PRINTING PLANTS

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1.0 SCOPE

This data sheet contains fire protection and fire prevention recommendations for printing plants.

1.1 Hazards

Printing plants use ignitable liquids including inks, fuels, lubricating oils, and hydraulic fluids. Inks may be stored in bulk quantities and piped to individual presses for printing operations. Where ignitable liquids are used, the potential exists for an ignitable liquid pool fire that will produce a significant heat release rate and can easily ignite nearby combustibles, damage steel building elements and destroy equipment.

Printing presses tend to have many areas that are shielded from ceiling sprinkler protection. These may include enclosures, catwalks, mezzanines or walkways where a fire can develop and expose the press if the shielded area is not protected.

Printing plant operations may also produce combustible dust. If not adequately controlled via a properly designed dust collection system, the potential for fires and explosions with these systems is high.

Accumulations of ink residue, paper or dust in press areas can create an unnecessary hazard which can be difficult to protect. Active in-press protection may not be enough to offset the unusual exposure that poor housekeeping will create.

1.2 Changes

July 2023. Interim revision. Significant changes include the following:

A. Revised protection guidance for press rooms with little to no in-process storage.

B. Revised protection guidance for control rooms and computer rooms.

C. Revised guidance for baler rooms that do not contain hydraulic equipment.

D. Renumbered tables and figures based on section number.

E. Document has been revised to provide a consistent format.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Introduction

2.1.1 Store and protect ignitable liquids in sealed, portable containers in accordance with Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*, and any occupancy specific requirements outlined in this data sheet. Ignitable liquids may include, but are not limited to:

- Ink
- Paste ink - See Section 2.1.1.1 for more information
- Solvent
- Blanket wash
- Hydraulic fluid
- Press lubrication fluid
- Heat transfer fluid

Low flash point ignitable liquids have a closed cup flash point less than 200°F [93°C]. High flash point ignitable liquids have a closed cup flash point greater than or equal to 200°F [93°C].

2.1.1.1 Paste inks are high-viscosity fluids that are transferred from the container by means of a trowel, scraper or high-pressure pumping system. Paste inks will flow under pressure or shear. Paste inks, as referenced in this standard, have closed cup flash points greater than 200°F (93°C).

2.1.2 Design, install, and protect ignitable liquid operations in accordance with requirements outlined in this data sheet and the following:

2.1.2.1 Design, install, and protect mixing and dispensing operations in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.1.2.2 Design, install and protect heat transfer fluid systems in accordance with Data Sheet 7-99, *Heat Transfer Fluid Systems*.

2.1.2.3 Design, install and protect parts washing operations in accordance with Data Sheet 7-97, *Metal Cleaning*, and Data Sheet 7-32, *Ignitable Liquid Operations*.

2.1.2.4 Design, install and protect solvent recovery systems in accordance with Data Sheet 7-2, *Waste Solvent Recovery*.

2.1.3 Provide dust collection equipment and collection points that are designed to prevent the accumulation of combustible dust for all dust producing operations. Dust producing operations may include, but are not limited to:

- Slitting
- Sawing
- Die cutting
- Folding
- Baler rooms
- Finishing operations

Manual housekeeping activities are not considered a replacement for properly designed, installed and maintained dust collection systems.

2.1.3.1 Evaluate the combustible dust exposure using Data Sheet 7-76, *Combustible Dusts*.

2.1.3.2 Design, install, and protect dust collection systems in accordance with Data Sheet 7-76, Combustible *Dusts*.

2.1.4 Design, install, and protect ducts in accordance with Data Sheet 7-78, *Industrial Exhaust Systems*.

2.1.5 Use FM Approved equipment, materials, and services whenever applicable. For a list of products and services that are FM Approved, see the *Approval Guide* and Roof*Nav*, online resources of FM Approvals.

2.2 Construction and Location

2.2.1 General

2.2.1.1 Use noncombustible or FM Approved building materials for exterior and interior construction.

2.2.1.2 Protect openings in fire-rated floors and walls with FM Approved fire doors.

2.2.1.3 Provide an FM Approved firestop system installed by an FM Approved firestop contractor in all fire-rated floor, wall and ceiling penetrations and joints.

2.2.1.4 Do not use polyvinyl chloride (PVC) piping for compressed air distribution systems.

2.2.2 Ignitable Liquids and Paste Inks

2.2.2.1 Isolate ignitable liquids and paste inks from other areas of the facility (e.g., press hall, roll paper storage, finished goods storage) as shown in Figure 2.2.2.1, and in accordance with the following data sheets, as applicable:

- Data Sheet 7-32, *Ignitable Liquid Operations*
- Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*
- Data Sheet 7-2, *Waste Solvent Recovery*
- Data Sheet 7-88, *Outdoor Ignitable Liquid Storage Tanks*

2.2.2.1.1 In printing operations that use only paste ink, uncut inks can be stored in the press hall and other areas.

2.2.3 Control Rooms, Computer Rooms, Motor Control Centers

2.2.3.1 Provide one-hour fire-rated separations for control rooms, computer rooms, motor control centers, electrical/mechanical rooms and mail rooms.

2.2.3.2 Provide positive pressure filtered air supplies to these rooms.

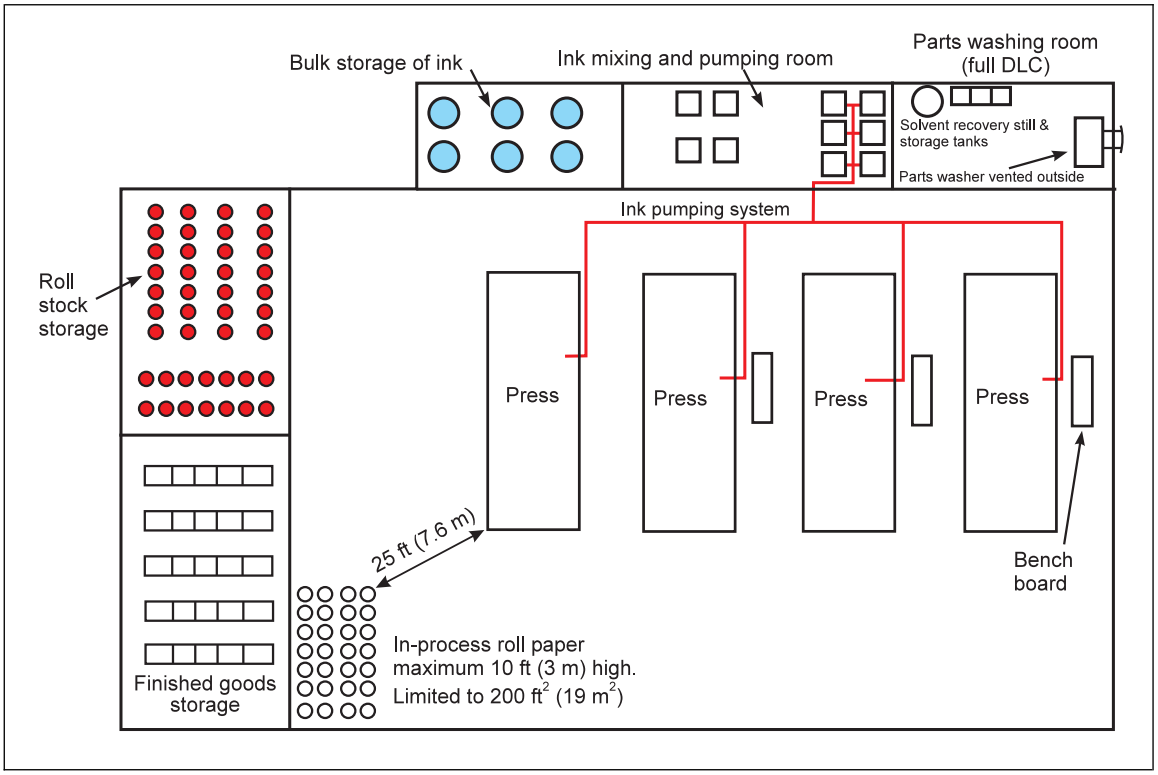


Fig. 2.2.2.1. Press room design and layout

2.2.4 Enclosures

Enclosures around presses or associated press operations may be used to contain sound or dust or for environmental reasons.

2.2.4.1 Construct enclosures out of noncombustible or FM Approved building materials. The provision of small clear plastic windows to allow visual inspection of the process is acceptable.

2.2.5 Baler Rooms

2.2.5.1 Provide a one-hour fire-rated wall to isolate baler rooms from other plant areas.

2.2.6 Roll Stock Bulk Storage

2.2.6.1 Store bulk roll paper in accordance with Data Sheet 8-21, *Roll Paper Storage*, and this section.

2.2.6.2 Provide a one-hour fire-rated wall to separate bulk storage of roll stock (e.g., roll paper, roll plastic, etc.) from the pressroom and from other production areas, as shown in Figure 2.2.2.1.

2.2.6.2.1 Design the wall to resist mechanical impact damage from material handling operations (e.g., fork truck).

2.3 Occupancy

2.3.1 Ignitable Liquid Staging (Excluding Paste Ink)

For paste inks, see Section 2.3.2.

Ignitable liquid staging refers to containers that are either in-use or are being prepared for use. Staging of ignitable liquids beyond what is contained in the printing press and its associated ink sump creates an ignitable liquid exposure in the printing occupancy that needs to be evaluated and protected in accordance with the appropriate ignitable liquid operating standard.

2.3.1.1 Limit quantities of ignitable liquids to 70 gal (265 L) in each fire area. If more than 70 gal (265 L) are needed for normal operations, refer to Data Sheet 7-32, *Ignitable Liquid Operations*, for proper handling.

2.3.1.1.1 Define a fire area by determining a separation distance that would prevent a spill from the largest container in one area from exposing containers in the next area.

2.3.1.2 Stage ignitable liquids a minimum of 25 ft (7.6 m) from presses.

2.3.1.3 Stage ignitable liquids a minimum of 35 ft (10.7 m) from other in-process storage in the press area.

2.3.2 Paste Ink Staging and Storage

2.3.2.1 Stage paste inks a minimum of 10 ft (3 m) from all press units, as shown in Figure 2.3.2.1.

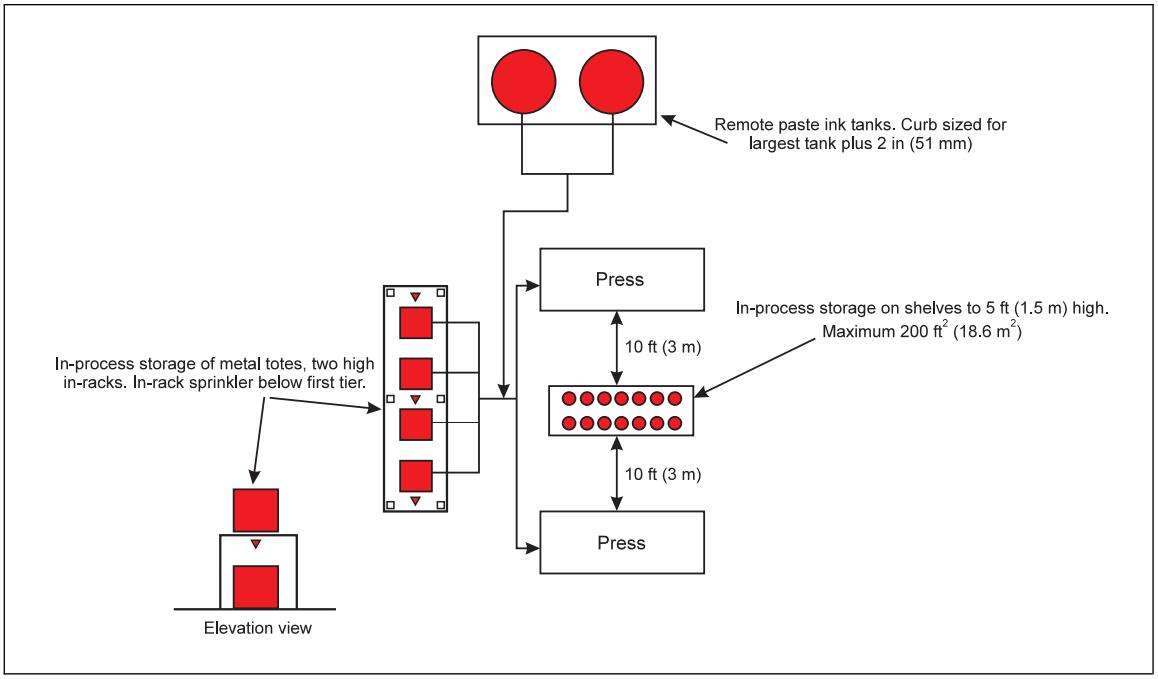


Fig. 2.3.2.1. Paste ink staging

2.3.2.2 Stage paste ink in combustible containers a minimum of 25 ft (7.6 m) from other combustible storage.

2.3.2.3 Stage paste ink in portable metal containers, including tanks, a minimum of 10 ft (3 m) from other combustible storage.

2.3.2.4 For containers of paste ink that are 6.5 gal (25 L) or less, limit staging to areas no larger than 200 ft^2 (18.6 m^2).

2.3.2.4.1 Limit palletized storage to one pallet high.

2.3.2.4.2 Limit storage on metal shelves to 5 ft (1.5 m) high.

2.3.2.5 For portable metal containers of paste ink that are greater than 6.5 gal (25 L), including tanks, limit staging to two-high in racks or two-high palletized. .

2.3.3 Roll Stock Staging

2.3.3.1 Limit staging of roll paper in the press room to 200 ft^2 (18.6 m^2) in area and a maximum of 10 ft (3 m) high.

2.3.3.2 Limit staging of roll plastic in the press room to 200 ft^2 (18.6 m^2) in area and a maximum of 5 ft (1.5 m) high.

2.3.3.3 Stage roll paper and roll plastic a minimum of 25 ft (7.6 m) from presses and other combustibles.

2.3.4 Housekeeping

2.3.4.1 Establish regular cleaning schedules for the following:

A. Presses, including all shielded areas around and below the press

B. Ink collection trough (below rolls)

C. Folders

D. Ovens and dryers (inside, above, and below)

E. Slitters

F. Dust collection ducts

G. Baler rooms

H. Oil collection pans (e.g., press roll seals, gear box face plates, oil trough pathways)

I. Electrical equipment (e.g., bearings, drive motors, gearboxes)

J. Ducts

K. Finishing operations/equipment

L. Structural members (e.g., roof, ceiling, beams)

M. Areas above suspended ceilings

2.3.4.2 Prevent the accumulation of paper scrap, ignitable liquids and cleaning rags.

2.3.4.3 Keep equipment that generates combustible dust (i.e., paper and starch) and the surrounding areas as dust-free as possible using automatic dust-collection equipment.

2.3.4.3.1 In the event of an accidental dust release, use vacuuming to clean up the dust. Refer to Data Sheet 7-76, Combustible *Dust*.

2.3.4.4 Do not allow continuous residue accumulations of greater than 1/16 in. (1.6 mm) high-density dust to 1/8 in. (3.2 mm) low-density dust between press units above or below the press operating floor.

2.3.4.5 Record cleaning frequencies.

2.3.4.6 Redesign of the ventilation system may be needed where frequent cleaning is required.

2.4 Protection

2.4.1 General

2.4.1.1 Install wet, dry or pre-action automatic sprinkler systems throughout the printing facility in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

2.4.1.2 For press rooms with limited or no in-process storage, as outlined in this data sheet, design ceiling sprinkler protection for an HC-3 occupancy in accordance with Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*.

2.4.1.3 For press rooms with excess amounts of in-process storage of ignitable liquids as outlined in Section 2.3.1, paste ink as outlined in Section 2.3.2, roll stock as outlined in Section 2.3.3, or other combustible storage, design ceiling sprinkler protection in accordance with the appropriate data sheet, as follows:

- Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*, for sealed containers
- Data Sheet 7-32, *Ignitable Liquids Operations*, for in-use and/or open containers
- Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*
- Data Sheet 8-21, *Roll Paper Storage*

2.4.1.3.1 Protect the entire press room area for the highest hazard.

2.4.2 In-Press Protection – General

2.4.2.1 Provide protection in all press shielded and concealed spaces containing ignitable liquids, combustible deposits, wiring harnesses, combustible insulation or other combustible materials. Examples of shielded and concealed spaces include, but are not limited to, catwalks, operator platforms, mezzanines, control rooms, and enclosures.

2.4.2.2 Provide in-press protection in accordance with the following sections, depending on press type:

A. Section 2.4.3 for lithograph, newspaper presses

B. Section 2.4.4 for lithograph, non-newspaper presses

C. Section 2.4.5 for rotogravure and flexographic presses

D. Section 2.4.6 for digital presses

2.4.2.3 For presses that use a variety of inks, protection should be designed based on the lowest flash point ink that would be used in the press.

2.4.2.4 Where automatic sprinkler protection is recommended, install FM Approved minimum K5.6 (K80), quick-response sprinklers.

2.4.2.4.1 Ensure the temperature rating of the sprinkler is at least 50°F (10°C) above the ambient temperature in the area, with a minimum temperature rating of 165°F (74°C).

2.4.2.5 Design in-press sprinklers to provide a minimum flow of 22 gpm (83 L/min) from the seven hydraulically most remote operating sprinklers, unless otherwise noted.

2.4.2.6 In-press sprinklers do not need to be balanced with the ceiling sprinkler system, unless otherwise noted.

2.4.2.7 Install cages or equivalent protection around sprinklers if mechanical damage could potentially result in their operation.

2.4.2.8 Cover automatic sprinklers that are subject to ink spray or other residue with thin plastic or paper bags. Replace covers frequently so heavy deposits of residue do not accumulate.

2.4.2.9 Where a special protection system is recommended, design and install in accordance with this section.

2.4.2.9.1 Protect enclosed presses with an FM Approved total flooding CO_2 system in accordance with Data Sheet 4-11N, *Carbon Dioxide Extinguishing Systems*.

2.4.2.9.2 Protect unenclosed presses with an FM Approved local application CO_2 system in accordance with Data Sheet 4-11N, *Carbon Dioxide Extinguishing Systems*.

2.4.2.9.2.1 Design the system so that the full quantity of agent needed to meet design concentration is discharged within 30 seconds.

2.4.2.9.2.2 Provide an agent supply quantity sufficient for two automatic CO_2 releases.

2.4.2.9.2.3 Configure the agent releasing controls for one automatic agent discharge with automatic agent flow stop at the end of the calculated maximum discharge period.

2.4.2.9.2.4 Configure the controls to provide a second agent release for the calculated maximum discharge period on an automatic activation system following a time delay after the first discharge if the fire detection goes back into alarm.

2.4.2.9.2.5 Design CO_2 protection using the local application rate-by-volume design method for all press hazards, including open process (e.g., ink fountains), surfaces coated with ignitable ink (e.g., rolls and frames) and a 3 ft (1 m) spherical radius around ink reservoirs.

2.4.2.9.3 Provide sufficient agent quantity for the hazard requiring the largest agent flowrate and duration.

2.4.2.9.4 Arrange the CO_2 discharge nozzles to cover all areas of the press that contain potentially combustible material, including:

A. Both the drive side and the operator side of the press

B. Surfaces coated with ignitable ink under normal operation

C. Floor beneath the areas where ignitable liquid spills can pool

D. Within enclosed areas

2.4.2.9.5 Arrange the system so that it can be automatically activated by a FM Approved fire detection system and manually activated by press operators.

2.4.2.9.5.1 Locate detectors in and around the press where the smoke, heat, or other effects from the fire are likely to occur.

2.4.2.9.6 Design press protection to either discharge over the entire press line at one time or subdivide into zones. In the latter case, provide adequate agent for a full discharge for all press units.

2.4.2.9.7 Conduct acceptance testing in accordance with FM Data Sheet 4-11N, *Carbon Dioxide Extinguishing Systems*.

2.4.3 In-Press Protection - Lithograph, Newspaper Press Protection

The protection recommended for newspaper presses is intended to confine a fire to one press unit for both single-unit-high presses and multiple-unit-high (tower) presses.

2.4.3.1 Install automatic sprinkler protection for reel rooms as follows and as shown in Figure 2.4.3.1-1 for single-level presses and Figure 2.4.3.1-2 for multi-level presses:

A. Between each reel stand. Alternatively, install a standard sidewall sprinkler, as high as possible, on one side of the press between each unit discharging across and under the press units.

B. Under metal skirts surrounding the press at the top of the reel level.

C. Over collection pans that contain oil or ink residues.

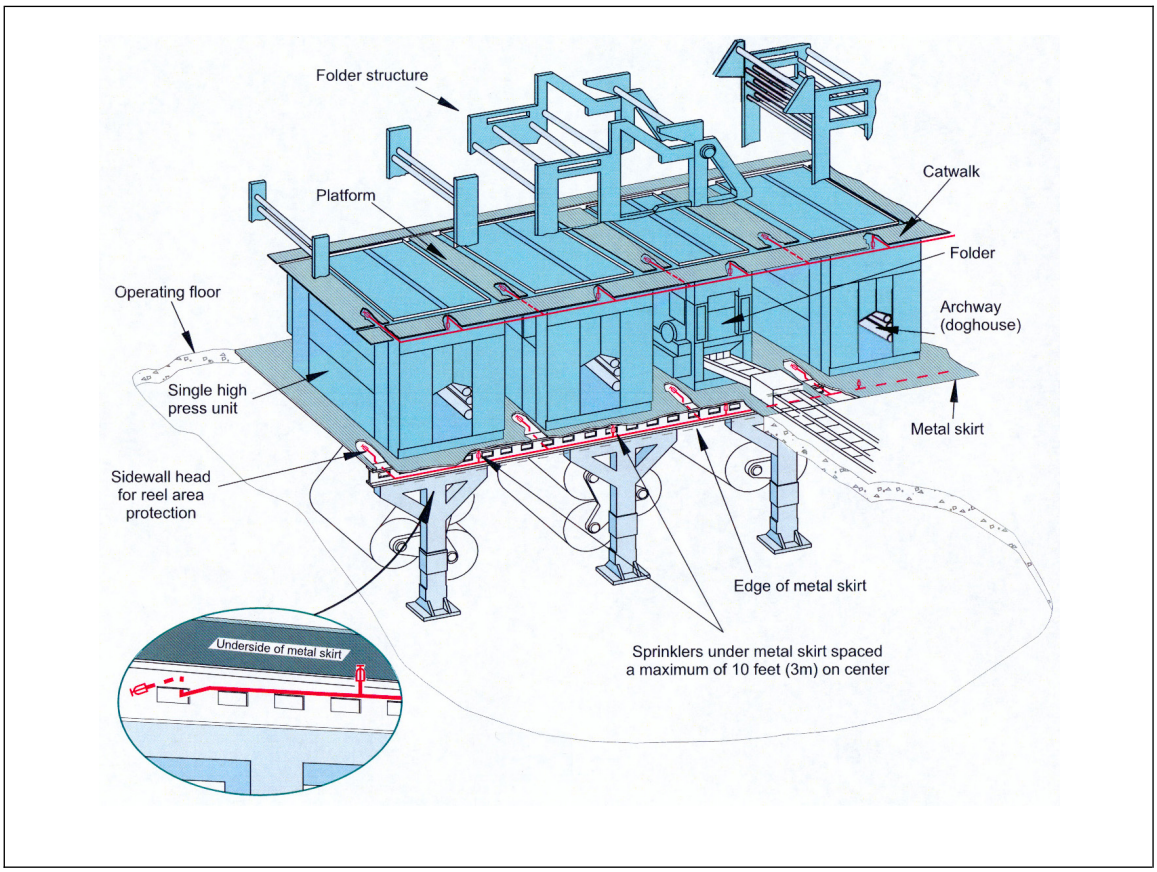


Fig. 2.4.3.1-1. In-press protection for single-level, lithographic, newspaper press

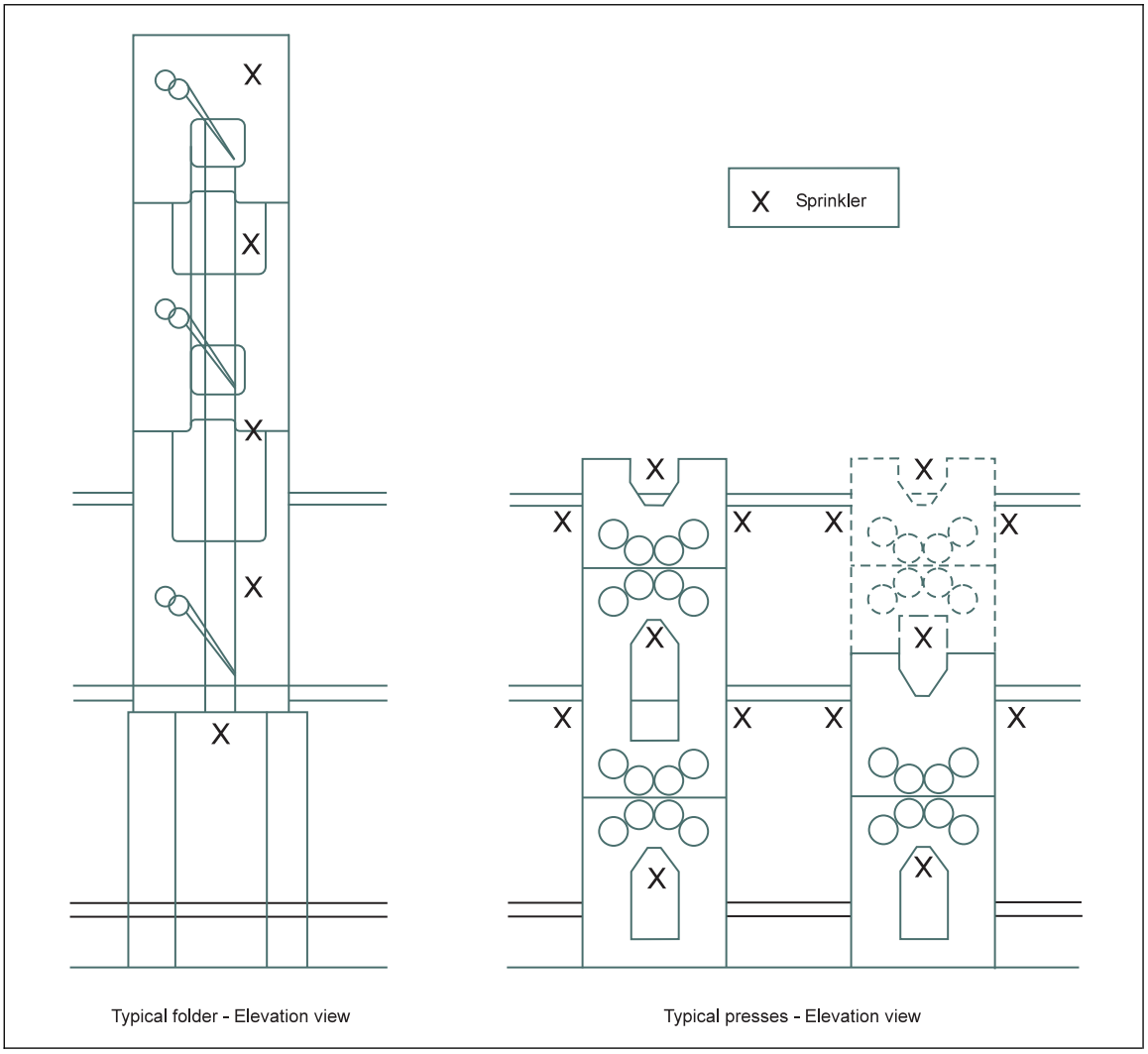


Fig. 2.4.3.1-2. In-press protection for multi-level, lithographic, newspaper press

2.4.3.2 Provide protection for single-unit-high presses shielded from ceiling sprinkler protection as follows:

2.4.3.2.1 Provide automatic sprinklers under all platforms or walkways, regardless of width between press units. Installation at the center of a platform (along centerline of press) is preferable; however, the sprinkler may need to be located at the side of the platform due to obstructions or web break. If the web runs under the platform, a web break could wrap around the sprinkler.

2.4.3.2.2 Provide automatic sprinkler protection under catwalks adjacent to the press when **any** of the following conditions exist:

A. Catwalks are above a press unit operating level

B. Catwalks are 4 ft (1.2 m) or more in width

C. There are combustibles under the catwalk, including ignitable liquid-piping or electrical cable

2.4.3.3 Provide one of the following types of fixed fire protection for multiple-unit-high (tower) presses:

A. Automatic sprinkler system below platforms, catwalks and in archways

B. Automatic fixed water spray system

2.4.3.4 When an automatic sprinkler system is provided for protection below platforms, catwalks, and in archways, use the following criteria:

2.4.3.4.1 Provide automatic sprinklers for multi-level presses at all operating levels as described in Section 2.4.3.2.

2.4.3.4.2 Provide automatic sprinklers to protect all archways (doghouses) of press towers to limit vertical fire spread.

2.4.3.4.3 Design sprinklers to provide a minimum flow of 22 gpm (83 L/min) from the 14 hydraulically most remote operating sprinklers (seven sprinklers on each of two levels).

2.4.3.5 When an automatic fixed water spray system is provided, use the following criteria:

2.4.3.5.1 Arrange FM Approved open nozzles around each press level, with the nozzles pointed into press openings.

2.4.3.5.2 Design the system to provide 22 gpm (85 L/min) with a minimum discharge pressure of 7 psig (0.5 barg) using solid cone, spray nozzles with a maximum discharge angle of 120°.

2.4.3.5.3 Provide a separate deluge valve for each tower tied to a heat detection system located above that tower. Alternatively, use automatic zone valves tied to a heat-detection system located above a tower and a single deluge valve.

2.4.3.5.4 Provide a water supply adequate for the water-spray systems in two adjacent towers.

2.4.4 In-Press Protection - Lithograph, Non-Newspaper Press

2.4.4.1 Protect vertical web presses in accordance with the recommendations in Section 2.4.3 and the following:

2.4.4.1.1 Provide sprinkler protection below solid or grated mezzanines between stacked horizontal presses.

2.4.4.1.2 For solid mezzanines, design sprinkler protection below the mezzanine for 0.20 gpm/ft^2 (8 mm/min) over 3000 ft^2 (280 m^2) or the area of the mezzanine, whichever is smaller.

2.4.4.1.3 For grated mezzanines, design sprinkler protection below the mezzanine to provide a minimum flow of 22 gpm (83 L/min) out of the seven hydraulically most remote operating sprinklers.

2.4.4.2 For horizontal web presses, provide sprinkler protection in concealed spaces within the press and under walkways as shown in Figures 2.4.4.2-1 and 2.4.4.2-2.

2.4.5 In-Press Protection - Rotogravure and Flexographic Press

2.4.5.1 For presses that contain high flash point ignitable liquids and/or combustible deposits, provide automatic sprinkler protection in accordance with this section.

2.4.5.1.1 For rotogravure presses, provide automatic sprinkler protection in the following areas as follows as shown in Figure 2.4.5.1.1:

A. Both sides of the roll stacks

B. Floor area under the press

C. Ink carts, ink reservoirs, or ink viscosity control equipment

D. Dryers

E. Exhaust ducts

F. Folders, if part of the press line; use automatic sprinkler protection if folder is in a separate enclosure

G. Below solid or grated mezzanines

H. In concealed spaces within the press

2.4.5.1.2 For flexographic presses, provide automatic sprinkler protection in the following areas as shown in Figures 2.4.5.1.2-1 and 2.4.5.1.2-2:

A. Printing stations

B. Floor area under the CI drum / frame

C. Rollers

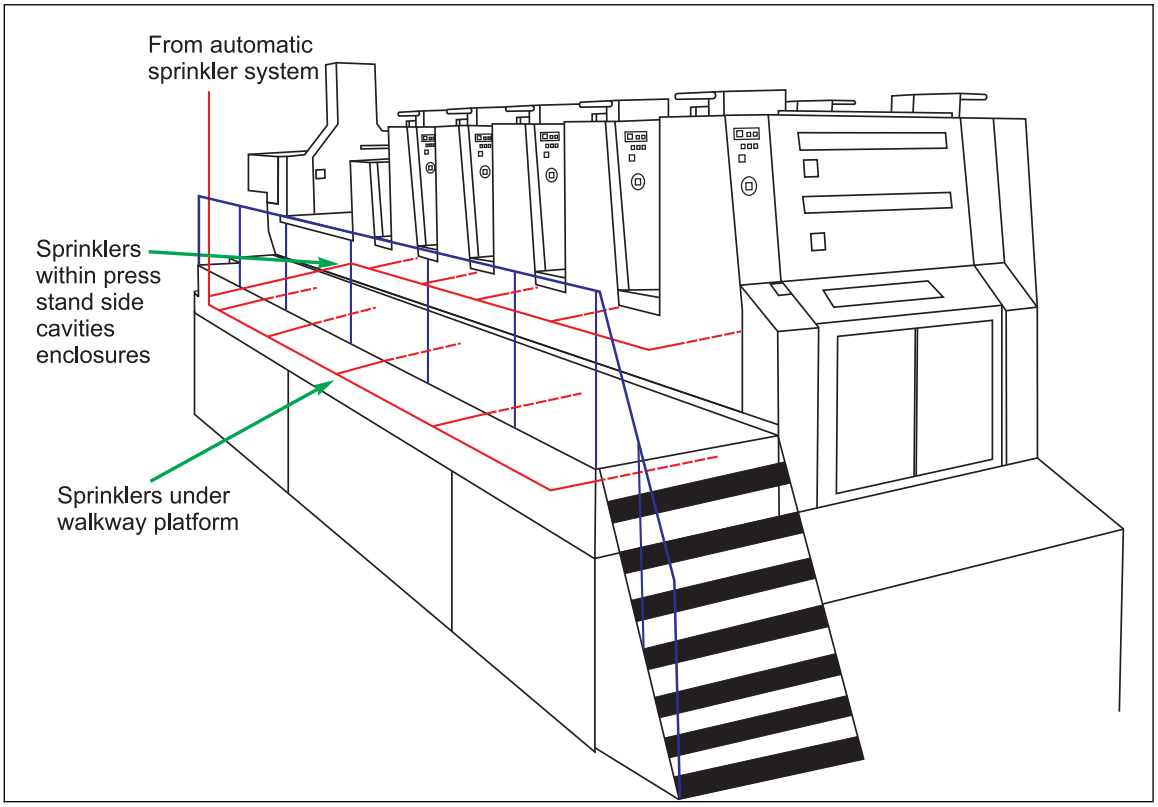


Fig. 2.4.4.2-1. In-press protection for lithographic, horizontal web press

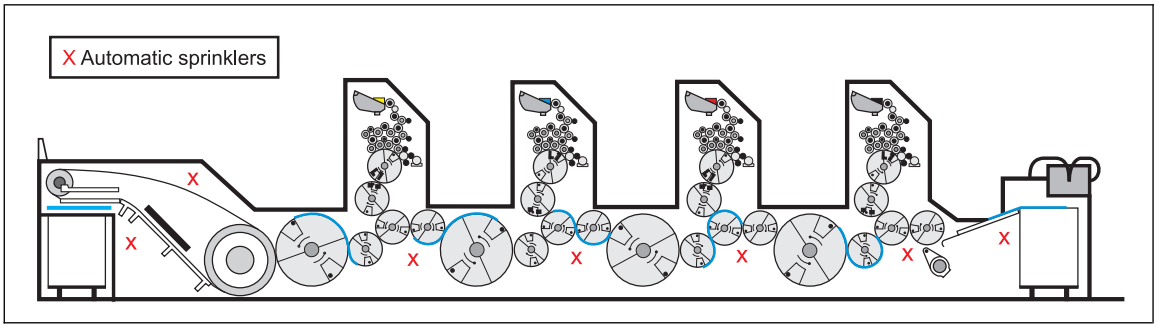


Fig. 2.4.4.2-2. In-press protection for lithographic, horizontal web press – alternate view

D. Ink, ink viscosity control equipment, and solvent tanks

E. Dryer

F. Exhaust ducts

G. Below solid or grated mezzanines

H. In concealed spaces within the press

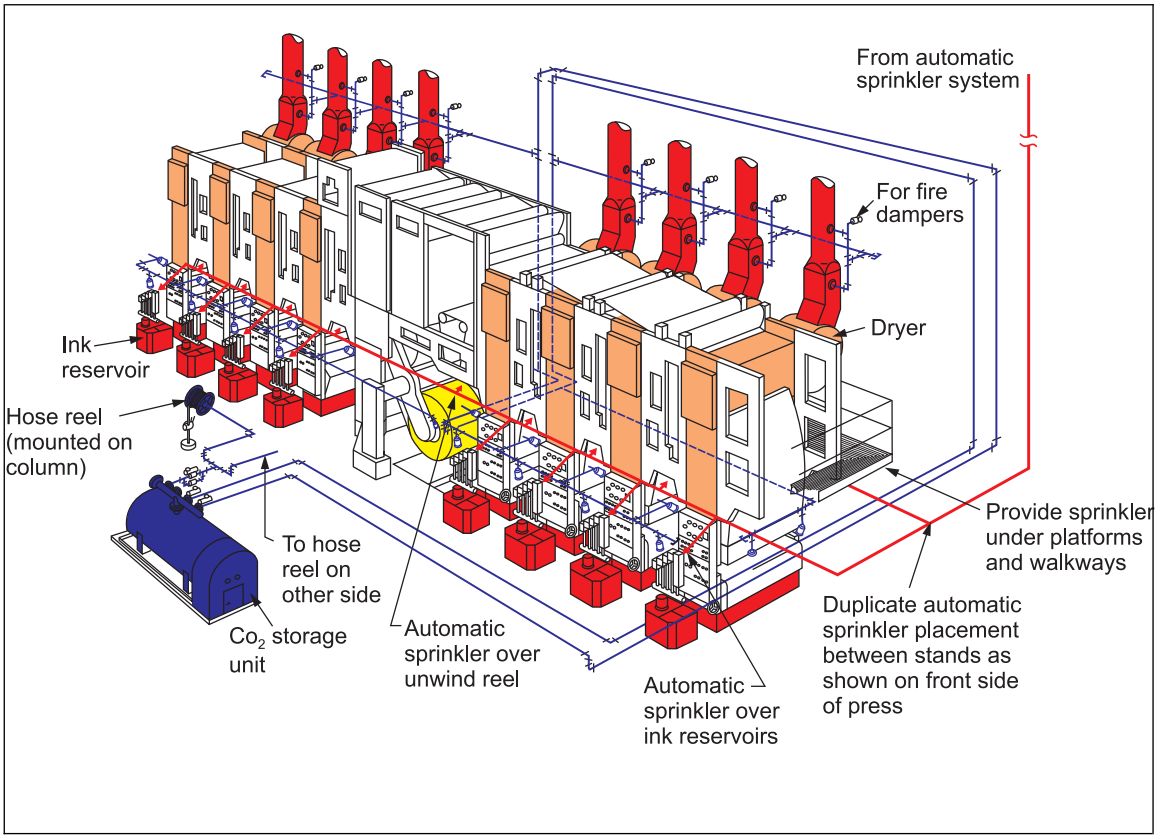


Fig. 2.4.5.1.1. In-press protection for rotogravure press

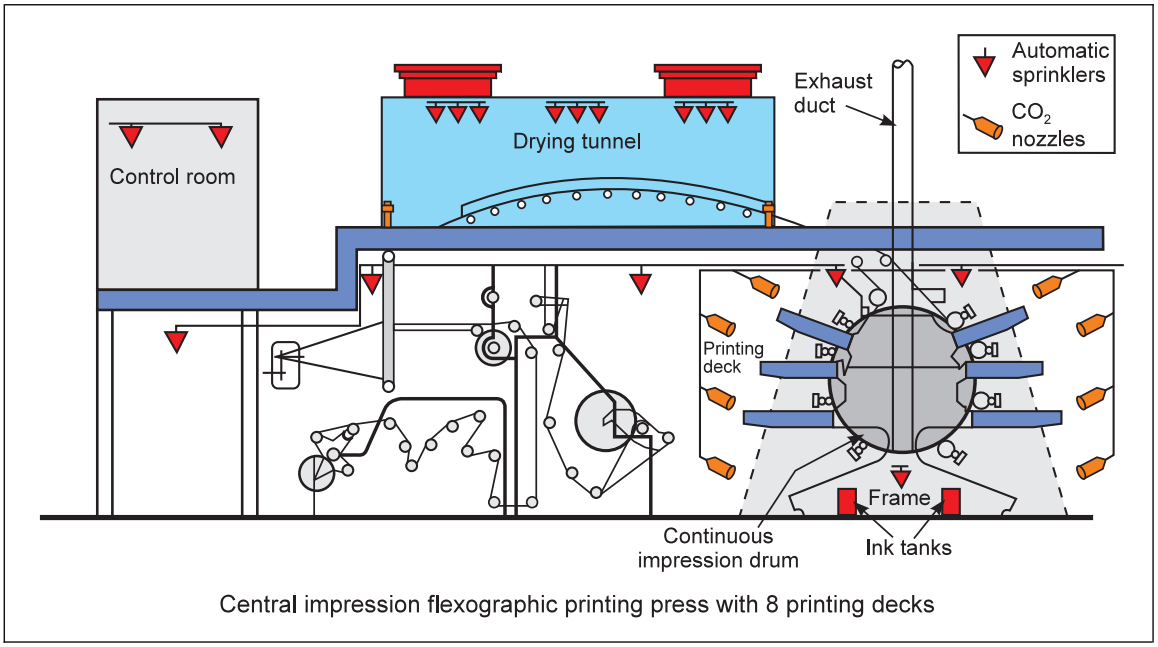


Fig. 2.4.5.1.2-1. In-press protection for central impression flexographic press

2.4.5.2 For presses that contain low flash point ignitable liquids, provide a combination of automatic sprinklers and special protection systems.

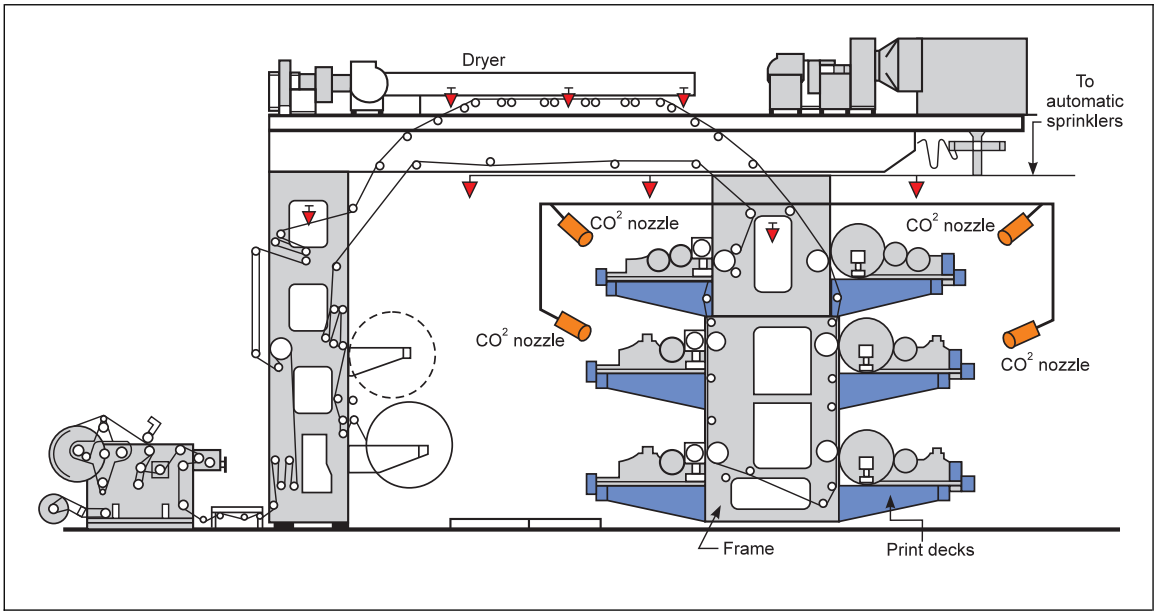


Fig. 2.4.5.1.2-2. In-press protection for stack-type flexographic press

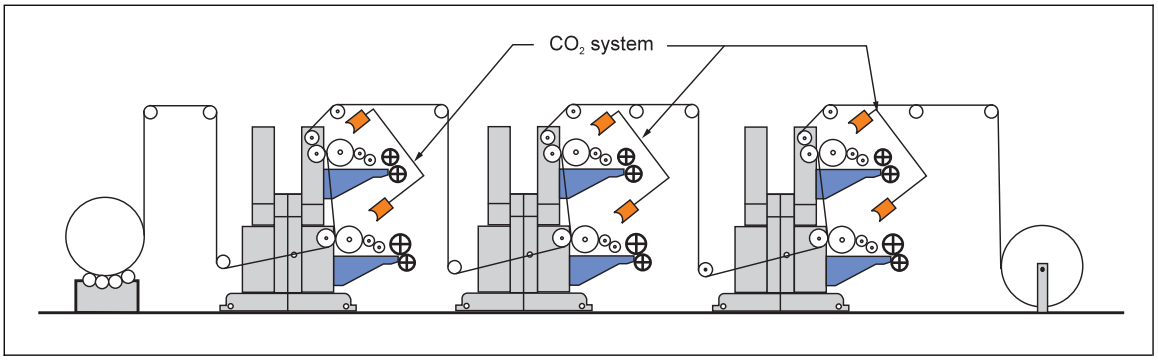


Fig. 2.4.5.2.2. In-press protection for in-line flexographic press

2.4.5.2.1 Design and install automatic sprinklers in accordance with 2.4.51.

2.4.5.2.2 Design and install a special protection system in accordance with Section 2.4.2.9, Figure 2.4.5.1.2-1, Figure 2.4.5.1.2-2, and Figure 2.4.5.2.2.

2.4.5.3 Provide web-break detection and interlocks to shut down the press to prevent burning or solvent/ink-soaked material from being pulled through the press.

2.4.6 In-Press Protection - Digital Press

2.4.6.1 Provide in-press sprinklers or a special protection system in concealed spaces where ignitable liquids are present.

2.4.7 Paste Ink Storage and Staging

Automatic sprinkler protection will be effective on a pool fire. Press-room protection as recommended in this data sheet is expected to control a fire involving paste ink.

2.4.7.1 For paste ink stored in containers that are 6.5 gal (25 L) or less, design ceiling sprinkler protection in accordance with Data Sheet 8-9, *Storage of Class 1, 2, 3, 4, and Plastic Commodities*, using the protection criteria for a cartoned unexpanded plastic.

2.4.7.2 For paste ink stored in portable metal containers, including tanks, that are greater than 6.5 gal (25 L), design ceiling sprinkler protection to provide minimum 0.30 gpm/ft^2 (12 mm/min) over 2000 ft^2 (190 m^2) using 165°F (73°C) sprinklers.

2.4.7.3 Provide in-rack sprinklers over the first tier of a tote storage rack located at each rack upright using a maximum horizontal spacing of 8 ft (2.4 m).

2.4.7.3.1 Use FM Approved, minimum K5.6 (K80), 165°F (73°C) temperature rated, quick-response, automatic in-rack sprinklers.

2.4.7.3.2 Design sprinklers to provide a minimum flow of 30 gpm (115 L/min) from the eight hydraulically most remote operating sprinklers.

2.4.7.3.3 Balance the in-rack sprinkler system with the ceiling sprinkler system.

2.4.8 Control Rooms, Computer Rooms, and Motor Control Centers

2.4.8.1 Protect control rooms and computer rooms in accordance with Data Sheet 7-110, *Industrial Control Systems*.

2.4.8.2 Protect motor control centers in accordance with Data Sheet 5-19, *Switchgear and Circuit Breakers*.

2.4.8.3 Provide automatic smoke detection in the room and below raised floors.

2.4.8.3.1 Detection shall alarm to a constantly attended location.

2.4.8.4 Prohibit combustible storage within these rooms.

2.4.9 Baler Rooms

2.4.9.1 Provide ceiling sprinkler protection designed for an HC-3 occupancy in accordance with Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*.

2.4.9.1.1 If hydraulic equipment is present, protect the baler room in accordance with Data Sheet 7-98, *Hydraulic Fluids*.

2.4.10 Roll Stock Bulk Storage

2.4.10.1 Protect bulk storage of roll paper in accordance with Data Sheet 8-21, *Roll Paper Storage*.

2.5 Equipment and Processes

2.5.1 General

2.5.1.1 Ensure the press and associated equipment controls meet the recommendations in Data Sheet 7-110, *Industrial Control Systems*.

2.5.1.2 Interlock the following systems to initiate a controlled automatic shutdown upon activation of a fire detection or fire protection system:

A. Press and interconnected equipment such as dryers, RTOs, etc.

B. Ignitable liquid transfer systems. Safety shutoff valves should close, and pumps should shut down.

C. Vacuum systems

D. Hydraulic oil systems where FM Approved industrial fluids cannot be utilized

E. Exhaust systems

F. Lube oil systems

G. Pneumatic systems

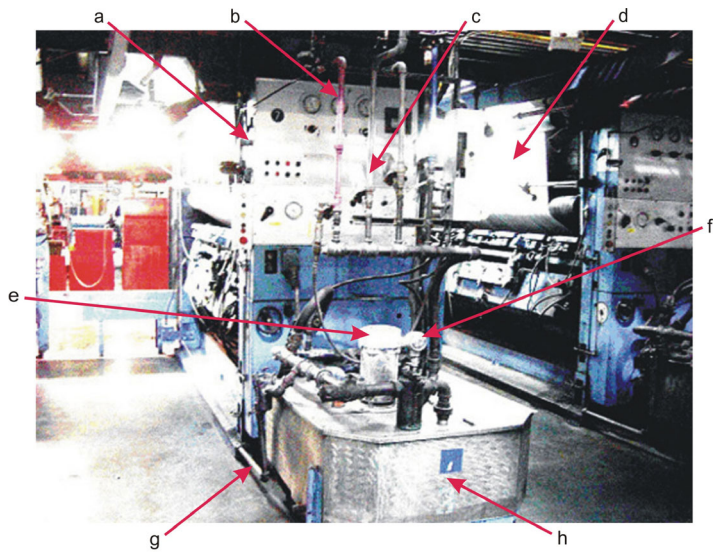
H. Plant air systems

2.5.1.2.1 Coordinate press shutdown procedures through the existing press control system. Automatic shutdown can incorporate a controlled shutdown in coordination with web, stop and impression roll release.

2.5.1.3 Provide a remotely accessible manual shut-off.

2.5.2 Ignitable Liquid Transfer Systems

2.5.2.1 Hard pipe all ignitable liquids from their appropriately isolated storage tanks or mixing rooms to the individual presses. Figure 2.5.2.1 shows an example of a piped system for a rotogravure press.



a) Press unit
b) Piping to bulk ink/solvent storage
c) Solenoid valves
d) Web
e) Motor for pump
f) Rated electrical equipment
g) Piping to ink pan and strainer
h) Ink sump

Fig. 2.5.2.1. Piped ink system on rotogravure press

2.5.2.2 Arrange piped ink transfer systems as follows:

2.5.2.2.1 Use welded steel pipe or tubing. Do not use piping that could fail under fire exposure such as plastic piping, rubber hose or copper pipe with sweat-soldered joints.

2.5.2.2.2 Limit flanged or screwed fittings to the minimum needed for equipment repair/replacement.

2.5.2.2.3 Provide high-level alarms and high-high-level alarm and pump shutoffs for ink reservoirs.

2.5.2.2.4 Use braided metal hose when flexible piping is needed.

2.5.2.2.5 Install an FM Approved safety shut-off valve at the liquid source.

2.5.2.2.6 Install an FM Approved safety shut-off valve at the point of use.

2.5.2.2.7 Interlock the safety shutoff valves to close upon detection of a fire or activation of a fire protection system.

2.5.2.2.8 Interlock the pumps to shut down upon detection of a fire or activation of a fire protection system.

2.5.2.2.9 Ensure the transfer system is properly bonded and grounded in accordance with Data Sheet 5-8, *Static Electricity*.

2.5.2.3 Where regular color changes prevent the use of a piped ink delivery system, use FM Approved safety cans to transfer ink to the press.

2.5.2.4 In cases where more than 55 gal (210 L) of solvent is needed at a press for normal operations, hard-pipe solvent from a properly arranged cut-off room or tank per Section 2.5.2.2 to the point of use on the press, and arrange in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.5.2.5 In cases where manual handling is needed, solvent dispensing stations shall be arranged as follows and as shown in Figure 2.5.2.5.

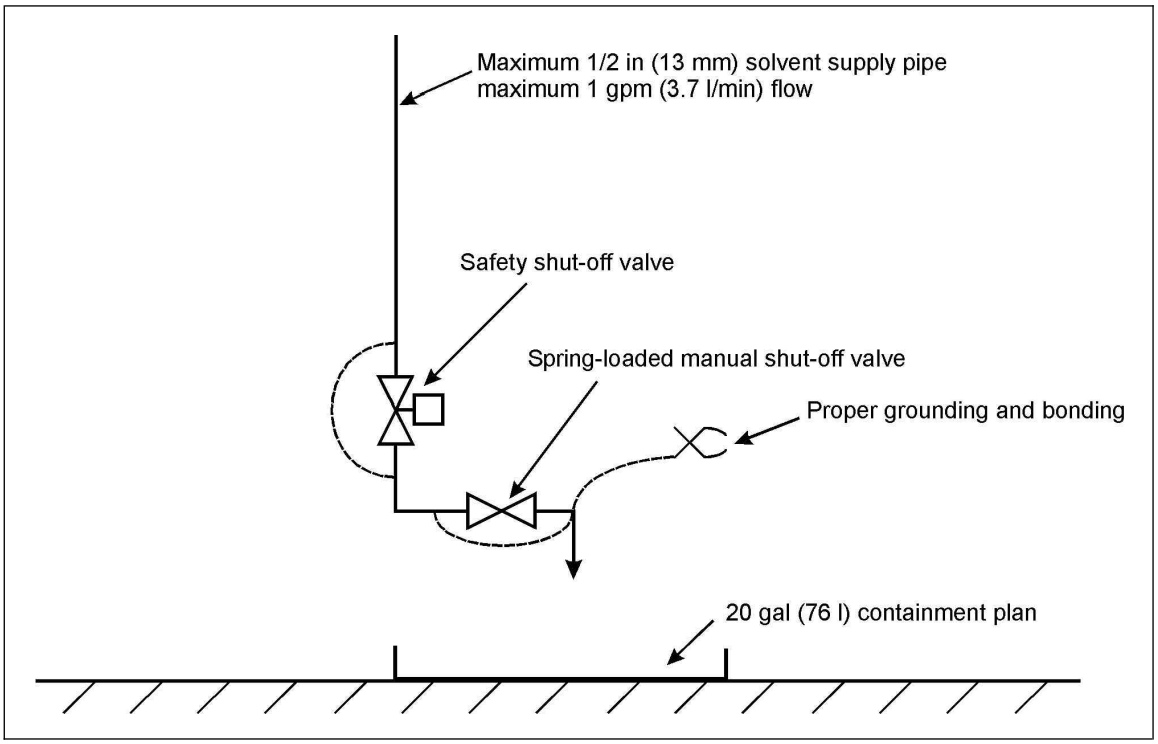


Fig. 2.5.2.5. Solvent dispensing station arrangement

2.5.2.5.1 Locate the dispensing station minimum 15 ft (4.6 m) from any press.

2.5.2.5.2 Locate the dispensing station minimum 25 ft (7.6 m) from any in-process storage.

2.5.2.5.3 Design the system to use the minimum flow rate necessary for normal operations, but do not exceed 1 gpm (3.8 L/min) and 1/2 in. (13 mm) diameter pipe/tubing.

2.5.2.5.4 Provide containment at the dispensing point designed to hold at least 20 gal (76 L) of solvent.

2.5.2.5.5 Install an FM Approved safety shut-off valve at the point of use.

2.5.2.5.6 Install an FM Approved, normally closed, spring-loaded valve at the dispensing point for regular dispensing operations.

2.5.2.5.7 Provide flammable vapor exhaust in accordance with Section 2.5.3.

2.5.2.5.8 Provide properly arranged bonding and grounding in accordance with Data Sheet 5-8, *Static Electricity*.

2.5.2.6 Do not dispense ignitable liquids in storage areas.

2.5.2.7 Transport ignitable liquids in sealed metal containers.

2.5.3 Ventilation

2.5.3.1 Provide local ignitable liquids vapor exhaust ventilation for the following:

A. Rotogravure and flexographic presses which use low flash point inks for normal operation

B. All presses which use low flash point solvents for cleaning, including cleaning during shutdowns.

2.5.3.1.1 Provide general area exhaust ventilation at a rate of 1 cfm/ft^2 (0.3 m^3/min m^2) based on one of the following:

A. The gross area of the press enclosure

B. The footprint area of the press vapor release points outside the press plus 10 ft (3 m) on all sides

2.5.3.1.1.1 Provide exhaust intakes as follows:

A. Maximum 12 in. (0.3 m) from the floor

B. Within 10 ft (3 m) of open ignitable liquids or dispensing locations (e.g., on each side of each ink reservoir or ink fountain).

2.5.3.1.2 Provide general area exhaust ventilation at dispensing locations or other open process vapor release points for low flash point ignitable liquids, which are located away from the press, per the design in Section 2.5.3.1.1.

2.5.3.1.3 Provide sensing for loss of exhaust air flowrate (i.e., not sensing fan operation) by an air movement sensor (e.g., pitot tube or sail switch) positioned in the exhaust duct.

2.5.3.1.3.1 Connect the airflow sensing system to the press and dryer safety control system, configured to stop the ink flow, solvent, thinner, and blanket wash systems. Provide an alarm if the airflow decreases below the required rate.

2.5.4 Dryers and Regenerative Thermal Oxidizers

2.5.4.1 Design and protect dryers in accordance with Data Sheet 6-9, *Industrial Ovens and Dryers*, and the guidance in this section.

2.5.4.2 Design and protect regenerative thermal oxidizers (RTOs) in accordance with Data Sheet 6-11, *Thermal and Regenerative Catalytic Oxidizers*, and the guidance in this section.

2.5.4.3 Provide the following additional protection where applicable and refer to Figure 2.5.4.3 for additional guidance on explosion venting of dryers and ducts.

Figure 2.5.4.3 shows a typical rotogravure exhaust system design with recirculated dryer atmosphere into a burner combustion chamber. The figure shows lower flammability limit (LFL) detectors for the dryer, explosion venting for the dryer and ductwork, and damper arrangement.

2.5.4.3.1 Where LFL detection is required, provide FM Approved LFL detectors directly on the dryer to minimize the length of sampling tubes (i.e. ensure the detector is local to the equipment). Sampling tubes with extended lengths can delay notification, increasing response time.

2.5.4.3.1.1 Test and maintain detectors in accordance with OEM specifications.

2.5.4.3.1.2 If a flammable calibration gas is needed for the detection system, locate cylinders outside of important buildings and follow guidance in Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage*.

2.5.4.3.2 Where dryers are operated above 25% of the LFL, interlock detectors to alarm at a maximum of 45% and trip at 50%.

2.5.4.3.2.1 Arrange the tripping of the interlocks to shut off burners, lift the press imprint roller, stop the web (fast stop), open ventilation dampers, and increase fan speed.

2.5.4.4 Interlock the imprint roller with exhaust ventilation on flexographic and rotogravure presses using low flash point inks. Conducting imprint roller color checks with the dryer ventilation system off could result in an explosion in the dryer.

2.5.4.5 Arrange damper settings so minimum exhaust ventilation is maintained based on ink application rate or automatic solvent wash, whichever is greater.

2.5.4.5.1 Provide dampers with proximity (position) switches so minimum exhaust ventilation is maintained.

2.5.4.5.1.1 Alternatively, provide mechanical stops on the dampers arranged to ensure the minimum needed exhaust rate will be maintained.

2.5.4.6 Provide damage-limiting construction for dryers that are direct fired and/or handle ignitable solvents in accordance with Data Sheet 6-9, *Industrial Ovens and Dryers*, Data Sheet 7-32, *Ignitable Liquid Operations*, and Data Sheet 1-44, *Damage-Limiting Construction*.

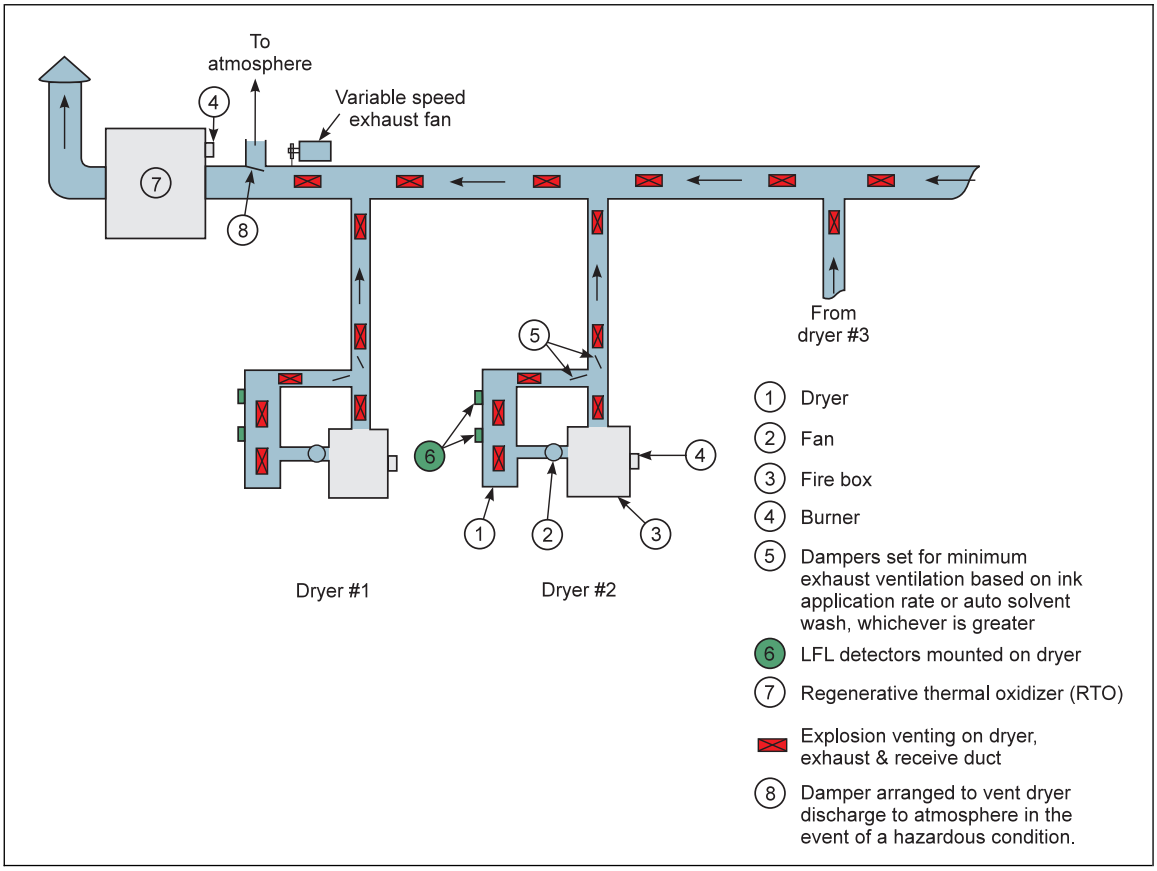


Fig. 2.5.4.3. Typical exhaust system design – rotogravure press

2.5.4.6.1 Provide explosion protection for exhaust ducts in accordance with Data Sheet 6-11, *Thermal and Regenerative Catalytic Oxidizers*. The ducts include dryer exhaust and recirculation ducts where dryer or oven atmosphere is re-circulated to the combustion chamber.

2.5.4.7 Provide separate exhaust ventilation for each dryer and the RTO, where possible, so each can be independently purged to atmosphere during startup or process upset conditions.

2.5.4.8 Where a common exhaust system is supported by a variable-speed exhaust fan downstream of the dryer or other vapor generating equipment that provides a constant negative exhaust system pressure, do the following:

2.5.4.8.1 Prevent operation of the RTO, or shut it down, and vent the dryer exhaust to atmosphere if a hazardous condition exists.

2.5.4.8.2 Provide LFL detection in the dryer and exhaust ducts connected to the RTO.

2.5.4.8.3 Provide direct airflow measurement in the duct connecting dryers to the central exhaust system.

2.5.4.8.3.1 Interlock the system to shut down dryers and RTO. Do not use a negative exhaust pressure interlock; this is not effective because the variable speed fan is designed to maintain a constant negative pressure.

2.5.4.8.4 Provide proper damper controls to ensure adequate ventilation of dryers, exhaust ducts, and RTO.

2.5.4.8.5 Do not allow re-circulation of exhaust from one dryer to other dryers.

2.5.4.8.6 Ensure the RTO is in operation before dryers are purged and the startup cycle is initiated.

2.5.4.8.7 Shut off the burner for the dryers and stop the press imprint roller and web if the thermal oxidizer trips.

2.5.4.9 Where press designs allow modification of re-circulation rates for the dryers, do the following:

2.5.4.9.1 Verify there has been no change in safety monitoring interlocks (air flow, air pressure switches, damper proximity switches) following a modification of recirculation rate.

2.5.4.9.2 Develop a formal procedure to confirm the change in recirculation rate will not result in hazardous vapor concentrations in the dryer and associated ductwork.

2.5.4.10 Provide sensing of exhaust air flowrate from the dryer (i.e. not sensing fan operation or speed measurement) by means of an air movement sensor (e.g. pitot or sail switch) positioned in the duct.

2.5.4.10.1 Connect the air flow measurement system to the press and dryer safety control systems.

2.5.4.10.2 Configure the air flow measurement system to stop the ignitable liquid systems.

2.5.4.10.3 Provide an alarm if the airflow decreases below the required rate.

2.5.4.10.4 Balance dryer exhaust minimum air flowrates using manual dampers in the ducts with positive lock axles and shake resistant linkage to provide certain blade position lock.

2.5.4.10.4.1 Provide an exterior visual position indicator marked with the minimum air flowrate.

2.5.4.10.5 Do not install automatic controlled variable position dampers in the dryer exhaust.

2.5.4.10.5.1 If installation of these dampers is unavoidable, provide a damper position sensor interlocked to provide an alarm and shut down ink flow if the damper travels past the dryer minimum exhaust air flowrate.

2.5.4.11 Interlock direct-fired dryers (or dryers that operate at a temperature high enough to ignite the printed material) to shut down when the press is stopped.

2.5.4.11.1 For rotary web press, the web could be automatically removed on press shutdown.

2.5.4.12 Provide dryers with access ports for manual firefighting.

2.6 Operation and Maintenance

2.6.1 Clean and test the static eliminator system periodically.

2.6.2 Establish a formal preventive and predictive maintenance program for press unit bearings, drive motors, clutches, gearboxes, dryer fans, and combustion blowers.

2.6.3 Establish a formal preventive and predictive maintenance program for the blades or cutting tools used in cutting and/or slitting operations. Combustible dust liberation occurs primarily during these operations, and it can be directly correlated to the condition of the cutting tool utilized.

2.6.4 Establish a formal preventive maintenance and testing program for all fuel-fired equipment burner safety controls.

2.6.5 Establish a formal preventive maintenance, testing, and calibration program for LFL detection systems and interlocks on press dryers and thermal oxidizer units in accordance with OEM specifications.

2.6.6 Maintain dryers and thermal oxidizing equipment in accordance with OEM specifications and Data Sheet 6-9, *Industrial Ovens and Dryers* and Data Sheet 6-11, *Thermal and Regenerative Catalytic Oxidizers*.

2.6.7 Inspect ducts, areas above suspended ceilings and all pit areas at least every six months.

2.6.8 For carbon dioxide extinguishing systems, conduct inspection, testing and maintenance in accordance with Data Sheet 4-11N, *Carbon Dioxide Extinguishing Systems* and Data Sheet 2-81, *Fire Protection System Inspection, Testing and Maintenance*.

2.6.8.1 Manage all impairments to CO_2 systems created by inspection, testing, and maintenance using the FM Red Tag Permit System in accordance with Data Sheet 10-7, *Fire Protection Impairment Management*.

2.6.9 Establish an asset integrity program in accordance with Data Sheet 9-0, *Asset Integrity*.

2.7 Human Factors

2.7.1 General

2.7.1.1 Establish formal management policies, procedures and audits for all Human Element control programs to ensure they are fully functional, staffed with trained personnel and supported for long term resilience.

2.7.1.2 Observe standard ignition source prevention practices with regard to hot work in accordance with Data Sheet 10-3, *Hot Work Management*.

2.7.1.3 Develop and implement an operator training program in accordance with Data Sheet 10-8, *Operators*. The program should include normal operation and emergency response.

2.7.2 Ignitable Liquid Handling Procedures

2.7.2.1 Develop a formal procedure to transport ignitable liquids that includes, but is not limited to:

A Transport in sealed containers only

B. Establish a transport route that minimizes the potential exposure (e.g., most direct path, along widest aisles, along aisles that are on an outside wall, avoid warehousing areas)

C. Transport only stable, properly secured loads

D. Do not allow transport when building fire protection is impaired

E. Transport a maximum of one pallet load at a time

2.7.2.2 Clean up spilled ink using processes that can remove dried ink without solvents, such as dry ice blast cleaning. Do not clean up spilled ink with low flash point solvents.

2.7.2.3 If solvent cleaning is used, develop a formal procedure to control the amount of solvent, ignition sources, flammable vapor generation, and waste rags that includes, but is not limited to:

A. Use safety cans to transport and dispense solvent.

B. Never use a mop to disperse the solvent.

C. Use rags or other materials that can be wetted with solvent.

D. Do not pour solvent on the floor.

E. Ensure low-level mechanical ventilation is provided to limit solvent vapor accumulation to 25% or less of the solvent's lower explosive limit.

F. Properly dispose of rags in sealed metal containers.

G. Strictly control all ignition sources in the area.

H. Provide a properly rated portable fire extinguisher in the area.

I. Where possible, use a solvent with a closed-cup flash point higher than 140°F (60°C).

2.7.2.4 Do not pour solvent on the web.

2.7.2.5 Use FM Approved safety cans and limit solvent use to no more than 5 gal (19 L).

2.7.2.6 Allow hot surfaces to cool before cleaning them.

2.7.2.7 When a manual wash is conducted on a lithograph press, have the web removed and the dryer shut down, but maintain safety ventilation.

2.7.2.8 Establish cleaning frequencies for automatic blanket and cylinder washes.

2.7.2.8.1 Base cleaning frequencies on OEM recommendations as a minimum and change them, if needed, based on observations of residue accumulations during use.

2.7.2.9 Maintain automatic blanket wash per the press OEM specifications so they continue to operate properly.

2.7.2.9.1 Always visually check the press for unusual conditions, such as fire, before initiating an automatic blanket wash using ignitable wash solvent.

2.7.2.10 Establish a formal procedure for manual application of blanket wash to the press in accordance with the dryer manufacturer's specifications.

2.7.3 Combustible Dust Handling Procedures

2.7.3.1 Inspect dust-producing areas in the facility weekly for dust accumulations.

2.7.3.2 Examine ducts and areas above suspended ceilings every six months for accumulations of paper or other combustible dust (e.g., starch, which is used for some plastic film/sheet printing operations).

2.7.3.3 When dust accumulations are found, immediately clean them up with a vacuum-type system. Never blow down dust with compressed air.

2.7.3.4 Identify the source of the leak in the dust collection system and promptly repair it.

2.7.3.5 Monitor pressure drop across filters of press dust collection systems to replace filters that have become plugged. Plugged filters reduce air flow and increase dust loading on the press and in the duct.

2.7.4 Emergency Response

2.7.4.1 Ensure press operators and plant emergency response personnel are trained for the following:

A. Manual activation/operation of any special protection systems

B. Isolation of all ignitable liquid systems (e.g., ink, solvent, wash solvent, hydraulic systems, HTF system, etc.)

C. Shutdown of electrical systems and compressed air systems

D. Prompt public fire service notification for any fire regardless of in-plant efforts to control or extinguish it

2.7.4.2 Develop a pre-fire plan in partnership with the public fire service in accordance with Data Sheet 10-1, *Pre-Incident and Emergency Response Planning*, and the following:

A. All emergency response actions; plans

B. Plan for evacuating smoke from the building of fire origin directly outside the building

C. Plan to reduce moisture content within plant buildings along with actions to dry and oil any equipment in areas exposed to smoke to reduce post-fire corrosion.

2.8 Contingency Planning

2.8.1 When a printing press breakdown would result in an unplanned outage to site processes and systems considered key to the continuity of operations, develop and maintain a documented, viable printing press equipment contingency plan per Data Sheet 9-0, *Asset Integrity*. See Appendix C of that data sheet for guidance on the process of developing and maintaining a viable equipment contingency plan. Also refer to sparing, rental and redundant equipment mitigation strategy guidance in that data sheet.

In addition, include the following elements in the contingency planning process specific to printing press:

A. Availability of replacement parts

B. Approximate cost of replacement parts

C. Availability of repairers

D. Confirmation of manufacturer support for the press model

2.9 Ignition Source Control

2.9.1 Provide hazardous-area-rated electrical equipment in areas with flammable vapors/gases or combustible dusts.

2.9.1.1 Ensure the equipment chosen is appropriate for the hazard. Refer to Data Sheet 5-1, *Electrical Equipment in Hazardous Locations*, Data Sheet 7-32, *Ignitable Liquid Operations*, Figure 2.9.1.1-1, and Figure 2.9.1.1-2 to determine what type of equipment rating is needed and where the equipment is needed.

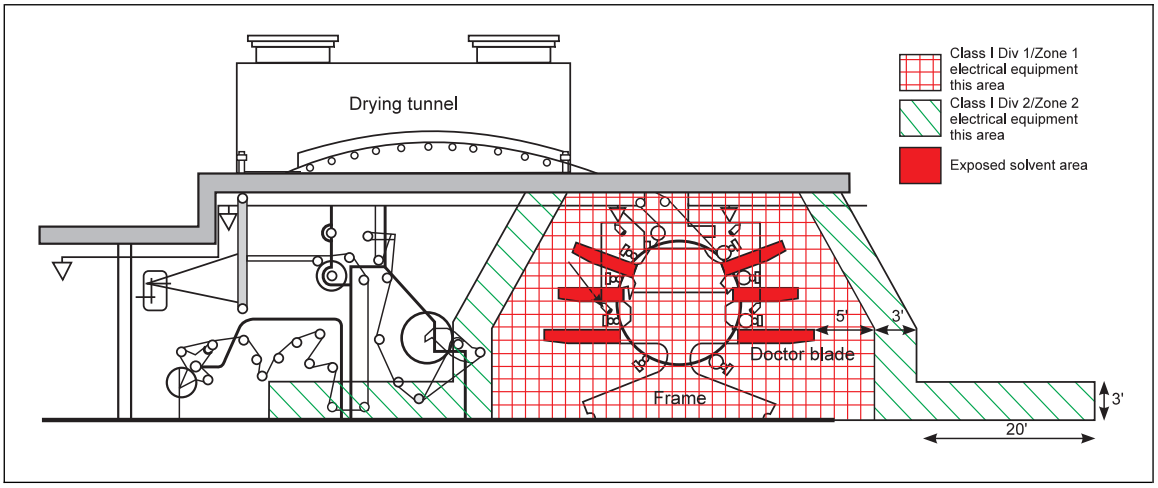


Fig. 2.9.1.1-1. Classified electrical equipment areas for flexographic press

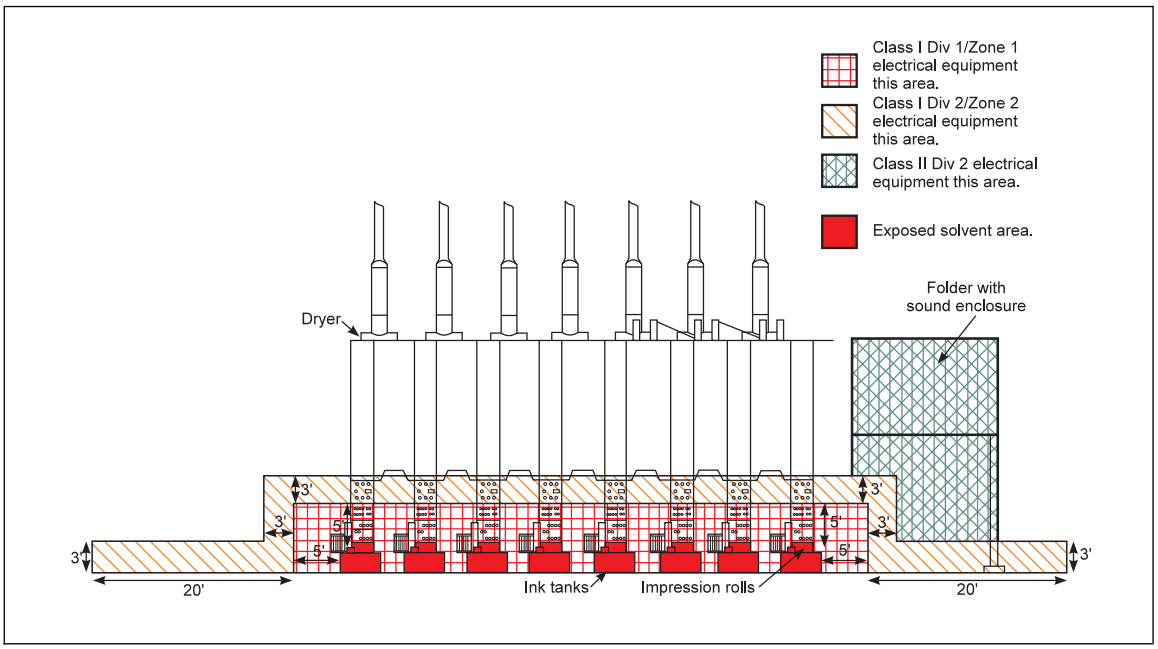


Fig. 2.9.1.1-2. Classified electrical equipment areas for hotogravure press

Class I Rated Equipment – Flammable vapors or gases
Division 1 or 2
Zone 0, 1, or 2

Class II Rated Equipment – Combustible dusts
Division 1 or 2 (US)
Zone 20 or 21 (IEC)

2.9.2 Provide wiring for presses in compliance with local jurisdictional electrical codes (in the United States, use the National Electric Code). Many presses are pre-wired to be suitable for the specific application.

2.9.2.1 Install wiring in metal raceways or conduits where they might be exposed to mechanical damage.

2.9.2.2 Provide an FM Approved firestop system in all vertical raceways between press levels.

2.9.3 Provide a means to eliminate static electricity for all press types in accordance with Data Sheet 5-8, *Static Electricity*. Copper tinsel (tacker bars) have been found effective on presses.

2.9.3.1 Use bonding and grounding when transferring any ignitable liquid that is at or above its closed-cup flash point.

2.9.3.2 Establish a formal procedure on static electricity control and prevention.

3.0 SUPPORT FOR RECOMMENDATIONS

Most printing equipment operates at high speed and produces high-quality printed products from newspaper to bottle labels. The equipment is complicated and requires precise tolerances. In most cases, protecting the building envelope against the collection of fire hazards that exist in this occupancy is done using ceiling-level automatic sprinklers. Unfortunately, ceiling sprinklers alone will not necessarily protect the equipment from the high temperatures and nonthermal damage associated with a fire. To achieve the level of protection against a fire or explosion that is really needed in a printing occupancy, efforts must be aimed at eliminating/minimizing potential exposures to the printing equipment, in addition to providing local area protection within the equipment.

3.1 Construction/Location

3.1.1 Noncombustible Construction

Plastics create severe fire hazards and large amounts of nonthermal damage (smoke); using plastics for equipment enclosures directly exposes printing equipment to both. Using expanded plastic materials for sound-deadening significantly increases the fire challenge by creating the potential for a fast-growing, severe fire within close proximity to press electronics, air tubing, and hydraulic lines.

3.1.2 Fire Hazard Isolation

The fire hazard within a printing press is tied to the media being printed to (paper, plastic film), the inks/solvents, hydraulic systems, heat transfer fluid (HTF) systems, pneumatic systems (plant air), electrical wiring, and potential combustible deposits created by dust and ink residue. Very few scenarios involving any of these exposures will result in thermal damage or water damage to adjacent presses, which should limit severe press damage to a single press. Rolled stock (paper or plastic film) storage creates a significant fire hazard that will produce large quantities of smoke and water. Ignitable liquid storage and mixing operations also create severe fire hazards that can spread across large areas and will produce extreme temperatures and black smoke. Using walls, curbs, and drains will eliminate the potential exposure created by either of these hazards to the printing equipment.

3.1.3 Explosion Hazard Isolation

Explosions create thermal, nonthermal, water, and pressure damage. The overpressures created during an explosion can easily cause improperly designed walls and roofs to fail. Movement of a roof or floor will result in damage to automatic sprinkler protection. The isolation of explosion hazards can only be accomplished through the use of properly designed damage-limiting construction. Similar protection is also needed for equipment that can explode. In most cases, the potential for an explosion is inherent to a process and using protection measures such as ventilation can only reduce the likelihood of an explosion. Data Sheet 7-32, *Ignitable Liquid Operations*, and Data Sheet 7-76, *Combustible Dusts*, provide guidelines for defining explosion hazards in buildings and equipment.

Printing occupancies create many potential explosion hazards, including the following:

- Ovens drying ignitable inks or solvents
- Direct-fired ovens
- Press operations involving or generating combustible dusts (e.g., printing, cutting, slitting, folding)
- Operations collecting combustible dusts (e.g., dust collectors, cyclones)
- Parts-washing operations
- Solvent recovery (e.g., solvent recovery stills, carbon bed absorbers, thermal oxidizers)
- Ignitable ink mixing operations

In many cases, ventilation and exhaust systems are used to control the accumulation of flammable vapors/gases or combustible dusts during normal operations. However, upset conditions will cause any provided ventilation design to fail, and the use of proper damage-limiting construction is the only way to ensure the products of a combustion explosion (heat, flame, pressure) are directed to a safe location.

3.2 Occupancy

3.2.1 Ignitable Liquids

One significant hazard in many printing occupancies is the use of ignitable liquids. These liquids create severe growing fire hazards if they are not controlled. A printing press alone can contain ignitable inks, solvents, hydraulic oils, lube oils, and HTF liquids. Most are pumped to/within the press and must be shut down in the event of a fire or damage to the press will be severe because there are no fire protection systems that can extinguish a flowing liquid fire. In most cases, shutting down the flow of ignitable liquid to/within the press will allow provided protection to limit thermal and nonthermal damage at the press.

Many printing occupancies store or stage large quantities of ignitable liquids adjacent to the presses. This storage/staging creates a significant ignitable liquid fire hazard in the press hall that must be protected in accordance with Data Sheet 7-29, *Ignitable Liquids Storage in Portable Containers,* or Data Sheet 7-32, *Ignitable Liquid Operations*. Failure to adequately control and protect these liquids exposes multiple printing presses to a severe fire scenario that could consume all electrical equipment and potentially warp the press frame.

3.2.2 Paste Inks

Paste inks are high-viscosity liquids that have to be transferred from their storage containers by means of a trowel, scraper, or high-pressure pumping system. Paste inks will flow under pressure or shear. Paste inks have flash points greater than or equal to 200°F (93°C). Automatic sprinkler protection will be effective on a pool fire. Press-room protection recommended in this data sheet is expected to control a fire in paste ink as long as it has not been cut with an ignitable solvent.

3.2.3 Combustible Dusts

Accumulations of combustible dust inside a building create the potential for a dust explosion. All dust-handling equipment create the potential for dust explosions within the equipment and outside the equipment if the equipment vents into a building.

3.2.4 Plant Air Systems

Another often-overlooked hazard is a pneumatic system (e.g., plant air). Many presses use air to control various aspects of their operation, and the air is delivered in flexible hoses. If a hose melts during a fire and the air is not shut down, the pressurized air will provide extra oxygen to the fire and increase its severity.

3.2.5 Hydraulic Systems

Many presses have hydraulic systems for controlling rollers on the press. The hydraulic systems are usually part of the press and can vary in size from 30 gal (110 L) to over 100 gal (379 L). A press fire involving the hydraulic oil system will severely damage the press, regardless of the system size.

3.2.6 Solvent Recovery

Solvent recovery operations may be needed for rotogravure and flexographic presses. They can represent a fire hazard and potentially an equipment and/or room explosion hazard, depending on the design of the equipment and solvents being used. A vacuum still may not present an explosion hazard due to the recovery process, but the impact of the solvent would need to be evaluated from a room explosion and fire hazard standpoint.

3.2.7 Parts Washers

Parts washing operations are usually needed for rotogravure and flexographic presses. They can represent a liquid fire hazard and potentially an equipment and/or room explosion hazard depending on the design of the equipment and solvents being used.

3.2.8 Housekeeping

Housekeeping is critical for printing occupancies. Hazards such as ignitable liquids, paper and dust that are allowed to accumulate around equipment can contribute to fire spread and increase fire severity. Even adequately installed in-press protection may not be able to control a fire if housekeeping in and around the press is poor. Having a well-established housekeeping program will reduce these accumulations and allow protection to work as designed.

3.3 Protection

3.3.1 Automatic Sprinkler Protection

Automatic sprinklers provide the best level of protection against a fire. In printing occupancies, the greatest challenge is getting fire protection water to fires concealed within presses, ovens, ducts, and concealed spaces around or below presses. Ceiling sprinklers alone will not adequately protect most printing presses, requiring the installation of sprinklers in/around the presses. However, sprinklers will not operate if they are not directly above/within the fire. Therefore, protecting a printing press has two parts: first, getting sprinklers near/around concealed spaces, and second, locating the sprinklers inside the press/concealed space to ensure it actually operates. Sprinklers located around press units can stop the horizontal spread of fire, but will not impact its vertical growth because they will not operate until the fire spreads horizontally. Unfortunately, getting automatic sprinklers where they need to be is challenging at best due to the moving web and press designs.

The best way to protect a printing press is to use an automatic water spray system with heat detection located over the individual printing units. This approach allows the installation of spray nozzles around press units aimed into the units. Currently this approach is not used and installing multiple deluge valves can be expensive; however, when balanced against the cost of refurbishing or replacing a printing press, the costs are justified. Automatic water-control zone valves could reduce the costs by limiting the number of deluge valves needed for a press. There are currently no FM Approved automatic water-control zone valves.

3.3.2 Special Protection

Loss experience indicates that special protection systems can significantly decreases property damage and business interruption for printing presses. Unfortunately, if these systems are not properly designed, installed, tested, and maintained, they will not work.

Local-application systems are used when the press or coater is not enclosed. CO_2 is the only local-application system used for press protection to date. There is guidance in Data Sheet 4-11N, *Carbon Dioxide Systems,* for the design of local-application systems.

CO_2 systems protecting press stands are also installed to protect dryers and exhaust ducts associated with the press. The design concentrations in dryers are 65% unless temperatures exceed 200°F (93°C). Where higher temperatures are encountered, concentrations are increased. If dryers are large enough nozzles may be located within the dryer. Where the size of the dryer or obstructions prevent internal installation, nozzles may be arranged to discharge into the dryer opening with exhaust air drawing in the CO_2. Exhaust ducts are protected between the dryer and the first automatically closing damper in the duct. Nozzles are also arranged on the upstream side of the damper to block fire spread past the damper.

Local application CO_2 systems are the most widely used special protection systems in printing plant operations.

One of the major factors affecting the proper operation of CO_2 systems is reliance on manual operation. Operators attempt to control and extinguish the fire with portable extinguishers and, if not successful, then activate the CO_2 system. In many incidents, this was effective. In some incidents, however, the delay in operation resulted in surface temperatures high enough to reignite ink when concentrations of CO_2 decreased. Another factor is lack of proper inspection, testing, and maintenance of protection systems. In one incident, a fire occurred on a rotogravure press. Sprinklers operated, operators left the area in anticipation of the CO_2 system actuating, but the system did not operate. Failure to shut down an ignitable liquid spray fire will also cause a CO_2 system to fail to extinguish a fire.

3.4 Maintenance

There are two types of maintenance for presses: preventive and predictive.

Preventive maintenance consists of regularly scheduled tests, measurements, adjustments, and parts replacement performed specifically to prevent faults from occurring.

Predictive maintenance is condition-driven. Oil changes and sump cleaning are conducted as described above; however, rather than replacing the bearing on a regular schedule, instruments are used to monitor the mechanical condition and other parameters in an attempt to determine the approximate time of failure so the bearing can be replaced before it fails.

4.0 REFERENCES

4.1 FM

Data Sheet 1-44, *Damage-Limiting Construction*
Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*
Data Sheet 2-81, *Fire Protection System Inspection, Testing and Maintenance*
Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*
Data Sheet 4-11N, *Carbon Dioxide Extinguishing Systems*
Data Sheet 5-1, *Electrical Equipment in Hazardous Locations*
Data Sheet 5-8, *Static Electricity*
Data Sheet 5-19, *Switchgear and Circuit Breakers*
Data Sheet 5-32, *Data Centers and Related Facilities*
Data Sheet 6-9, *Industrial Ovens and Dryers*
Data Sheet 6-11, *Thermal and Regenerative Catalytic Oxidizers*
Data Sheet 7-2, *Waste Solvent Recovery*
Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*
Data Sheet 7-32, *Ignitable Liquid Operations*
Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage*
Data Sheet 7-76, *Combustible Dusts*
Data Sheet 7-78, *Industrial Exhaust Systems*
Data Sheet 7-88, *Outdoor Ignitable Liquid Storage Tanks*
Data Sheet 7-97, *Metal Cleaning*
Data Sheet 7-98, *Hydraulic Fluids*
Data Sheet 7-99, *Heat Transfer Fluid Systems*
Data Sheet 7-110, *Industrial Control Systems*
Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*
Data Sheet 8-21, *Roll Paper Storage*
Data Sheet 9-0, *Asset Integrity*
Data Sheet 10-1, *Pre-Incident Planning*
Data Sheet 10-3, *Hot Work Management*
Data Sheet 10-7, *Fire Protection Impairment Management*
Data Sheet 10-8, *Operators*

APPENDIX A GLOSSARY OF TERMS

FM Approved: References to ‘‘FM Approved’’ in this data sheet mean the product or service has satisfied the criteria for Approval by FM Approvals. Refer to the *Approval Guide*, an online resource of FM Approvals, for a complete listing of products and services that are FM Approved.

Combustible liquid: See ignitable liquid.

Cylinder: Round, cylindrical copper or chrome-plated roller that carries etched image on the printing press, revolving in a fountain of ink and being wiped by the doctor blade, prints on the moving web or substrate.

Flat-bed cylinder presses are sheet-fed and used mainly for short-run work such as booklets, folders, catalogs, and labels. The quality of paper can vary widely from coarse to coated paper. Fine register multicolor work also may be done, each color requiring a separate printing operation. The maximum press speed is 5,000 impressions per hour.

Ignitable Liquid: Any liquid or liquid mixture that has a measurable flash point. The hazard of a liquid depends on its ability to sustain combustion or create a flammable vapor-air mixture above its surface. Flash point is one way of understanding if a liquid can create that flammable vapor-air mixture. For a liquid to burn in a

pool, it must have a fire point as well as a flash point. Ignitable liquids include flammable liquids, combustible liquids, inflammable liquids, or any other term for a liquid that will burn.

Intermediate bulk container (IBC): Defined by the U.S. Department of Transportation in CFR Title 49, Part 178, Subpart N, dated October 1, 1997, and the United Nations Recommendations on the Transport of Dangerous Goods, Ninth Edition, Chapter 16. The container size is limited to 3000 L or 793 gal There are no other specific requirements on the design or material of construction. All IBCs must pass the required performance-based testing designed to evaluate their resistance to leakage during transport. No existing test requirements evaluate the container's performance when exposed to fire. The IBC category also includes the containers previously defined as portable tanks or tote tanks. Some limitations on the type of liquid storage allowed in an IBC used for transportation do exist. However, for most commonly transported ignitable liquids, there are few limitations.

Paste ink: An ink with a closed cup flash point greater than or equal to 200°F (93°C) that in an unsheared condition at room temperature will not pour or readily flow. There is no definition for paste ink in the printing industry.

Sealed container: This term refers to a container that is tightly covered. An example is a container that is ready for shipment versus a container that has a loose fitting cover provided.

Tote Tank: Heavy steel cylindrical tank generally used for paste ink storage, dispensing, and shipping. They range in size from 200 gal (750 L) to 400 gal (1510 L). The tanks are designed for pressurized dispensing of paste ink.

Web: Material to be printed and/or processed in roll form.

APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

July 2023. Interim revision. Significant changes include the following:

A. Revised protection guidance for press rooms with little to no in-process storage.

B. Revised protection guidance for control rooms and computer rooms.

C. Revised guidance for baler rooms that do not contain hydraulic equipment.

D. Renumbered tables and figures based on section number.

E. Document has been revised to provide a consistent format.

October 2019. Interim revision. Minor editorial changes were made.

April 2019. Interim revision. Changes include the following:

A. Clarified guidance for sprinklers, special protection systems and flammable vapor exhaust.

B. Added protection guidance for a horizontal lithograph non-newspaper press.

C. Added guidance for digital presses.

D. Clarified existing Figures and added new Figures.

April 2012. Interim revision. This data sheet has been revised to eliminate a conflict that existed with Data Sheets 6-9, *Ovens and Dryers*, and 6-11, *Thermal and Regenerative Catalytic Oxidizers*. Changes include the following:

1. The advice in Section 2.4 regarding the need for ventilation and LEL detectors was rewritten to align with Data Sheets 6-9 and 6-11.

2. Instructions to refer to Data Sheets 6-9 and 6-11 were added where appropriate to avoid creating potential future conflicts.

April 2010. The following changes were made:

1. Separated flammable/combustible liquid protection into three categories: (1) low flash-point (below 200°F [93°C]), (2) high flash-point (200°F [93°C] and above), and (3) paste inks.

2. Added guidance on when to protect a printing occupancy as an flammable/combustible liquid-use area in accordance with Data Sheet 7-32, *Flammable Liquid Operations*.

3. Added recommendations for in-process storage of roll paper in the press room.

4. Added recommendations for housekeeping in newspaper offset lithograph press operations.

5. Added details on the location and type of automatic fire protection for single and multiple-level lithograph presses.

6. Added details on local-application CO_2 system installation to promote better understanding of the system design.

7. Added requirements for proper testing and maintenance of CO_2 systems.

8. Added recommendations for control and computer room protection, carbon bed adsorbers, plate washers, solvent recovery, lube oil, hydraulic, pneumatic, and heat transfer fluid (HTF) systems.

9. Added recommendations for dryers, exhaust ducts, and thermal oxidizers where design variations for printing plant installations are different than those covered in existing standards.

January 2000. The document was reorganized to provide a consistent format.