

Industrial Investigation #1

ENGINEERING REPORT

June 2006

PREPARED FOR: CLAIMS COMPANY #1
ATTENTION: MS. ANGIE SINGLETON

INSURED: INDUSTRIAL PRINT COMPANY #1
DATE OF LOSS: MARCH 2004
LOSS LOCATION: PORTLAND, TENNESSEE
POLICY NUMBER: N/A
CLAIM NUMBER: <omitted>
IC1 FILE NUMBER: <omitted>

Introduction

On March 2004, Mr. Jimmy Roberts, an employee at Industrial Print Company #1 production facility in Portland, Tennessee, was injured when a steel access door mounted upon a scrap paper collection/baling machine unexpectedly opened. It was believed that the door struck Mr. Roberts on the left side of his face resulting in a head trauma injury. Since the event, Mr. Roberts retained the services of an attorney and returned to work.

On January 2005, Mr. Eddie Coolidge of Claims Company #2 of Nashville, Tennessee, contacted Investigation Company #1 and requested IC1's assistance at determining the cause of the workplace incident. The author of this Engineering Report, Scott A. Jones, P.E. and Senior Mechanical & Electrical Engineer of Investigation Company #1, (812) 944-9988, was assigned to conduct the investigation.

The observations and conclusions of this investigation were based upon the author's inspection of the equipment and systems involved at the loss site in Portland, Tennessee; adjuster's notes and photographs; Tennessee Division of Occupational Safety and Health Citations and Notification of Penalty; transcript of a recorded statement by Mr. Roberts, offered on April 2004; transcript of a recorded statement by Ms. Sonia Jean Johnson, offered on April 2004; transcript of a recorded statement by Mr. Jim W. Rawlings, offered on March 2004; transcript of a recorded statement by Mr. Sanford M. Feree, offered on March 2004; transcript of a recorded statement by Mr. Ricky Glen Thorton, offered on March 2004; component description, operating and service manuals, electrical schematics, and software ladder logic diagrams for the systems comprising the subject baling machine. All written materials other than the author's written observation notes were forwarded to the author by Mr. Coolidge.

Background

The Industrial Print Company #1 facility in Portland, Tennessee provided printing and publishing services for soft cover publications. The publishing service was comprised, in part, of automated machinery that bound, trimmed, glued, and collated the publications. The subject paper collection/baling machine received clean paper waste (i.e., clean paper offal that was not contaminated with glue) from binding machinery saws and trimmers and compressed the same into bales for eventual sale to recycling entity(s).

Process Flow

The author created ***Figure 1*** to assist the reader in understanding the layout and operation of system components.

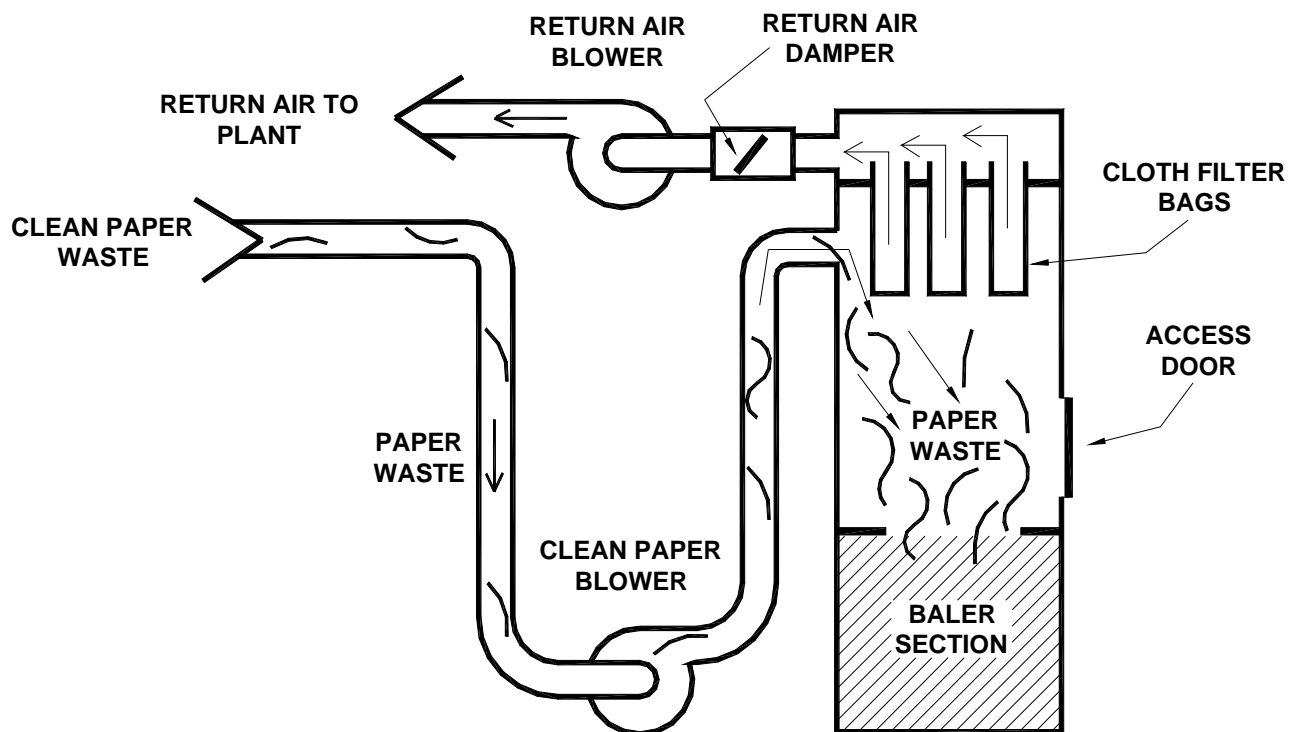


Figure 1 - Paper Waste Collection System Layout

The clean paper waste was pneumatically conveyed approximately 50 yards from binding machinery via a ducting system to the suction of a *clean paper centrifugal blower*. The blower transported the paper waste to a collection bin positioned above the *baling section*. Air was removed from the bin by a *return air centrifugal blower* that was positioned opposite a set of *cloth filter bags* at the top of the collection bin. A pressure balance across the filters was maintained by a set of moveable vanes in the *return air damper* that were controlled by a programmable logic controller (PLC).

At the time of the event, Mr. Roberts was reportedly walking at or near the access door positioned on the side of the collection chamber as shown in *Figure 1*, which was designated as “Baler A”. Two other collection/baler systems, designated “Baler B” and “Baler C”, were positioned sequentially to the west of Baler A. Baler B served to collect contaminated waste paper (i.e., paper trimmings that contained glue), and Baler C served to collect floor waste along with wastes from Balers A and B in case either system was taken out-of-service.

The system was designed with moveable vanes inside the *return air damper*. A PLC controller received pressure signals from below and above the cloth filter bags. The

controller was designed to operate the damper vanes (i.e., allow more suction from the **return air blower**) as the bags became clogged with paper dust. The cloth filter bags were automatically agitated with compressed air every few minutes to alleviate clogging. The bags reportedly were manually cleaned two times per week.

Reported Events of the Loss

Recorded Interview Testimony of Mr. Jimmy Roberts, Injured Employee

The author reviewed the transcript from the recorded statement that Mr. Roberts offered on April 2004. Salient items taken from the interview were as follows:

- Mr. Roberts reported that he worked as a Bindery Operator at the time of the loss. He reportedly had worked at the facility for 12½ years, which included the 6 years that the insured had owned and operated the facility.
- Mr. Roberts reported the conditions present before the event as follows:

“My binder quit pulling the paper at the sawing stuff, the bailer had quit working, it’s got a pipe that runs back to the bailer itself, I went back to make sure it was on there’s a guy that was back there running the bailer named Mr. James Dunn at the moment and Ricky [Thorton] happened to be back there too and I got back there with him and he looked at me and says “it’s not working and we’re going to have to get someone to come and work on it” so we went back to where the buttons are to turn it off and on to see if it was on and he went to the right, Ricky, he went to the right looking back and I was heading back up to the machine myself because with it being messed up and clogged up Ricky said we didn’t need to be fooling with it and someone is going to have to come to look at it. [sic]” (p. 3)

- Mr. Roberts described his injuries as follows:

“My injury from what I’ve been discussed with the doctors and stuff from the left hand side of my face from just above my chin to just above my eyeball on the left was all swollen and all red and then on the right hand back behind my ear was swollen from the bottom of my neck up to the back of my head. What happens on the left side it came and blew up in my face and then on the backside it slammed me up somewhere.” (p. 4)

- Mr. Roberts described his interaction with the access door as follows:

“Q: [Mr. Coolidge] Mr. Thorton told me he found you lying flat on your back and said that you were hit in the head with something but you didn’t grab the hopper door there?”

A: [Mr. Roberts] Oh no, no, no. I didn’t touch the doors for any reason because there’s too much pressure.

Q: You didn’t touch the machinery at all prior to the accident?”

A: No

Q: The hopper door, if that’s what hit you, all you remember is walking between the two [Baler A and Baler B] and then you were knocked out is that right?”

A: I remember walking back toward the machine but as far as getting knocked out yeah I got knocked out but I couldn’t tell you all I know is something blew up. I didn’t hear that.” (p. 4)

Recorded Interview Testimony of Mr. Ricky Glen Thorton

The author reviewed the transcript from the recorded statement that Mr. Thorton offered on March 2004. Salient items taken from the interview were as follows:

- Mr. Thorton reported that he served as an employee of Industrial Print Company #1 in the position of Fork Lift Operator. He reportedly served as Warehouse Supervisor when Ms. Sonia Jean Johnson, Warehouse Supervisor, was not in the building. Mr. Thorton worked for Industrial Print Company #1 for approximately 4½ years up to the time of the injury event.
- Mr. Thorton reported that he was authorized to start and stop the balers as well as perform corrective maintenance such as unclogging the balers when backed up with waste paper.
- Mr. Thorton reported that Mr. Mike Mitchell, a plant employee, manually cleaned the filters in Baler A on the Friday before the event. *Author’s note: the event occurred two days later, on Sunday.*
- Mr. Thorton noted that the handle-pull latches on Balers A and Baler B would sometimes become clogged with paper scrap to the point that the latches would not latch shut, once opened. He reported that once the paper scrap was cleared from the doorframe, the latches would hold the access doors shut.

- With regard to the events immediately preceding the injury event, Mr. Thorton reported that Mr. Roberts had lost suction on the bindery machinery that he was responsible for. Mr. Thorton reportedly checked the status of the Baler system by observing the status indicator lamps on the Baler Control Board mounted upon the south wall of the building.
- Mr. Roberts reportedly returned to his workstation. Mr. Roberts then returned to the Baler area and once again complained to Mr. Thorton about the lack of suction. Again, Mr. Thorton reportedly checked the status indicator lamps on the Baler Control Board and reported to Mr. Roberts that he observed no anomalies.
- Mr. Thorton reported:

“Q: [Mr. Coolidge] Did he see you when he came back the second time?”

A: [Mr. Thorton] Yes sir.

Q: What did he say this time?

A: He said the same thing, he said something’s off on the bailer and I told him that nothing was off so we walked back there again [Baler Control Panel] and we checked everything and everything was on and I was standing at the tower looking at the tower and he turned to my left and walked away and some dust had collected to the left of me so I started walking that way and I guess I probably 10 yards and that’s when I heard something go boom.

Q: What did it sound like?

A: Well, not like a big explosion because it wasn’t real loud just like boom just like that.

Q: What was that?

A: To my knowledge when I turned around I couldn’t see nothing but dust so I took another 3 steps to get away from the dust and I realized Jimmy [Roberts] was back there so I hollered Jimmy and he didn’t say nothing so I stood there a few seconds for the dust to clear & when it cleared I came back to A bailer & he was laying on the floor.

Q: Was the hopper access door open?

A: *Yes sir.*

Q: *Was the machine still running?*

A: *Yes sir.*" (p. 6-7)

Observations

On January 2005, the author inspected the baler systems at the Industrial Print Company #1 production facility in Portland, Tennessee. Mr. Coolidge and Mr. Sanford Feree, Industrial Print Company #1 Maintenance Manager, were in attendance for the inspection. The facility was not in production at the time of the inspection, but Baler C, which collected floor wastes as well as diversion from Balers A and B, was operating.

The Baler A baler section, which was the floor-mounted portion of the baler assembly, consisted mainly of the vertical scrap collection plenum and the horizontal ram/compaction system as shown in *Photograph 1*. The subject door was situated in the vertical collection plenum. The Industrial Parts Company #1 of North Carolina manufactured the baler section as shown on the manufacturer's sticker (*Photograph 2*).

A sheet steel transition plenum (*Photograph 3*) spanned between the top of the baler and the air filter enclosure, which housed cloth air filters and the automatic pneumatic equipment that provided periodic agitation to the filter bags (*Photograph 4*). The air filter enclosure appeared to have been manufactured by Industrial Parts Company #2 of Louisville, Kentucky (*Photograph 5*).

As shown in *Photograph 3*, an "Industrial Parts Company #4 Trim Collection Systems" name plaque appeared on the tower support structure surrounding the baler systems along with the notation: "FABRICATED and INSTALLED by the INDUSTRIAL PARTS COMPANY #3".

Mr. Feree permitted access to the inside of the air filter enclosure. The cloth filter bags appeared as shown in *Photographs 6 and 7*. A protective screen appeared opposite the filters as shown in *Photograph 8*.

A 40 horsepower 3 phase motor (*Photograph 9*) provided power for the clean paper blower (reference **Figure 1**) that was manufactured by Industrial Parts Company #3 of Tennessee (*Photograph 10*). A 50 horsepower 3 phase motor (*Photograph 11*) provided power for the AcostaFoil return air blower (reference **Figure 1**).

The clean paper blower appeared in the background of *Photograph 13* with the return air blower shown to the right when observed from the upper filter region. The return air dampers for Balers B and C appeared as shown in *Photograph 14*. The Baler A return air damper appeared as shown in *Photograph 15*.

Baler A Access Door

The Baler A access door appeared on the western side of the waste paper collection area as shown in *Photograph 16*. The door was equipped with an optical sensor mounted in the windowpane to detect the presence or absence of stacked scrap paper in the region (*Photographs 17 and 18*). The sensor output served as an input to the baler compression ram operating system.

The 26 inch x 26 inch door was constructed of 1.5 inch L-section steel frame with a central section consisting of steel plate. A flat rubber seal was adhered to the backside of the frame L-sections, which mated with a 24¼ inch by 24¼ inch projecting frame from the collector body (*Photograph 19*).

A magnetic proximity switch and pickup were mounted on the upper edge of the door and doorframe (*Photograph 20*). The proximity switch output served as an input to the compactor ram shutdown circuit.

A handle-pull latch was mounted on the left side of the door as shown in *Photograph 21* as well as a thumbscrew hold down that was reportedly installed after the injury event. The thumbscrew installation was similar to the installation of two thumbscrew latches on the door for Baler C when the baler section was replaced by the Industrial Parts Company #3 several years before the subject event.

The area below the access door was marked with multiple caution stickers including keep out, keep hands clear, and automated machinery startup up cautions (*Photographs 22 and 25*). A "DANGER KEEP OUT" sticker and an additional caution sticker were applied to the door as shown in *Photographs 23 and 25*.

The door latch appeared as shown in *Photograph 24* with the door open. The author cycled the hand-pull latch through the full range of travel. The latch smoothly operated through the opening operation but did not routinely return to the fully extended latched position. *Author's note: further observations on the latch condition will be given later this report.*

The Balers A and B Control Panel (*Photograph 26*) was mounted on the south wall of the building adjacent to the balers. The clean air blower, Baler A damper, and Baler A filter agitation controls were grouped on the left side of the panel.

Baler A Operational Tests

Test 1 – Normal Operation

The author directed Mr. Feree to start the return air and clean paper blowers to establish normal system alignment and pressures. The return air damper position was under programmable logic controller (PLC) control. The author observed the differential pressure gauge mounted on the Panel.

Author's note: The digital gauge appeared to present the differential pressure between the baler and atmospheric pressure. There was no scale given for the graduations that spanned between +10 and -10 with mid-scale given as "0".

The PLC controller controlled the Baler A return air damper position to maintain "0" differential pressure between the inside of the baler and atmospheric pressure (i.e., no pressure difference across the access door).

The author released the hand-pull latch on the access door while both blowers were operating. The access door opened without event. There was no discernable differential pressure across the door. Swirling paper remnants remained inside the collection chamber with no discernable expulsion of dust or scrap paper (*Photograph 27*).

Mr. Feree was able to re-latch the door by slamming it shut (i.e., agitating the latch). The author then pulled on the latch side of the door with both hands in an attempt to release the latch. The latch securely held the door shut in all opening attempts.

Test 2 – Simulation of Blocked Filter Bags

The author directed Mr. Feree to take manual control of the return air damper position and to shut the Baler A damper sufficiently to simulate clogged filter bags (i.e., permit the clean air blower to pressurize the baler by blocking the path of the return (exit) air). The Damper A position was taken from approximately "100" down to "66" by Control Panel indication (*Photograph 28*).

Air with entrained paper dust was observed escaping from the crevices in and around the Baler A ram/compaction section. The differential pressure gauge was off the scale in the

“+10” direction. The door latch securely held the door throughout the trial. The author did not attempt to unlatch the door due to the positive pressure behind the door.

The author directed Mr. Feree to return the return air damper control to automatic (i.e., PLC) control. The differential pressure rapidly returned to “0” as the Baler A return air damper opened.

Discussion/Conclusions

Per the account of the injured worker, Mr. Jimmy Roberts, he sustained his injury when he was walking in a northerly direction in the aisle way between Balers A and B. His reported path that started at the Baler Control Panels is shown below in *Figure 2*.

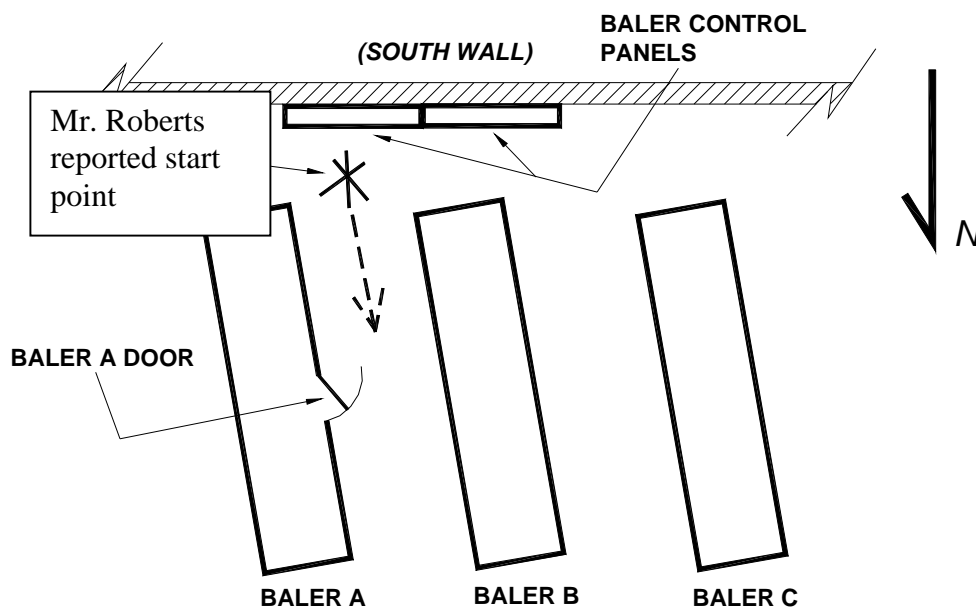


Figure 2 - Mr. Roberts's Reported Walking Path Prior to Injury Event

Mr. Roberts's reported medical injuries were not consistent with his statements of his activities prior to the injury event. Mr. Roberts stated that he was walking along the dotted path shown in *Figure 2* when the Baler A door unexpectedly opened causing him injury.

Medical authorities noted that Mr. Roberts sustained injury on the left side of his face. The bottom edge of the Baler A access door was 60 ½ inches from the floor, therefore it is consistent with the reported accounts that the door might have come into contact with only his face (i.e., the door was above the level of his chest).

*But, the left side facial injuries are consistent with Mr. Roberts facing or standing at a slight oblique angle to the access door and not simply walking beside the access door, which would have been positioned to the right of his path (reference **Figure 2**).*

The author applied substantial opening force to the latch side of the shut Baler A access door in two conditions: 1) normal operating with low differential pressure across the door and 2) large differential pressure across the door caused by simulation of the conditions at the time of the injury event. In both cases, the handle-pull access door latch securely held the door shut.

The mechanical pull required to release a handle-pull latch increases with increasing differential pressure applied to the door. As noted in the Observations section of this report, the Baler A access door latch did not properly re-extend once the latch was operated (i.e., the door had to be slammed shut), but once the latch was engaged, it securely held the door shut.

It is therefore believed with a reasonable degree of engineering certainty that at the time of the injury event:

- *Baler A was at substantial positive pressure relative to atmospheric pressure most probably caused by blocked filtration bags or other return air side obstruction.*
- *Mr. Roberts was aware that the clean paper suction had been lost to the bindery machinery that was serviced by the Baler A clean air suction.*
- *Following his second conversation with Mr. Thorton regarding the abnormal condition of the Baler A system, Mr. Roberts proceeded to the Baler A access door and stood facing or at a slight oblique angle to the access door.*
- *With the intent of diagnosing the cause of the Baler A loss of suction condition (i.e., performing maintenance), Mr. Roberts purposely operated the Baler A access door handle-pull latch.*
- *With a large pressure differential across the door, the door suddenly swung open and struck Mr. Roberts in the left side of his face. Consistent with Mr. Thorton's report, the positive pressure condition within the baler caused the release of large amounts of paper dust and paper particles into the vicinity surrounding Baler A. It should be noted that operation of the access door latch under normal (i.e., "0" differential pressure conditions) the access door would not have been propelled open.*

- *Following the facial impact, Mr. Roberts's head most probably impacted the concrete floor causing the reported injury behind his right ear.*

The author reviewed the PLC ladder logic diagrams for the Baler A control system to understand whether the Baler A PLC control system was designed to shut down Baler A clean air blower to eliminate the positive pressure condition within the baler. As shown in **Appendix A**, ladder logic step 684 showed that a relay would be set for a "BOX A PRESSURE ALARM TIMER". The relay would then set a contact that would sound an "ALARM HORN" as shown in ladder logic step 540.

It is believed with a reasonable degree of engineering certainty that:

- *The subject Baler A access door was marked with sufficient Cautions and Warnings that would have stopped the operation of the handle-pull door latch by any employee(s) who was/were not trained in the operation of the baler systems.*
- *The Baler A access door latch would have securely held the access door shut under normal and abnormal baler system differential pressure conditions.*
- *Mr. Roberts, who was not trained or authorized to perform maintenance on the baler systems, operated the Baler A access door handle-pull latch, with the intent of diagnosing the loss-of-suction condition at the bindery equipment.*
- *The baler pneumatic equipment designer, manufacturer, and installer, Industrial Parts Company #3, did not design a high differential pressure cutoff to the system, which allowed an unnecessarily dangerous pressure condition to exist within the baler system when the filtration bags were clogged.*

The analysis and conclusions are based upon information reviewed to date, plus general engineering knowledge and experience. Information reviewed at a later date may warrant modifying or augmenting the conclusions.

We appreciate the opportunity to work with you on this evaluation. Pending further direction, this file is considered closed. Please let us know whether we can be of further assistance to you.

Sincerely,

Investigation Company #1

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Senior Mechanical Engineer/Electrical Engineer