TECHNICAL RESOURCE:

HEATING | AIR CONDITIONING TEMPORARY DUCTWORK

BEST PRACTICES

NOTICE

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Table of Contents

Introduction 2

Types of Temporary Ductwork 2

Challenges of Temporary Ductwork in HVAC Systems 3

General Dynamics of HVAC Air Flow 3

Managing Friction Loss 3

Effects of Friction Loss on HVAC Systems 6

Introduction

One of the critical factors in the proper function of a HVAC unit is how well the ductwork into the conditioned space is laid out and installed. This is even more critical in temporary HVAC installations, which often require adapting to unusual and/or difficult locations and environments. The ability of the HVAC unit to get either cooled or heated air to where it is needed in a conditioned space is primarily determined by how well the ductwork is laid out and installed—a poorly designed and/or implemented duct array can lead to time-consuming and frustrating issues in the conditioned space. This document provides guidelines for designing and installing an efficient and effective temporary ductwork system.

Types of Temporary Ductwork

There are several types of ductwork available for use in HVAC installations, however when installing ductwork in a temporary installation the choices are diminished.

- **Rigid Ductwork**. Rigid ducts are only used in permanent HVAC installations and are therefore **not applicable to temporary installations**. Rigid ducts have several benefits, including being available in either rectangular or cylindrical configurations, cannot be kinked or over-bent, and cannot be torn or punctured. There are three common types of rigid ductwork:
  - **Sheet Metal** (galvanized steel, stainless-steel, or aluminum)
  - **Fiberglas-Lined**
  - **Fiberboard**
- **Flexible Ductwork.** Flexible ductwork is the best option for installations in confined or hard-to-fit locations, is easy to install, and is available in many diameters. This style of ductwork is usually constructed of fabric or vinyl material wrapped around a telescoping steel wire spiral helix. Because of this construction, the interior path is punctuated by regular ridges, which restrict air flow, unless the entire length of duct is pulled taut. Although flexible ductwork is susceptible for puncture, the material is not prone to mold formation or oxidation which enhances air quality. There are several common types of flexible ductwork:

- **Flexible Metallic**. This type is usually constructed of metallized polyester, aluminum foil, and/or polyester laminate and retains its shape well. It is also air-tight with a smooth inner core that means low friction loss.
- **Flexible Fiberglas/Vinyl**. This type is often silicone coated inside and outside to maintain flexibility in temperature extremes and to minimize friction loss. Galvanized steel or stainless-steel collars are common for years of rust-free connections. Other materials (urethane-coated polyester, polyethylene, mold/mildew resistant, fire resistant, odor-free, etc.), insulation temperature ratings, and various options (colors, coil pitch distance, collar-lock combinations, wear strips, etc.) are also available with this type of ductwork.
- **Fabric**. This type is available in air porous on non-porous materials and in various shape configurations, including round, half-round, quarter-round, and oval, that are maintained by an internal skeletal structure. Some installations also offer adjustable flow devices which can vary air resistance in the duct to balance airflow, reduce turbulence, and soften on/off transitions.
- **Lay-Flat Tubing**. This type is often marketed as disposable, but is also economical and easy to install. This lightweight polyethylene tubing comes packaged in a roll format allowing installers to cut it to customs lengths and easily add diffusion holes for confined spaces. When air flow through the duct stops, the duct collapses to flat.

Challenges of Temporary Ductwork in HVAC Systems

General Dynamics of HVAC Air Flow

The job of a HVAC system is to move conditioned air (either heated, cooled, and/or dehumidified) into a confined space and recycle the existing air through the HVAC unit and back into the space. Moving air, like moving water, requires a circulation device (a fan blower or pump) and some form of ducting or piping to accomplish that circulation. The largest variable in the efficiency and performance of a particular temporary HVAC system sized properly for a job is the associated ductwork. FRICTION LOSS is the term used to describe the dynamics of what happens in the ductwork of an HVAC system.

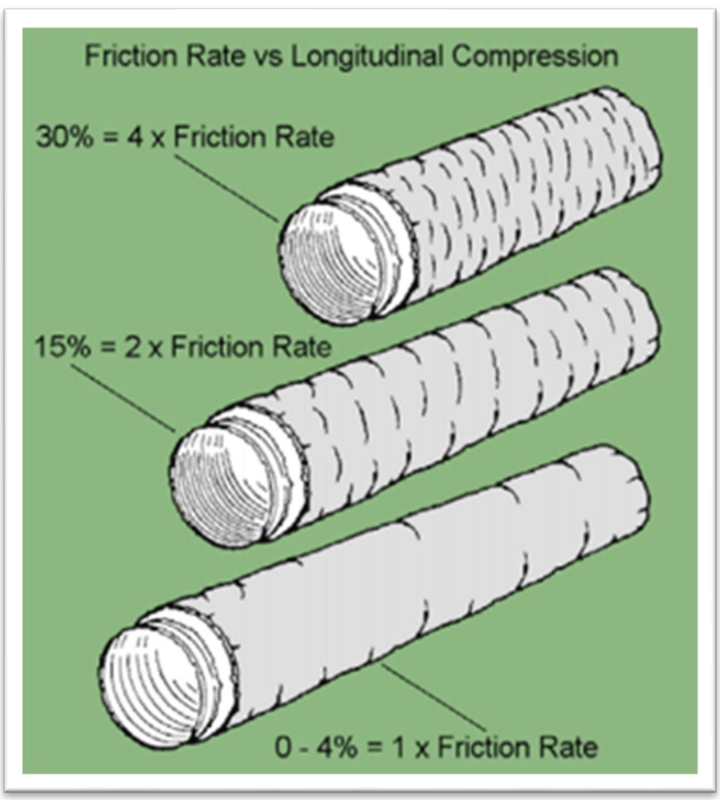
As air moves through ductwork either on its way to or from a conditioned space, the air encounters resistance as it passes through the ducts and this resistance is referred to as friction loss. The resistance that the air experiences in the ductwork creates a reduction in air pressure and a drop in air flow efficiency. In turn, friction loss reduces energy efficiency of the unit, affects system performance (sometimes adversely), and can increase wear on HVAC components. When considering friction loss, the total amount of ducting, including both supply ducts AND return ducts, must be considered.

Managing Friction Loss

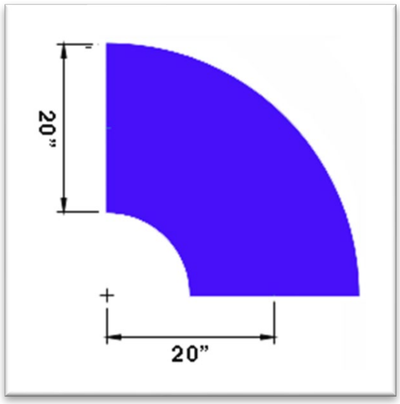
While friction loss is a necessary result of either air or water travelling through a confined duct, the correct and efficient use of ductwork is what makes a temporary HVAC solution viable in the field; without being able to channel the conditioned air to the space where it is needed, we are just blowing smoke into the wind. Although friction loss is primarily a drain on a heat-based HVAC solution, friction loss in a cool-based solution creates a flow restriction that, if managed properly, can enhance the performance of the system.

Friction Loss is affected by several variables, including:

- **Duct Size**. Ducts should be at least the diameter of the supply and return duct connections on the unit. Reducing duct diameter results in greater pressure drops and decreased efficiency. All supply air and return air duct connections on the unit should be used.
- **Duct Material**. Ductwork material also effects friction loss. Permanent ductwork created from sheet metal exhibits far less friction loss than temporary collapsible vinyl ducting.
  NOTE: Most flexible ductwork is directional, so check the tag on the duct to make sure that it is connected to enhance flow.
  NOTE: Using insulated ductwork can reduce temperature fluctuations in conditioned spaces and enhance the efficiency of the overall HVAC system.
- **Length of Duct Runs**. Naturally, the longer a duct run, the more friction loss there will be. However, there are guidelines that will allow you to minimize that loss. Make sure that ducting is extended only as is practical, minimizing bunched up sections or tight turns. Do not bunch up the ductwork to make the next connection (see **Longitudinal Compression** below).
  NOTE: Limit lengths of duct runs to match the external static pressure capability of the fan-motor assembly.
- **Longitudinal Compression**. Flexible ductwork, usually vinyl, by its very nature is compressible, and if the duct is not stretched taut along its full length, friction loss will suffer.



- **Number of Duct Bends**. A 45° duct bend contributes less friction loss than a 90° bend, and by extension, if an installation requires multiple direction changes, using multiple 45° bends will be more efficient than using multiple 90° bends.
- **Angle of Duct Bends**. Make sure that all duct turns have a wide radius to minimize friction loss. Sharp bends in the ductwork quickly multiply the static loading of the unit. Use the diameter dimension of one duct as the minimum bend radius (i.e., if you are using a 20" duct, make sure that the distance from the center of the bend radius to the midpoint of the duct is at least, or greater than, 20").



- **Transition Restraints**. If duct size transitions are necessary to the installation, keeping the transitions gradual will keep the friction loss to the minimum. Tapering down from 20" to 12" will affect your performance more than tapering down from 20" to 18".
- **Vertical Rises**. If the installation is for a multi-story building, vertical ducts will be necessary to carry conditioned air to and return air from non-ground floors. Pushing air against the forces of gravity will also create friction loss, which must be considered in the system design.
- **Negotiate Obstacles**. Often in an installation there are impediments to smooth and straight duct runs. Do not crimp or crease ducts against sharp objects like frame members, wall edges, etc. which contribute to turbulence within the ductwork and greatly increase friction loss. If long duct runs are used, support them adequately to eliminate sagging.
- **Maintain Air-Tight Connections**. Use duct tape or additional fasteners to ensure airtight connections between duct runs and allow minimal leakage, which contributes greatly to friction loss. Leaks in the ductwork cause air to escape, forcing the system to work harder to compensate.
- **Air Flow Velocity**. When air flows at greater velocities, more friction loss is created within the confines of its path than when air is flowing at a lower velocity.
  NOTE: If the return air duct is under a high negative static pressure, care should take when using flexible duct to ensure that it will not collapse under negative pressure.

Effects of Friction Loss on HVAC Systems

The effects of friction loss on the HVAC system may include:

- **Increased Energy Draw**. As friction loss increases, the HVAC system must overcome the greater air resistance in the ducts, causing components to work harder to accomplish the same conditioned space comfort. In worse case scenarios, the operating static pressure rises to the point that components can be forced to function beyond their design parameters and ideal operating range, which may lead to premature failure.
- **Diminished HVAC Performance**. When friction loss can is excessive, conditioned air may not reach the intended spaces in enough volume to provide comfort. It is also vital that the HVAC system is sized properly for the job at hand. No amount of setup enhancement can overcome a system design that does not account for sufficient airflow and adequate static pressure.
- **Evaporator Coil Freeze-Up**. The evaporator coil requires a minimum amount of air flow across its surface to be able to throw off the condensation that forms on the coil. Without sufficient air flow, condensation freezes on the coil instead of draining properly.

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