Air Source Heat Pump
Cold-Climate Duct Evaluation Guide

NEW YORK STATE | NYSERDA

Evaluate the Duct System Before Heat Pump Installation

Adequate duct sizing, air-sealing, and insulation are essential for a heat pump to operate efficiently and maintain comfort. Heat pumps supply ***warm*** air as opposed to the ***hot*** air that comes from an existing furnace. When repurposing existing ducts, it may be necessary to size the trunk and/or branches larger to provide the heat load of each room. In many cases the existing ducts were oversized initially and therefore will still work for the heat pump. To optimize the heat pump performance and customer satisfaction, installers must inspect and test the existing ductwork to determine if they can be repurposed as-is, need to be modified, or need to be replaced entirely by new ductwork.

This guide will help contractors make the decision to replace, decommission, modify, or reuse existing ductwork. Homeowners can be reluctant to spend extra for the necessary changes to their duct system. Using this process allows you to confidently recommend changes and provide authentic reasons to backup your recommendations.

Why do Ducts Matter?

Perfectly sized ducts go completely unnoticed; supplying the correct amount of conditioned air to each zone without straining the system. Improperly sized ducts, however, can cause lack of comfort, hot and cold zones, vibrations, loud popping sounds known as oil canning, and decreases in efficiency. Excessive bends and compressions greatly restrict airflow through the ducts. Compressions of just 15% can decrease pressure by 400-800%.

If left unaddressed, the complaints a homeowner had about their existing system will likely carry over to their new heat pump. Fix these issues to avoid callbacks and increase customer satisfaction.

USE EXISTING

If the ducts are in good condition, pass a visual evaluation, are within the acceptable range of total external static pressure (TESP), are sized to provide sufficient airflow for the heat pump, and do not have leaks or gaps in insulation.

MODIFY

If the ducts have minor deficiencies like leaks or gaps in insulation, if small adjustments can be made to balance the system, or if registers blow air directly onto occupants.

REPLACE OR DECOMMISSION

If the ducts are showing substantial signs of aging (rust or degrading materials), if the duct capacity is too small for the heat pump, or if the ducts are uninsulated in unconditioned spaces and insulation cannot be added.

Kitchen Table Discussions | Gather customer feedback on the existing system

Ask about the age of the system, comfort in each room, noise from ducts or registers, registers that blow too much or not enough, filter cleaning and replacing habits, maintenance records, if they are aware of any asbestos, and any recent modifications or assessments.

Visual Evaluation | Check the ducts for quick fixes and signs of aging

Conducting a brief visual evaluation can detect causes of issues the homeowner may have been noticing and can detect early symptoms of a struggling or aging duct system that should be replaced. Check each joint and trace each duct branch for leaks, gaps in insulation, disconnections, and compressions. Excessive duct length, bends, and compressions will inhibit airflow. Collect lengths and sizes of duct plenums and branches.

Duct Testing | Test the TESP of the duct system

Ducted HVAC units depend on duct airflow for proper air distribution. TESP is a key duct quality indicator. Employ a manometer to measure TESP and filter pressure drop.

For step-by-step testing process, see the CEE Duct Retrofit Decision Guide.

Verify Duct Airflow

Duct sizing and design considers the duct's dimensions, lengths, and materials. Following Air Conditioning Contractors of America (ACCA) Manual D is crucial when installing new ducts or when installing a new heat pump with existing ducts. Checking duct capacity and balancing will identify problems with existing duct systems but does not substitute for completing a Manual D or testing the duct system.

If the duct system capacity is not adequate, replace with larger ducts or install extra duct branches to the necessary rooms.

For an estimate of duct capacities, consult the National Comfort Institute's (NCI) Standardized Duct Sizing Tables on Page 4.

When sizing for a heat pump in a heating driven climate like New York, ducts should be sized to the heating design load.

1. **How much air is the duct system supposed to handle?**
   Check the heat pump specifications and use the listed airflow value. Undersized ducts cause inefficiencies, excess noise, and vibration.

2. **Are the supply *trunks* able to handle the airflow?**
   Calculate the total air capacity of the supply trunks and make sure it is equal to or larger than the required airflow.

3. **Are the supply *branches* able to handle the airflow?**
   Confirm the supply branch capacities are large enough to handle the required airflow to the rooms they serve.

4. **Are the return ducts able to handle the airflow?**
   Confirm the return duct capacity is large enough to handle the required airflow.

5. **Does the duct system behave as expected?**
   Confirm the ducts are supplying the expected airflow by testing the cubic feet per minute (CFM) at each register. More airflow than expected may result in comfort issues. Less airflow than expected may be a sign of damaged, compressed, or deteriorating ducts.

Verify Duct Balancing

A properly balanced duct system will distribute the correct amount of heating and cooling to each room. Minor adjustments can be made with dampers, but installing a heat pump provides the opportunity to comprehensively balance the duct system. A Manual J must be completed to calculate the loads of each zone.

The suggested method to balance a system is to compare the zonal load of the room to the measured airflow:

1. **Turn the fan on high and use a balancing hood or anemometer to measure CFM at each register**
2. **Calculate the total airflow into each room**
3. **Divide each room's airflow by its design load to get the room's balancing ratio (CFM/BTU)**

What does the balancing ratio tell us?

Less than average = More airflow needed

More than average = Less airflow needed

Perform Manual D calculations to size ducts for airflow appropriate to the zonal loads, verify changes, and balance the system for complete comfort from the heat pump.

Test the Ductwork

Air flow

To assess duct condition and airflow, measure the duct airflow and compare to the heat pump manufacturer's rating. Measure the airflow at each register using a balancing hood or anemometer. Compare this value to the expected airflow and balance the duct system.

Duct leakage

Duct leaks waste energy by letting hot or cold air escape to the surroundings. Leaks force HVAC systems to expend more energy to maintain comfort. On average, 25% of air is lost through leaks which equates to a 25% increase in energy use. Conduct a duct leakage test to measure airflow and identify leaks. Seal leaks detected through the visual inspection prior to testing the system for leakage.

Cost of Duct Replacement

Some duct systems will not be adequate to reuse or fix for the new system. At this point, the homeowner must decide if they would like to replace the ducts or decommission them and install ductless heat pumps instead. Cost is often a driving factor. Consider these factors when providing an estimate:

- Removal of existing ducts
- New vents and registers
- Air sealing
- Insulating
- Duct material
- Duct location
- Permits

Duct Retrofit Best Practice

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- ✓ Interview the homeowner
- ✓ Visually evaluate the ducts
- ✓ Confirm duct capacity meets heat pump needs
- ✓ Non-diagnostic commissioning

★★

- ✓ All ★ items
- ✓ Check total external static pressure (TESP)
- ✓ Verify duct balancing
- ✓ Measure airflow at registers with flow-hood

★★★

- ✓ All ★ and ★★ items
- ✓ Assess duct leakage with duct-blaster or blower door and pressure pan
- ✓ Complete a Manual D and compare to existing ducts

NCI Standardized Duct Sizing

The airflow values shown in these charts are expected averages and should only be used as a reference. Ducts exceeding 25' in length or with excessive transitions will have less capacity than shown. Always test and balance the duct system to verify sizing in the field.

Flexible Duct

Duct Size	CFM
5"	50
6"	75
7"	110
8"	160
9"	225
10"	300
12"	480
14"	700
16"	1000
18"	1300
20"	1700

Round Metal Pipe

Duct Size	CFM
5″	60
6″	85
7″	125
8″	180
9″	240
10″	325
12″	525
14″	750
16″	1200
18″	1500
20″	2000

Rectangular Duct

CFM	4"	CFM	6"	CFM	8"	CFM	10"	CFM	12"
60	**6x4**	60	**4x6**	90	**4x8**	120	**4x10**	150	**4x12**
90	**8x4**	110	**6x6**	160	**6x8**	215	**6x10**	270	**6x12**
120	**10x4**	160	**8x6**	230	**8x8**	310	**8x10**	400	**8x12**
150	**12x4**	215	**10x6**	310	**10x8**	430	**10x10**	550	**10x12**
180	**14x4**	270	**12x6**	400	**12x8**	550	**12x10**	680	**12x12**
210	**16x4**	320	**14x6**	490	**14x8**	670	**14x10**	800	**14x12**
240	**18x4**	375	**16x6**	580	**16x8**	800	**16x10**	950	**16x12**
270	**20x4**	430	**18x6**	670	**18x8**	930	**18x10**	1100	**18x12**
300	**22x4**	490	**20x6**	750	**20x8**	1060	**20x10**	1250	**20x12**
330	**24x4**	540	**22x6**	840	**22x8**	1200	**22x10**	1400	**22x12**
-		600	**24x6**	930	**24x8**	1320	**24x10**	1600	**24x12**
		650	**26x6**	1020	**26x8**	1430	**26x10**	1750	**26x12**
		710	**28x6**	1100	**28x8**	1550	**28x10**	1950	**28x12**
		775	**30x6**	1200	**30x8**	1670	**30x10**	2150	**30x12**
40	**21/2 x10**	-		1300	**32x8**	1800	**32x10**	2300	**32x12**
70	**21/2 x14**			1400	**34x8**	1930	**34x10**	2450	**34x12**
150	**21/2 x30**			1500	**36x8**	2060	**36x10**	2600	**36x12**
-		100	**31/2 x14**	-		2200	**38x10**	2750	**38x12**
		220	**31/2 x30**			2350	**40x10**	2900	**40x12**
						-		3050	**42x12**