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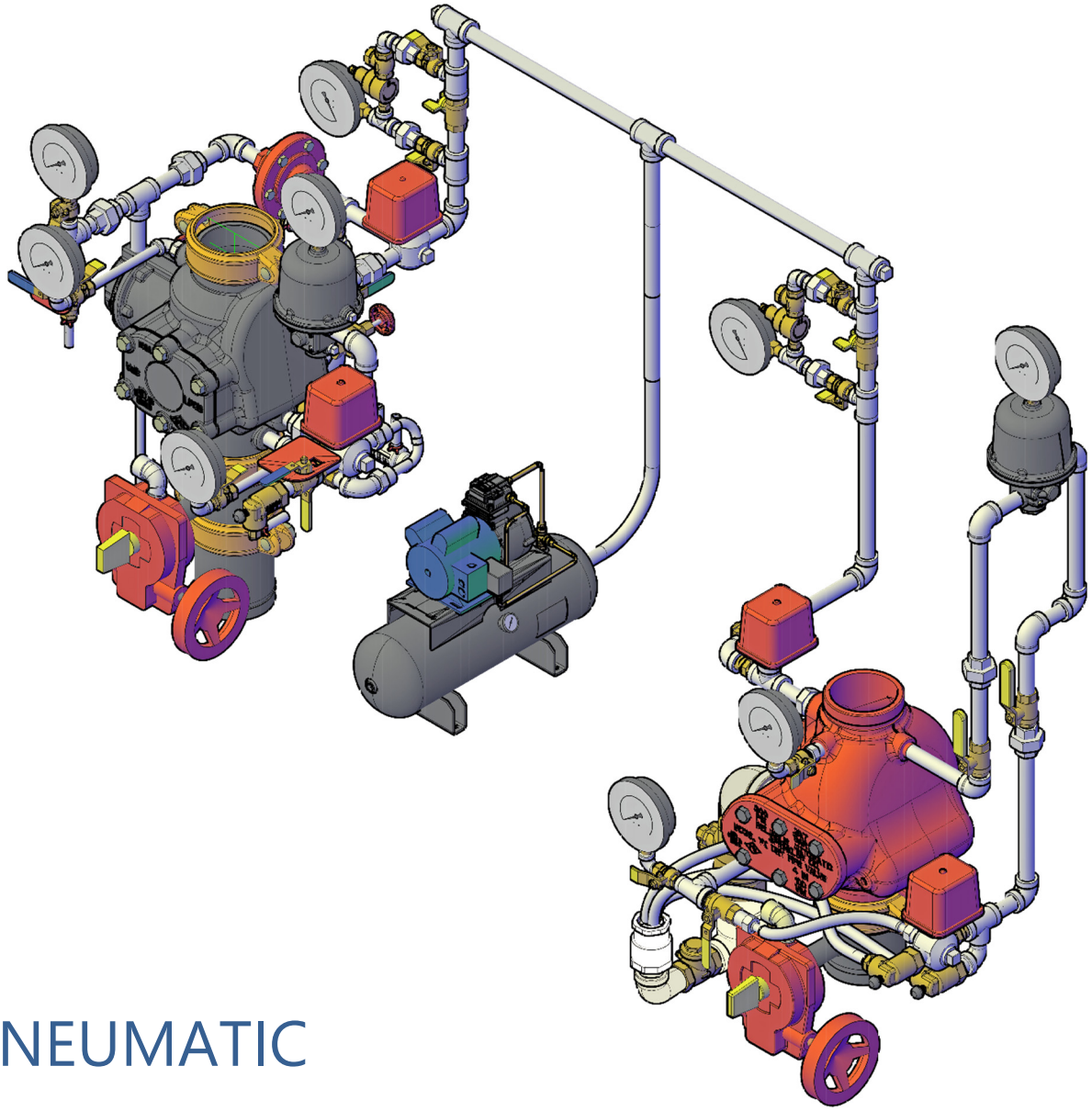

PNEUMATIC SUPPLY DESIGN GUIDE

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1. INTRODUCTION

This design guide has been prepared by The Reliable Automatic Sprinkler Co., Inc. to provide a source of information that will help users understand and select the correct arrangement and components for introducing and maintaining air and/or nitrogen into dry type and preaction fire sprinkler systems. This guide complements other Reliable Automatic Sprinkler Company design guides that provide more specific insight into the type of systems that utilize supervisory air pressure.

The goal is to provide a comprehensive overview of the specific equipment necessary to complete the installation along with the National Fire Protection Association (NFPA) requirements for air supplies. For a detailed description of the specific equipment outlined in this guide, it will be necessary to reference the appropriate technical bulletin and NFPA installation standard. Where applicable, bulletin numbers have been included to facilitate a more detailed analysis and description of Reliable valves and components.

Note that the information included herein is only a guide. Responsibility for the actual design and installation of any fire sprinkler system, including the air or nitrogen supply, rests with the engineer of record, certified layout technician and/or the Authority Having Jurisdiction.

For additional product information and other resources, please visit www.reliablesprinkler.com. Should you have additional questions about Reliable products, please do not hesitate to contact our Technical Services Department at 800.557.2726 or email us at techserv@reliablesprinkler.com.

2. DEFINITIONS

The definitions included in this document are as described in National Fire Protection Association (NFPA) standards where applicable. Those definitions are marked with an asterisk. Where no specific definition is available in the standard, Reliable terminology has been used to describe or define a process, product, or device.

Air- The invisible gas making up the atmosphere surrounding the earth consisting of mainly oxygen (O_2) and nitrogen (N_2).

Air Compressor- An air compressor is a mechanical device that draws atmospheric air through a pump that increases the pressure of the gas by forcing it into a vessel, either a receiver or a system, by reducing its volume.

Air Receiver*- A chamber, compatible with an air compressor, that can store air under pressure that is higher in pressure than that in the dry pipe or preaction system.

Approved*- Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction (AHJ)*- An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

Dry Pipe Sprinkler System*- A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air or nitrogen under pressure, the release of which (as from opening of a sprinkler) permits the water pressure to open a valve know as a dry pipe valve, and the water then flows into the piping system and out the open sprinklers.

Listed*- Equipment, materials or services included in a list published by an organization that is acceptable to the authority having jurisdiction.

Nitrogen (N_2)- A colorless, odorless unreactive (inert) gas that forms about 78% of the Earth's atmosphere. The invisible gaseous substance surrounding the Earth, a mixture mainly of oxygen and nitrogen.

Nitrogen Bottle- A pressure vessel for storage and containment of nitrogen at a pressure above atmospheric pressure.

Nitrogen Generator- A specialized device that utilizes an air compressor to pump compressed air through a special filter that separates and captures the nitrogen in the compressed air.

Preaction System*- A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers.

Pressure Maintenance Device (PMD)- A device specifically listed to maintain supervisory pressure and limit flow of air or nitrogen into in a dry or preaction fire sprinkler system.

3. AIR SUPPLY

There are many choices when buying an air compressor to fill and maintain supervisory pressure in your dry or preaction system. The air compressor choice you make is based on several factors such as NFPA requirements, supervisory pressure required by the dry or preaction system, and system volume. An air compressor with an air receiver *and* a listed air maintenance device is required by NFPA 13 for maintaining supervisory air pressure in dry type sprinkler systems. There is an exception to this rule in NFPA 13 that allows a tankless (no air receiver) compressor to be used. That exception limits the output of the compressor to 5.5 cfm @ 10 psi or less.

3.1 Tank Mounted Air Compressor

A tank mounted compressor is a compressor that is combined with a tank (air receiver) to make a complete unit. It has its own pressure switch that maintains air pressure in the tank. The tank pressure is higher than that of the systems it will be supplying. From the tank, the higher pressure is reduced and regulated through a listed pressure maintenance device (PMD) such as the Reliable Model A before being fed into the system. The PMD regulates the system pressure and restricts the volume of air entering a system so it will not keep up with the air discharging from an open sprinkler or inspector's test valve. If the incoming air supply keeps up to the outgoing air pressure through an open sprinkler, operation of the dry or preaction system may be delayed or impaired.

Reliable Model QRM Tank Mounted Air Compressor

The pressure maintained by a tank mounted compressor and regulator will be steady and this setup will provide a reserve air supply in the event the compressor fails or loses power. This arrangement is highly recommended (preferred) for all systems, particularly those systems utilizing an accelerator because the supervisory pressure is constant and stable.

Reliable QRM "Quiet" series tank mounted air compressors can be found in Bulletin 256. Model RTM series tank mounted compressors can be found in Bulletin 258.

3.2 Tankless Air Compressor with Pressure Switch

A tankless compressor can be bought with or without a pressure switch. A tankless compressor with a pressure switch feeds directly into a system without the use of a listed air maintenance device. Because it feeds directly into a system without restriction, NFPA 13 limits the volume output of these types of compressors to 5.5 cfm @ 10 psi or less. This limit prevents the compressor from keeping up with a single open sprinkler which could prevent the dry or preaction valve from tripping.

The pressure from a tankless compressor will not be maintained at a steady pressure. It will vary between the start (or cut-in) pressure setting of the switch and the stop (or cut-out) pressure setting of the switch. This will vary depending on the compressor, but the pressure difference between cut-in and cut-out pressures is usually between 5 & 10 psi. Reliable RRM models, available for low pressure systems, are factory set with a cut-in pressure of 20 psi (1.4 bar) and cut-out pressure of 26 psi (1.8 bar). The RRM is also available with higher pressure range settings for standard differential dry systems and are factory set with a cut-in pressure of 40 psi (2.8 bar) and cut-out pressure of 50 psi (3.4 bar).

Reliable Model QRM Tank Mounted Air Compressor

Reliable QRM "Quiet" series tank tankless air compressors can be found in Bulletin 256. Model RRM series tankless compressors can be found in Bulletin 258.

3.3 Bare Compressor

Bare air compressors are tankless compressors without a motor control pressure switch. Since it does not have its own pressure switch to control the start and stop of the compressor, it will need a pressure controller such as the Reliable Model B to control the compressor pump (see 5.2).

Bare Air Compressor (Courtesy GAST)

Listed maintenance devices such as the Reliable Model B incorporate a restricted orifice that limits the amount of air that may pass into the system; therefore, size of the compressor is not limited.

The pressure maintained with a tankless compressor will not be maintained at a steady pressure. It will vary between the start (or cut-in) pressure setting of the switch and the stop (or cut-out) pressure setting of the switch. This will vary depending on the compressor, but the pressure difference between the cut-in and cut-out pressures is usually between 5 & 10 psi.

Gast bare air compressors can be found in the System Components section of our website (www.reliablesprinkler.com).

4. NITROGEN SUPPLY

NFPA 13 allows the use of nitrogen or any other approved gas to be used as supervisory pressure in a sprinkler system. It must be an inert gas or a gas that is unreactive with elements. Nitrogen is the most available inert gas since it already makes up about 78% of the Earth's atmosphere. The two main sources of nitrogen for a sprinkler system are through bottles or nitrogen generators. Nitrogen is a good choice for supervisory pressure in systems protecting refrigerated areas since it has a very low dew point of 40°F (4.4°C) or less and can substantially reduce the amount of corrosion within steel piping.

Nitrogen Cylinders (Contact Local Supplier)

The setup and air supply requirements in NFPA 13 for dry systems are required to be followed when using nitrogen. This includes the use of listed components and meeting system fill time requirements.

4.1 Nitrogen Cylinders

Nitrogen cylinders are a prepackaged source of nitrogen containing a fixed volume. The volume will vary depending on the size of tank used. The nitrogen in the tanks is under very high pressure so a special regulator is required to make the tank connection. The regulator has two gauges. The first indicates the pressure inside the tank. The second indicates the regulator's outlet pressure. The pressure coming out of the tank is regulated down to a managable pressure for the piping used. Before the nitrogen can be fed into the system it must **also** be run through a listed pressure maintenance device like the Model A to regulate the pressure and restrict the volume of the nitrogen entering the system. Since the bottle has a fixed volume, NFPA 13 requires a low pressure alarm to signal when the bottle(s) need refilling.

Nitrogen Generator (Courtesy South Tek Systems)

4.2 Nitrogen Generator

Nitrogen generators utilize an air compressor and a filter system to capture the nitrogen from the atmosphere around the generator. An air compressor draws air from the atmosphere. It then pumps the compressed air through a special filter that separates the nitrogen from the other elements that make up the air. From the filter, the nitrogen is stored in a receiver adjacent to the nitrogen generator. The stored nitrogen is then fed into the sprinkler system through a listed pressure maintenance device such as the Reliable Model A. If the generator is not capable of filling a system in the required time, a supplementary air compressor may be needed to comply with required fill time requirements.

Nitrogen generator information for both South-Tek Systems and Potter Corrosion Solutions can be found in the System Components section of our website.

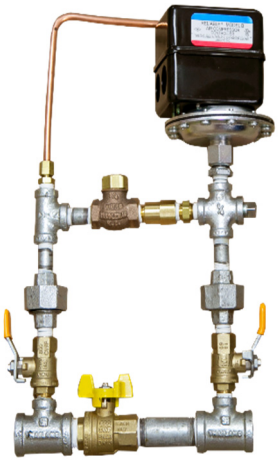
5. PRESSURE MAINTENANCE DEVICES

Pressure maintenance devices (PMD) are also called air maintenance devices. The Reliable mechanical PMD's can be utilized with either compressed air or nitrogen. A listed PMD device is required by NFPA 13. The purpose for the PMD and the listing requirement is to have a proven device that is specifically listed to admit, restrict incoming flow and maintain supervisory pressure in a dry fire sprinkler system.

Reliable Model A Pressure Maintenance Device

5.1 Model A Mechanical Pressure Maintenance Device

The Model A PMD is designed for use with a source of compressed air from a plant air system, tankmounted compressor with a pressure control, etc. or nitrogen cylinder(s) when equipped with a high pressure regulator. The regulator in the Model A PMD reduces higher pressure air or nitrogen to a level required by a dry pipe valve, dry pilot line, or a deluge valve based preaction system. The Model A PMD will maintain a constant pressure in the system regardless of any pressure fluctuations from the compressed air or nitrogen source. The Model A has ½" National Pipe Threads (NPT) connections. A ½" ball valve is provided that can be used as a non-regulated quick fill to help meet any required air fill time. The quick fill valve must be closed when not filling the system. The regulator loop includes ¼" ball valves, strainer, adjustable pressure regulator, and a check valve. The Model A PMD can be found in bulletin 251.



Reliable Model B Pressure Maintenance Device

5.2 Model B Electric Pressure Maintenance Device

The Model B PMD is designed for use in conjunction with a tankless air compressor without a pressure control switch to maintain the correct air pressure in a dry pipe valve, dry pilot line, or a deluge valve based preaction system. Without a tank or air receiver the supervisory pressure in the system is not maintained at a constant pressure. The pressure in the system will vary between the cut-in (on) and the cut-out (off) set point of the pressure switch. The Model B is factory set with an approximate 6 psi difference between the 29 psi cut-in and 35 psi cut-out pressures. A drop in the system air pressure causes the pressure switch contacts to close, starting the air compressor. When the preadjusted cut-out air pressure is restored, the pressure switch contacts re-open, stopping the air compressor. The pressure switch is also equipped with an unloader valve that automatically bleeds off the air compressor outlet

pressure each time the contacts of the pressure switch open. Like the Model A PMD, the Model B has ½" NPT connections, quick fill option, regulator loop ball valves, straine,r and check valve. The Model B PMD can be found in bulletin 251.

5.3 Model B-SI Air Compressor Panel

The Reliable Model B-SI Air Compressor panel is a listed self-contained supervisory air supply for single interlock preaction systems. The Model B-SI utilizes a small air compressor controlled by a pressure switch which maintains a supervisory pressure between approximately 5 and 7 psi. The B-SI also activates a low air switch when pressure drops to approximately 4 psi. A set of dry contacts is provided for remote monitoring of low air pressure. The B-SI also includes a hose kit which includes a 1/4" shut-off valve, 1/4" x 72" flexible stainless-steel hose, 1/4" x 1/2" bushing, and 1/2" check valve. The panel is designed with keyhole slots for ease of wall mounting. A quick-fill bypass connection outside the enclosure is provided to reduce system setup time using an auxiliary compressor, if desired. The Model B-SI can be found in bulletin 252.

Reliable Model B-SI

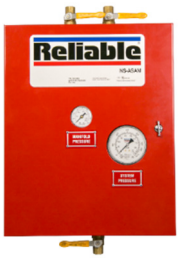
5.4 NS-PaK

The NS-PaK is a listed self-contained unit used to connect a single nitrogen cylinder to a single system. The NS-PaK includes a high-pressure adjustable regulator for connection to a nitrogen bottle, two high pressure flexible stainless-steel hoses to connect the regulator to the NS-PaK and the NS-PaK to the system. Inside the NS-PaK is a low pressure supervisory switch that monitors the incoming nitrogen pressure, a pressure regulator to maintain pressure in the system, a bypass for quick fill, and second low-pressure supervisory switch to monitor the regulated system pressure. The Model NS-PaK can be found in bulletin 254. High-pressure cylinders are not included.

Reliable Model NS-PaK

5.5 NS-ASAM

The NS-ASAM is a listed self-contained unit to connect both primary and secondary sources of nitrogen or air to a system. The primary and secondary nitrogen or air sources should supply a minimum pressure of 100 psi (6.9 bar) up to a maximum pressure of 250 psi (17.2 bar). The NS-ASAM admits nitrogen or air from the primary source, until the primary source drops to a pressure of approximately 80 psi (5.5 bar). When this happens, the secondary supply opens and maintains system pressure. The NS-ASAM has one low-pressure supervisory switch which monitors the incoming primary source and is factory-set to activate at a pressure of 90 psi (6.2 bar). The pressure switch includes an auxiliary set of contacts that may be field adjusted to indicate loss of pressure from the secondary source. There is also a pressure regulator to set the



Reliable Model NS-ASAM

outgoing pressure for a system. A bypass valve is provided to rapidly introduce nitrogen or air into the system. Individual system low-pressure switches are not provided. The Model NS-ASAM can be found in bulletin 254. High-pressure cylinders are not included.

5.6 Nitrogen Regulating Device

The Nitrogen Regulating Device is a listed assembly designed to connect to a single high-pressure nitrogen cylinder. The Nitrogen Regulator can supply one or more listed PMD's (not included) controlling pressure to the sprinkler system(s). As the cylinder pressure depletes below 90 psi (6.2 bar), the optional, but required low pressure supervisory switch activates to indicate low pressure in the nitrogen cylinder. The Nitogen Regulating Device can be found in bulletin 254. High-pressure cylinders are not included.

Reliable Nitrogen Regulating Device

6. REFRIGERATED SPACES

Refrigerated spaces are defined in NFPA 13 as spaces that are maintained at a temperature of 32°F (0°C) or less. Refrigerated space sprinkler system air supplies have additional requirements in place to help prevent too much moisture from getting pumped into the system which increases the chances of an ice plug to form inside the system piping. NFPA 13 recommends an air supply setup that reduces the dew point of the supervisory gas to no more than 20°F (-6.6°C). There are currently three options listed in the 2019 edition of NFPA 13 section 8.8.2.4 for supplying supervisory pressure into a refrigerated system.

6.1 Refrigerated Space Supply Option 1

An air compressor that draws air from the refrigerated area, compresses it, and pumps it back into the system. This option requires an air piping arrangement with redundant loops that run through the refrigerated area before connecting into the system piping. The intent with this arrangement is to draw cold dry air from the refrigerated space, compress it, and pipe that back into the system. The specific piping arrangement for this option is detailed in NFPA 13.

6.2 Refrigerated Space Supply Option 2

Utilize a listed air compressor/air dryer package which draws ambient air from the area around the compressor versus from the refrigerated area. These units are meant specifically for use with dry type sprinkler systems protecting refrigerated areas. An example of this type of unit is the Dry Air Pac® from General Air Products. This unit utilizes an air compressor and regenerative air dryer combination to produce supervisory pressure for the system with a dew point -40°F (4.4°C) or less.

6.3 Refrigerated Space Supply Option 3

Utilize nitrogen gas from bottles or generators. The components for this option are a nitrogen generator or simply one or more nitrogen bottles with the pressure maintenance equipment noted in section 5.

Dry Air Pac® (Courtesy General Air Products)

7. SIZING AIR COMPRESSORS

NFPA 13 requires that dry pipe systems have an air supply that can fill a system up to the required supervisory pressure within 30 or 60 minutes depending on the environment the system is installed. The purpose of this requirement is to restore a system to normal operating conditions to limit downtime.

NFPA 13 (2019 Edition) Section 8.2.6.3.2 states:
"The air supply shall have a capacity capable of restoring normal air pressure in the system within 30 minutes."

The Annex notes in Section A.8.2.6.3.2 states:
"When a single compressor serves multiple dry pipe systems, the 30-minute fill time is based on the single largest system."

NFPA 13 (2019 Edition) Section 8.2.6.3.3 states:
"The requirements of 8.2.6.3.2 shall not apply in refrigerated spaces maintained below 5°F (-15°C), where the normal system air pressure shall be permitted to be restored within 60 minutes."

NFPA 13 (2019 Edition) Section 8.2.6.7.1 states:
"The system air pressure shall be maintained in accordance with the instruction sheet furnished with the dry pipe valve, or 20 psi (1.4 bar) in excess of the calculated trip pressure of the dry pipe valve, based on the highest normal pressure of the system supply."

Before selecting the type of compressor to be used, the size of the compressor must be determined. Air compressors are typically defined by cubic feet per minute (CFM) output, so converting the system volume from gallons to CFM is the first step.

Variables:

V = System volume in gallons
P = Supervisory pressure in psi
CFM = Air compressor output in Cubic Feet per Minute
T = Fill time in minutes (60 minutes or 30 minutes or less required by NFPA standards)

Constants:

Gallons per ft^3 = 7.48
Atmospheric pressure = 14.7 psi

Solving for time will require a CFM rating to enter in the formula. This can be found in the air compressor manufacturer's technical documentation.

Assuming we have all the information needed, the formulas below can be used to solve for either the compressor size in CFM, or the solving for the dry system fill time in minutes.

Solving for Compressor CFM Rating

$$CFM = \frac{V \times P}{7.48 \times 14.7 \times T}$$

Solving for Fill Time

$$T = \frac{V \times P}{7.48 \times 14.7 \times CFM}$$

Given the importance of the air supply to proper system maintenance and operation, a quality compressor designed for use with fire protection systems should be utilized. Additional information regarding compressor selection can be found on the technical documents provided with the compressor.

DESIGN GUIDES AVAILABLE FROM

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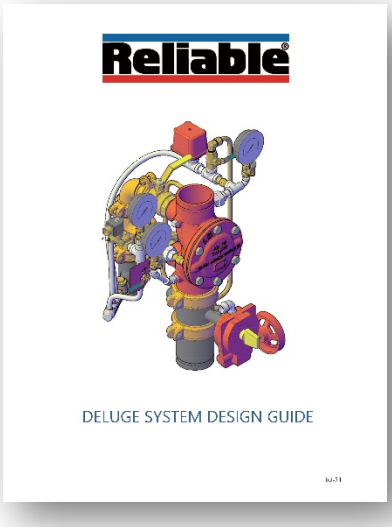

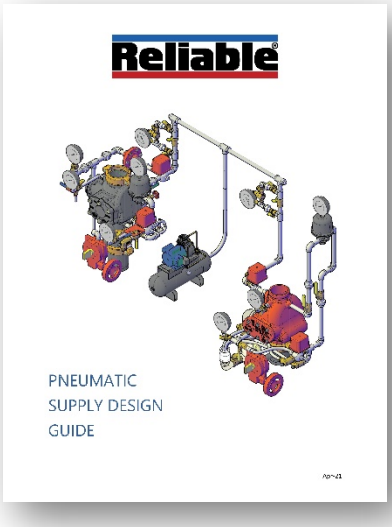

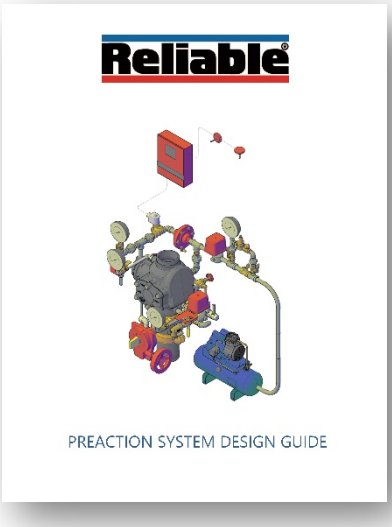

PLEASE CONTACT RELIABLE TECHNICAL SERVICES FOR ADDITIONAL SUPPORT

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