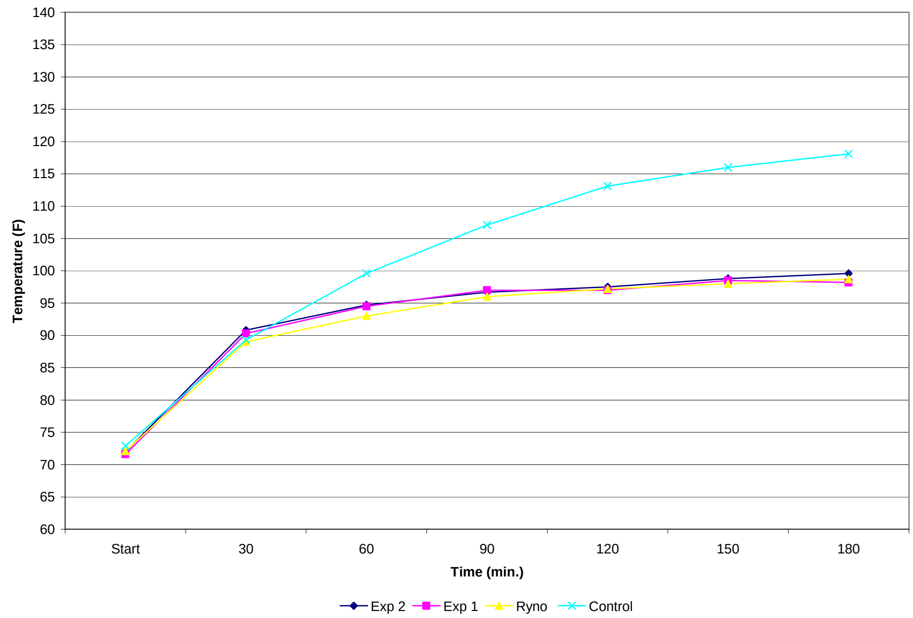


Figure 3: Example of typical roller transients from the 140mm roller

There is a clear distinction between the rollers submitted by Afton Inc. and the control rollers. The temperatures of all roller compounds are similar for the first thirty minutes of the evaluation. After thirty minutes, the control rollers continue to heat up at a rate disproportional to all of the experimental rollers. The temperature variation between experimental compounds was found to be minimal. All of the experimental rollers appear to have stabilized approximately 60 minutes into the trial, with an increase of only five degrees fahrenheit between 60 and 180 minutes. The control rollers increase an average of fifteen degrees between 60 and 180 minutes. The temperatures of the blankets were also monitored throughout the duration of the trial. Previous press trials have demonstrated that typically unit 4 blankets run the warmest followed by unit 3, unit 2, and unit 1 running the coolest of the units. This is due to the downstream build-up on the blankets and the close proximity to the dryer. During this section of the trial the data indicates the inverse of this trend with unit 1 blankets finishing ≈10˚F warmer than the other units. When printing lithographically it is desirable to minimize the temperature of the inking train. Temperature and viscosity are directly related in that as the temperature of the ink increases the viscosity is reduced. Lithography requires a rapid rise in ink viscosity once the film is printed. This is required to maintain a sharp dot structure and subsequently high quality printing.

An illustration of the durometer measurements can be seen in Figure 4.The data indicates that the rollers on unit 2 were the least stable with respect to durometer with little difference between those on the other units, those on unit 3 being the most consistent. The rollers exhibited an average change in durometer between three and five points.

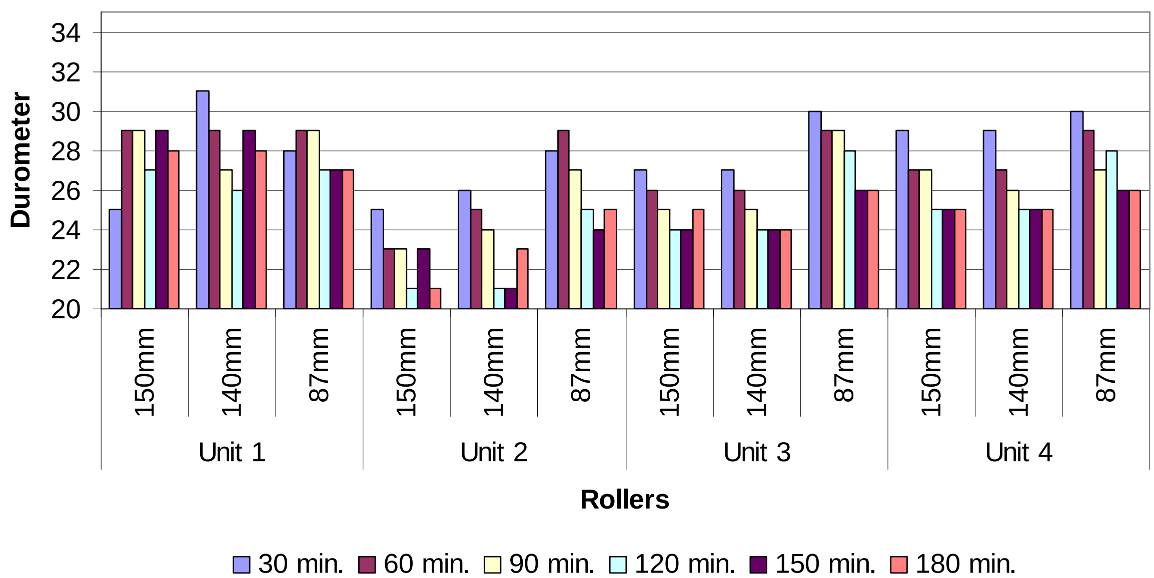


Figure 4: Section 1 Durometer Measurements

The durometer readings prior to, and following the trial can be found in Table 2. The experimental rollers appear to have re-acclimated following the trial. The changes that the experimental rollers experienced during the trial would likely have no impact on the lithographic process.

	150mm		**140mm**		**87mm**	
	Start	End	Start	End	Start	End
Unit 2	22	21	24	23	30	25
Unit 3	25	26	26	24	27.5	26.5
Unit 4	27	27	26.5	26.5	26	28

Table 2: Start/End Durometer readings

The second section of this trial involved printing, at a typical commercial production speed of 50,000 imps/hr. The second section of the trial immediately followed the first. This resulted in starting roller and blanket temperatures that were warmer than the start of the trial. At the start of section 2, the blanket on unit 1 was warmer than the other units, however by the end of this section all of the blanket temperature stabilized around 95˚F. An illustration of the blanket temperatures can be found in Appendix 2 Figure 2. This implies there was no abnormal effect on the blanket temperatures as a result of the roller compounds. This is important considering the blanket is the last surface the ink contacts before being transferred to the substrate.

The roller temperature measurements for this section of the trial can be found in Appendix 3. The temperature transients of the rollers and blankets for this section of the trial were distinctively different than the first section. The experimental compounds exhibited a temperature increase of ≈10˚F during the trial. Conversely, the control rollers exhibited a temperature decrease of ≈10-12˚F. The data indicated that the rollers in all four units appear to stabilize around 100˚F at the duration of the trial. An example of how the rollers responded during the second section of the trial is shown in Figure 5 for the 140 mm roller. The three experimental rollers all performed to a similar manner.

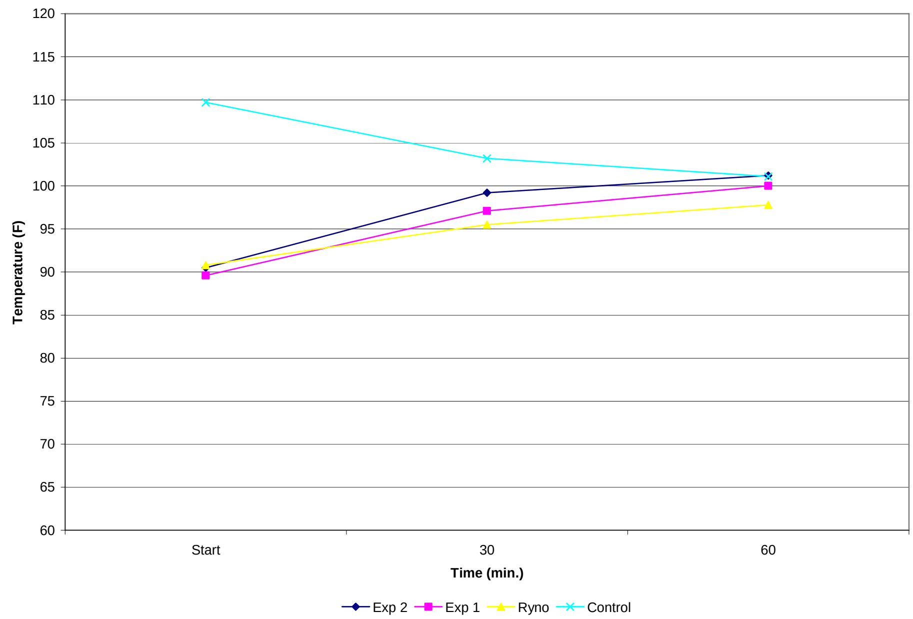


Figure 5: Example of roller behavior during section 2 of the trial for the 140 mm roller

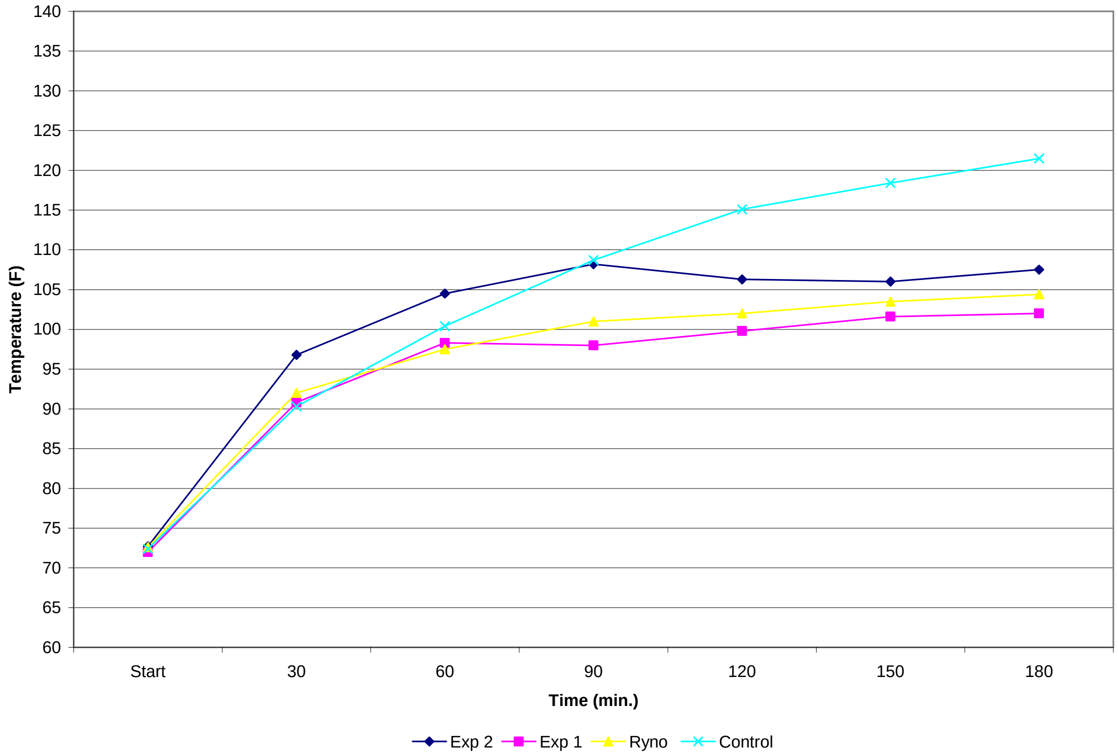
The rollers were measured for concentricity following the trial and none of them were found to be out of round. These results indicate that the behavior of the experimental compounds is comparable to the control rollers with respect to temperature. At a typical production speed, using commercially available consumables, the operating temperatures of the experimental compounds was similar to that of the rubber control rollers.

Both sections of this investigation indicate that the roller compounds evaluated are suitable for use in a lithographic web press with respect to temperature. There was no testing performed to evaluate durability. This would be recommended prior to producing these rollers for commercial use in a web offset press.

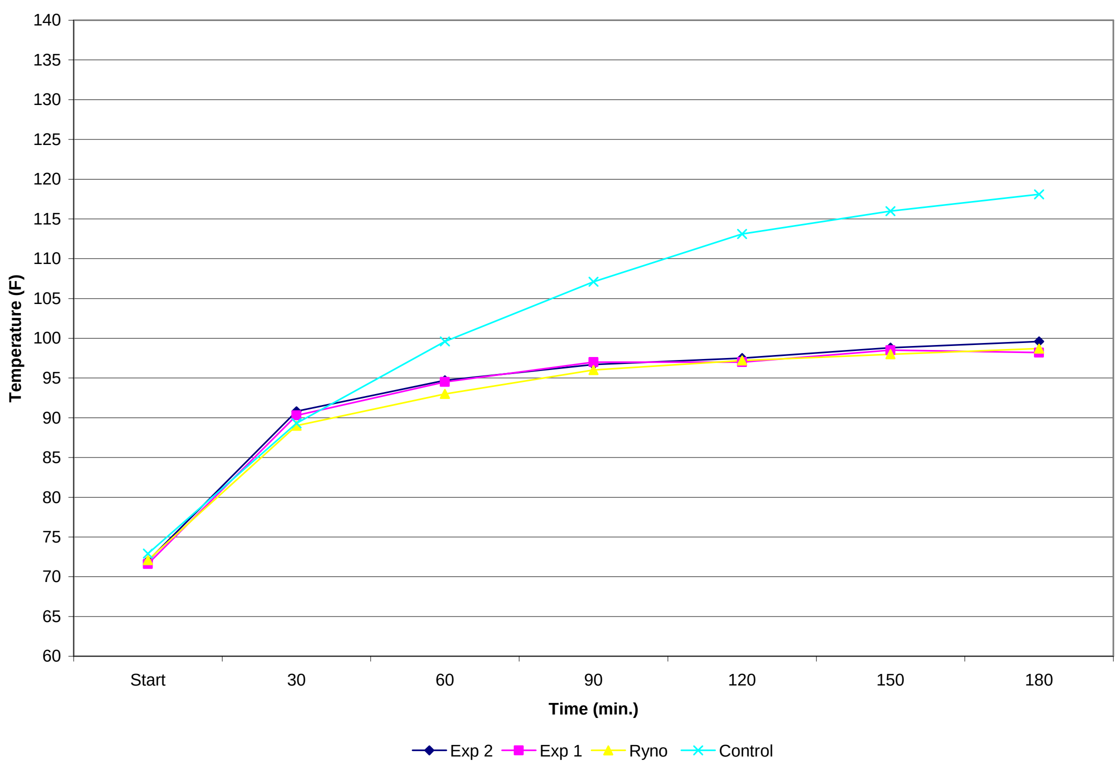
Conclusions

The trial performed at PIA/GATF indicates that all of the compounds tested are capable of being used on a web offset printing press. The rollers were tested at much higher temperatures than would be typical operating temperatures of a web press ink train. Under these extreme conditions there was no abnormal swelling or distortion of the rollers. Theoretically, a cooler inking system is advantageous for lithographic printing. For every 1˚C the ink changes in temperature, there is approximately a 10% reduction in viscosity. When considering the image is comprised of many small dots, viscosity becomes a very important property in lithographic printing. The process is dependent on a rapid rise in viscosity of a printed ink film to maintain a sharp dot. The less viscous the ink film is, the higher the propensity for excessive dot gain. Although there was no exploration into longevity/durability of the rollers, our testing indicates that all of the compounds used in this trial are suitable for a web offset printing press, with respect to temperature.

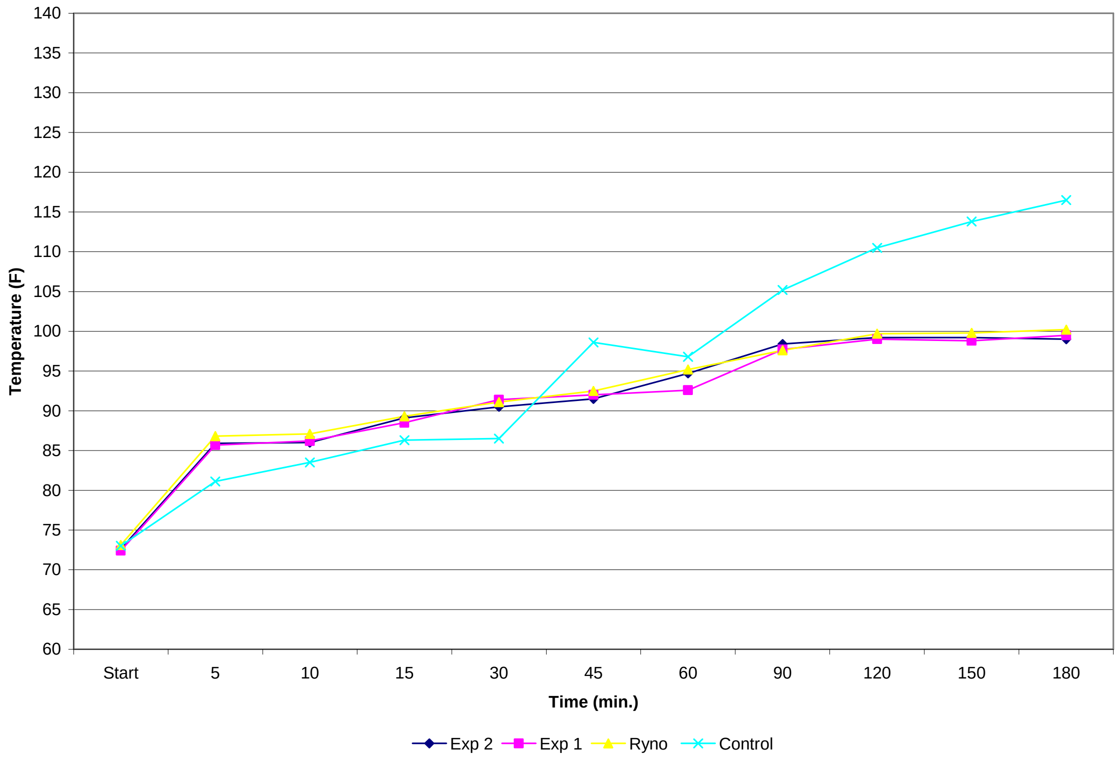
Appendix 1



Appendix 1 Figure 1: Part 1 87mm Ink Form Roller Temperatures

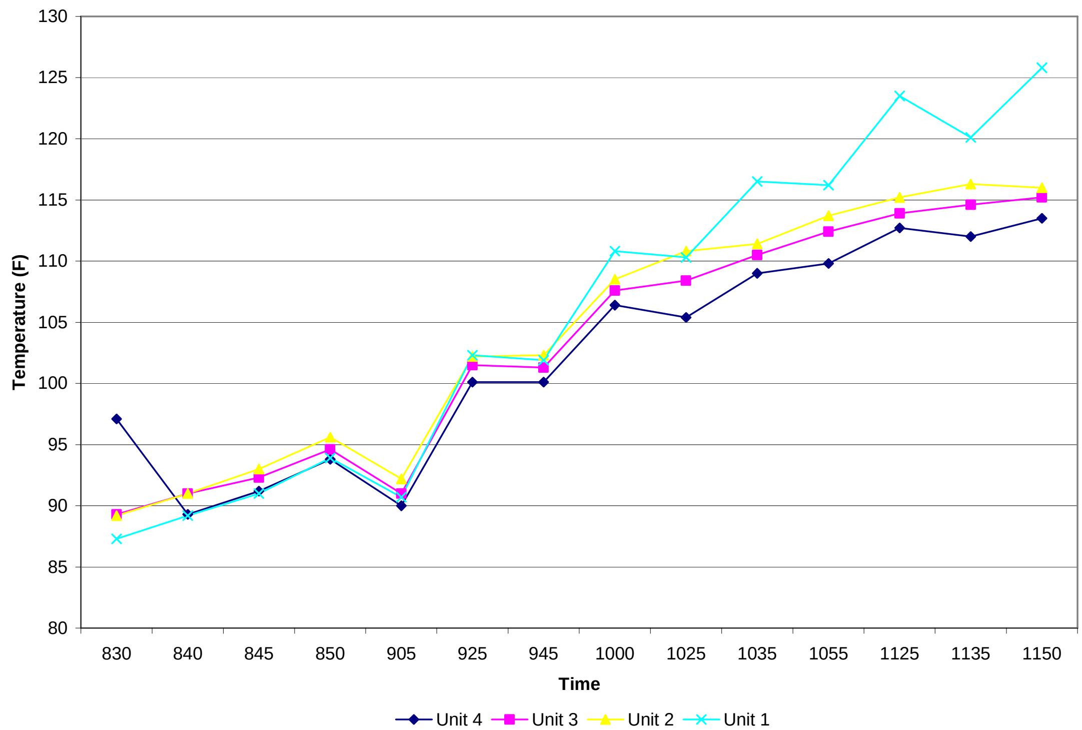


Appendix 1 Figure 2: Part 1 140mm Transfer Roller Temperatures

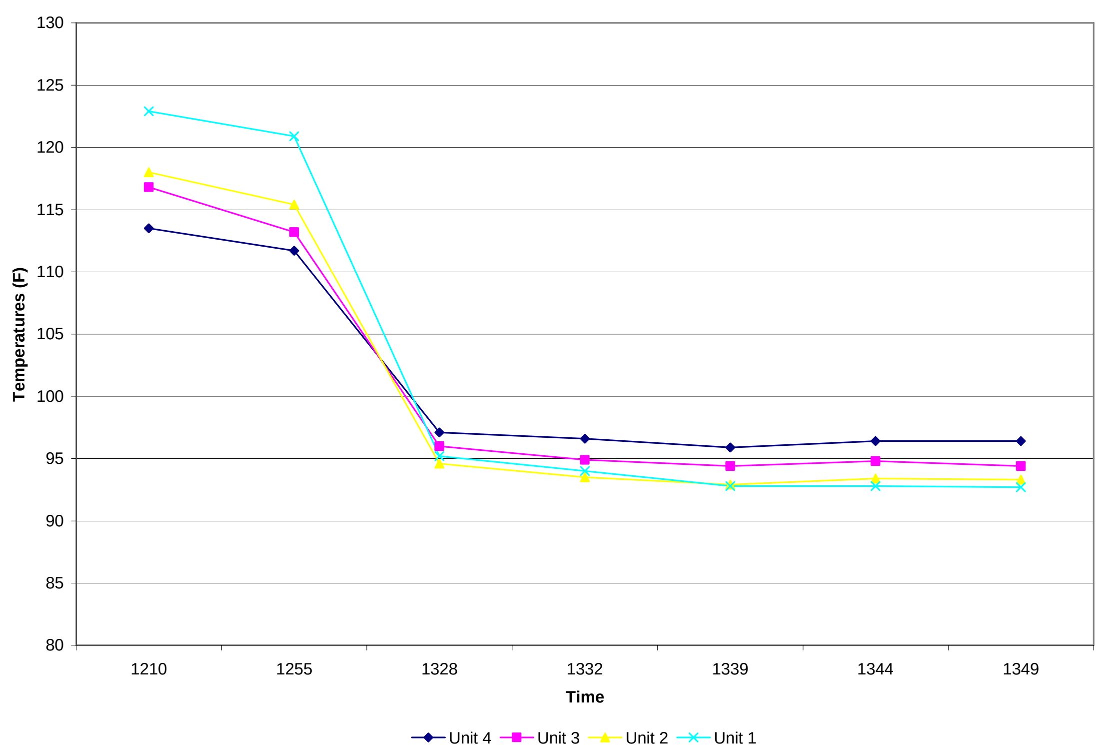


Appendix 1 Figure 3: Part 1 150mm Transfer Roller Temperatures

Appendix 2

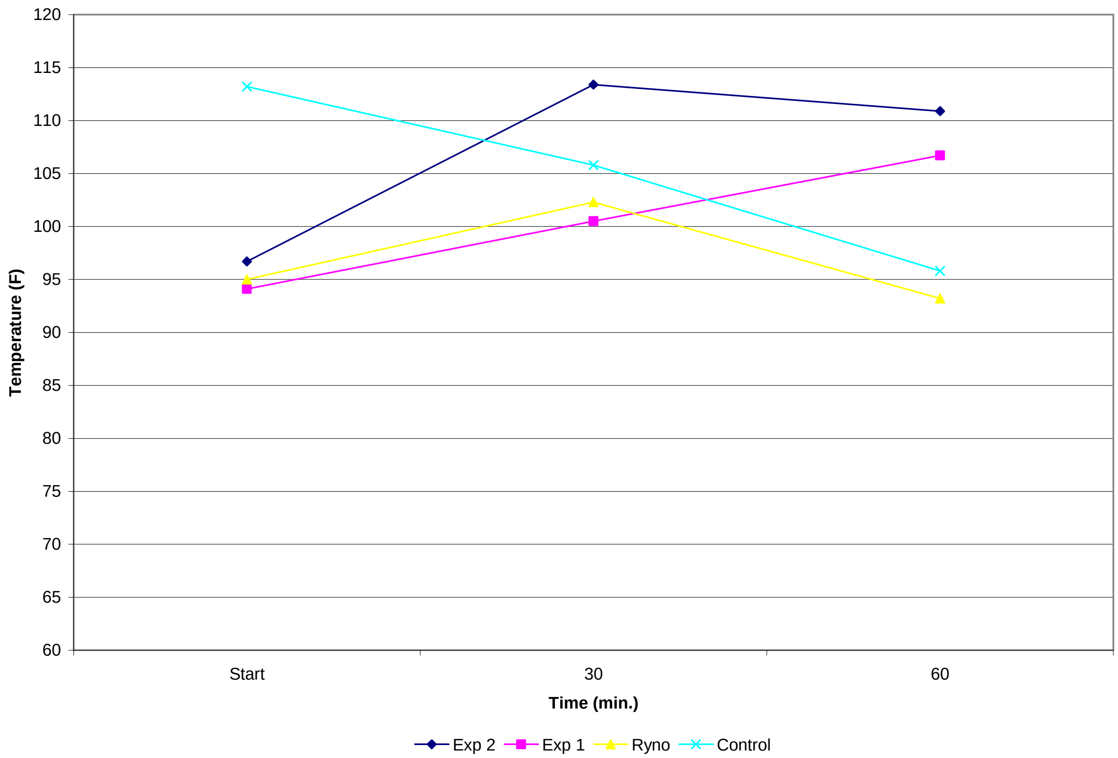


Appendix 2 Figure 1: Part 1 Blanket Temperatures

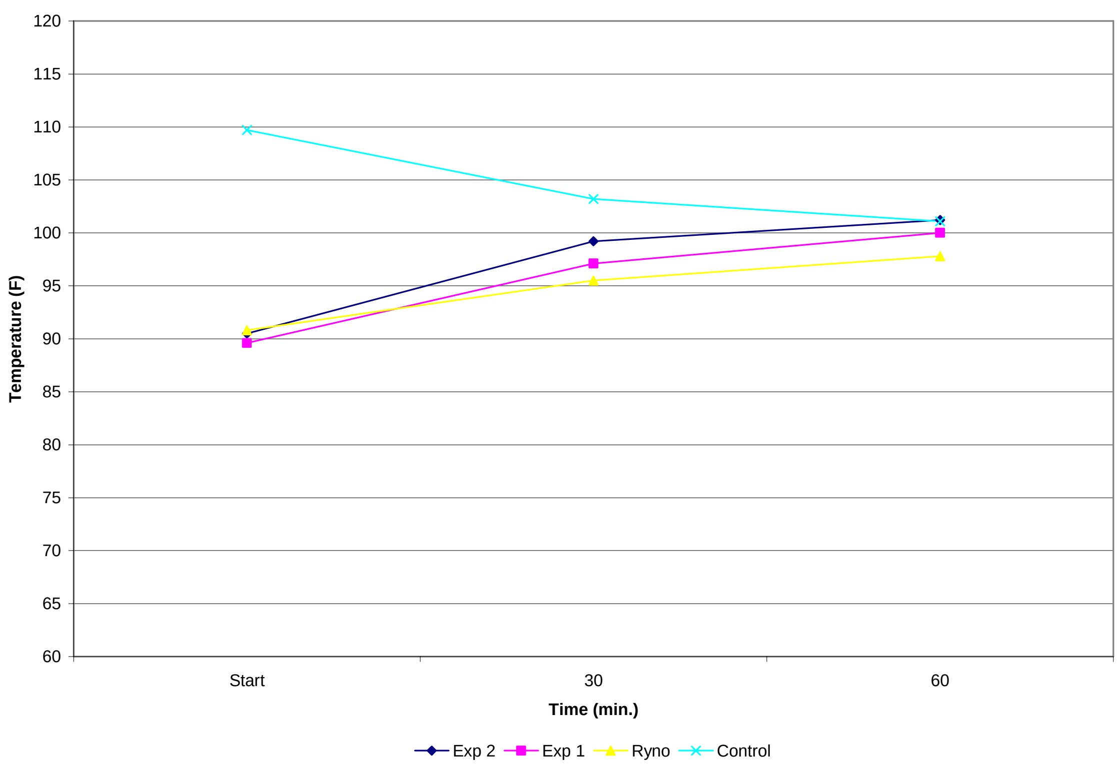


Appendix 2 Figure 2: Part 2 Blanket Temperatures

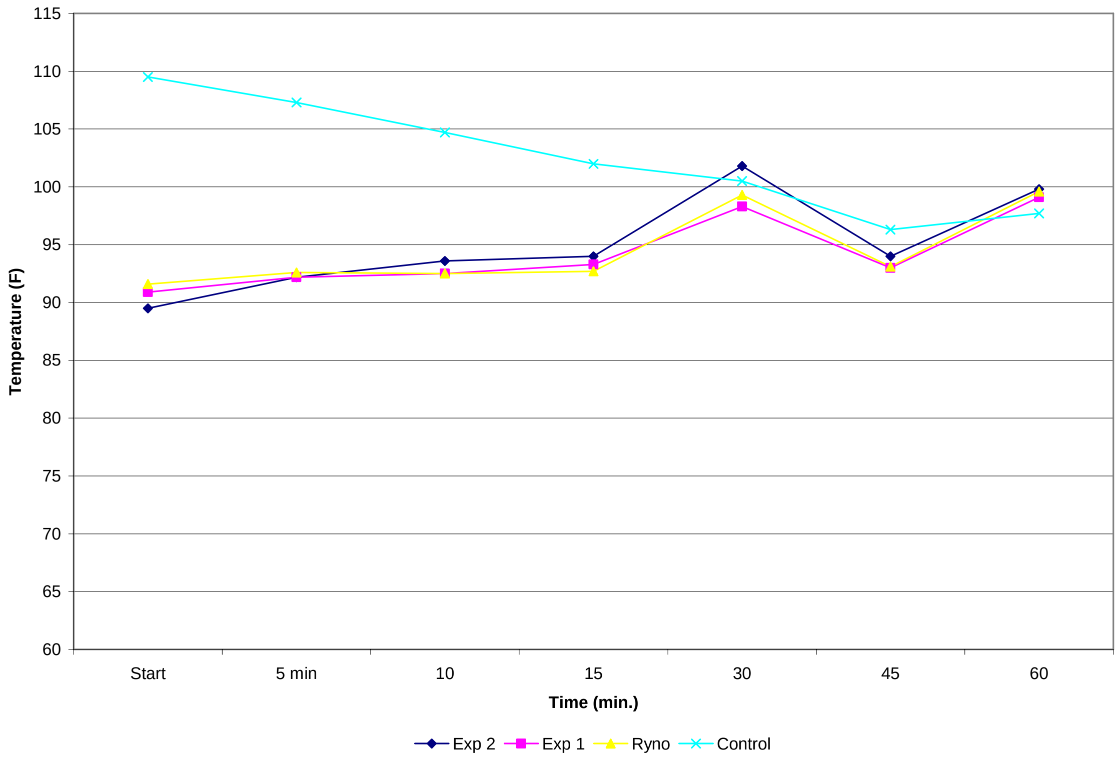
Appendix 3



Appendix 3 Figure 1: Part 2 87mm Ink Form Roller Temperatures



Appendix 3 Figure 2: Part 2 140mm Transfer Roller Temperatures



Appendix 3 Figure 3: Part 2 150mm Transfer Roller Temperatures