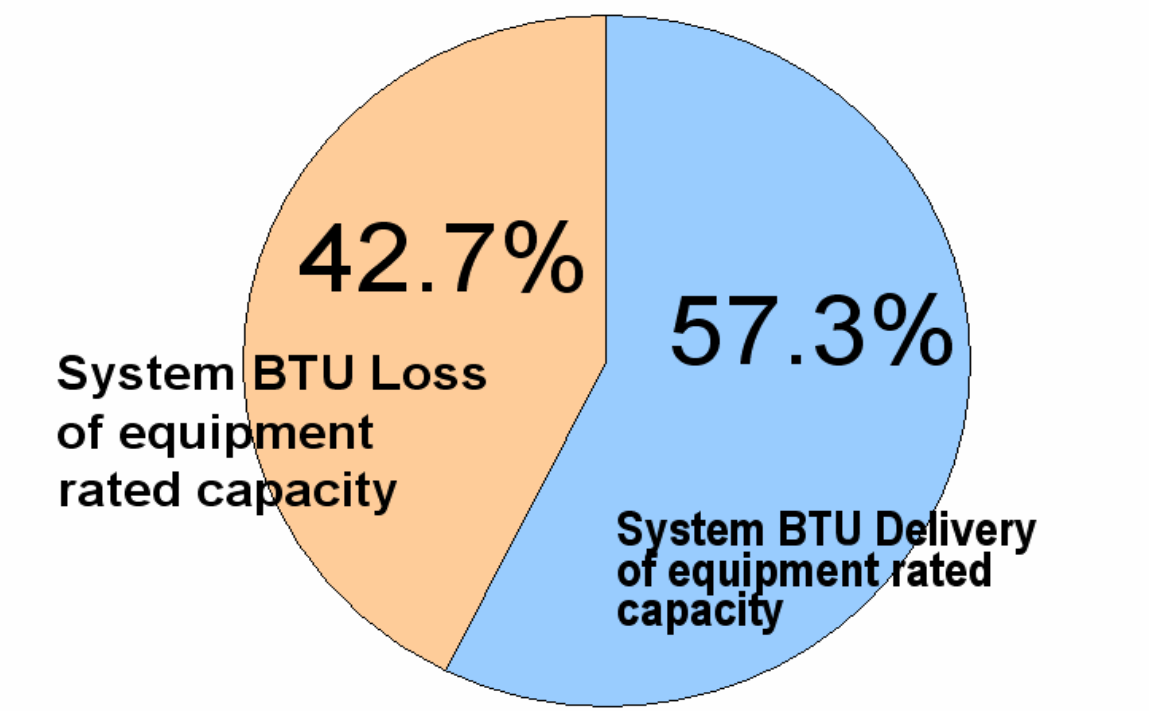
# Performance Verification


# The average HVAC system delivers only 57% of the equipment rated BTU into the building



# PRACTICAL INDUSTRY PERFORMANCE STANDARDS

- System heating or cooling performance should be within 90% of rated equipment capacity.
- One ton of cooling equals 12,000 Nominal BTU
- Cooling airflow should be 400 CFM  per ton.
- Heating airflow should be 100-150 CFM per every 10,000 BTU rated input
- System delivered BTU can be measured: Delivered BTU = Supply CFM x System temperature change x 1.08.

# PRACTICAL INDUSTRY STATIC PRESSURE STANDARDS

- Fans operate properly when static pressure is at or below the rated maximum Total External Static Pressure

- Ideally filter pressure drop should not exceed 20% of equipment rated total external static pressure (typically .10”)

- Ideally coil pressure drop should not exceed 40% of equipment rated total external static pressure (typically .20”)

# PRACTICAL INDUSTRY TEMPERATURE STANDARDS

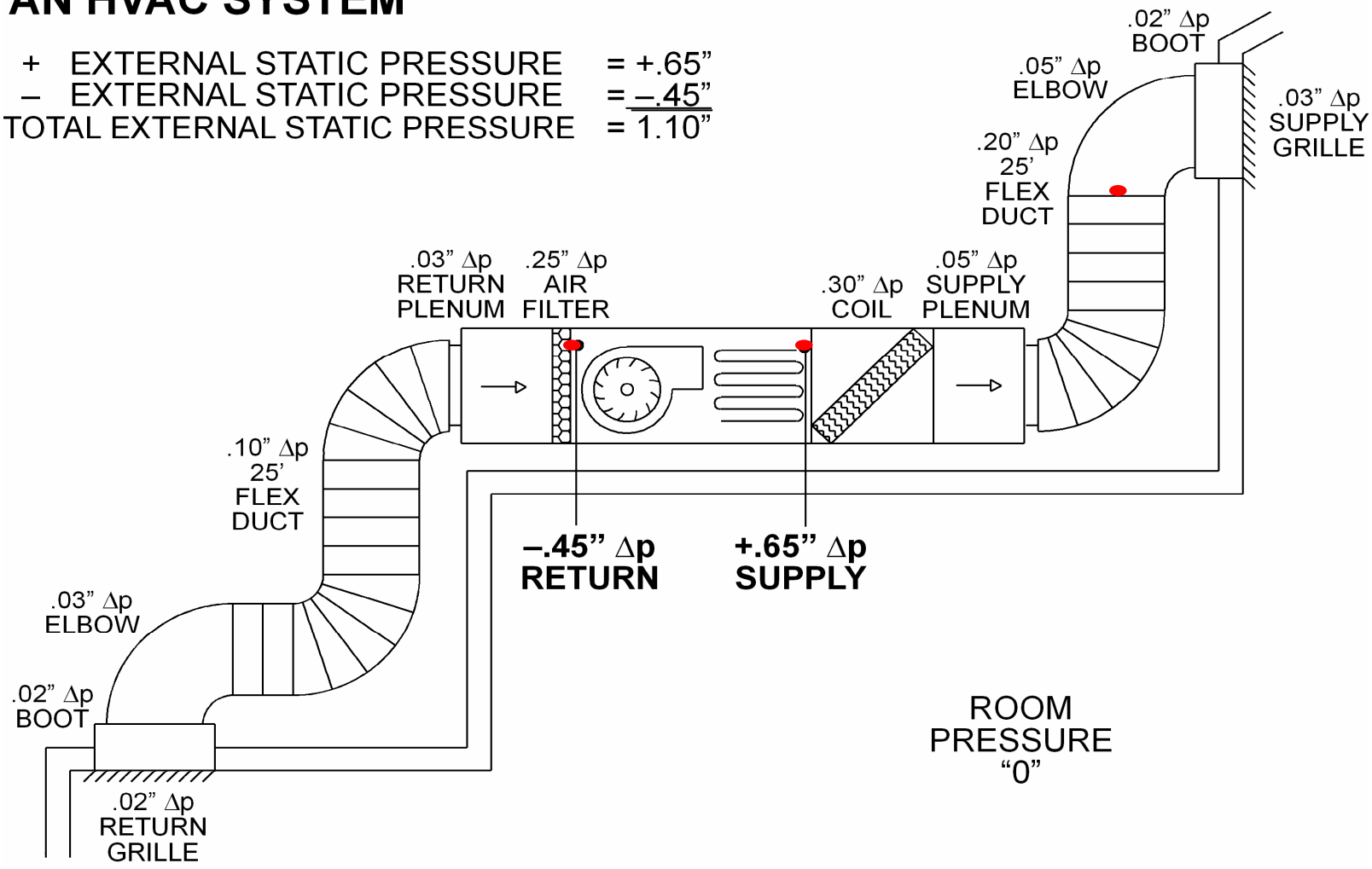
- System temperature drop should be 18°-22°F in coolin g mode.
- System temperature rise should be 35°-75°F for gas furnaces.
- Heat Pump temperature drop is dependent on ambient outside air temperature

## PRACTICAL INDUSTRY TEMPERATURE STANDARDS

- **System Performance** temperature change is the difference between the average return grille and the average supply register.
- **Equipment performance**, temperature change is measured as the difference between entering and exiting air temperature.
- Comfort is defined as 68°- 72°in heating mode and 72 ° - 78°in cooling mode, with relative humidity between 40% & 55%.
- Ideally room temperatures should be are to be within 3° of each other. and duct loss should not exceed 3° through a system.

# STATIC PRESSURES THROUGHOUT AN HVAC SYSTEM

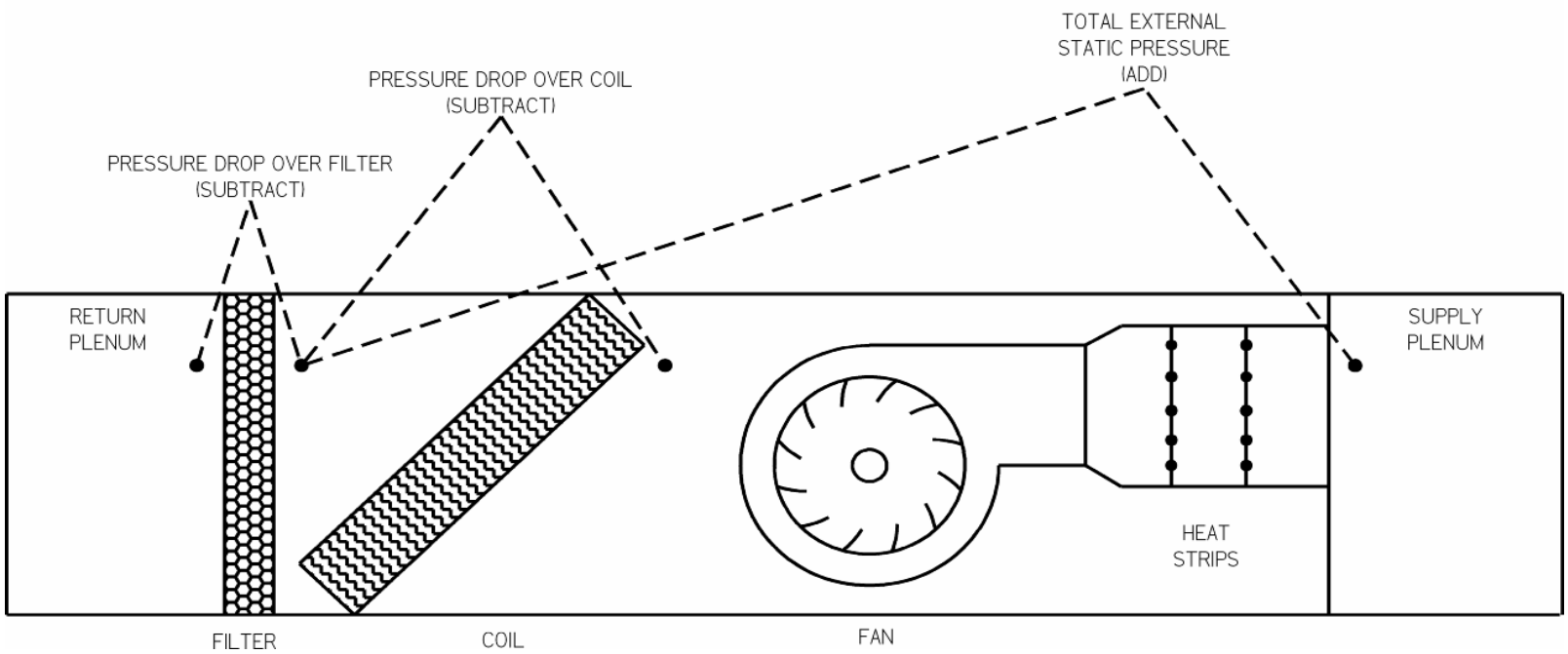
\+ EXTERNAL STATIC PRESSURE = +.65”
– EXTERNAL STATIC PRESSURE = –.45”
TOTAL EXTERNAL STATIC PRESSURE = 1.10”



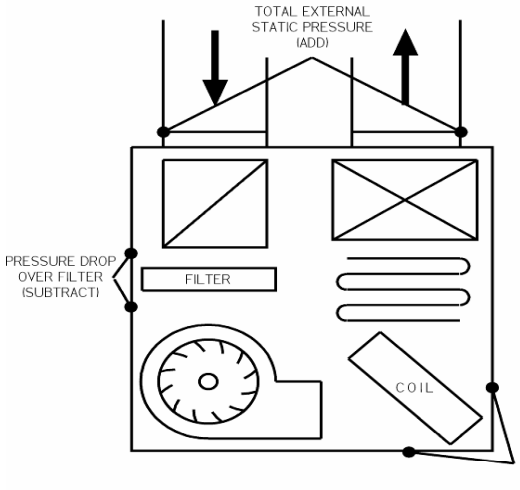

NOTE: AIR HANDLER RATED AT .50” TESP

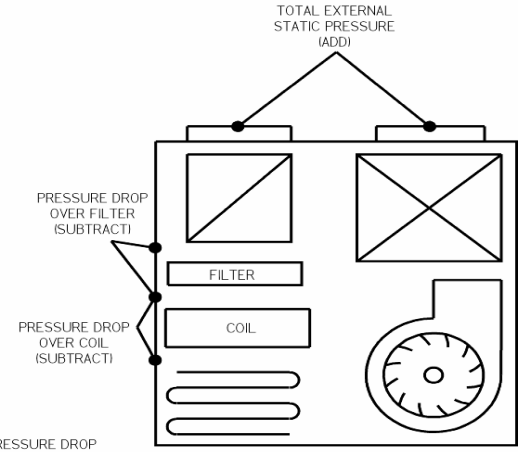
# HORIZONTAL HEAT PUMP
# FILTER IN UNIT



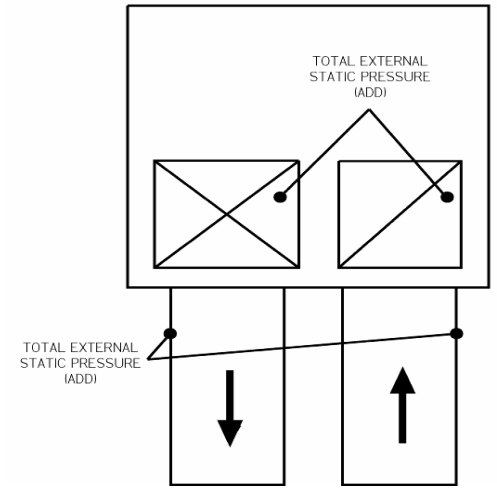


# ROOFTOP/PACKAGE UNITS




TOP VIEW




## MEASURING PRESSURES ON PACKAGE UNITS

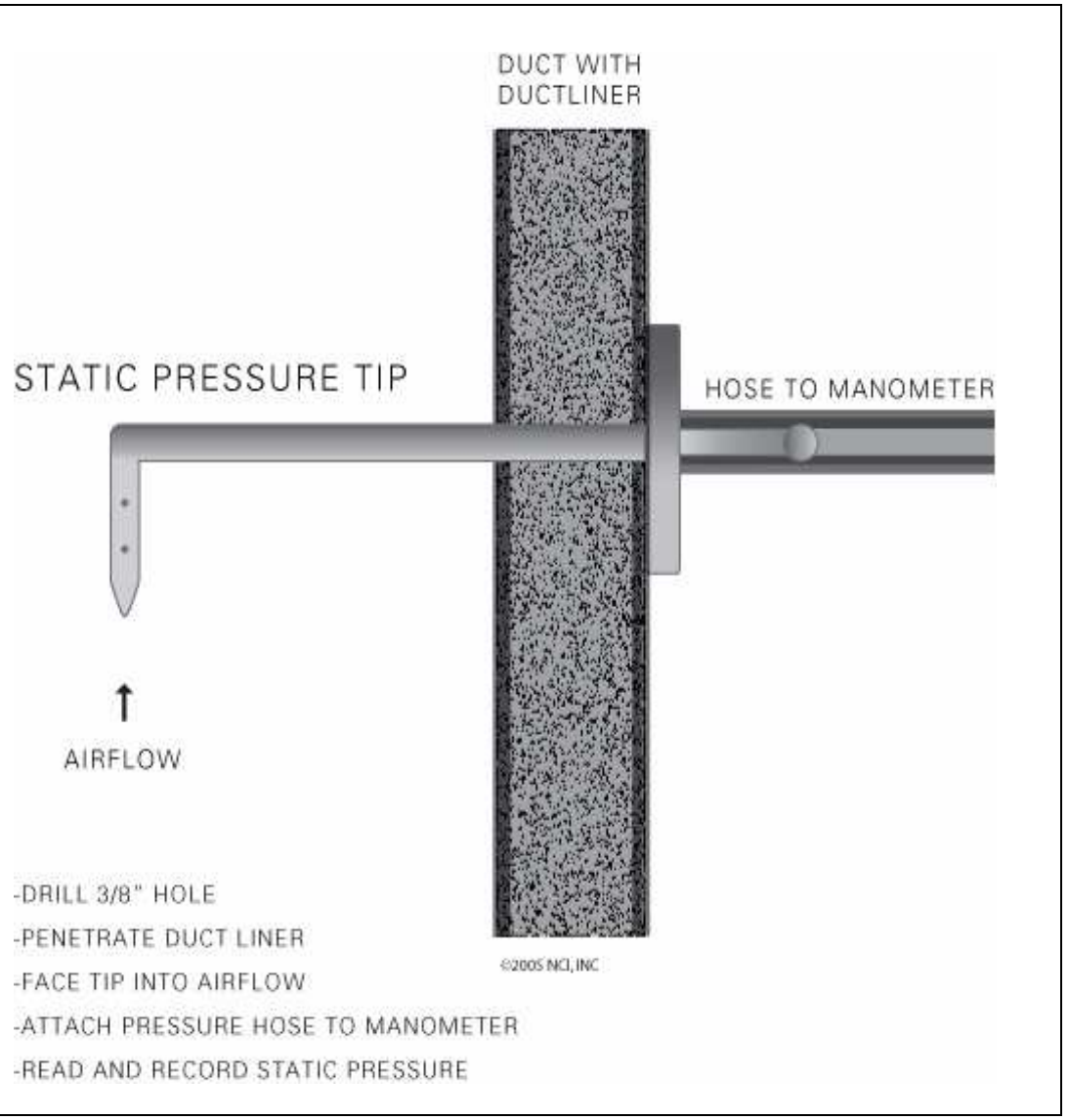
1. Measure positive and negative pressures where ducts or plenums enter or exit the unit.

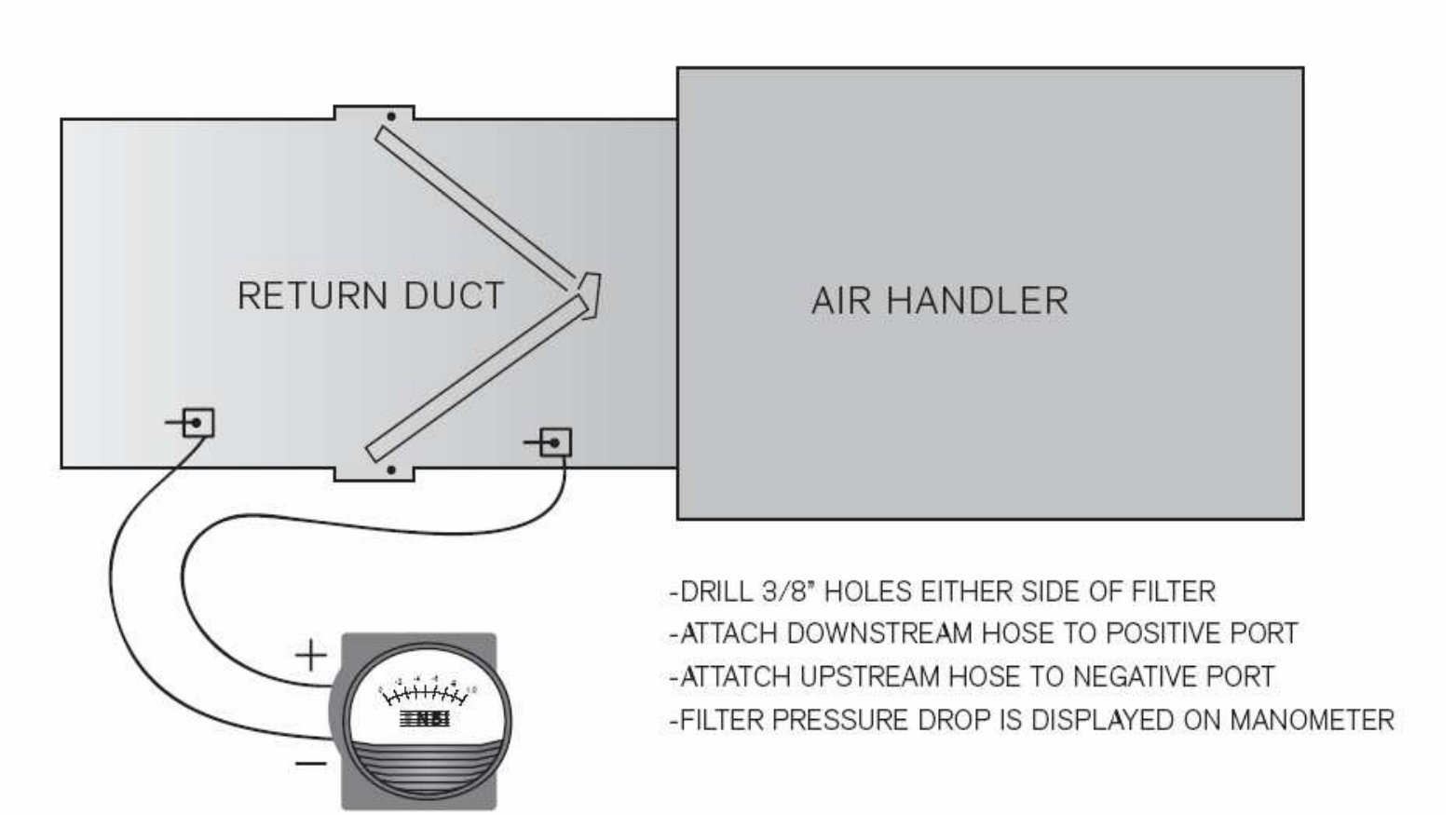
2. Drill holes only in vertical surfaces; horizontal holes will leak water.

3. Remove panels to inspect for coil, filter, and fan locations.

4. Test holes must be in a vertical surface to remain watertight.

5. Some readings may need to be taken through service access panels.


DUCT WITH
DUCTLINER
STATIC PRESSURE TIP
HOSE TO MANOMETER
AIRFLOW
-DRILL 3/8" HOLE
-PENETRATE DUCT LINER
-FACE TIP INTO AIRFLOW
-ATTACH PRESSURE HOSE TO MANOMETER
-READ AND RECORD STATIC PRESSURE
©2005 NCI, INC



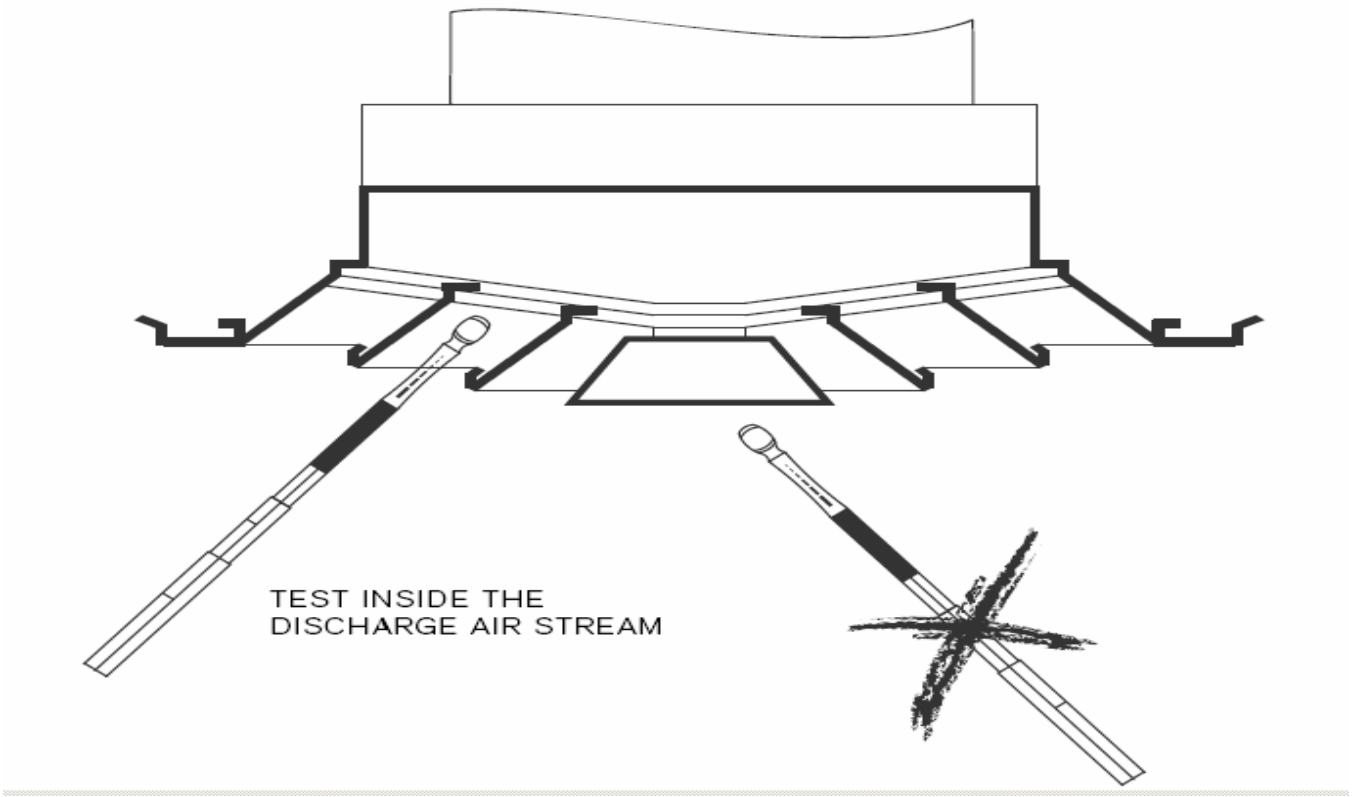

-DRILL 3/8" HOLES EITHER SIDE OF FILTER
-ATTACH DOWNSTREAM HOSE TO POSITIVE PORT
-ATTATCH UPSTREAM HOSE TO NEGATIVE PORT
-FILTER PRESSURE DROP IS DISPLAYED ON MANOMETER

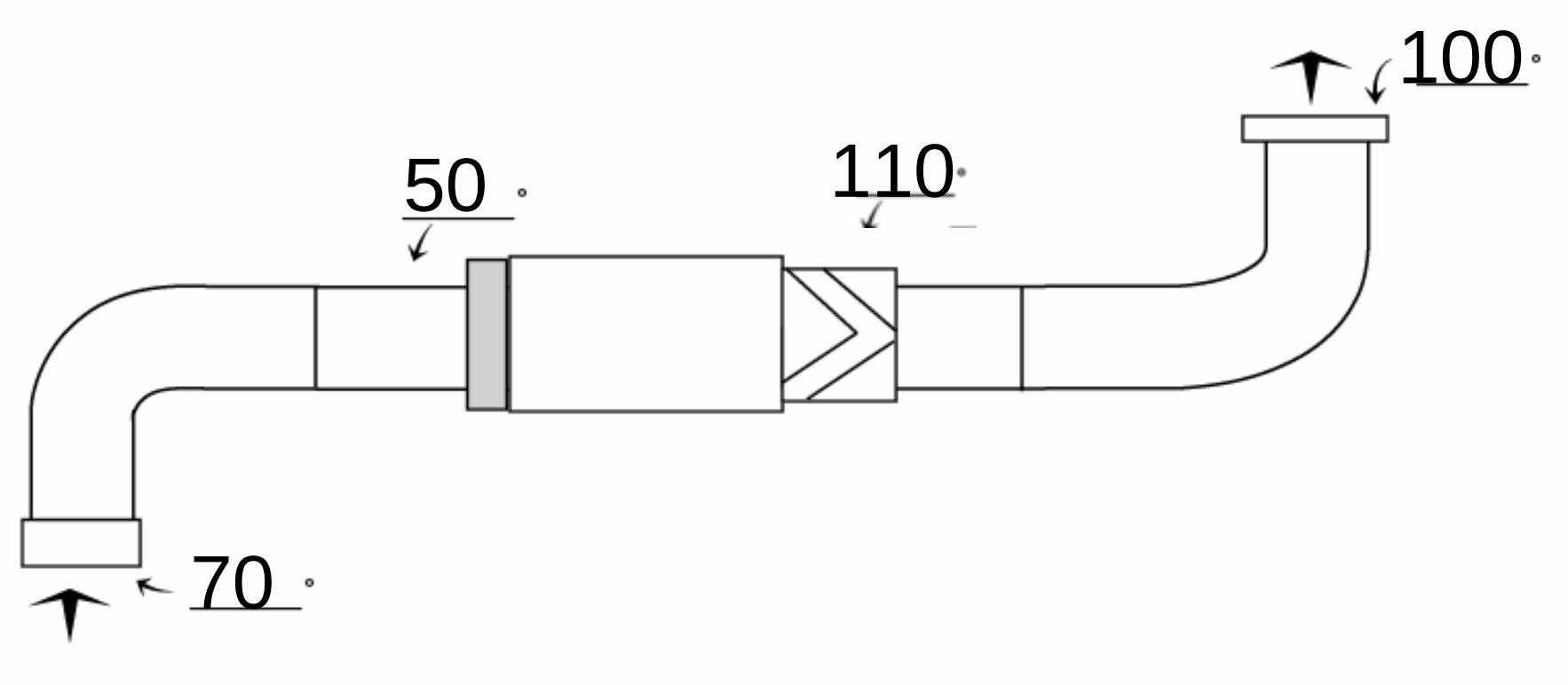
- Turn system fan on
- Attach hose to negative pressure port
- Penetrate grille and filter with static pressure tip
- Pressure drop is displayed on manometer

# TYPICAL RESIDENTIAL PRESSURE DROPS

| SYSTEM COMPONENT | TYPICAL PRESSURE DROP |
|---|---|
| **FILTERS @ 1.33 SQ. FT./TON** | |
| 1" Fiberglass | .04"-.08" |
| Electronic | .06"-.12" |
| Hog Hair | .05"-.11" |
| Washable | .08"-.14" |
| 40% Efficient Pleated | .20"-.30" |
| Electrostatic | .20"-.50" |
| 90% Efficient Media | .30"-.70" |
| **COOLING COILS** | |
| Horizontal - Older | .05"-.15" |
| Horizontal - Standard | .08"-.19" |
| Horizontal - High Efficiency | .15"-.30" |
| Up or Down Flow - Older | .05"-.15" |
| Up or Down Flow - Standard | .15"-.25" |
| Up or Down Flow - High Efficiency | .20"-.50" |
| **SYSTEM COMPONENTS** | |
| 25 Feet of Flex Duct | .05"-.30" |
| 25 Feet of Sheet Metal Duct | .03"-.07" |
| 90 Degree Elbows | .02"-.06" |
| Residential Registers and Grilles | .03"-.10" |
| Sheet Metal Wye | .02"-.05" |
| Duct Board Wye | .05"-.15" |
| Remote Plenum | .15"-.40" |

# Air Temperature at a Register






Duct Loss Measurement

# BTU LOSS OR GAIN THROUGH RETURN DUCTS

| CFM | △t BETWEEN RETURN AIR TEMP AND AIR TEMP SURROUNDING DUCT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° | 100° |
| 100 | 1,080 | 2,160 | 3,240 | 4,320 | 5,400 | 6,480 | 7,560 | 8,640 | 9,720 | 10,800 |
| 150 | 1,620 | 3,240 | 4,860 | 6,480 | 8,100 | 9,720 | 11,340 | 12,960 | 14,580 | 16,200 |
| 200 | 2,160 | 4,320 | 6,480 | 8,640 | 10,800 | 12,960 | 15,120 | 17,280 | 19,440 | 21,600 |
| 250 | 2,700 | 5,400 | 8,100 | 10,800 | 13,500 | 16,200 | 18,900 | 21,600 | 24,300 | 27,000 |
| 300 | 3,240 | 6,480 | 9,720 | 12,960 | 16,200 | 19,440 | 22,680 | 25,920 | 29,160 | 32,400 |
| 350 | 3,780 | 7,560 | 11,340 | 15,120 | 18,900 | 22,680 | 26,460 | 30,240 | 34,020 | 37,800 |
| 400 | 4,320 | 8,640 | 12,960 | 17,280 | 21,600 | 25,920 | 30,240 | 34,560 | 38,880 | 43,200 |
| 500 | 5,400 | 10,800 | 16,200 | 21,600 | 27,000 | 32,400 | 37,800 | 43,200 | 48,600 | 54,000 |
| 600 | 6,480 | 12,960 | 19,440 | 25,920 | 32,400 | 38,880 | 45,360 | 51,840 | 58,320 | 64,800 |
| 700 | 7,560 | 15,120 | 22,680 | 30,240 | 37,800 | 45,360 | 52,920 | 60,480 | 68,040 | 75,600 |
| 800 | 8,640 | 17,280 | 25,920 | 34,560 | 43,200 | 51,840 | 60,480 | 69,120 | 77,760 | 86,400 |
| 900 | 9,720 | 19,440 | 29,160 | 38,880 | 48,600 | 58,320 | 68,040 | 77,760 | 87,480 | 97,200 |
| 1000 | 10,800 | 21,600 | 32,400 | 43,200 | 54,000 | 64,800 | 75,600 | 86,400 | 97,200 | 108,000 |

CoolMaxx™

Name_____

Address_____

System_____ Date _____

Phone _____ Comfort Consultant Appointment _____

## CoolMaxx Total Cooling – System Performance Analysis

### 1) SYSTEM PRESSURES

Like the doctor takes our blood pressure as an overall test of our well-being, we do a similar test called Static Pressure to test your system's overall performance.

**Your maximum pressure rating is** _____

**Your measured static pressure is** _____

### 2) FILTER RESISTANCE

Ideally the filter pressure drop should not exceed 20% of fan rated total external static pressure.

**Rated fan total static pressure x 20%** _____

**The actual filter pressure drop is** _____

A filter with excessive resistance reduces airflow and may decrease cooling capacity.

### 3) FAN AIRFLOW

In order to work properly your cooling system needs adequate airflow.

**Your current fan speed setting is** _____

**Required Airflow is calculated:**

_____ **Nominal Tons x 400 CFM per ton =** _____

**Your Actual Fan Airflow is** _____

Actual Fan Airflow should be plus or minus 10% of Required Airflow to assure proper system performance.

### 4) TEMPERATURES

**Current outdoor temperature** _____

**Current entering coil WB** _____

**DRY BULB TEMPERATURES**

**Average DB Return Grille Air Temp** _____

**Average DB Supply Register Temp** _____

**System DB Temp Change (Δt)** _____

**WET BULB TEMPERATURES/ENTHALPY CHANGE**

**Average WB Return Grille Air Temp** _____

**Average WB Supply Register Temp** _____

**Average Return Grille Enthalpy** _____

**Average Supply Register Enthalpy** _____

**Enthalpy Change** _____

### 5) BTU DELIVERY

Once we know airflow and enthalpy change, we can calculate how well the system is operating.

**Under current conditions the Equipment Rated Total BTU removal capacity is** _____

**Fan Airflow** _____

**Times Enthalpy Change (Δht)** _____

**Times the constant 4.65** _____

**System Delivered Total BTU** _____

### 6) EFFECTIVE EFFICIENCY

Divide the equipment Rated TBTU by the measured BTU to find the percentage of system efficiency.

**System Delivered Total BTU** _____

**Divided by Equipment Rated TBTU** _____

**System Effective Efficiency** _____ %

According to NCI Standards, an acceptable working cooling system Total BTU delivery should meet or exceed 90% of the equipment rated Total BTU cooling capacity.

RECOMMENDATIONS