Technical Bulletin

Total External Static Pressure

Troubleshooting HVAC Systems Failing Airflow and Fan Efficacy Testing

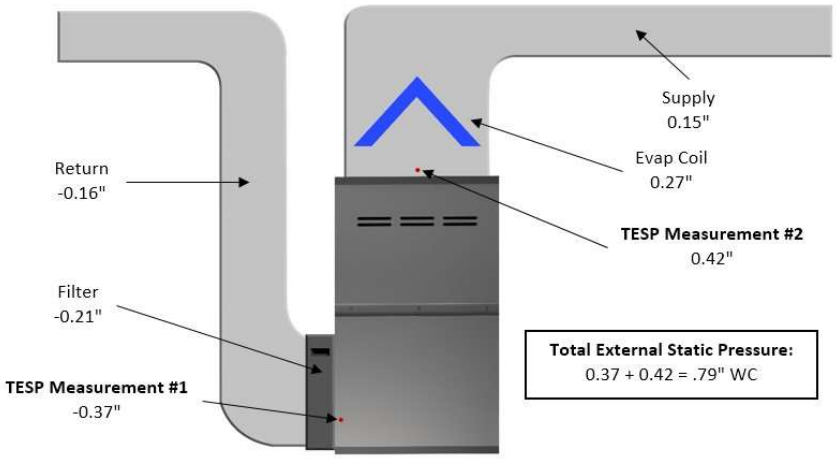
Excessive *total external static pressure (TESP)* across the air handler is the most common reason an HVAC system doesn't meet Title 24 Airflow and Fan Efficacy requirements. Static pressure is the overall resistance to airflow created by components of an HVAC system, such as evaporator coil, air filters, ducts, grilles, registers, etc.

A common design TESP used for typical residential furnaces with a PSC blower is .5" of water column (WC). The typical residential furnace is rated to deliver an approximate amount of airflow at .5" WC. When the TESP is higher than .5" WC, the blower will deliver less airflow; when it is lower than .5 WC, the blower will deliver more airflow.

Undersized filters, return/supply ducts, restrictive grilles, evaporator coils, and/or poor installation techniques will result in an increased TESP.

Review the following diagram of a common split HVAC system as an example:

- The return (ducts, grilles, bends) results in -.16" WC of static pressure. The filter results in -.21" WC. A measurement of total return static measured at the inlet of the blower *after* the filter is -.37" WC.
- On the supply side, the installed coil causes .27" WC of static pressure while the supply ducts and grilles result in an additional .15" WC. In this scenario, total supply static is measured *after* the discharge of the furnace and *before* the evaporator coil. The result is .42" WC.
- Disregard the – and + and add the two TESP measurements together (.37" + .42") for a **Total External Static Pressure** of .79" WC. This is much higher than the .5" WC goal and will result in less airflow than expected.



A blower performance data chart is generally included in the installation manual with each furnace. The following is a generic blower chart for the purposes of this technical bulletin.

Blower Motor Speed	EXTERNAL STATIC PRESSURE (Inches Water Column)							
	0.10"	0.20"	0.30"	0.40"	0.50"	0.60"	0.70"	0.80"
High	1452 cfm	1412 cfm	1324 cfm	1280 cfm	1212 cfm	1190 cfm	1128 cfm	1010 cfm
Medium	1198 cfm	1170 cfm	1145 cfm	1099 cfm	1050 cfm	977 cfm	910 cfm	800 cfm
Med-Lo	977 cfm	957 cfm	940 cfm	912 cfm	884 cfm	820 cfm	756 cfm	653 cfm
Low	752 cfm	732 cfm	718 cfm	701 cfm	667 cfm	625 cfm	572 cfm	501 cfm

Note that with the blower set at *high speed*, and a TESP of .79" WC, your maximum airflow will likely be around 1010 cfm. The overall resistance (static pressure) in the system must be reduced in order to improve airflow. The alternative is to introduce a more efficient ECM blower designed to overcome higher TESP. Keep in mind that while this will likely increase airflow, it will do so at an increased watt draw. The system is *still restrictive* and even a very efficient ECM motor may not allow the system to meet fan watt draw requirements. Efficient ECM motors are not a cure-all solution. Very often, restrictions will need to be reduced.

It is important to note that the above is a generalized explanation of static pressure and how it affects a typical split condenser-furnace combination. There are a myriad of equipment types and design ideologies available. For example, many manufacturers of fan/coil and package units take into account the evaporator coil in their rated TESP capacity and in these cases, *supply* static measurements often occur *after* the evaporator coil. The total TESP rating will likely differ as well. A capable HVAC installer should take all components into account in order to design a system with a relatively low amount of restriction.

It is very common for restrictions to be excessive to the point that TESP is "off the chart". In other words, too high to be listed on the factory performance data chart. Some of the most common reasons are undersized ducts and filtration.

Understanding how to measure **Total External Static Pressure** can be a powerful tool for installers. Learning to measure static pressure across different components can aid a technician in troubleshooting airflow issues by finding where restrictions are located and where changes would create optimal reductions in restriction.

For more information regarding static pressure and system design, we recommend your local utility-sponsored training as well as reaching out to agencies that specialize in a complete approach to system performance such as the National Comfort Institute (NCI) and the Air Conditioning Contractors of America (ACCA).

Additional questions about HERS verification of airflow may be directed to CalCERTS support: support@calcerts.com or (916) 985-3400, ext.*