HVAC Retrofit Paradigm Shift;
First, attack distribution system; Second, replace equipment

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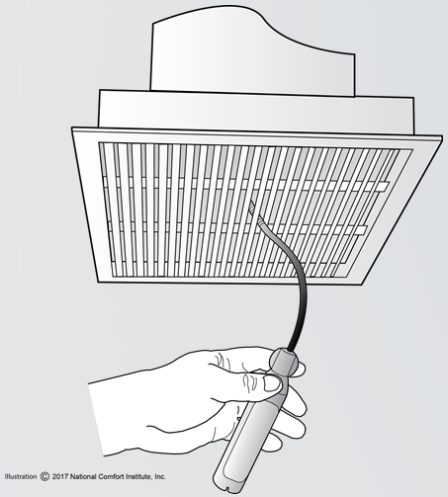
National Balancing Council

First, attack distribution system - Second, replace equipment

- A revolutionary approach to retrofit HVAC projects, **focusing on the distribution system first** and the equipment replacement second
- The purpose of this presentation is to question the way you approach a retrofit HVAC project, whatever your role.
- Equipment will be replaced, once the air distribution enables it to operate within the designer's and equipment manufacturer's specification.
- First **inspect, test, diagnose** and then prescribe duct solutions
- Considered by some an emerging technology.

Why the offer System First, Equipment Second approach?



- Provide **superior retrofit** project results
- Address major **system issues missed in a change-out**
- **Distinguish you from your competition** and deliver a product your competition doesn't offer
- Superior comfort and efficiency
- **Reduced warranty costs**
- Customer **satisfaction greater than the increased project cost**
- **Verify** promised efficiency and comfort were achieved

What difference does it make?

Pre-and Post System Delivered Cooling Capacity - Cooling System Performance Ratio (CSP-r)

Test Site	Pre-CSP-r	Post-CSP-r	% Improved
1	52%	93%	79%
2	32%	80%	147%
3	72%	85%	18%
4	68%	79%	16%
5	70%	86%	23%
6	66%	98%	50%
7	80%	98%	22%
Study Avg.	63%	88%	41%

What difference does it make?

Pre-and Post Installed System EER – Installed Cooling System EER (ICS-eer)

Test Site	Pre-ICS-eer	Post-ICS-eer	% Improved
1	5.1	8.8	74%
2	3.5	8.3	139%
3	7.2	8.2	14%
4	7.6	8.1	6%
5	6.4	10.0	57%
6	6.1	8.6	42%
7	9.1	10.6	16%
Study Avg.	6.42	8.95	39%

More work than a change-out project

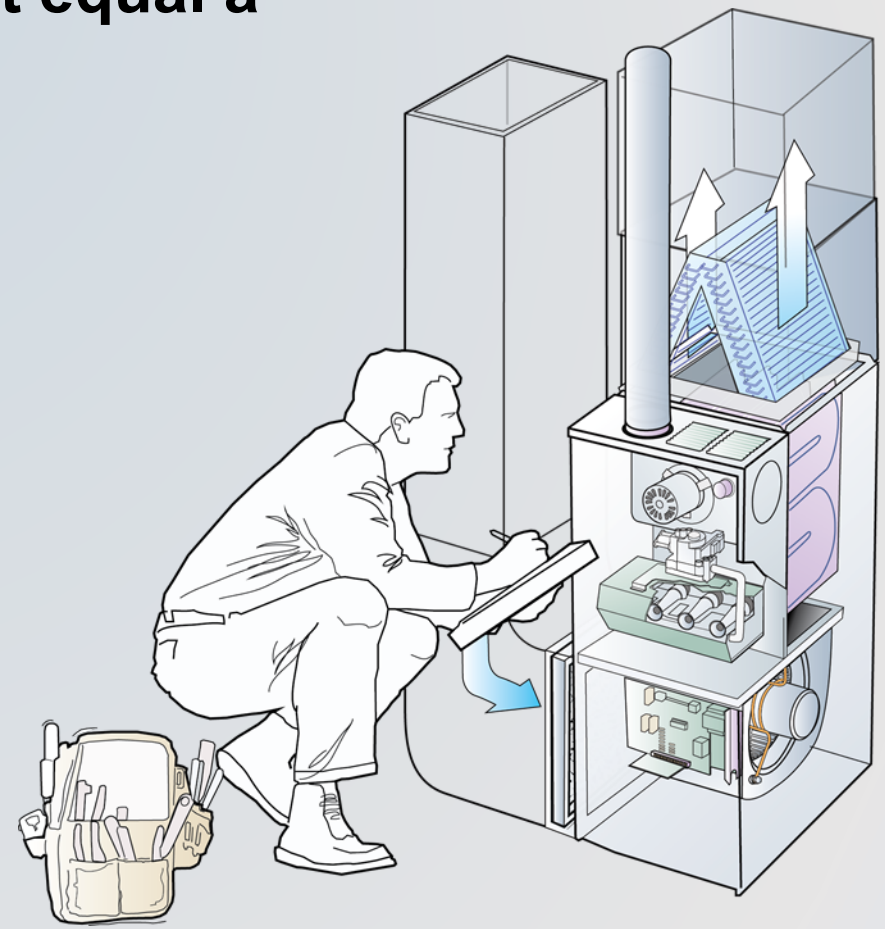
- Requires more effort by the designer/contractor
- Demands knowledge and ingenuity

- Increases the cost and profit of the project
- Eliminates your competition
- Satisfies a more demanding consumer
- Provide documentation of installed system performance

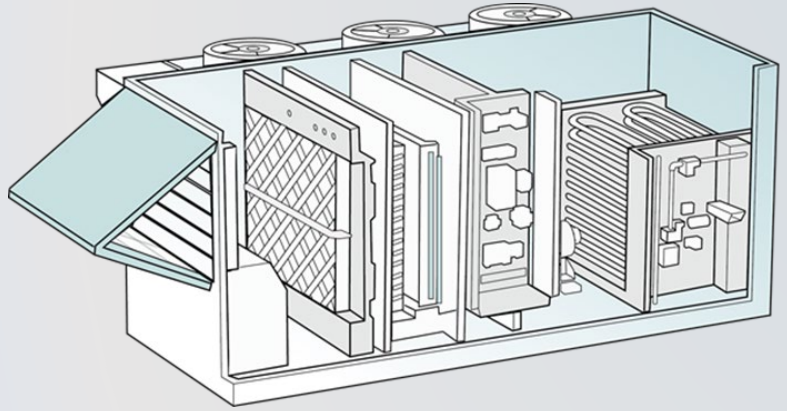
Additional repairs beyond change-out

Hard Fact – High Efficiency equipment does not equal a high efficiency system.

- Test and documentation before and after project
- Increase duct capacity, **reduce static pressure**
- Low pressure **air filter systems**
- Add **duct insulation**
- Repair of **old installation defects**
- **Test, adjust and balance**
- HVAC system **commissioning**
- Design **verification**



Assumptions - equipment replacement only



Equipment replacement only approach assumes near perfect function of non-equipment system components.

- Is new equipment is a plug-and-play appliance?
- Does new equipment solve all system problems?
- Can the duct system deliver required system airflow and temperature?
- Does equipment deliver the comfort or does the system?
- Was Individual room comfort satisfactory.
- Has your design been verified?

System First, Equipment Second Project – How it's done

1. **Interview** decision makers, define project approach.
2. **Inspect** equipment, accessories, controls and distribution system.
3. **Compare** installation to design, specs and best practices.
4. **Prepare diagnostic reports** with design data.
5. **Test and record** air pressures, airflows and temperatures
6. **Diagnose** the system and document needed improvements.
7. **Prescribe a solution** for each defect discovered and present to decision maker.
8. **Proceed** with design and construction, including equipment replacement.

1. Interview decision makers, define project approach

Objectives

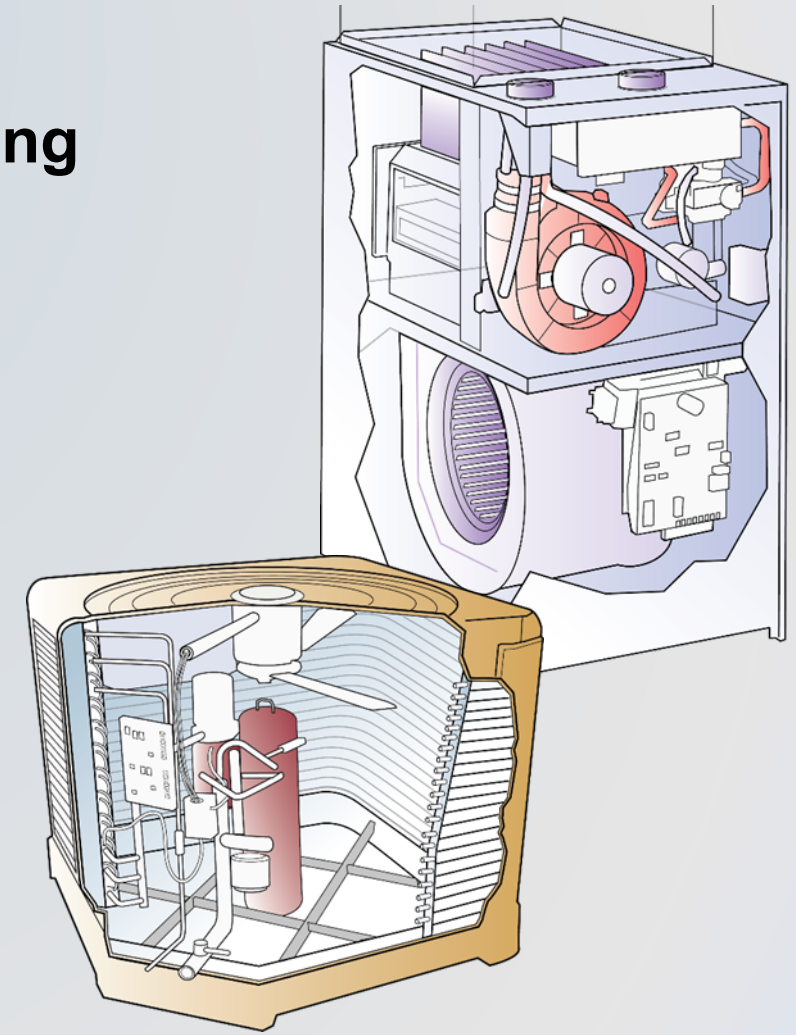
- **Educate** decision makers about System First, Equipment Second approach to a retrofit project
- **Teach** assumptions and benefits
- **Describe** testing, diagnostics and invite discovery
- **Spot test** to reveal system defects
- **Discuss** your anticipated role in the project
- **Agree** on principles of approach and increased cost

Any Questions?

2. Inspect equipment, accessories, controls and distribution system.

Your mission – discover system defects deteriorating system performance

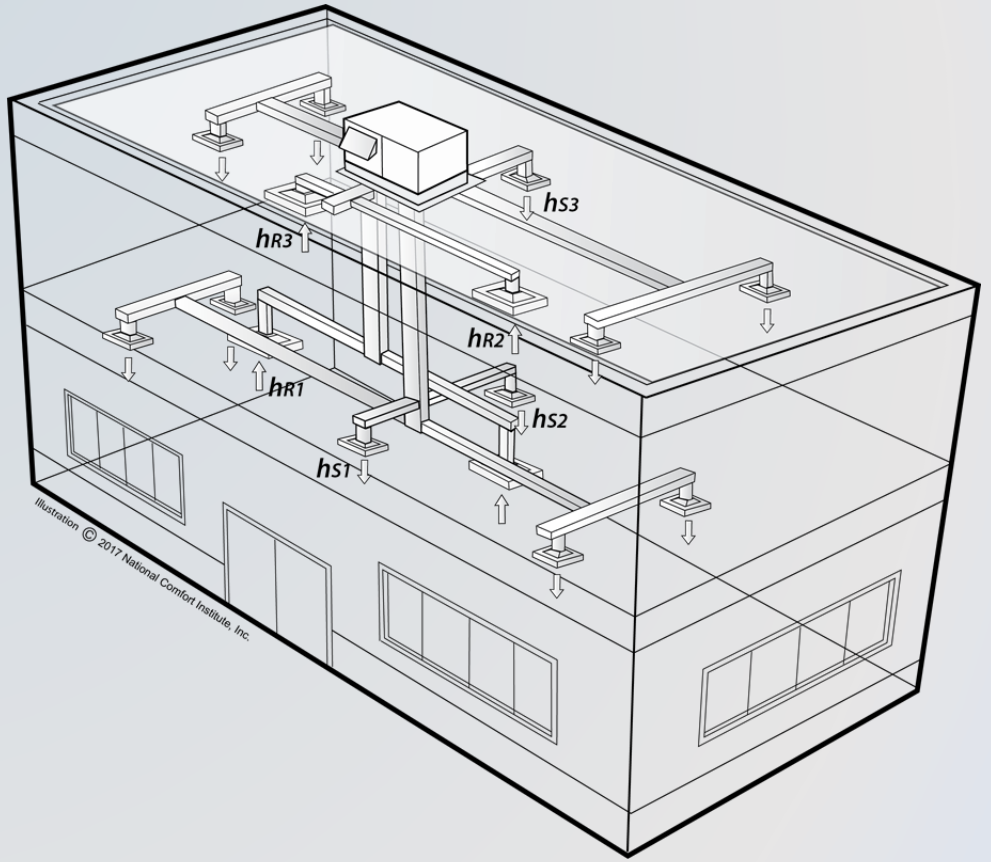
- Usual equipment replacement information
- Start at equipment and work outward
- Lots of pictures and notes to engage customers
- Gather evidence of system defects and solutions
- Walk or crawl the duct system
- Compare to as-built drawings (if available)



3. Compare installation to design, specs and best practices

Compare design to actual. Discover obvious improvements needed and pinpoint beneficial upgrades

- Appearance and installation quality
- Equipment size to be reduce once defects are corrected
- Duct disconnects, suspension, insulations, accessories, modifications, obvious defects.
- Consider and capture repair solutions
- Write or enter data on plans and specs

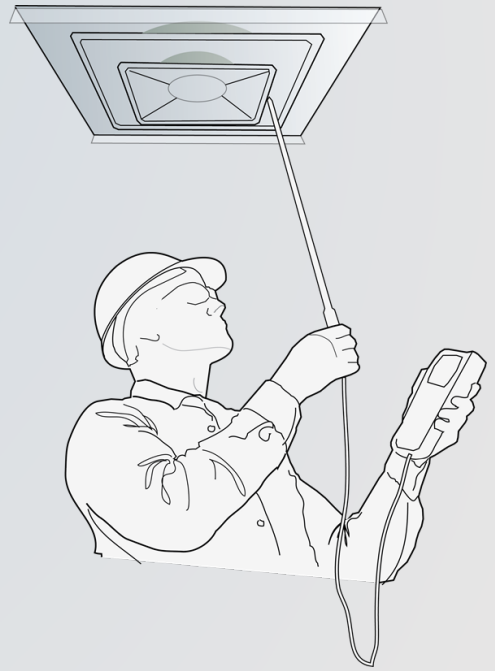


4. Prepare diagnostic reports with design data

Unique pre-design exercise - The preparation of diagnostic reports has a profound effect on your comprehension of the system

A diagnostic report compares design to actual

- Equipment data
- Blower motor
- Rated static pressure
- System pressures
- System temperatures
- System, grille and register airflows



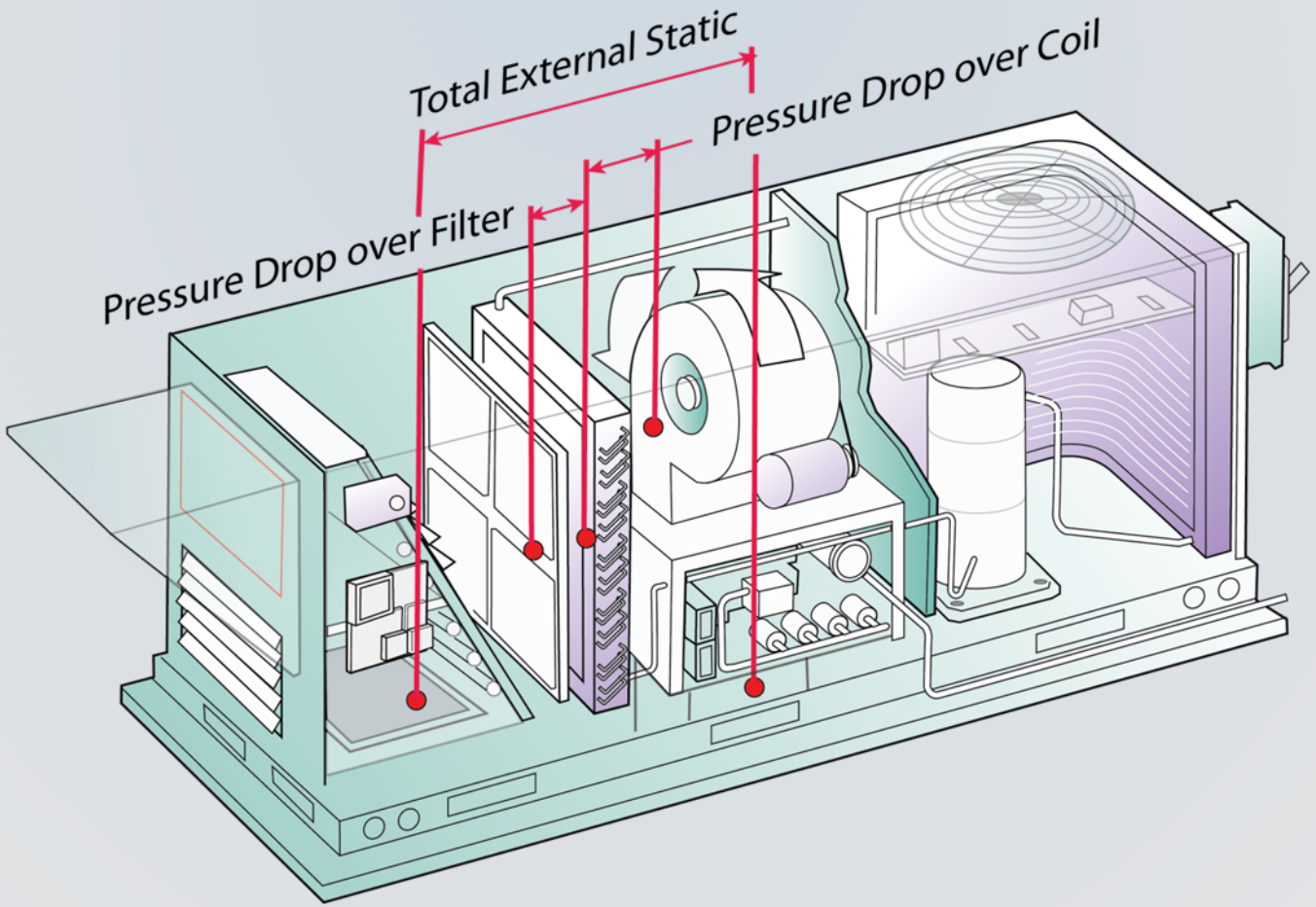
Any Questions?

5. Test and record air pressures, airflows and temperatures and compare to design.

Field measure system values to assess the installed performance of the system

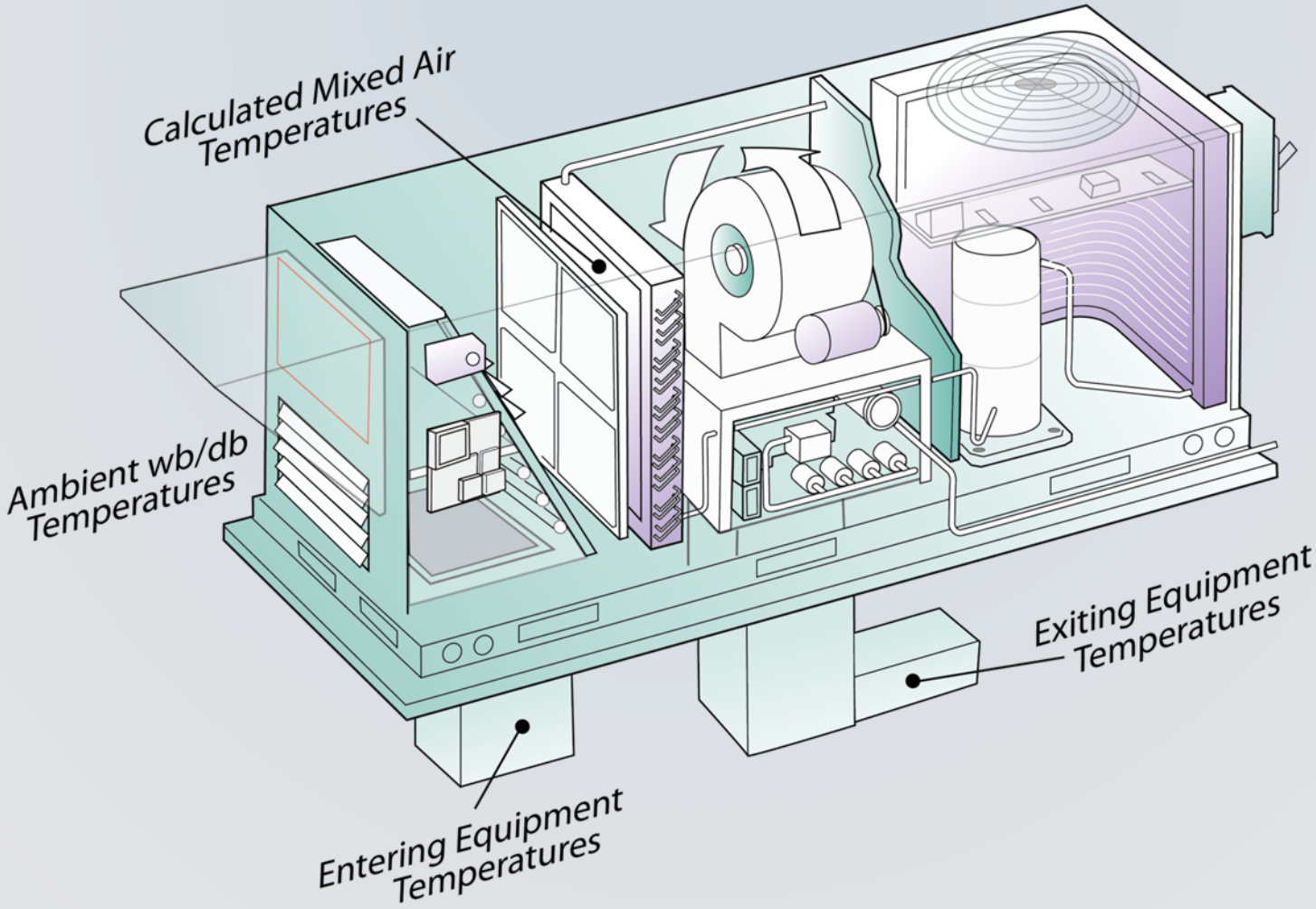
- Static pressure profile
- Fan, duct and grille airflow
- System temperature profiles
- Calculate and diagnose static pressures over budget
- Calculate difference between design and actual airflows
- Calculate live duct leakage
- Calculate duct temperature losses ad delivered capacity

5. Test and record air pressures

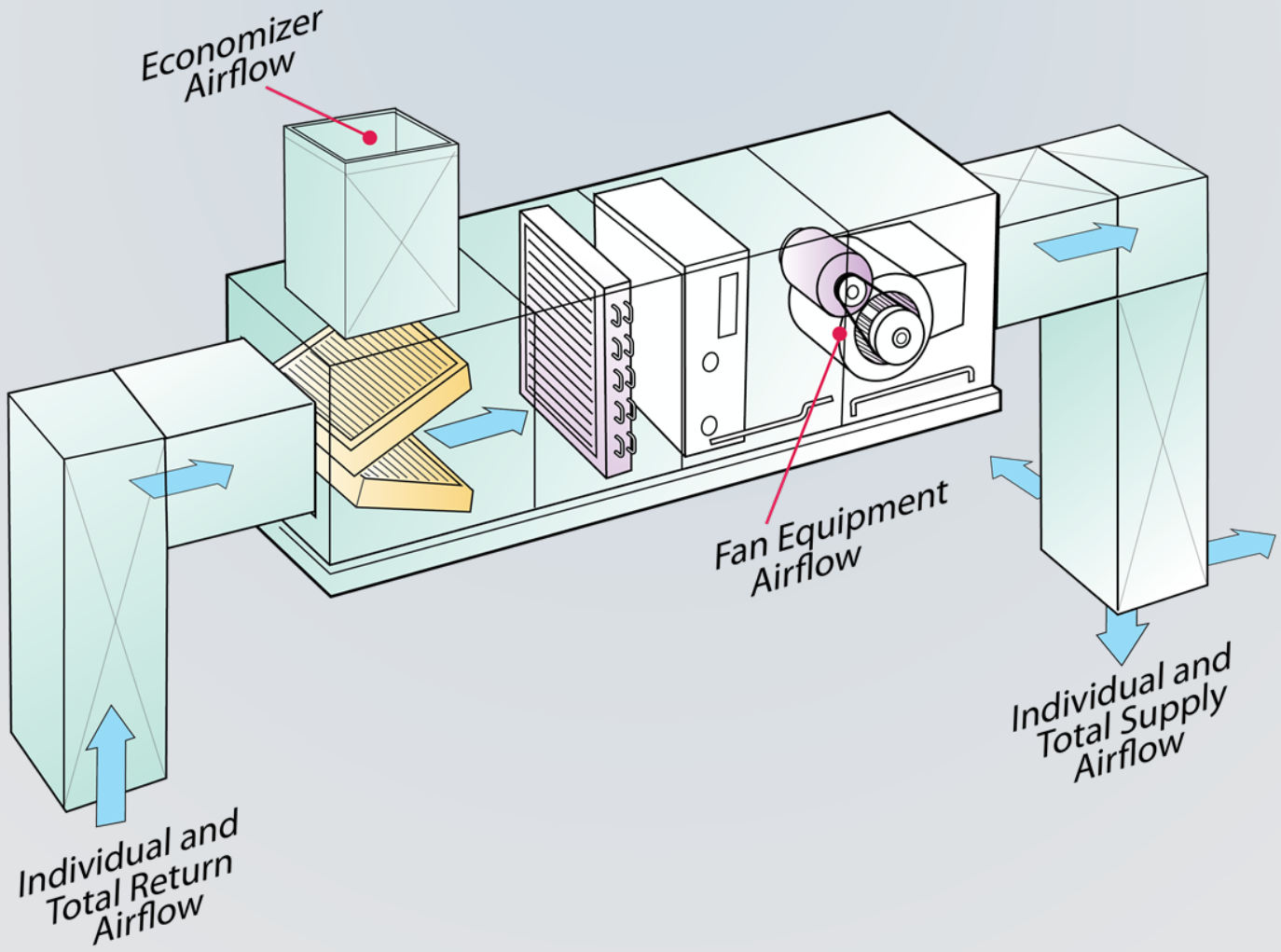


Time - About 4 minutes to take and record readings

5. Test and record air temperatures and compare to design.



5. Test and record system airflows and compare to design.



Any Questions?

6. Diagnose the system and document needed improvements

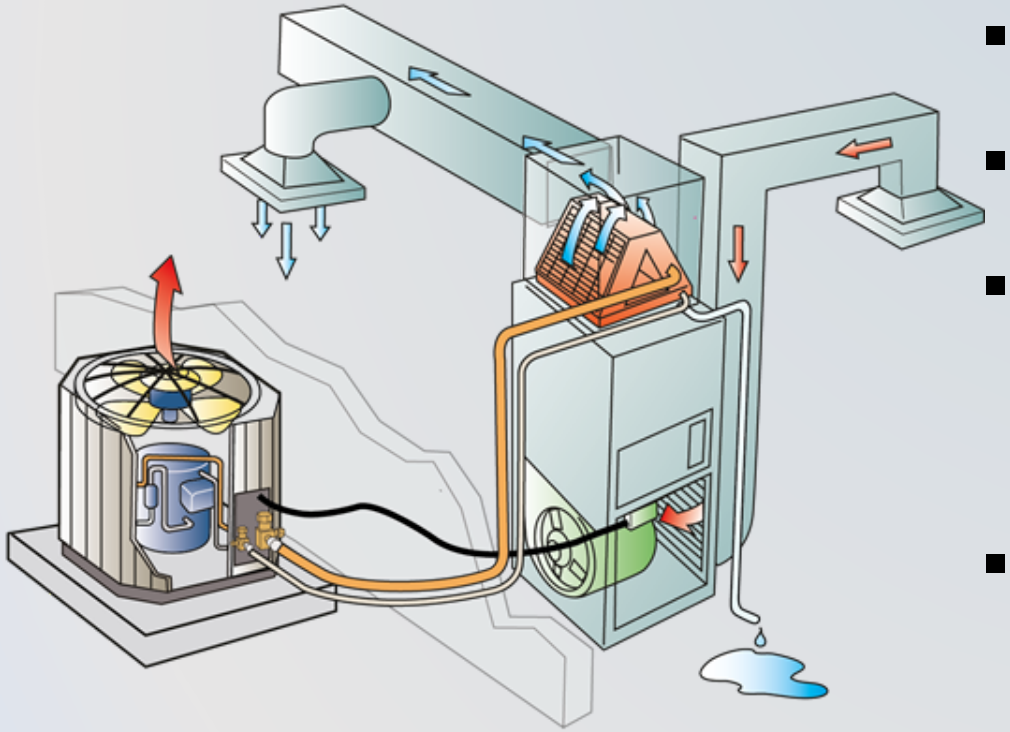
Ask Hard Questions to Find Solutions!

Analyze field test data by comparing to design or ideal to diagnose the system's performance

- Identify **equipment installation conditions** to be changed
- Where is the **highest resistance** to airflow?
- Is an **alternate fan** required?
- How to add **more duct capacity**, increase airflow to rooms?
- Increase **duct insulation** and tightness?
- Does **equipment size** really match load?

7. Prescribe a solution for each defect discovered and present to decision maker

Interview and inspection information tell a story when coupled with system test data.



- Low delivered **system capacity** calls for action
- High static pressures pinpoints **restrictions**
- Airflow delivers the heating, cooling and ventilation. **Follow the airflow, discover the solution.**
- **Temperature changes** isolate negative impact on the system

8. Proceed with design and construction, including equipment replacement

Nothing happens till somebody sells something. Organize and present your solutions to the satisfaction of your customer.

- Service company or mechanical contracting firm
- Engineer, designer or member of a design team
- Design-build contractor
- Balancing or commissioning firms
- Building owner or representative
- Facility management or maintenance team

An invitation

Consider a shift in your retrofit paradigm.

Step one – Question the results of your current replacement projects

Step two - Invest time assessing the duct system and its impact on the equipment on one job.

Or, prepare to respond to a evaluation of the performance of your equipment changeout project

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