CHEMETRON Fire Systems™

CARDOX

CO$_2$

Application Bulletin

CHEMETRON Fire Systems™
A World of Protection

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CARBON DIOXIDE FIRE SUPPRESSION —

Microwave Cooking Systems

Introduction

In the large microwave cooking systems, meat products are cooked or partially cooked in one or more microwave chambers (cavities). Fat is rendered in the process and presents a potential fire problem. Therefore, it is desirable to have a positive means of fire suppression in the event of fire.

The use of carbon dioxide (CO_2) as the fire suppressant offers some significant advantages. A system using CO_2 can be designed in accordance with recognized and accepted international codes (Standards). The CO_2 gas used in the system is the same grade as used in beverage carbonation and other food processing applications. It is stored as a liquid under pressure (thus saving space), but when it discharges CO_2 turns to vapor and finely divided particles of "dry ice" that sublime almost immediately, leaving no mess or clean-up.

The gas suppresses the fire by diluting the oxygen in the area where it is applied, extinguishing all open burning. Subsequently, the gas dissipates in the air leaving no residue, thus allowing immediate resumption of production. The "dry ice" component of the discharge allows the CO_2 to be projected onto a hazard that is not enclosed, and, by formation of an engineered discharge pattern that envelops the hazard, provide fire suppression, even though the hazard is not enclosed. Stainless steel nozzles and piping are used in the cooking areas to supply and apply the gas so that the systems can meet all USDA requirements.

DETERMINING CO_2 REQUIREMENTS

Carbon dioxide fire extinguishing systems are designed in accordance with National Fire Protection Association (International) Standard No. 12 and are designed to treat protected equipment in either of two ways.

Issued 7/2000

Branded: 06/2023 20230601SM

One method is "total flooding" wherein an enclosure is flooded with CO_2 gas to the fire extinguishing level and kept flooded until the fire is extinguished. The second method is called "local application." It is used to cover equipment that requires that the CO_2 discharge envelop the hazard by proper placement of discharge nozzles that have been approved and rated as to their fire extinguishing capability. The CO_2 is discharged so as to blanket all hazard surfaces and components. The discharge is maintained for the time period required by the Standard until the fire is totally extinguished. It is important that the entire hazard be protected.

This is covered in NFPA #12 in Para. 3-2.1:

> 3-2.1 EXTENT OF HAZARD. THE HAZRDSHALL BE SO ISOLATED FROM OTHERS HAZARDSOR COMBUSTIBLESTHAT FIRE WILL NOT SPREADOUTSIDE THE PROTECTED AREA. THE ENTIRE HAZARDSHALL BE PROTECTED. THE HAZARDSHALL INCLUDE ALL AREASTHAT ARE, OR MAY BECOME, COATED BY COMBUSTIBLELIQUIDSOR SHALLOW SOLID COATINGS, SUCH AS AREASSUBJECTTO SPILLAGE, LEAKAGE, DRIPPING, SPLASHING OR CONDENSATION. THE HAZARD ALSO INCLUDES ALL ASSOCIATED MATERIALS OR EQUIPMENT, SUCH AS FRESHLY COATED STOCK, DRAIN BOARDS, HOODS, DUCTS AND SO FORTH, THAT MIGHTEXTENDFIREOUTSIDEORLEADFIREINTO THE PROTECTED AREA.

When the hazard consists both of enclosures requiring flooding – such as the microwave cavities and the exhaust ducts – and an open hazard requiring local application coverage, as represented by the belts and associated drip pans (see below), the CO_2 system design combines both methods of protection.

Cavities and Exhaust Ducts

(Refer to Figure #1) The minimum design concentration (per NFPA #12) for flooding the cavities is 34% CO_2 by volume, while that for the exhaust ducts is 65%.

In flooding the cavities it must be recognized that the cavity is not a gas-tight enclosure. However, the Suppression Tunnels at each end are also flooded by the CO_2 discharge blocking CO_2 losses from the end cavities. All cavities are flooded simultaneously and enclosed tunnels connect them. Therefore, little additional CO_2 is required to compensate for that lost out the conveyor openings.

During operation the doors to the cavities are kept closed and the CO_2 system design is based on them being closed. However, fires have occurred when the line has been stopped and a door is opened and left open but cleaning has not yet taken place. Therefore, cavity nozzle placement is designed to minimize the CO_2 loss during discharge in this eventuality. CO_2 systems are traditionally given a full discharge test upon completion of the installation (NFPA #12 - Para.1-6.3 (d)). A part of this test should determine how effective the flooding might be with a door ajar.

In addition, debris can fall off the belt into the bottom of a cavity presenting the potential for a smoldering fire which could reignite the grease after its fire has been extinguished and the CO_2 dissipates. Therefore, there is a requirement that the normal 1 minute flooding time for the cavity flooding be extended. We recommend a 3 minute discharge in the cavities (see NFPA#12 2-1.2).

Concerns for proper fire detection in the cavities involves whether or not the cavity is equipped with a hot air supply system which might create an internal operating temperature over 200°F (93°C). Detector settings are usually 100°F (38°C) over the operating temperature in the cavity. In a fire condition the detector response is important as the polypropylene belts, handling the product being cooked, will soften and will melt at fairly low temperatures.

Since the CO_2 flooding requirement for each cavity is not large, proper and cost effective protection can be afforded by flooding all cavities and the exhaust system at one time while compensating for losses from the cavities and continuing the discharge for a full 3 minutes.

Provisions for mounting the CO_2 nozzles in the cavities can and have been made a part of the cavity design.

Fire detection in the cavities uses shielded rate-compensated, heat actuated fire detectors. These units normally provide a speedy response to fire, are rugged and easily tested. The detectors must be properly shielded so that induced currents from the microwaving does not cause false actuation. As most fires start in the cavity, it is important that they be quickly detected and suppressed before the fire has a chance to spread outside the cavity.

While provisions are required on all systems to allow manual release of the system by an operator, automatic operation is extremely important as fire experience has shown fires start when operators are busy away from the cavities.

As there is an exhaust system to remove vapors from these cooking lines, there is a possibility that fire could be pulled up into the exhaust system. Therefore, the exhaust system is also flooded at the same time the cavities are flooded.

Upon system operation the power to the line and the fans will be shut down . Provision to do so is incorporated in the CO_2 system control panel and by pressure switch operation (see below).

Conveyor Belts and Drip Pans

(See Figure # 2) For the local application protection, “spot-type” nozzles, each covering an appropriate square area of the total hazard surface, are used. The CO_2 nozzle approval process rates the nozzles based on squares and whether the protected surface is liquid in depth or a coated surface. Each type nozzle has an approved area based on the projection distance used and the CO_2 discharge rate. Therefore, the conveyor belt/drip pan is a coated surface and the nozzles protect it from above with the nozzles usually mounted at the ceiling of the cooking room. The total length of the conveyor is broken down into squares with a nozzle assigned to each. All discharge at once. For coated surfaces there is a minimum discharge period of 30 seconds.

Additional fire detectors are needed at the ceiling above each line when local application protection for the conveyor/drip pans is provided.

Coverage is also provided for grease collection pans and for the conveyor at the end of the cooking line. This meets the NFPA requirements stated above. These nozzles are discharged simultaneously with the conveyor belt/drip pan nozzles.

When several cooking lines are installed in a room close together, the Fire Risk Analysis should include a determination if the lines are inter-exposing and, therefore, there may be a need for simultaneous protection of two lines. In case the fire should spread from one line to that next to it or the wrong manual release operated in an emergency, you would want to make sure that full protection can still be provided.

System Arrangement

The figures herewith illustrate the two protection arrangements described above.

In the case of high pressure (cylinder type as shown on figures) system use, the cylinders are provided with a free-standing rack that can be installed to suit but should be outside the Cooking Room. They do not have to be near the protected hazard(s) but the system performs best with pipe runs of less than 100 - 150 ft (30 - 45 meters) or so.

The system is arranged with automatic control and manual release capability. Operation of the system is by a control panel that is equipped with a back-up power supply and supervision of control and operating circuits. The control panel is NEMA 12 (or can be NEMA 4 or 4X). It should not be installed in the Cooking Area.

Alarms (both audible and visual) are provided for installation in the Cooking Area (but not where extensive cleaning is routinely done) and at points of egress from the area to alert personnel of an impending CO_2 discharge. The Cooking Area may become untenable in case of a CO_2 discharge; therefore, a warning to evacuate the area before the discharge is mandatory. The Fire Risk Analysis and system design process interfaces with the owner to ensure a safe system.

When lines are installed in separate areas and maintenance on a line is necessary with extra personnel present, a lock-out valve for that line will help protect those working on the line, while keeping the other lines in service. A pressure switch, which ties in to operate the alarms and equipment shutdowns in the event that the Emergency Manual Release is used, is provided for each line protected.

NOTE

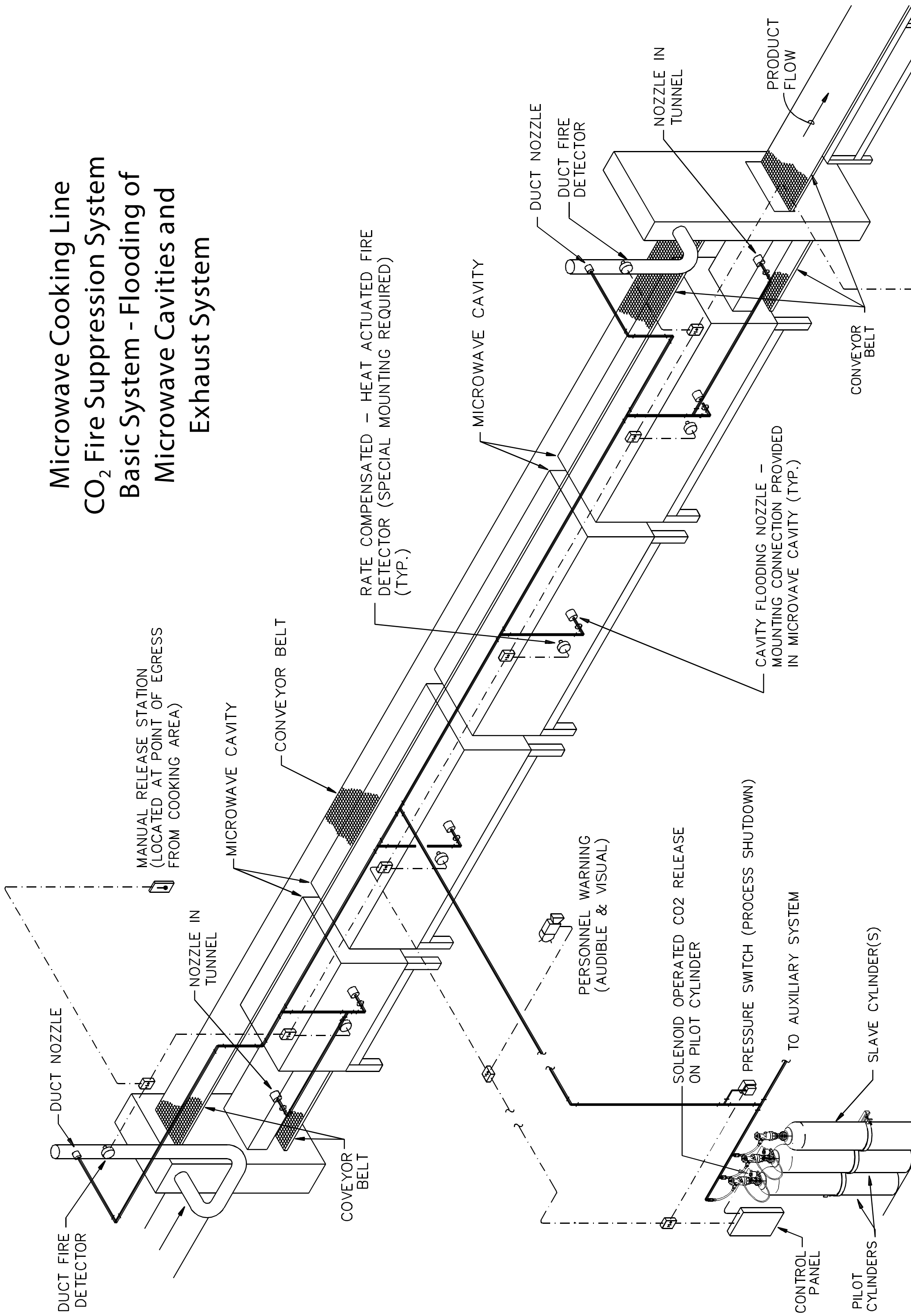
IF THE GREASE COLLECTION AT THE BOTTOM OF THE COOKING LINE IS NOT HARD-PIPED AND THE LOWER DRIP PAN PRESENTS A SIGNIFICANT HAZARD, LOCAL APPLICATION NOZZLES COVERING THIS AREA MAY BE NEEDED. THIS DETERMINATION WOULD BE PART OF THE FIRE RISK ANALYSIS. AS THE NFPA STANDARD RECOMMENDS A FULL DISCHARGE TEST OF COMPLETED INSTALLATION, A NUMBER OF THESE LINES HAVE BEEN DISCHARGE TESTED AND THE COVERAGE VERIFIED. THE RESULT HAS BEEN THAT THERE WAS A SIGNIFICANT LOW LEVEL FLOODING OF THE LOWER PART OF THE COOKING ROOM WHICH PROVIDES MORE THAN ADEQUATE COVERAGE IN THIS AREA.

While the above description and figures cover the high pressure type system, a CARDOX low pressure system offers some significant advantages for large installations. Information on this is available upon request.

IMPORTANT – HAZARD RISK ANALYSIS

SINCE THERE IS A MYRIAD OF ARRANGEMENTS OF EQUIPMENT POSSIBLE, EACH POTENTIAL INSTALLATION SHOULD BE ANALYZED AS TO THE TYPE, NUMBERS, ARRANGEMENT AND OPERATION OF ALL EQUIPMENT. THAT INFORMATION SHOULD THEN BE RELATED TO THE HAZARD PROTECTION REQUIREMENTS IN ORDER TO ENSURE THAT PROPER PROTECTION IS PROVIDED IN A SAFE MANNER THAT IS COMPATIBLE WITH THE OPERATION AND MAINTENANCE OF THE FACILITY AND THAT THE SYSTEM WILL MEET ALL APPROVAL AGENCY REQUIREMENTS. CHEMETRON FIRE SYSTEMS IS YOUR RESOURCE TO HELP IN THIS REGARD.

Microwave Cooking Line CO_2 Fire Suppression System Basic System - Flooding of Microwave Cavities and Exhaust System



Schematic of System
View of Microwave Cooking Line from Rear

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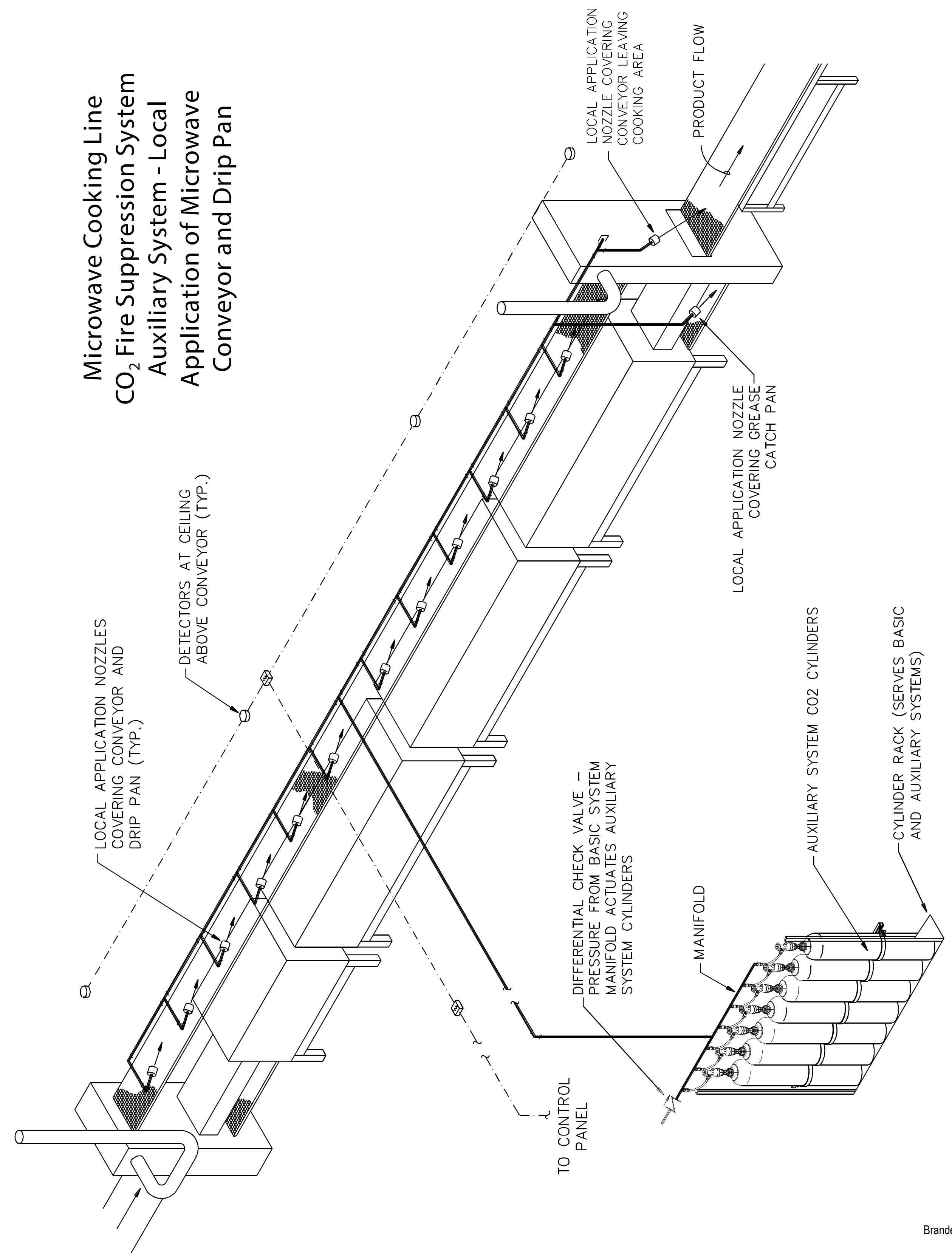

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