

ASHRAE/ARI RP 1292

Comparisons of the Total Energy Consumption of Series vs. Parallel Fan Powered VAV Terminal Units

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FIRST PHASE

- 3 Manufacturers (Picked to represent largest possible cross section of equipment in market.)
- 4 Units each for 12 units to test
- 2 Parallel (1 large and 1 small)
- 2 Series (1 large and 1 small)
- 2 Representative sizes of zones selected by Project Monitoring Subcommittee
- Testing descriptions and numerical results covered in other papers

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SECOND PHASE

- First Phase mathematical models inserted them into workbooks that represent the performance of a system with 5 zones N E S W and Interior.
- Each workbook has several spreadsheets.
- Each spreadsheet covers 1 part of the total model.
- Spreadsheets designed so that certain functions could be turned on or off for evaluation.
- Improved the evaluation process allowing designer to look at individual energy loads of system components.
- At this point conclusions began filtering out.
- This process is covered in another paper.

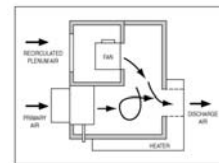
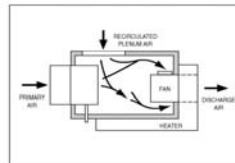
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WHAT DID WE DISCOVER?

I. Experience Differences

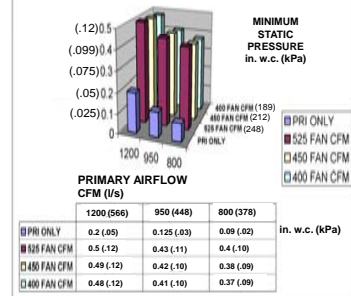
- Researchers had little application experience
- PMS had mostly application experience.
- Small overlap – lots of energetic discussions.

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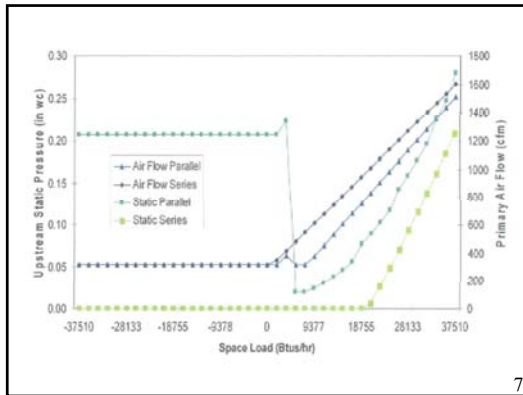


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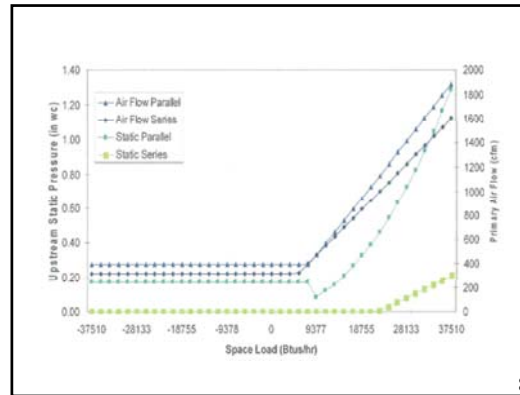
STATIC PRESSURE COMPARISON - SIZE 2



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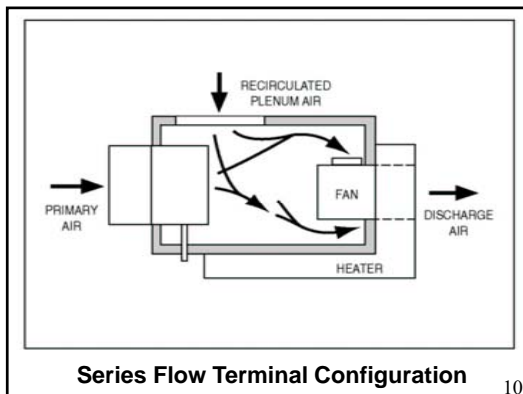


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II. INLET STATIC PRESSURE NOT THE ISSUE EXPECTED.

- **Pneumatic vs. Electronic and ASHRAE/IESNA 90.1 paragraph 6.3.3.2.3**

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III. MOTOR HEAT

- **Biggest Issue on Series Boxes 1 – 3° F (.56 to 1.7° C) at All Flows – Not Just at Maximum Airflow.**

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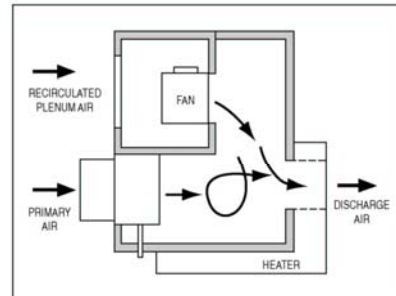
PARALLEL UNIT	SERIES UNIT
<ul style="list-style-type: none"> • Motor heat only present when motor is running • Deadband mode • Heating mode 	<ul style="list-style-type: none"> • Motor heat present all the time • Motor heat adds to heat load at part load conditions • Motor heat add is constant and bigger part of total load at part load conditions

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IV. LEAKAGE

- Largest Single Issue Next To Operating Schedule

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Parallel Flow Terminal Configuration

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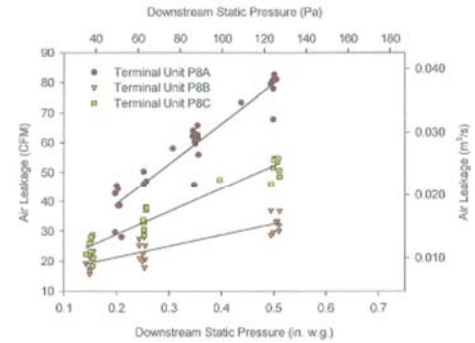


Figure 5-7: Air Leakage for 8 in. (203 mm) Inlet Parallel Terminal Units

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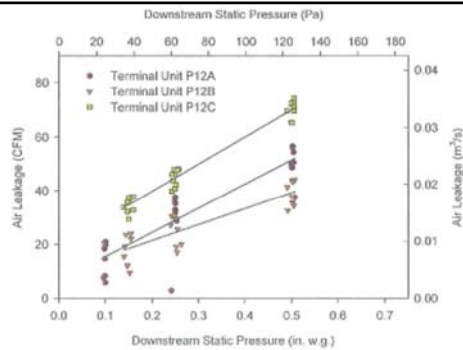
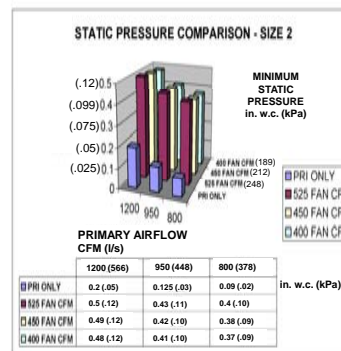


Figure 5-8: Air Leakage for 12 in. (304 mm) Inlet Parallel Terminal Units

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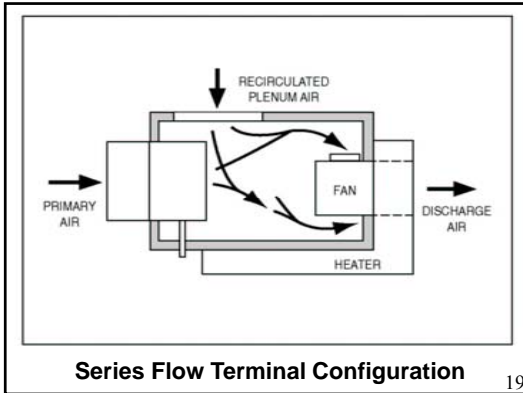


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IV. LEAKAGE

- Largest Single Issue Next To Operating Schedule
- Neither Unit Has Sealed Panels
- PARALLEL UNIT
 - All Backdraft Dampers Leak
 - Casing Is Pressurized
 - Highest At Full Cooling
 - Lowest At Minimum Cooling Before Fan Starts
 - When Fan Runs The Backdraft Damper Leakage Is Zero

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- **SERIES UNIT**
 - **Casing Is Neutral To Slightly Negative**
 - **Most Neutral At Full Cooling**
 - **Most Negative At Minimum Damper Setting**
 - **When Negative, Plenum Air Is Being Induced Through the Induction Port**
 - **Leakage Is No Issue**

PARALLEL UNIT	SERIES UNIT
<ul style="list-style-type: none"> • Positive internal casing pressure • Primary air leaks outward bypassing the zone 	<ul style="list-style-type: none"> • Neutral internal casing pressure • Plenum air leaks inward replacing plenum air pulled into the induction port
<ul style="list-style-type: none"> • Highest leakage at full cooling • Typical leakage is between 5% & 20% But average is above 10% • All bypassed primary air must be replaced by additional primary air to satisfy the zone requirements • At full load, the unit may be undersized 	<ul style="list-style-type: none"> • Lowest leakage at full cooling • Typical leakage not measured
	<ul style="list-style-type: none"> • No effect to energy • No effect on sizing

ENERGY USE:

BASED ON ENERGY, WHICH ONE DO WE USE?

PARALLEL UNIT	SERIES UNIT
<ul style="list-style-type: none"> • USES 17% LESS ENERGY THAN SERIES UNIT WITH 0% LEAKAGE • USES 3-4% LESS ENERGY THAN SERIES UNIT WITH 10% LEAKAGE • MAXIMUM LEAKAGE CAN BE IN EXCESS OF 30% • TYPICAL LEAKAGE WILL BE BETWEEN 5 AND 20% • AVERAGE LEAKAGE IS ABOVE 10% 	<ul style="list-style-type: none"> • USES 5.5% LESS ENERGY THAN PARALLEL UNIT WITH 20% LEAKAGE • UNITS ARE EQUAL IN ENERGY USE FOR ALL PRACTICAL PURPOSES

- GOALS OF RP-1292 – HELP TO DECIDE HOW TO:**
- **BUILD BETTER BUILDINGS**
 - **CREATE BETTER ENVIRONMENTS**
 - **CAPITALIZE ON NEW AND EXISTING TECHNOLOGIES**

**THESE NEW TECHNOLOGIES
INCLUDE:**

- **DEDICATED OUTDOOR AIR SYSTEMS**
- **LOWER COIL AND DISCHARGE AIR TEMPERATURES**
- **ECM MOTORS**

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**ECM MOTORS ARE IN
A NEW RESEARCH
PROGRAM
CURRENTLY
UNDERWAY AT TEXAS
A&M UNIVERSITY**

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**CONSIDERING EVERYTHING
WHICH ONE DO WE USE?**

- **Every Job Should Be Evaluated On Local Issues And Occupant Needs**
- **Some Local Codes May Benefit One Or The Other**
- **If The Local Climate Has Very Short Heating Seasons, Maybe A Single Duct Unit With Reheat Is Best**
- **Fan Cycling And Associated Noise Has To Be Evaluated**

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IN GENERAL, THESE ISSUES WILL DICTATE CHOICE

ISSUE	PARALLEL	SERIES
LOW TEMPERATURE AIR	POOR CONTROL	AVAILABLE OPTION
DEDICATED OUTDOOR AIR SUPPLY	POOR CONTROL	AVAILABLE OPTION
FIRST COST	INCREASED	UNCHANGED
OPERATING COSTS	INCREASED	UNCHANGED
90.1 REQUIREMENT TO COUNT MOTOR HORSEPOWER	NO	YES
INCREASED AIR HANDLER HP	YES	NO
NOISE LEVELS	VARIABLE	CONSTANT
COMFORT LEVELS	VARIABLE	CONSTANT
62.1 ALLOWS CREDIT FOR RECIRCULATED AIR REDUCING OUTDOOR AIR REQUIREMENTS	NO	YES
POTENTIAL SAVINGS WITH ECM MOTORS	NO	YES

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**QUESTIONS
AND
COMMENTS?**



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