

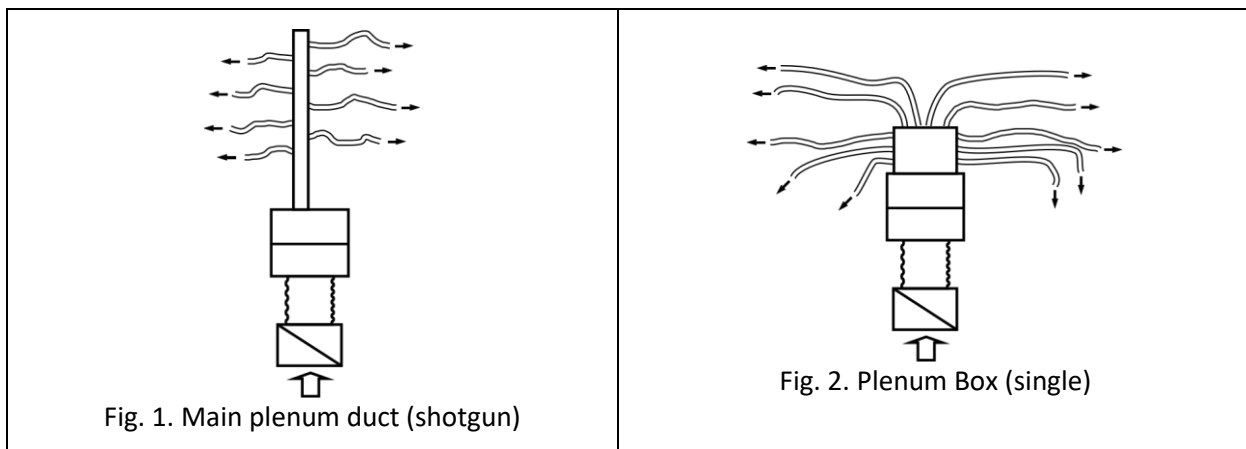
## Small Duct High Velocity Plenum Box vs Plenum Duct

This document delves into the principles of small duct high velocity (SDHV) duct design, comparing plenum boxes and main plenum ducts, and offering simplified design guidelines for plenum boxes in conjunction with the Unico Design Rules outlined in Bulletin 30-10.

The choice between a plenum box and a main plenum duct depends on factors such as available space and budget. Plenum boxes are often employed in compact zones with central locations that can accommodate them, such as basements with limited headroom or small hotel rooms. They can also be installed in utility rooms or closets, with small branch ducts routed through joist spaces. Additionally, plenum boxes are suitable for zoned systems featuring one duct damper per box.

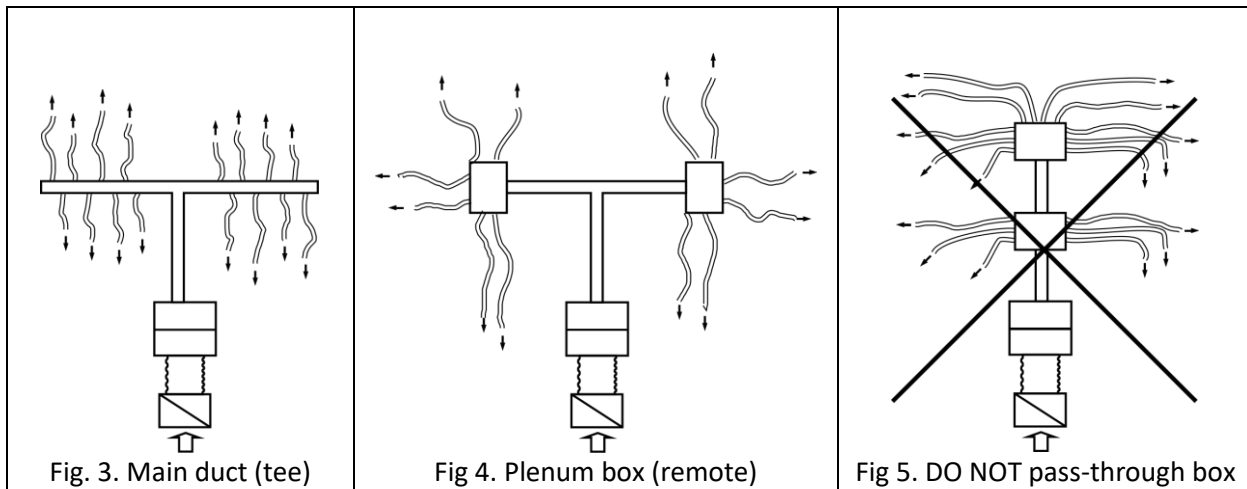
SDHV duct systems, in general, are straightforward to design, focusing on main duct design and the number of branch ducts (outlets). A plenum box can be considered a short, wide plenum duct, leading to a trade-off between short plenums with lengthy branch ducts or long plenums with shorter branch ducts. The building's geometry ultimately constrains the total length.

Main duct size calculations involve Bernoulli's law, friction, and minor losses to maintain constant duct static pressure, known as the equal pressure method of duct design, as outlined in the ASHRAE Fundamentals Handbook. The goal of equal pressure remains the same, whether utilizing a lengthy main duct or a plenum box. In this context, a plenum box can be regarded as a large diameter, short length main duct, which simplifies duct design to a single decision: the number of outlets. This concept is illustrated in Figures 1 and 2 below.



Naturally, some applications are best suited for multiple plenum boxes connected via a plenum duct. The plenum duct generates friction, which must be deducted from the available static pressure. Inside a plenum box, friction is not a concern, as there is complete static regain along with minor pressure recovery losses. As a result, a plenum box should always be positioned at the end of the plenum duct. Similarly, pass-through plenum boxes should be avoided due to considerable entry losses into the outlet plenum duct.

In summary, to achieve optimal performance, all branch ducts should connect to a plenum box, each plenum duct should end with a plenum box, and every plenum box should have only one incoming plenum duct attached (avoiding pass-through boxes). This concept is demonstrated in Figures 3, 4, and 5.



Test results indicate that the static pressure (airflow) for each branch duct connected to a plenum box is fairly uniform, with one notable exception. When a branch duct takeoff is situated directly in front of the blower's discharge, the airflow increases by 50 percent. This is due to the heightened pressure resulting from the velocity pressure of the moving air. To mitigate this effect, consider avoiding takeoffs in this location, employing balancing orifices, or connecting the longest runs to ensure the most even airflow distribution at the outlets.

### Plenum Box Simplified Design Rules

Use the following rules to design a system using a plenum box.

- Apply standard outlet rules: 6-10 outlets per ton for 2-inch ducts, or 4-8 outlets per ton for 2.5-inch ducts.
- For multiple plenum box designs, the plenum duct total length should be less than 100 ft (33 m)
- Avoid pass-through configurations. Each plenum box should terminate with branch ducts.
- Ensure a minimum of 6 outlets per box. For fewer than 6 outlets, use a main duct instead, as there is no need for a box.
- The maximum number of outlets per box is 12, 20, 30 depending on the plenum box model
- Refrain from placing takeoffs directly in front of the blower opening, or alternatively, use balancing orifices or longer ducts.

### Plenum Box Specifications.

The Unico System plenum box is a pre-insulated, five-sided box featuring markings (dimples) for locating 2-inch twist fit system (TFS) takeoffs and cutting the holes. For 2.5-inch metal takeoffs, manual location is required. Outlets can be attached to the sides, top, or both of the box. The box also includes a blank plate for attaching a duct collar when used in a remote box configuration. For more information, refer to the Plenum Box installation bulletin. The table below lists the available models.

Model		1218	2430	3036
<b>Max. Outlets</b>		12	20	30
<b>Dimensions, in. (mm)</b>	H:	12 (300)	17.5 (445)	17.5 (445)
	W:	20 (508)	25 (635)	30 (762)
	D:	18 (457)	18 (457)	18 (457)

**Maximum Allowable Pressure: 3 inches water (744 Pa)**