THERMAL CONTROL OF IMPRESSION IN OFFSET PRESSES

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Results of thermal impression control on Offset presses are now confirmed on production on two dissimilar designs of printing unit. One press is a Baker Perkins G16 14 years old, the other a six year old M1000B. We will cover the improvements and reduction in negative features seen in Web Offset production as a result of dynamic loading.

In controlling impressions at any bearer nip point, we found many adverse factors disappeared or were greatly reduced.

The conclusions listed then are not just one run results, but are characteristic of sixteen months production on the G16 and four months production on the M1000B. Many printers have witnessed the following results and have been agreeably surprised by the print quality, Make Ready and Restart waste reductions. Here are our findings.

1.) DOT GAIN The printer tells us that both his scrutiny with an Xrite densitometer and a completely separate investigation by Sun Chemical that the conclusions drawn were the same by both parties. These conclusions were as follows......

Press gain on the fourteen year old G16 before the addition of the Thermotrac System was in the order of 26 to 28% or slightly above S.W.O.P. standards. With the Thermotrac, we have seen dot gains of 12, 15 and 16 as the normal condition. The ink densities were all compared with the standards when evaluating these gains. The press crews on all shifts recorded the usage of less water. It is true to say that even single digit dot gain percentages have been seen. The printer frankly has difficulty in believing what he is seeing, but the results are accepted. We have also seen much closer dot gain variation, or stability nearer the accepted standard of 5% tolerance all across the web. The M1000B also produced more even print quality all across the web and again reduction in dampening solution was seen. The reduction in print variation between the "A" and "B" sections of the blanket was also reduced.

2.) REGISTER CONTROL The press crews are extremely pleased with the fact that many hours of changing print quality during Monday morning startups due to impression variances while the press warms up are now reduced to minutes. Much quicker register control and inking up are also seen during restarts. It is important to note that the plate cylinder bearers and the plate itself run much cooler with the Thermotrac than without it. This removes fan out and misregister which occurs on production machines.

3.) BEARER AND FRAME TEMPERATURES We are now recording 35 to 40 deg. F. temperature reductions in the bearers at any press speed and the temperatures remain stable whether the press is running or not. More importantly, it doesn't matter how long the press has been running or how long it has been stopped. This technically is a major breakthrough since the press is now stable under any dynamic or static condition. This assures us of better ink/water balance and straighter cylinders and reductions in plate to blanket and blanket to blanket pressures. This creates less web breaks due to more consistent tension across the web.

With absolutely no proof yet, a number of printers believe it is now possible to run waterless Offset due to the much cooler and stable plate cylinder temperatures. Toray plate life should also increase since we will be running with less pressure. See Waterless note.

4.) PAPER SAVINGS The foregoing paragraphs result in an absolute reduction in paper waste on Make Readies and restarts to the tune of 5,000 waste impressions being dropped to 1,200 impressions with the Thermotrac which on a 100,000 impression run is 3.8% paper savings. Obviously two webs and shorter runs will enhance the paper saving conditions accordingly. We do not have anything definite on run waste savings since machine stoppages for any reason cloud these numbers, but we do know that there have been run hours saved on many occasions due to less web breaks.

5.) MAINTENANCE Of course the unit reduces the bearer, bearing, bearing cell, journal deflections and loads in the frames considerably to the point that the life of these components can only be extended dramatically. For example, if you halve the radial load on a bearing, the life goes up 8 times not twice! Since we generally utilize less than a third of normal loads on the bearers and bearings, the life expectancy must be dramatic. In fact, the G16 press is now running with no oil coolant and with no change in bearer temperatures.

6.) RETURN ON INVESTMENT Shorter times are seen due to reductions in Make Ready waste and Run waste. Since samples may be taken earlier into the run, much greater savings are seen on short run presses. This is amplified when either wider webs or when two webs are being run. In both cases, Make Ready and Restart waste numbers are excessively high under normal conditions.

We know that if signatures are taken in quarter of an hour intervals from start ups or restarts without impression control, dot fidelity suffers over signatures taken with impression control over the same periods. From this alone run lengths are shortened reducing the cost per thousand impressions.

TECHNICAL ANALYSIS

How do we accomplish all these good things? We control the center distance between individual cylinders in each frame thermally which in turn changes the impression even to the point of running off bearers.

This is carried out through the control by microprocessors of heating elements and sensors which can be added to any existing press or bored in new frames..(See FIG. ONE). Both elements and sensors go into blind holes from the inside of each frame and each pair of elements with their sensor control the distance between bearing centers. Each frame has a tracker unit which controls each of the three nip points between the relative cylinders. These tracker units are controlled from a supervisor unit which indicates the temperatures at each position in the printing unit and in the whole press. Individual nip points can be controlled without affecting other nip points in the printing unit and can be adjusted to sharpen dots.

In FIGURE TWO we have the cross section of a printing unit off impression with no Thermotrac and little bearer load. It is easily seen that the cylinders are not deflected and is an ideal condition but is only in theory. We are now able to produce this condition with the Thermotrac on production .

FIGURE THREE, in the real world running on bearers, we can see all the idiosyncrasies of production difficulties on press. First of all, the upper plate cylinder is deflected upwards, "banana style," the lower plate cylinder is deflected downwards in a similar way, with the upper and lower blanket cylinders conforming to their respective plate cylinders in deflection. These deformations then are caused by bearer pressures causing massive stresses in the bearers, bearings, bearing cells, journals and gears.

The deflection of the journals causes the upper plate cylinder bearings to be thrust upwards in their cells showing wear at the top of the cell. In the lower plate cylinder bearings the load shows wear at the bottom of the bearing cell while gears wear out on the outside edge due to the journal deflections. These deliterious conditions are proven facts known by experienced maintenance staff in any Web Fed pressrooms.

The journal and cylinder body deflections are caused by bearer loads of approximately three thousand pounds per inch of bearer width between plate and blanket cylinders. These loads can be 5-1/4 tons each side of 2" wide bearers on blanket cylinders.

If bearer loads of some 5-1/4 tons and center distances of .00033" reduced to virtually straight journals, then a 5 deg. F. temperature increase in the frames will lift off the bearers with ensuing loss of impression.

From the foregoing, it is easy for anyone to ignore .00033" as meaningful and 5 degrees F. equally so, but the affect of 5-1/4 tons on each bearer cannot be ignored.

Of course it is impossible to print say a 25% dot all across the cylinder with deflections of this nature and in fact this has been proven with an Xrite densitometer. Not withstanding, the aluminum plate expands twice as much as steel for the same temperature increase since the co-efficient of linear expansion of aluminum is twice that of steel. This tends to relax plate tension at the edges causing plate cracking. Add to this the heat generation by the bearers diffusing into the cylinder body drying out dampening solutions on the edge of the plate causing poor print quality and waste. The Thermotrac System maintains much cooler plate cylinder temperatures, i.e. 35 Deg. F. below uncontrolled plate cylinders on production.

The heavy loads on bearers shorten bearer and bearing life. It is important to recognize that a reduction of bearing load by 50% increases the life of the bearing 8 times,

$$L = \frac{C^3}{P^3}$$

L = Life of bearing in millions of revolutions
C = Basic dynamic load rating
P = Equivalent dynamic bearing load

(ref. SKF Bearing catalog)

FIG. FOUR SHOWS PRESS RETURNING TO FIG. TWO CONDITION WITH THE THERMAL IMPRESSION CONTROL ACTIVATED.

GRAPH ONE With respect to bearing preloads and bearer loads heating the frames we have discovered a very important phenomenon. We have graphed the time taken in both a hot and cold pressroom for the temperature to stabilize in about 1/2 hour in the frame but with the frame growing for some three to four hours in addition. We have found then, that just measuring the temperature in the frame for stability does not show what is really happening on the press. We took 50 deg F. increases in temperature and showed an increase in the cold pressroom of .00275" and .0035" in a warm pressroom with both dropping some .003" in one hour when the press stops. This means that impression changes of .002 minimum occur once the press stops for one hour with corresponding dot growth and can take about an hour to return to its original condition of impression running substandard print quality all that time. If .002" difference in impression does not seem important, let me add that .0005" differential is the difference between printing a sharp dot and not printing at all!

Each time the machine is stopped for even one half hour for any reason the actual lost time to obtain original print quality is more than one hour and a half.

This is due to frame cooling while the press is down. Controlling impressions and stabilizing the printing unit negates completely the variations in dot gain depicted saving paper waste during restarts.

GRAPH TWO is similiar to Graph one with slightly less impression change, but with a cold pressroom with an ambient temperature of 62 deg. and raising 50 deg. to 112 deg. F. It may be noted that growth continues for a minimum of a three hour period in these changed ambient conditions versus Graph one.

THE AWAKENING. When we discovered what really happens during the production run on an Offset press it WOKE US UP to the real world of quality printing. GRAPH THREE shows at the left vertical axis dot fidelity versus the lower horizontal axis i.e. run length in hours and days. The right vertical axis depicts blanket cylinder center distance change in thousandths of an inch as the press starts up.

At the top of the graph you will note 100% line going horizontally straight between the two vertical axes. This line depicts perfect print quality or ultimate customer satisfaction.

The next horizontal line with thermal control, at say 98% efficiency, shows that after a certain time, maybe days, blankets gradually beat down showing reduced impression, first giving the sharpest dot and then losing dot structure. By lowering the temperature between the centers of the cylinders, under controlled conditions, we return the under impressed dot to it's original condition ON THE RUN.

The curve on the third graph shows the uncontrolled impressions between the relevant cylinders changing as the press warms up. As seen in GRAPHS ONE and TWO, this can take a minimum of four hours and settling out at a dot structure uneven across the web due to cylinder deflection and CONTROLLED BY PRESS SPEED. If now we consider blanket beat down requiring .0005" increased impression, we either accept poor print quality or have to stop the press to repack the blankets. Since we can only repack blankets by .001" ON EACH BLANKET we are actually over impressed by .0015" when we restart the press. THIS DOES NOT INCLUDE THE .002" that the blanket cylinder centers close through cooling when the press is stopped to repack the blankets.

The result then is that more waste is run during the restart and this particular printing unit CAN NEVER return to its original condition even after warming up.

It is important to note that press packing and web tensions are not affected by the thermally controlled system when changing impression on the run. Reduced blanket packing can be used since cylinder deflections are vastly reduced assisting the tension in the folder by some 1/2% gain reducing ribbon weave.

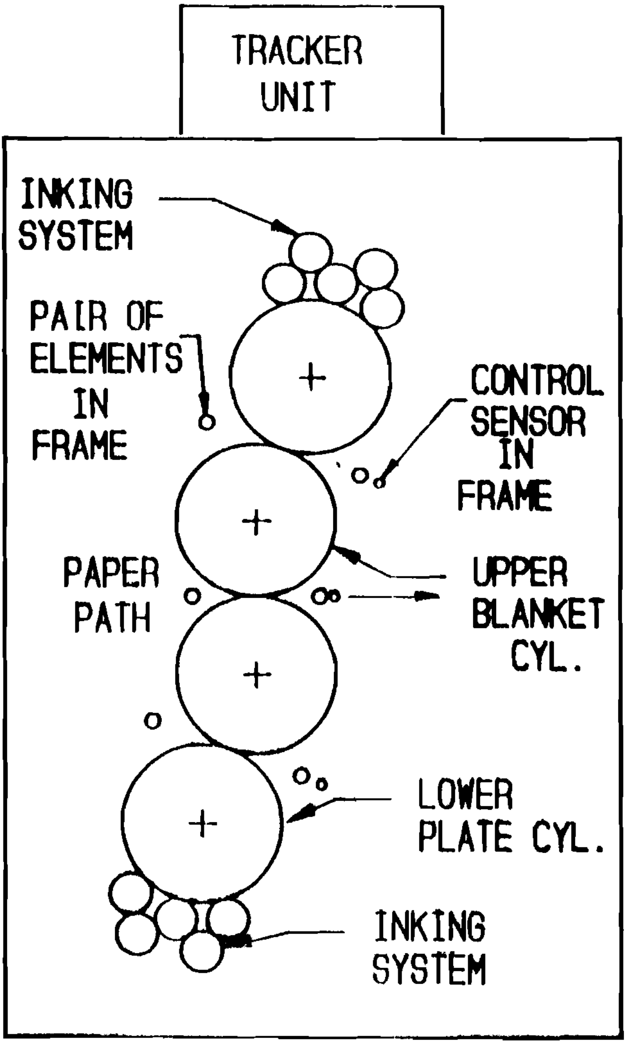
WATERLESS PRINTING Since the problems with waterless printing are magnified through the increase in printing cylinder temperatures well above the 10 Deg. F. limit required by the inks the industry is excited by the fact that the thermally controlled system retains the ability to keep the plate cylinder temperature within this limit. It appears that a major obstruction to running waterless printing WebFed at high speeds is now removed.

Another important factor forseen in Waterless printing is that the life of the plate should be dramatically enhanced through less blanket pressure on the plate. Reduced blanket surface speed differential should both reduce the temperature at the plate and increase the life of the plate since much less work is being done at the plate surface.

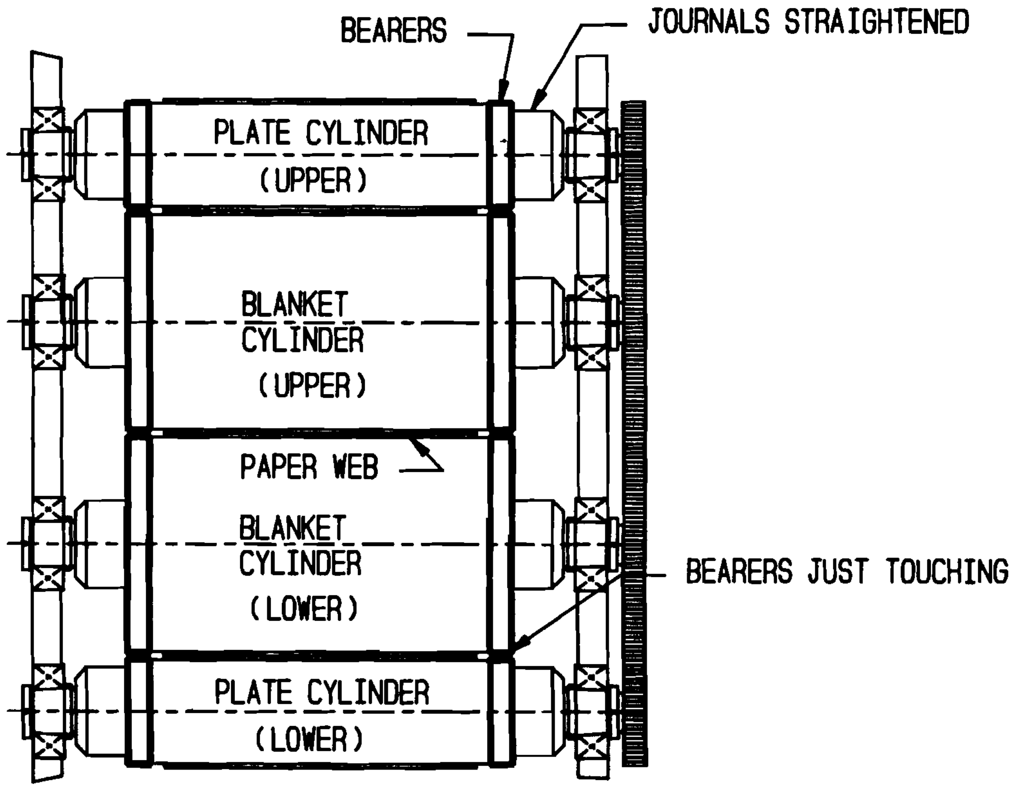
POWER SUPPLY The total power supply on the press is reduced when utilizing the Thermotrac with the press running. On a four unit press, starting cold, 24 kilowatts are used leveling off to about 12 kilowatts per hour after 3-1/2 hours with the press stopped.

With the press running, this drops to about 5 kilowatts per hour for the impression control gross, but since no coolant energy is used in the gearbox and the reduction in main press power supply is in evidence, there is net savings of power over all.

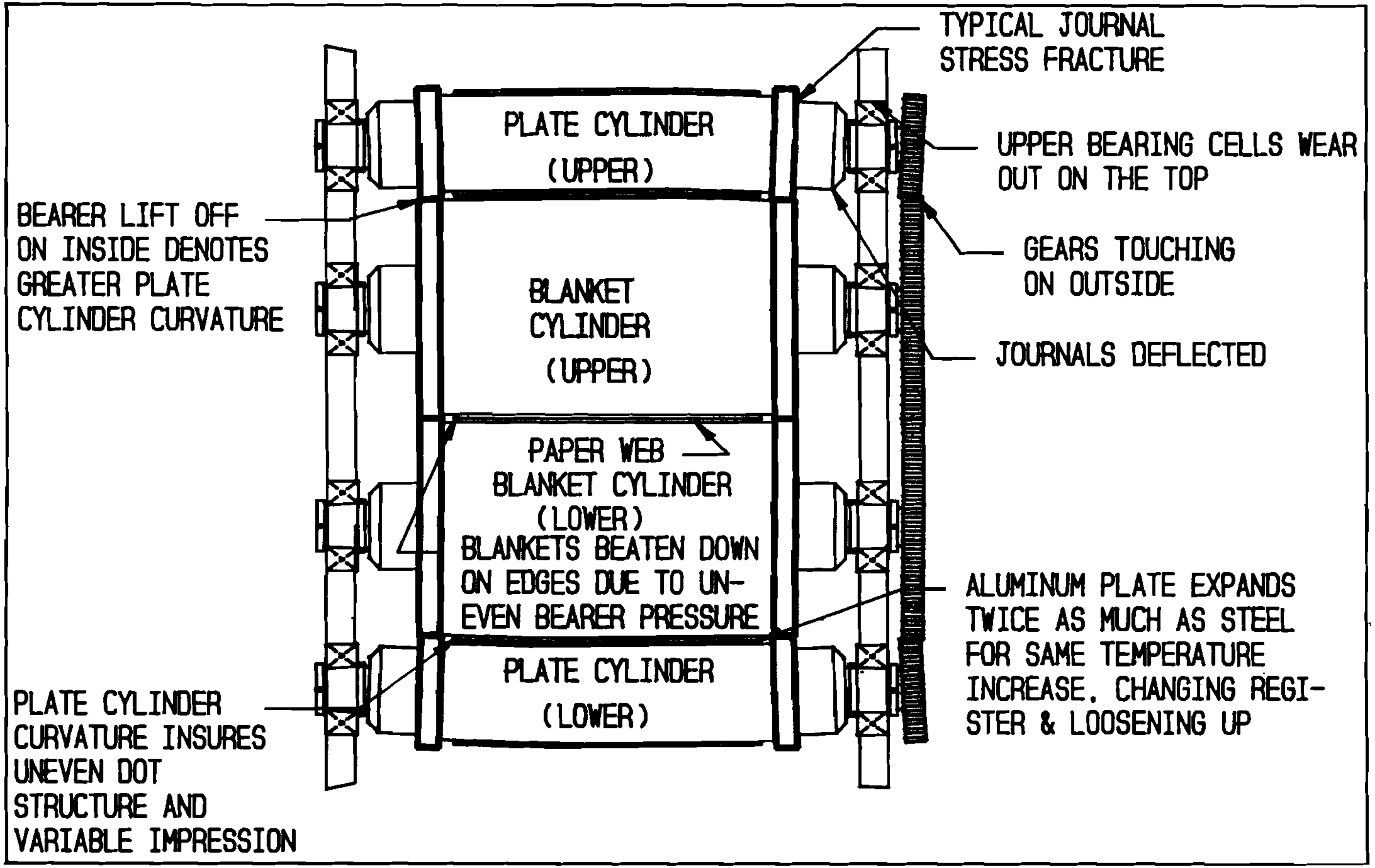
CONCLUSION The advantages then to thermal control of impression on the Web Offset printing industry can only appear to be positive. We can envisage running wider webs at very high speeds with controlled print quality, less web breaks, reduced maintenance and shorter Return on Investment with or without using waterless printing technology.

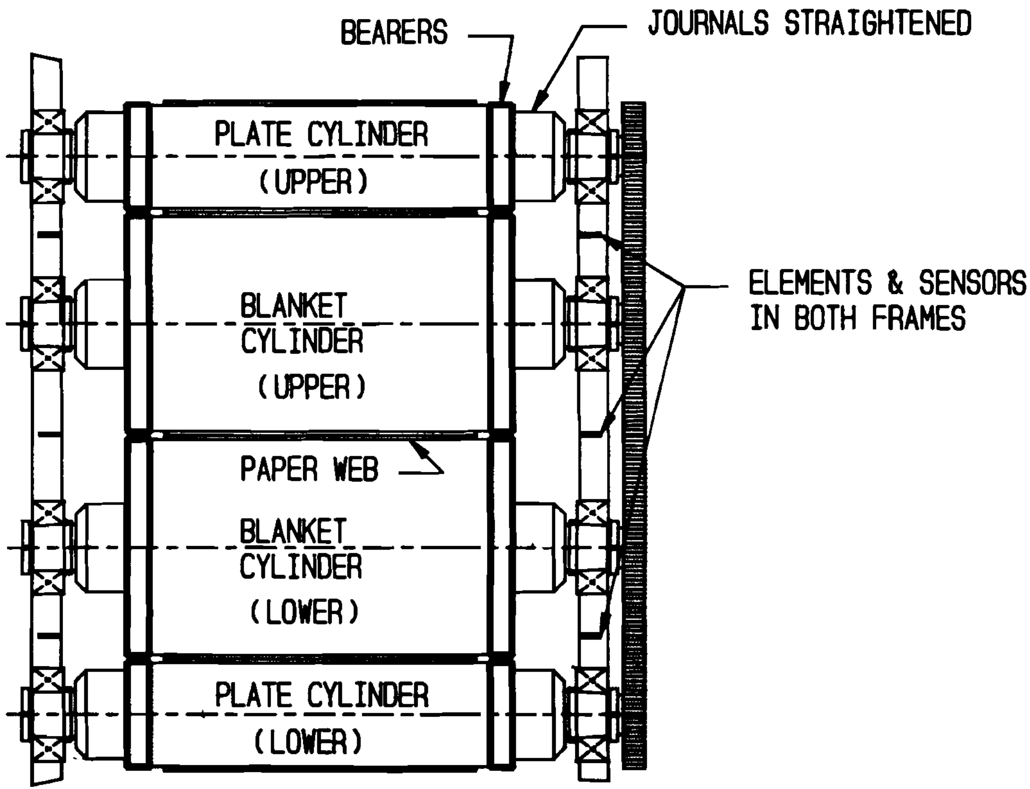


IMPRESSION CONTROL
THROUGH FRAME HEATING



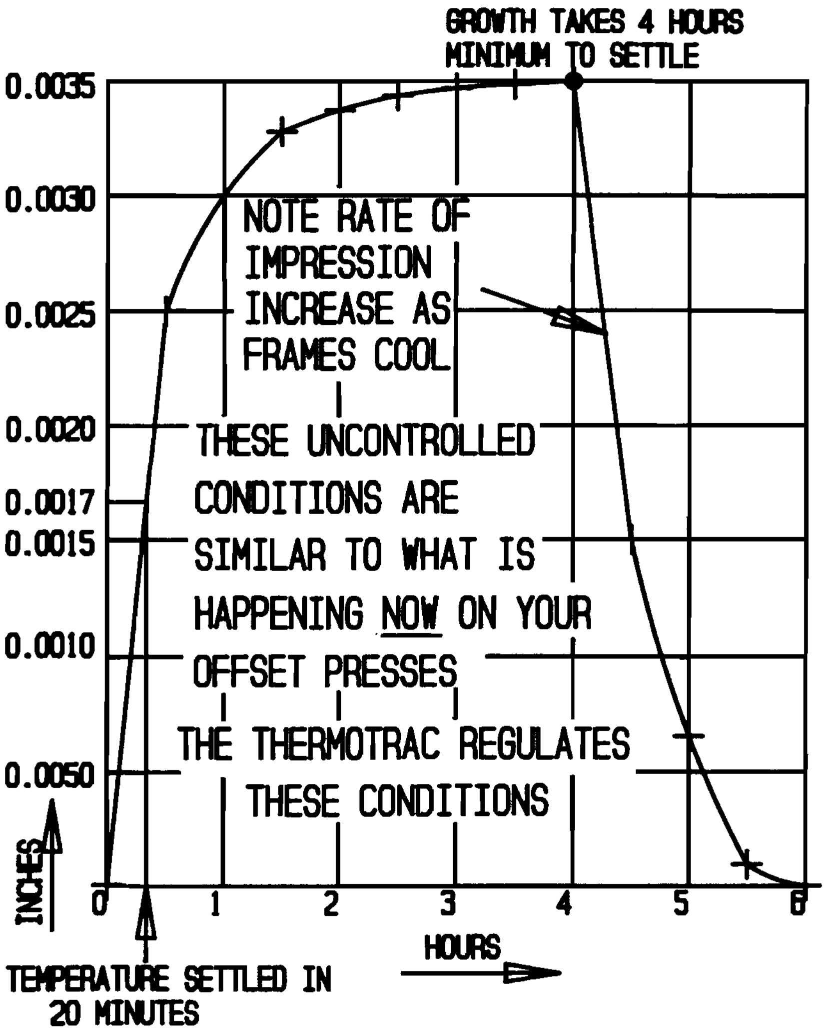
CROSS SECTION OF PRINTING UNIT
OFF IMPRESSION OR NO BEARER LOAD

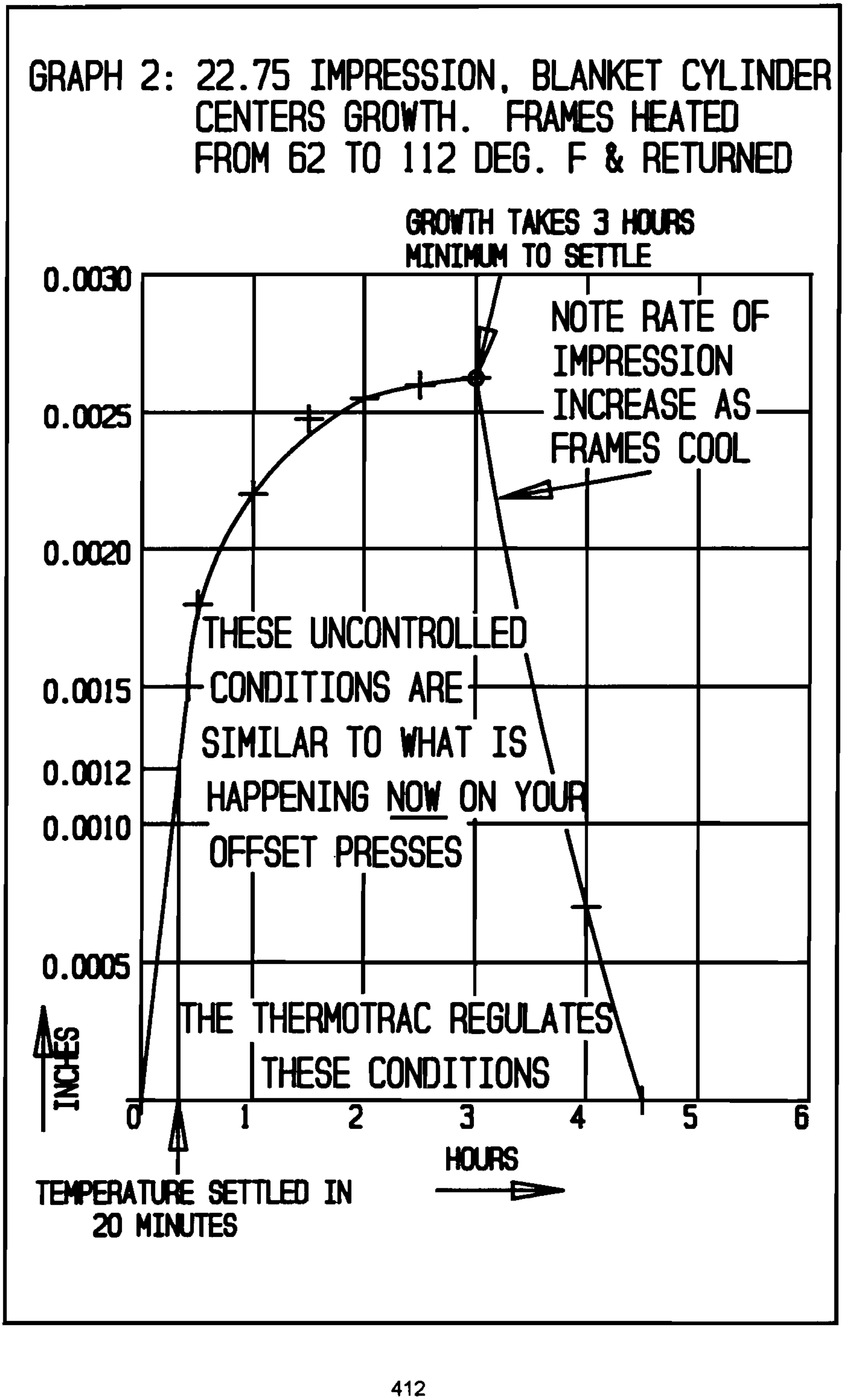

TYPICAL JOURNAL STRESS FRACTURE
PLATE CYLINDER (UPPER)
UPPER BEARING CELLS WEAR OUT ON THE TOP
BEARER LIFT OFF ON INSIDE DENOTES GREATER PLATE CYLINDER CURVATURE
BLANKET CYLINDER (UPPER)
GEARS TOUCHING ON OUTSIDE
JOURNALS DEFLECTED
PAPER WEB
BLANKET CYLINDER (LOWER)
BLANKETS BEATEN DOWN ON EDGES DUE TO UN-EVEN BEARER PRESSURE
ALUMINUM PLATE EXPANDS TWICE AS MUCH AS STEEL FOR SAME TEMPERATURE INCREASE, CHANGING REGI-STER & LOOSENING UP
PLATE CYLINDER (LOWER)
PLATE CYLINDER CURVATURE INSURES UNEVEN DOT STRUCTURE AND VARIABLE IMPRESSION

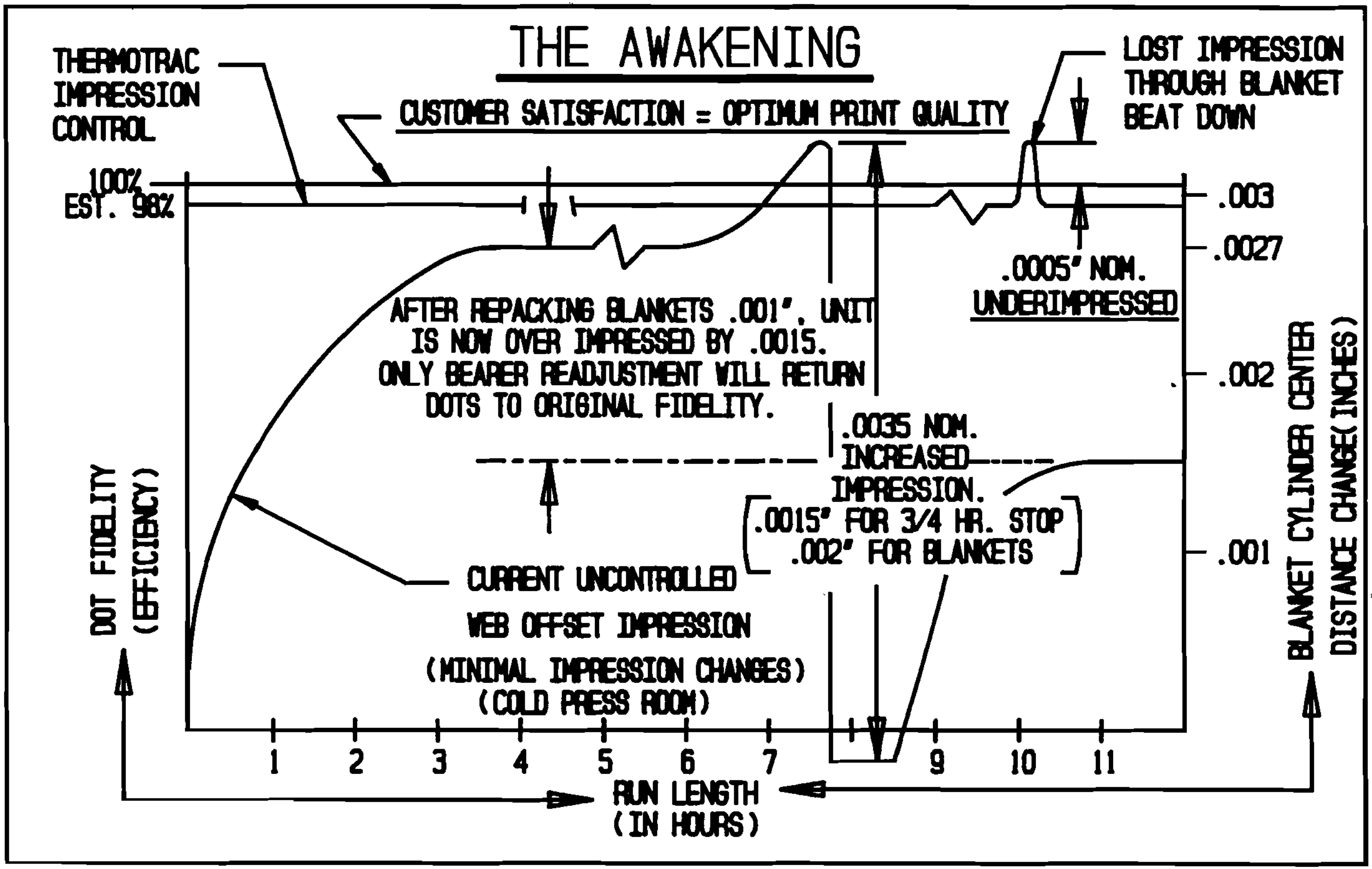


PRESS RUNNING WITH
IMPRESSION CONTROL ON

GRAPH 1: 22.75 IMPRESSION, BLANKET CYLINDER CENTERS GROWTH. FRAMES HEATED FROM 100 TO 150 DEG. F & RETURNED




GRAPH 2: 22.75 IMPRESSION, BLANKET CYLINDER CENTERS GROWTH. FRAMES HEATED FROM 62 TO 112 DEG. F & RETURNED
GROWTH TAKES 3 HOURS MINIMUM TO SETTLE
NOTE RATE OF IMPRESSION INCREASE AS FRAMES COOL
0.0030
0.0025
0.0020
0.0015
0.0012
0.0010
0.0005
THESE UNCONTROLLED CONDITIONS ARE SIMILAR TO WHAT IS HAPPENING NOW ON YOUR OFFSET PRESSES
THE THERMOTRAC REGULATES THESE CONDITIONS
INCHES
0
1
2
3
4
5
6
HOURS
TEMPERATURE SETTLED IN 20 MINUTES


THE AWAKENING
THERMOTRAC IMPRESSION CONTROL
CUSTOMER SATISFACTION = OPTIMUM PRINT QUALITY
LOST IMPRESSION THROUGH BLANKET BEAT DOWN
100%
EST. 98%
.003
.0027
.0005" NOM. UNDERIMPRESSED
AFTER REPACKING BLANKETS .001", UNIT IS NOW OVER IMPRESSED BY .0015. ONLY BEARER READJUSTMENT WILL RETURN DOTS TO ORIGINAL FIDELITY.
.002
.0035 NOM. INCREASED IMPRESSION.
.0015" FOR 3/4 HR. STOP
.002" FOR BLANKETS
.001
DOT FIDELITY (EFFICIENCY)
CURRENT UNCONTROLLED WEB OFFSET IMPRESSION
(MINIMAL IMPRESSION CHANGES)
(COLD PRESS ROOM)
BLANKET CYLINDER CENTER DISTANCE CHANGE(INCHES)
1 2 3 4 5 6 7 9 10 11
RUN LENGTH (IN HOURS)