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# EzERV BTF VENTILATION AIR DESIGN TOOL

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**DEMO DESIGN**

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THE ERVz DESIGN GUIDE IS DESIGNED FOR USE WITHIN ALL 50 STATES, BY MEETING AND/OR EXCEEDING THE RESIDENTIAL VENTILATION AIR REQUIREMENTS OUTLINED BY BOTH ASHRAE 62.2 (VERSION 2022) AND IECC / IMC (VERSION 2024). VERY FEW JURISDICTIONS (SUCH AS CITY SPECIFIC CODES & STANDARDS) REQUIRE VENTILATION AIR RATES ALTERNATIVE TO EITHER ASHRAE 62.2 OR THE IECC/IMC/IRC. VERIFY WITH YOUR LOCAL BUILDING AUTHORITY AS TO THE EXACT CODE REQUIREMENTS YOUR BUILDING LOCATION IS SUBJECT TO PRIOR TO CONSTRUCTION.

CODE REQUIREMENTS DIFFER FOR RETURN VENTILATION RATES BETWEEN ASHRAE & IECC - THUS BTF DESIGNED AROUND THE MOST STRINGENT AIR FLOW REQUIREMENTS. ASHRAE 62.2 REQUIRES CONTINUOUS RETURN AIR MINIMUMS OF 20 CFM PER BATHROOM AND 25 CFM PER KITCHEN. WHERE AS IECC/IMC REQUIRES CONTINUOUS RETURN AIR MINIMUMS OF 25 CFM PER BATHROOM AND 50 CFM PER KITCHEN. BOTH UTILIZE THE SUPPLY AIR FORMULA, VENTILATION RATE= $0.03 \times \text{CFA (SQ FT)} + 7.5 \times (\text{NBR} + 1)$

THUS MEETING BOTH ASHRAE 62.2 AND IRC/ IECC / IMC RESIDENTIAL VENTILATION AIR REQUIREMENTS THE FORMULA USED AS FOLLOWS: VENTILATION RATE= $0.03 \times \text{CFA (SQ FT)} + 7.5 \times (\text{NBR} + 1)$ . MIN. 25 CFM CONTINUOUS RA PER BATHROOM AND 50 CFM RA PER KITCHEN (ASSUMING ONE KITCHEN PER UNIT). AIR FLOW RATES WERE THEN ADJUSTED TO PROVIDE A BALANCED VENTILATION AIR SYSTEM DESIGN WITH MIN. 20 CFM AIR FLOW RATE PER DAMPER AS TO ALLOW FOR ACCURATE BALANCING IN FIELD.

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# M0.1

SCALE AS NOTED | SHEET SIZE 8.5"x11" | SHEET 1 OF 10

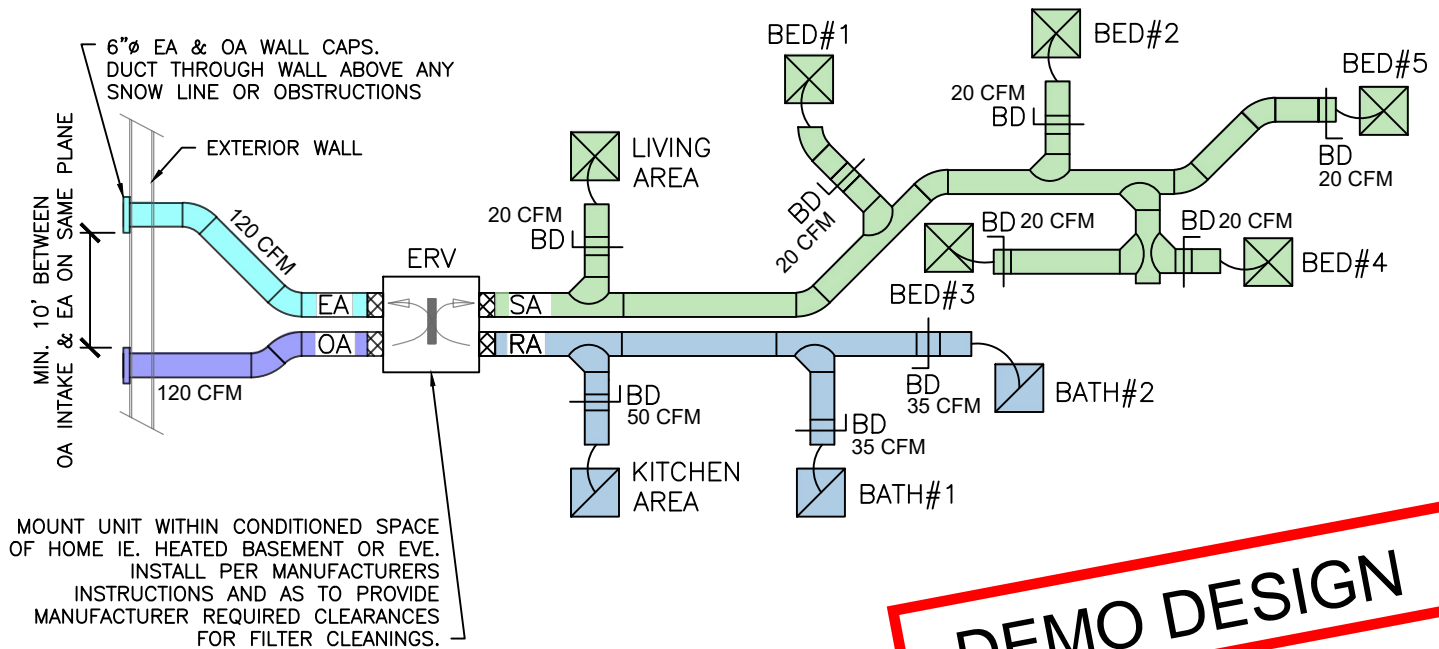


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# EzERV BTF VENTILATION AIR DESIGN TOOL

## YOUR DESIGN: STYLE 95



**DEMO DESIGN**

This example duct layout above is a starting point. Adjustments to ductwork routing and sizing may be needed to fit your home's exact layout & ensure proper performance. For tips, see 'Customizing Your Ventilation Design.' CFM RATES SHOWN ARE CORRECT & SET BY CODE, REGARDLESS OF HOME'S EXACT LAYOUT.

DUCTWORK SIZING GUIDE			BATHROOM EXHAUST FANS & KITCHEN HOOD:
CFM	ROUND DUCT SIZE	RECTANGULAR DUCT SIZE(S)	BASED ON INDUSTRY FINDINGS, BTF RECOMMENDS EVERY BATHROOM THAT HAS EITHER A BATH TUB OR A SHOWER HAS AT LEAST 80 CFM REMOVAL METHOD. LOWER CFMS ARE NOT CAPABLE OF 'PICKING UP' DENSE MOIST AIR - WHICH LEADS TO HIGH HUMIDITY, MILDEW AND POTENTIAL MOLD GROWTH. TWO UNITS AT 40 CFM IS NOT AN ACCEPTABLE ALTERNATIVE.
20–35	4"ø	3"x5", OR 4"x4"	
36–100	6"ø	3"x10", 4"x8", 5"x6", OR 6"x6"	
101– 210	8"ø	4"x14", 5"x12", 6"x9", 7"x8", OR 8"x8"	
FOR INDUSTRY DUCT DESIGN TIPS & TRICKS, SEE EDUCATIONAL SECTION OF Ez–ERV & 'CUSTOMIZING YOUR VENTILATION DESIGN' SHEET			IN BATHROOMS WITH TUBS & SHOWERS, INSTALL SEPARATE FROM THE ERV SYSTEM, EXHAUST FANS CAPABLE OF MIN. 80 CFM, DUCTED DIRECTLY TO OUTDOORS.

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**M1.1**

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# **EzERV** *BTF VENTILATION AIR DESIGN TOOL*

ERV/U Unit Style: C

ERV/U Unit SIZE: **150 - 175 CFM**

**DEMO DESIGN**

## ERU/ERV UNIT SELECTION

WHEN SELECTING AN ERU/V, ENSURE IT CAN ACHIEVE YOUR DESIGN CFM DURING OPERATION BY CHOOSING A UNIT WITH A CFM CAPACITY 10–20% GREATER THAN YOUR DESIGN CFM. THIS EXTRA CAPACITY ACCOUNTS FOR SYSTEM LOSSES FROM FILTERS, FRICTION, AND NORMAL OPERATING CONDITIONS.

### BALANCED DESIGN CFM RATES:

120 CFM / 130 CFM

### SUGGESTED UNIT SELECTION CFM RANGE:

150 CFM TO 175 CFM

### NOTES FOR SELECTING & INSTALLING AN ERU/ ERV UNIT:

IN LOCATIONS, WHERE CLIMATES ARE HOT & HUMID AND/OR COLD AND DRY, AN ERV IS TYPICALLY THE BEST CHOICE BECAUSE IT BALANCES BOTH HEAT AND MOISTURE EXCHANGE, HELPING TO MAINTAIN COMFORTABLE INDOOR HUMIDITY LEVELS YEAR-ROUND. THIS PREVENTS EXCESSIVE DRYNESS IN WINTER AND LIMITS EXCESS HUMIDITY IN SUMMER. ERUS WHICH FOCUS SOLELY ON HEAT RECOVERY WITHOUT TRANSFERRING MOISTURE, ARE BETTER SUITED FOR CLIMATES OR APPLICATIONS WHERE HUMIDITY CONTROL ISN'T NECESSARY.

1. FOR BATHROOMS WITH SHOWERS, PROVIDE ON DEMAND EXHAUST FANS – REFER TO EXHAUST FAN SCHEDULE.

2. RUN ERU/V CONTINUOUSLY, 24/7 – PER CODE REQUIREMENT.

3. IN COLD CLIMATES, PROVIDE INTEGRAL ELECTRIC DUCT HEATER TO RE-HEAT SUPPLY AIR SIDE IN WINTER/ COOL OUT DOOR AIR CONDITIONS. SIZE DUCT HEATER TO SUPPLY BETWEEN 90°F –120°F DISCHARGE AIR TO THE INTERIOR SPACE.

4. DO NOT INSTALL ERU/V OUTSIDE OF THE HEATING ENVELOPE. ERU/V & ASSOCIATED SUPPLY & RETURN DUCTWORK MUST BE INSTALLED WITHIN THE HEATING ENVELOPE FOR MANUFACTURE & CODE COMPLIANCE. TO ENSURE EFFICIENT OPERATION AND PROTECT THE UNIT, INSTALL IT IN A CONDITIONED SPACE LIKE A BASEMENT, UTILITY ROOM, OR MECHANICAL CLOSET WITH EASY ACCESS FOR MAINTENANCE.

5. FILTRATION: PROVIDE DUCT MOUNTED MERV 13 FILTERS AT THE RA AND OA DUCTWORK PRIOR TO ENTERING ERU/V. FILTERS CODE REQUIREMENT DESIGNED TO PROTECT MECHANICAL EQUIPMENT INTEGRITY AND LONGEVITY. REFER TO MANUFACTURERS INSTALLATION RECOMMENDATIONS.

6. LABEL VENTILATION SYSTEM: COMPLIANCE WITH ASHRAE 62.2 SECTION 4.4 (CONTROL AND OPERATION) SHALL REQUIRE MANUAL ON-OFF CONTROL SWITCHES ASSOCIATED WITH WHOLE-DWELLING UNIT VENTILATION SYSTEMS TO HAVE A LABEL CLEARLY DISPLAYING THE FOLLOWING TEXT, OR EQUIVALENT TEXT: "THIS SWITCH CONTROLS THE INDOOR AIR QUALITY VENTILATION FOR WHOLE-HOME." FOR CLEANING & MAINTENANCE ALSO PROVIDE LABEL FOR DUCT MOUNTED FILTER ACCESS DOOR(S)/LOCATION AS APPLICABLE.

7. FOR EASE, POPULAR BALANCED VENTILATION AIR UNIT BRANDS INCLUDE:

ALDES, APRILAIRE, BROAN-NUTONE, FANTECH, HONEYWELL, LENNOX, LIFE BREATH, PANASONIC, RENEWAIRE, TRANE

8. WHEN SELECTING YOUR ERU/ERV, YOU MAY CHOOSE ONE WITH FEATURES SUCH AS MULTIPLE SPEED SETTINGS, AUTOMATED CONTROLS, AND SMART HOME INTEGRATION. CONSIDER UNITS WITH HIGH HEAT EXCHANGE EFFICIENCY, QUIET OPERATION, AND SUITABILITY FOR YOUR CLIMATE, INCLUDING DEFROST AND HUMIDITY CONTROL. ADDITIONAL OPTIONS MAY INCLUDE ENERGY STAR CERTIFICATION, BUILT-IN AIR FILTRATION, AND EASY-TO-ACCESS FILTERS FOR MAINTENANCE. CHECK WITH YOUR LOCAL BUILDING AUTHORITY FOR RECOMMENDATIONS OR SPECIFIC REQUIREMENTS. REFER TO LOCAL BUILDING CODES/ INCENTIVES FOR SPECIFIC IDEAL UNIT EFFICIENCY RATINGS.

9. ALWAYS INSTALL EQUIPMENT PER MANUFACTURER'S RECOMMENDATIONS.

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**M1.2**

SCALE AS NOTED | SHEET SIZE 8.5"x11" | SHEET 3 OF 10





# EzERV BTF VENTILATION AIR DESIGN TOOL

## BATHROOM EXHAUST FANS & KITCHEN HOODS

**DEMO DESIGN**

### EXHAUST FAN (EF) & HOOD SELECTIONS

UNIT TAG(S)  	MANUFACTURER & MODEL	FAN TYPE	CFM
EXHAUST FAN(S): INSTALL ONE PER EACH BATHROOM WITH A TUB AND/OR SHOWER	SELECTION BY OWNER/ BUILDER	CEILING MOUNTED EXHAUST FAN	80–150 CFM
HOOD–1	SELECTION BY OWNER/ BUILDER	KITCHEN EXHAUST HOOD	160–240 CFM

#### BATHROOM EXHAUST FAN(S) & KITCHEN HOOD NOTES:

- HOOD & EXHAUST FANS SHALL BE ENERGY COMPLIANT AND BE DUCTED TO TERMINATE OUTSIDE THE BUILDING. INSTALL EXHAUST FANS AND KITCHEN HOOD SO THAT EXHAUST AIR IS DUCTED DIRECTLY TO THE OUT DOORS. SEPARATE FROM THE ERU/V SYSTEM. REFER TO LOCAL BUILDING CODES/ INCENTIVES FOR SPECIFIC IDEAL EFFICIENCY RATINGS.
- INSTALL FAN(S) AND HOOD PER MANUFACTURERS RECOMMENDATIONS AND REQUIREMENTS.
- FAN TO RUN WHEN SHOWER AND/OR TUB FIXTURE IS IN USE. SUGGESTED OPERATION VIA WALL SWITCH OR MOTION SENSOR. BATHROOMS WITH ONLY A LAV AND TOILET DO NOT REQUIRE THESE DEDICATED EXHAUST FANS, AND ARE SERVED BY THE 24/7 ERU/V. SELECT A FAN CAPABLE OF MOVING AT LEAST 80 CFM WHEN IN OPERATION.
- SELECTIONS SHALL MEET THE FOLLOWING DEMAND-CONTROLLED LOCAL VENTILATION EXHAUST AIRFLOW RATES:
  - BATHROOMS: MIN 80 CFM DIRECT VENT EXHAUST FAN
  - KITCHENS: MIN 160 CFM DIRECT VENT EXHAUST HOOD
- MAKE-UP AIR UNITS: YOUR LOCAL BUILDING AUTHORITY MAY REQUEST YOU PROVIDE A DEDICATED MAKE UP AIR UNIT FOR WHEN THE EXHAUST FAN(S) AND/OR HOOD ARE RUNNING. OFTEN MAKE-UP AIR REQUIREMENTS APPLY TO KITCHEN HOODS OVER 300 CFM. IN PROVIDING A MAKE-UP AIR UNIT, RECOMMEND: MATCHING THE EXHAUSTING CFM, PROVIDING INTEGRAL BACK-DRAFT DAMPER, 100F SUPPLY AIR TEMP, AND AUTOMATION/ REPLAY FOR MAKE-UP AIR UNIT (MAU) TO AUTOMATICALLY START WHEN THE EXHAUST FAN(S) AND/OR HOODS ARE ENERGIZED.
- HUMIDITY CONTROL: MANAGING INDOOR HUMIDITY LEVELS IS ESSENTIAL FOR COMFORT AND HEALTH. AIR THAT IS TOO DRY CAN CAUSE SKIN IRRITATION, RESPIRATORY PROBLEMS, AND STATIC ELECTRICITY. CONVERSELY, AIR THAT IS TOO MOIST CAN LEAD TO MOLD GROWTH, DUST MITES, AND DISCOMFORT. PROPER HUMIDITY CONTROL THROUGH VENTILATION AND DEHUMIDIFICATION SYSTEMS HELPS MAINTAIN A HEALTHY INDOOR ENVIRONMENT. DEHUMIDIFICATION LOADS ARE GREATER IN TIGHT HOMES WITH REDUCED INFILTRATION. UNMET MOISTURE LOADS VARY BASED ON THE OCCUPANTS NEEDS & SCHEDULES. BOILING WATER, HANG DRY-ING CLOTHES, LONG SHOWERS – ARE EXAMPLES OF OCCUPANT BASED INTERNAL LATENT GAINS. SHOULD OCCUPANT NOTICE HIGH HUMIDITY, RECOMMEND INSTALLING A DEHUMIDIFIER CAPABLE OF REMOVING 30–60 PINTS/DAY. DEHUMIDIFIER SELECTION BY OWNER/ CONTRACTOR.
- FOR CONSTRUCTION IN CALIFORNIA:
  - REFERENCING T24, PART 6, CHAPTER 7, TABLE 150.0–G KITCHEN RANGE HOOD AIRFLOW RATES (CFM) AND ASTM E3087 CAPTURE EFFICIENCY (CE) RATINGS ACCORDING TO DWELLING UNIT FLOOR AREA AND KITCHEN RANGE FUEL TYPE. PROPOSED 1040SF HOME W/ ELECTRIC RANGE REQUIRES MIN OF 110 CFM EA FROM HOOD.
  - PROVIDE A SEPARATE SWITCH FOR EXHAUST FAN, PER CALIFORNIA ENERGY CODE 150.0 (K) 2B. PROVIDE A SEPARATE SWITCH FOR EXHAUST FAN. (FOR CONSTRUCTION IN CA: PER CALIFORNIA ENERGY CODE 150.0 (K) 2B. IN BATHROOMS AT LEAST ONE LUMINAIRE IN EACH OF THESE SPACES SHALL BE CONTROLLED BY A VACANCY SENSOR. (150(K)2J CEC))
  - SEE CGBSC 4.506.1.

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**M1.3**

SCALE AS NOTED | SHEET SIZE 8.5"x11" | SHEET 4 OF 10



# EzERV BTF VENTILATION AIR DESIGN TOOL

## EDUCATION SECTION

(NEXT FEW SHEETS)

**DEMO DESIGN**

### Helpful Hints for Customizing Your Ductwork Layout

#### #1 Balance is Key - Stick to the CFM Rates & Install Balance Dampers

Ensuring the supply air (SA) and return air (RA) have equal airflow (measured in CFM) to maintain system efficiency and performance, the provided airflow rates (CFM) at each balance damper are based on building codes and standards. Do not adjust these rates—they are critical for proper system function and code compliance. Use balance dampers or properly sized grilles/registers to balance the system and prevent pressure imbalances, which can reduce HVAC efficiency.

#### #2 Keep the ERV/ERU Accessible

Install the ERV/ERU unit in a conditioned space with easy access for maintenance tasks like filter changes & servicing. Install units per manufacturer's recommendations & manuals.

#### #3 Size & Install Ducts Properly

Use industry standard duct sizing as provided. Undersized ducts restrict airflow, while oversized ducts can reduce efficiency and increase noise levels.

**Seal Duct Joints Securely:** Use appropriate ductwork sealing methods to seal all joints and connections. Leaky ducts can lead to significant energy losses and impact system performance.

**Minimize Duct Lengths & Avoid Sharp Bends:** Shorter ducts mean less energy loss and better airflow. When adapting the layout, aim for the most direct routes. Gradual bends help maintain smooth airflow and minimize pressure drops. Sharp bends can create noise, cause uneven airflow, and reduce efficiency. Round ducts are the most efficient for airflow, with less resistance than rectangular options. They're also easier to clean and often more affordable.

#### #4 Register's, Grille's & Diffusers (RGD's)

**Return Air Grille:** A duct work cover that allows air to flow back into the HVAC system from a room. It typically does not have adjustable louvers.

**Supply Air Diffuser:** A device installed at the end of supply ducts to distribute conditioned air evenly throughout a room. It often includes angled vanes to control air direction and speed.

**Supply Register:** A vent cover for supply ducts that typically includes adjustable louvers or dampers to control the flow and direction of air into a room.

#### Tips for Selecting Grilles, Diffusers, and Registers

Choose RGDs rated to handle the CFM of airflow designed. Ensure RGDs size matches or smoothly transition to match the duct opening dimensions for a proper fit and airflow efficiency. Larger grilles or diffusers with more open area reduce noise (lower pressure drop). High-velocity airflow through small grilles can create whistling sounds.

#### #5 Additional Considerations

Some ERU/ERV systems use flexible ducts or tubes for high-velocity airflow. These require specialized layout considerations to function properly. For these systems refer to the manufacturer for layout design and install instructions.

In areas of sloped ceilings, or where you simply need a little extra space, consider field fabricating a flat ceiling soffit!

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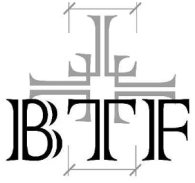
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# M2.1

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# EzERV BTF VENTILATION AIR DESIGN TOOL

## KEY NOTES & ABBREVIATIONS

**DEMO DESIGN**

### ABBREVIATIONS LIST

AFF	ABOVE FINISHED FLOOR	LF	LINEAR FEET
ALT	ALTERNATE	MECH	MECHANICAL
APPROX	APPROXIMATELY	MEP	MECHANICAL, ELECTRICAL & PLUMBING
ARCH	ARCHITECT OR ARCHITECTURAL	MIN	MINIMUM/ MINUTE
BD	BALANCE DAMPER	MISC	MISCELLANEOUS
BTF	BITE THE FROST LLC	N/A	NOT APPLICABLE
BLDG	BUILDING	QTY	QUANTITY
BR	BEDROOM	REF	REFERENCE
BT	BATH ROOM	REQ'D	REQUIRED
CLNG	CEILING	REV	REVISION
CONT	CONTINUE	SF	SQUARE FOOT
DIM	DIMENSIONS	STRUCT	STRUCTURAL
DN	DOWN	SYM	SYMBOL
DWG	DRAWING	TBD	TO BE DETERMINED
EA	EACH	TEMP	TEMPORARY/ TEMPERATURE
ELECT	ELECTRIC OR ELECTRICAL	THRU	THROUGH
EQUIP	EQUIPMENT	TYP	TYPICAL
FLR	FLOOR	VIF	VERIFY IN FIELD
FT	FEET	w/	WITH
IN	INCHES	w/o	WITHOUT

### MECHANICAL DUCTWORK KEY

	SUPPLY AIR DIFFUSER, REGISTER OR GRILLE (AIR COMING FROM ERV/U)		ROUND FLEXIBLE DUCT REDUCES NOISE, WHEN INSTALLED BETWEEN DUCT TRUNKS & REGISTERS OR GRILLES
	RETURN AIR REGISTER OR GRILLE (AIR RETURNING TO ERV/U)		TYPICAL 45° ANGLE (BEST TURNING METHOD FOR AIR FLOW, RECTANGULAR/ROUND)
	EXHAUST AIR REGISTER OR GRILLE (USED FOR BATHROOM EFs & KITCHEN HOODS)		RECTANGULAR DUCT 90° ELBOW W/ TURNING VANES
	RECTANGULAR DUCT, (WIDTH x HEIGHT, INCHES)		TYPICAL LONG RADIUS ELBOW, RECTANGULAR/ROUND
	ROUND DUCT (PREFERRED) (DIAMETER, INCHES)		VOLUME/ BALANCING DAMPER (DAMPER FOOT REFLECTS DIRECTION OF AIR FLOW)

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# M2.2

SCALE AS NOTED | SHEET SIZE 8.5"x11" | SHEET 6 OF 10



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# EzERV BTF VENTILATION AIR DESIGN TOOL

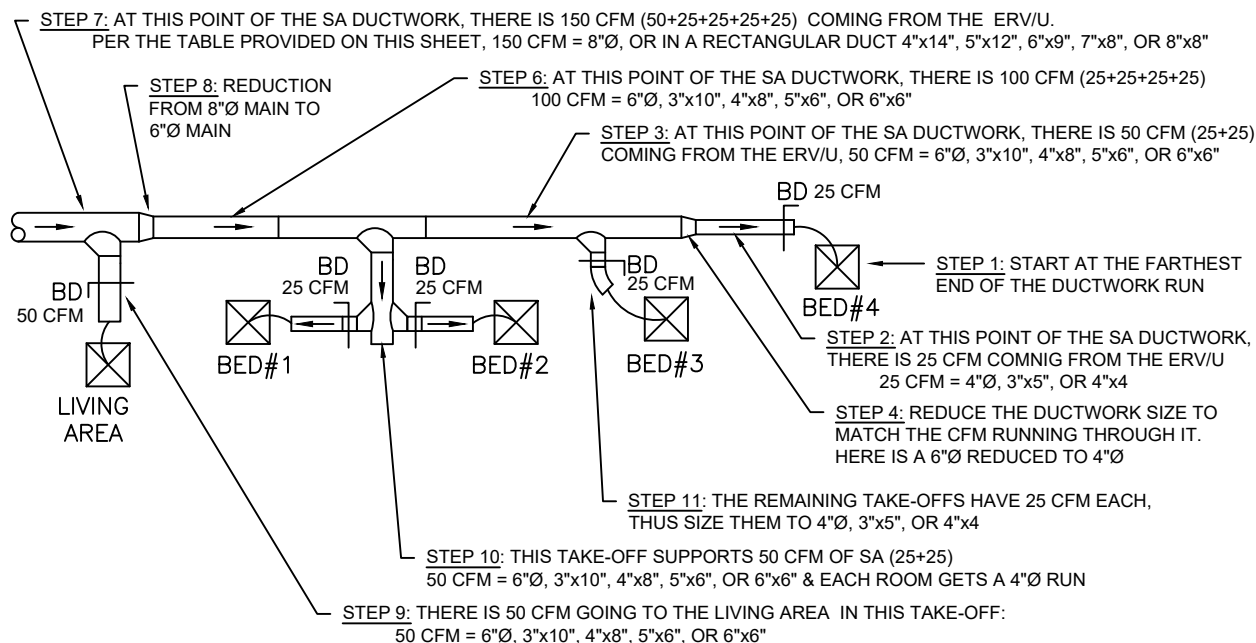
## HOW TO SIZE YOUR SUPPLY AIR (SA) DUCTWORK

DEMO DESIGN

THE TROUBLE WITH DUCTWORK THAT IS TOO SMALL?	THE TROUBLE WITH DUCTWORK THAT IS TOO BIG?	WHAT HAPPENS WHEN DUCTWORK IS SIZED JUST RIGHT?
DUCTS THAT ARE TOO SMALL CHOKE THE AIRFLOW, MAKING THE SYSTEM NOISY, HARDER TO BALANCE, AND LESS EFFICIENT—PLUS, IT CAN OVERWORK THE EQUIPMENT.	OVERSIZED DUCTS SLOW DOWN THE AIRFLOW, WHICH CAN LEAVE ROOMS FEELING STUFFY OR UNEVEN AND MAKE THE SYSTEM LESS EFFECTIVE AT KEEPING THE HOUSE COMFORTABLE.	WHEN DUCTWORK SYSTEMS ARE SIZED RIGHT, THE AIR MOVES SMOOTHLY AND QUIETLY, THE SYSTEM RUNS EFFICIENTLY, AND EVERY ROOM GETS THE COMFORT AND VENTILATION IT NEEDS.

SA DUCTWORK SIZING EXAMPLE BELOW:  
YOU'LL NOTICE IS VERY SIMILAR TO THE  
RA EXAMPLE ON THE PREVIOUS SHEET

DUCTWORK SIZING GUIDE		
CFM	ROUND DUCT SIZE	RECTANGULAR DUCT SIZE(S)
20–35	4"Ø	3"x5", OR 4"x4"
36–100	6"Ø	3"x10", 4"x8", 5"x6", OR 6"x6"
101–210	8"Ø	4"x14", 5"x12", 6"x9", 7"x8", OR 8"x8"



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M2.3

SCALE AS NOTED | SHEET SIZE 8.5"x11" | SHEET 7 OF 10



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# EzERV BTF VENTILATION AIR DESIGN TOOL

## HOW TO SIZE YOUR RETURN AIR (RA) DUCTWORK

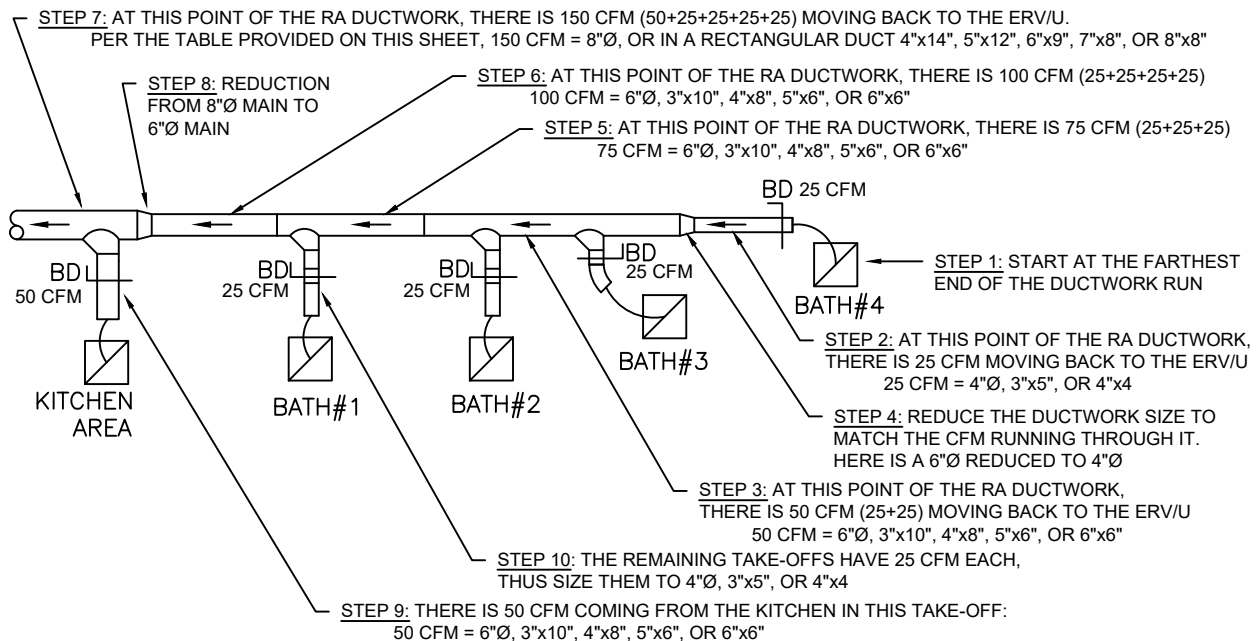
**DEMO DESIGN**

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SIZING DUCTWORK IS LARGELY THE SAME PROCESS FOR BOTH RA AS IT IS FOR SA, ITS A MATTER OF TOTALING THE CFM AFTER EACH GRILLE/DIFFUSER – STARTING FROM THE VERY END OF THE DUCT RUN, FARTHEST FROM THE ERV/U.

EXAMPLE BELOW:

DUCTWORK SIZING GUIDE		
CFM	ROUND DUCT SIZE	RECTANGULAR DUCT SIZE(S)
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**M2.4**

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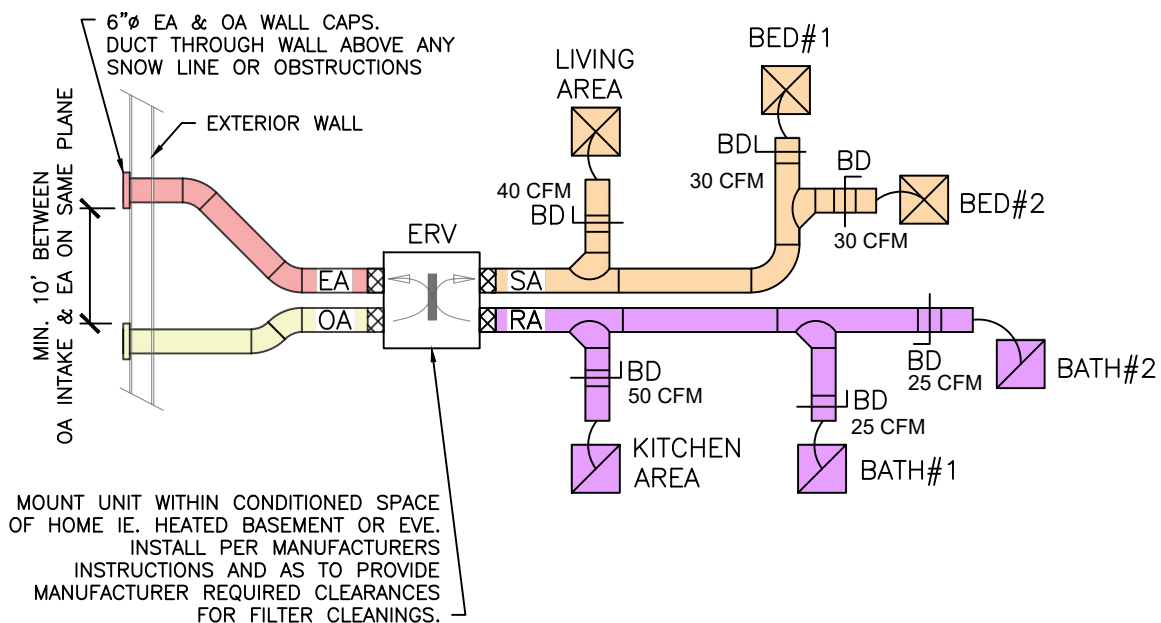
## EXAMPLE: CUSTOMIZING YOUR DESIGN

Every home is unique, but ventilation design principles remain consistent. This guide helps you adapt the example design layout(s) to fit the specific needs of your project while ensuring balanced airflow and code compliance.

# EXAMPLE

**DEMO DESIGN**

TO SEE WHAT THIS EXAMPLE DESIGN WOULD LOOK LIKE IN A FLOOR PLAN, SEE THE NEXT SHEET.



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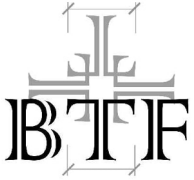
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# M2.5

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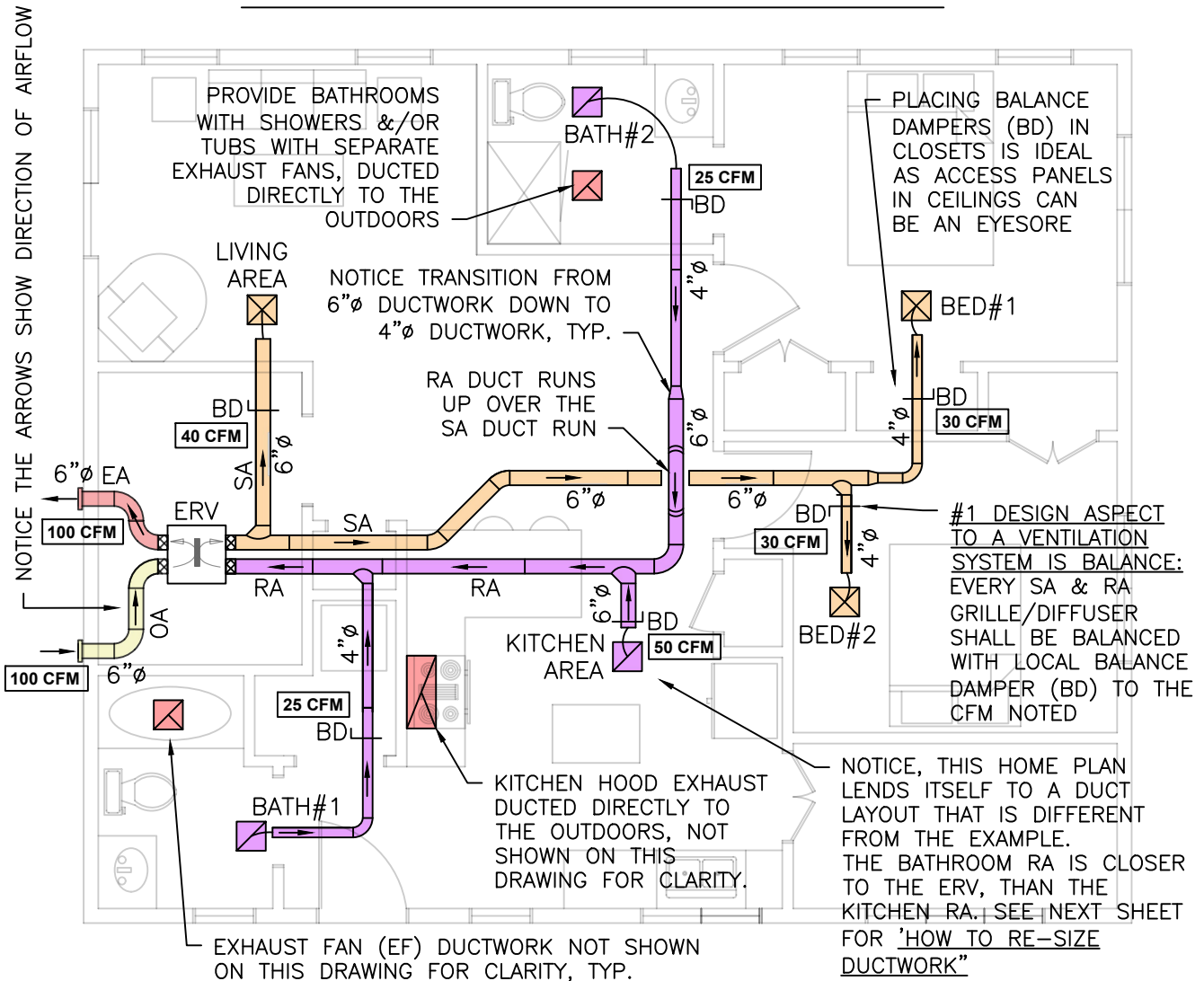


# EzERV BTF VENTILATION AIR DESIGN TOOL

## EXAMPLE CONTINUED: CUSTOMIZING YOUR DESIGN

**DEMO DESIGN**

### EXAMPLE CONTINUED.



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# M2.6

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## DOT GRID SHEET FOR NOTES

**DEMO DESIGN**

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# **NOTES**

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BTF Net Zero Designs

DEMO DESIGN

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