Multiple Fan

rev-2017-04-20

Blower Door Operation Manual

For Series 1000

and 3000

systems

retrotec

Table of Contents

1. When do you need more than one fan?

Multiple fans are required for testing an enclosure when the maximum flow generated by the power of one fan (running at 100% Speed with Open Range) is not enough to reach the desired test pressure. For example, you try to pressurize an enclosure to a target pressure of 75 Pa but even when the fan is running at 100% Speed with Open Range, you can only reach a pressure of 25 Pa. This problem occurs because there is too much leakage in the building to reach the target pressure. In this case, you will need additional fans.

A large enclosure area (greater than 10,000 cu ft) usually suggests a large amount of leakage, and you should investigate how many fans you'll need.

1.1 Maximum flow capacity of Retrotec fans

The maximum flows generated by Door Fans depend on which Range Configuration the fan has installed – a Range with a larger opening produces a higher maximum flow. They also depend on the induced pressures generated in the enclosure, known as the "backpressure" imposed on the fan – if the enclosure is being pressurized to a positive pressure, the higher the backpressure, the lower the flow capacity. The voltage/frequency of the fan's motor also affects the flow rate. Figure 1 illustrates the flow capacities of DU200, and 1000, 2000, and 3000 series Retrotec fans, at 50 Pa back pressure, with various Range Configurations:

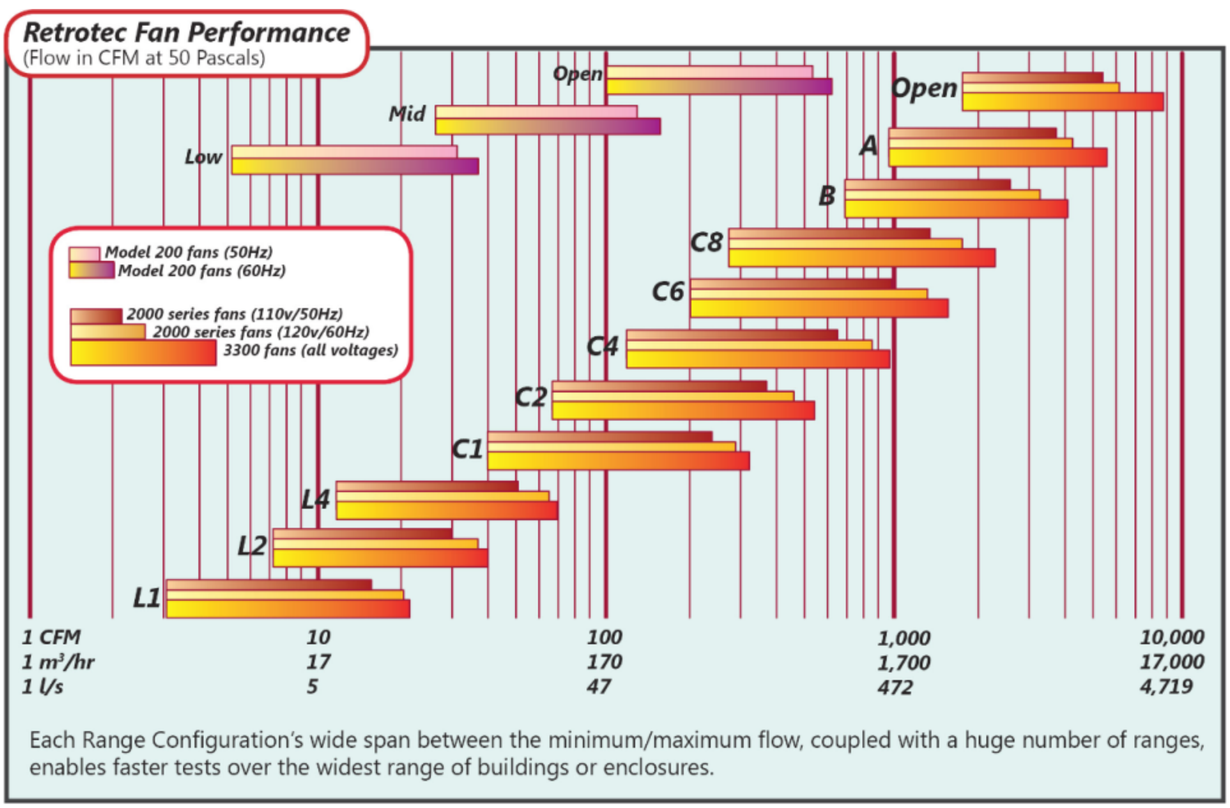


Figure 1: Minimum and Maximum Fan Flow Rates per Installed Range

1.2 Calculate number of fans needed based on leakage requirement

Simply knowing the volume of the building is not enough information to estimate how many fans are needed, because for the same volume, an extremely leaky enclosure will require more fans to pressurize the enclosure than a very tight enclosure.

To more accurately estimate how many fans you need, you can perform a calculation based on enclosure area. This calculation can depend on the allowable leakage specified in the standard you are trying to comply with (e.g., ATTMA TSL1, ASTM E779 – 10, CGSB, USACE Protocol) or another leakage requirement that you are specifically trying to achieve (e.g., Air leakage, Permeability, Air Change rate). For typical leakage requirements around the world, refer to Table 4 in the Appendix (page 37).

To estimate how many fans you need, here's an example of the calculation to perform:

Let's assume you are testing a 70,000 sq ft enclosure area and the Standard you are trying to comply with requires that you can only allow a maximum permeability of 0.25 CFM/sq ft @ 75 Pa (compliance requirement for USACE).

$$Enclosure\ Area = 70{,}000\ sq\ ft$$

$$Permeability\ requirement = 0.25\frac{CFM}{sq\ ft}$$

Multiplying this permeability requirement by the enclosure area, you can estimate that you would need a total flow rate of 17,500 CFM to reach 75 Pa.

$$Flow\ \ required = Permeability\ requirement\ x\ enclosure\ area$$

$$Flow\ \ required = 0.25\frac{CFM}{sq\ ft}\ x\ 70{,}000sq\ ft$$

$$Flow\ \ required = 17{,}500\ CFM$$

If you are using Retrotec's high output fans, they generate a maximum flow rate of approximately 7,000 CFM at 75 Pa (see Figure 1 for maximum flows of Retrotec fans), so you can divide the Flow required by the Flow capacity of the fan at 75 Pa to determine how many fans you need.

$$Number\ of\ fans\ required\ (at\ 75\ Pa) = \frac{Flow\ required}{Flow\ capacity\ of\ fan\ (at\ 75\ Pa)}$$

$$Number\ of\ fans\ required\ (at\ 75\ Pa) = \frac{17{,}500}{7{,}000}$$

$$Number\ of\ fans\ required\ (at\ 75\ Pa) = 2.5 = 3\ fans$$

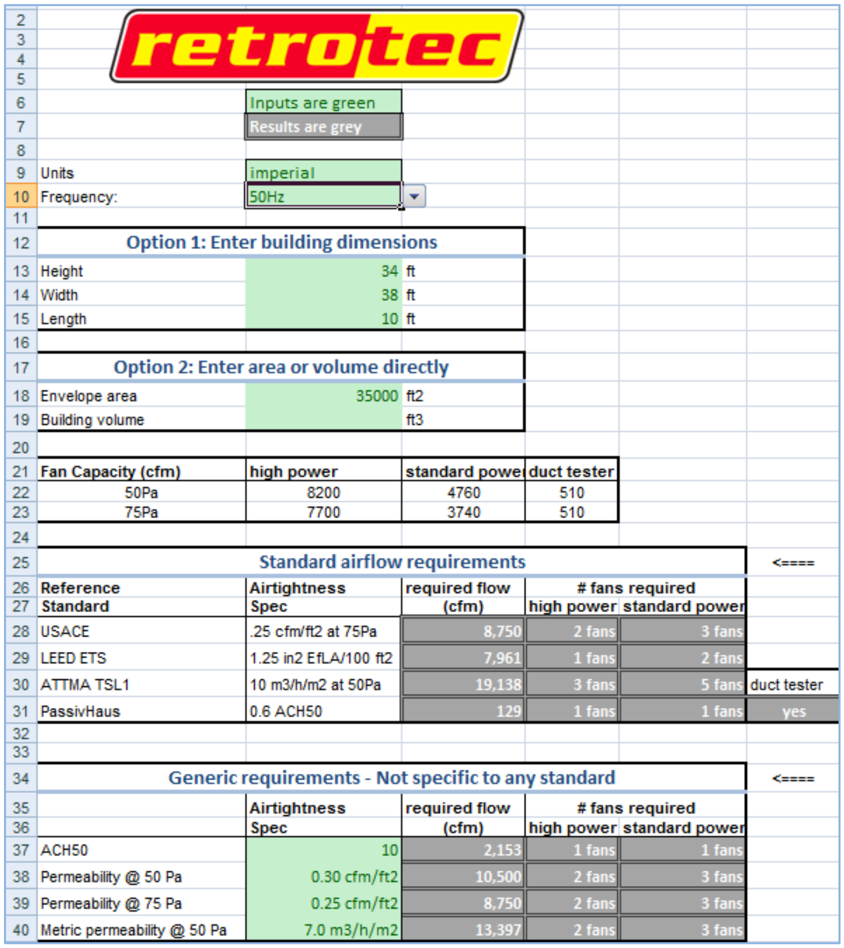
In this example, the quotient is 2.5, meaning you would need at least 3 fans. (If the quotient is not a whole number, you would round it up to a whole number). In the event that you run a test using 3 fans and find that you cannot achieve a pressure of 75 Pa, you know that there is too much leakage in the building to comply with the permeability requirement for the standard (0.25 CFM/sq ft @ 75 Pa); hence, seal up some leakages and try the test again.

This example makes the assumption that the permeability requirement of the building is 0.25 CFM/sq ft to comply with USACE. If you are testing to a different standard, you are to use the requirement from the correct standard.

Keep in mind that the size of the building cannot tell you in advance what the permeability will be. If you need to determine what the permeability is, and are not doing sealing to make the enclosure comply, it is generally safer to calculate conservatively (assuming a higher permeability or leakage) to ensure you have enough fans to run your test.

1.3 Use Retrotec's 'Number of Fan Calculator' spreadsheet

Retrotec's 'Number of Fan Calculator' is an Excel spreadsheet that performs the calculations described above, for Retrotec fans. Instructions on how to use the spreadsheet are embedded within it. To obtain a copy of this spreadsheet, please contact support@retrotec.com.

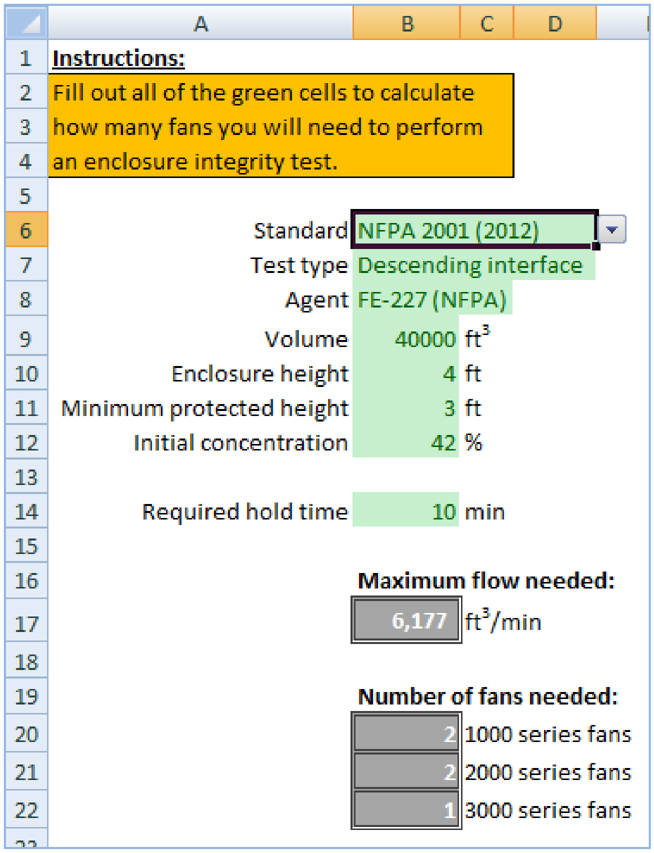


2						
3	retrotec					
4						
5						
6		Inputs are green				
7		Results are grey				
8						
9	Units	imperial				
10	Frequency:	50Hz				
11						
12	Option 1: Enter building dimensions					
13	Height	34	ft			
14	Width	38	ft			
15	Length	10	ft			
16						
17	Option 2: Enter area or volume directly					
18	Envelope area	35000	ft2			
19	Building volume		ft3			
20						
21	Fan Capacity (cfm)	high power	standard powe	duct tester		
22	50Pa	8200	4760	510		
23	75Pa	7700	3740	510		
24						
25	Standard airflow requirements					<====
26	Reference	Airtightness	required flow	# fans required		
27	Standard	Spec	(cfm)	high power	standard power	
28	USACE	.25 cfm/ft2 at 75Pa	8,750	2 fans	3 fans	
29	LEED ETS	1.25 in2 EfLA/100 ft2	7,961	1 fans	2 fans	
30	ATTMA TSL1	10 m3/h/m2 at 50Pa	19,138	3 fans	5 fans	duct tester
31	PassivHaus	0.6 ACH50	129	1 fans	1 fans	yes
32						
33						
34	Generic requirements - Not specific to any standard					<====
35		Airtightness	required flow	# fans required		
36		Spec	(cfm)	high power	standard power	
37	ACH50	10	2,153	1 fans	1 fans	
38	Permeability @ 50 Pa	0.30 cfm/ft2	10,500	2 fans	3 fans	
39	Permeability @ 75 Pa	0.25 cfm/ft2	8,750	2 fans	3 fans	
40	Metric permeability @ 50 Pa	7.0 m3/h/m2	13,397	2 fans	3 fans	

Figure 2: Number of fans calculator based on allowable air leakage

1.4 Use Retrotec's 'Number of Fan Calculator' spreadsheet, for Enclosure Integrity Tests

Enclosure Integrity Tests for testing clean agent fire suppression systems don't have specific permeability requirements, but rather, they have Hold time requirements, which can be used to calculate how many fans are required to test an enclosure of a particular size. To obtain a copy of this spreadsheet, please contact support@retrotec.com.



	A	B	C	D
1	**Instructions:**			
2	Fill out all of the green cells to calculate			
3	how many fans you will need to perform			
4	an enclosure integrity test.			
5				
6	Standard	NFPA 2001 (2012)		
7	Test type	Descending interface		
8	Agent	FE-227 (NFPA)		
9	Volume	40000	ft^3	
10	Enclosure height	4	ft	
11	Minimum protected height	3	ft	
12	Initial concentration	42	%	
13				
14	Required hold time	10	min	
15				
16		**Maximum flow needed:**		
17		6,177	ft^3/min	
18				
19		**Number of fans needed:**		
20		2	1000 series fans	
21		2	2000 series fans	
22		1	3000 series fans	

Figure 3: Number of fans calculator based on Hold Time for Enclosure Integrity Tests

2. Large Building Leakage tests

There are two basic types of tests: Total Zone Leakage and Zone-to-Zone Leakage.

Total Zone Leakage is any test where the objective is to measure the total leakage of an enclosed volume. This enclosed volume could be anything from a one bedroom apartment to a commercial office building.

Zone-to-Zone Leakage is any test where the objective is to measure the leakage of one zone into another zone. This includes a wide variety of measurements, such as the leakage from one floor to another, the leakage between two neighboring apartments, or the leakage from a house into an attic space.

Although the setup of the Door Fan systems is the same for both types of leakage tests, the actual test procedures for measuring leakage between multiple zones is different than that for measuring the total leakage of one zone.

2.1 Total Zone Leakage Test

In a Total Zone Leakage test, the entire zone is pressurized (or depressurized) to a uniform pressure and the leakage measured is the Total Zone Leakage.

In Figure 4, the Door Fans are pressurizing one zone, so they are measuring the total leakage of the entire zone or building.

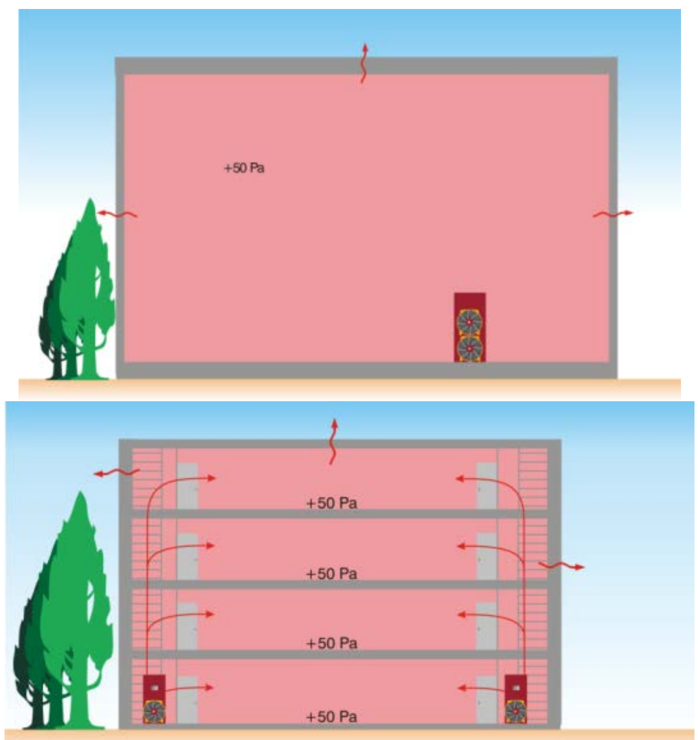


Figure 4: Buildings pressurized as a single zone to measure Total Zone Leakage

2.2 Zone-to-Zone Leakage Test

Zone-to-Zone Leakage tests are the only way to measure the leakage through a particular surface, such as a partition wall between two apartments, or the leakage from a hallway into an apartment.

Zone to zone leakage is more complicated than total zone leakage – it involves pressure neutralization between two zones. How to set up your fans is based on the fundamental concept of Pressure Neutralization, described in the next section.

2.2.1. Pressure Neutralization

Flow is caused by a pressure differential across a hole. The idea behind Pressure Neutralization (sometimes confusingly called "guarded testing" even though nothing is actually guarded) is that if you pressurize both sides of any hole to the same pressure, there will be no flow (hence, no leakage measured) through the hole since there is no pressure differential. The magnitude of this pressure can be large or small, but as long as the pressure on both sides is the same, there will be no flow.

2.2.2. Measure Leakage between floors using pressure neutralization

The procedure below describes how leakage between floors of a high rise building is measured by Pressure Neutralization.

<table>
<tr>
<td>
To measure the leakage between the 10th floor and the 9th floor, you would set up Door Fans on both floors.

1. Pressurizing only the 10th floor, the gauge on the 10th floor will be measuring the flow (or leakage) across all barriers of that floor.

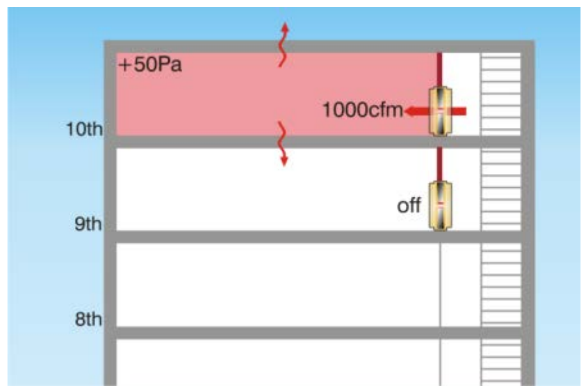
In Figure 5, 1000 CFM is measured as the flow across all barriers of the 10th floor.
</td>
<td>


Figure 5: Measure the flow across all barriers on the top floor
</td>
</tr>
<tr>
<td>
2. Pressurizing both 10th and 9th floors, the gauge on the 10th floor will now be measuring the flow (or leakage) across all barriers except the slab between floors - there is no flow between the 10th and 9th floor due to Pressure Neutralization.

In Figure 6, 800 CFM was measured as the flow; This means that the flow between the 10th and 9th floor must be 200 CFM, by subtraction from the result of step 1.

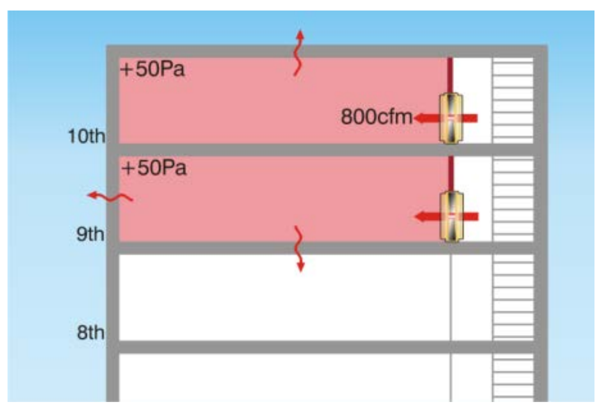
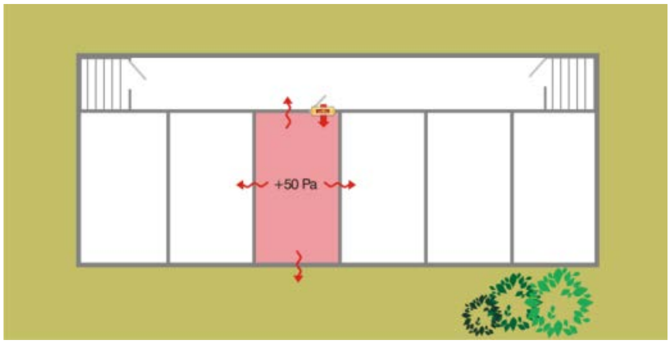
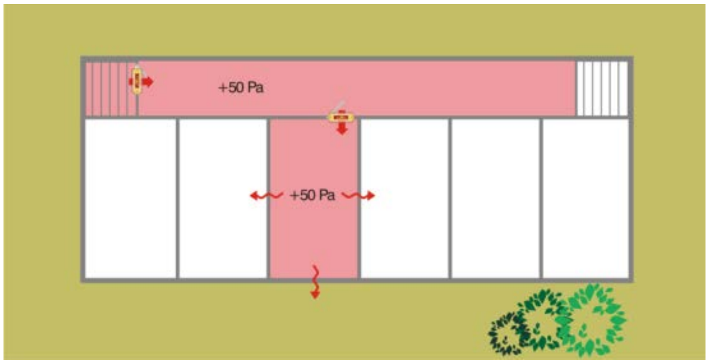
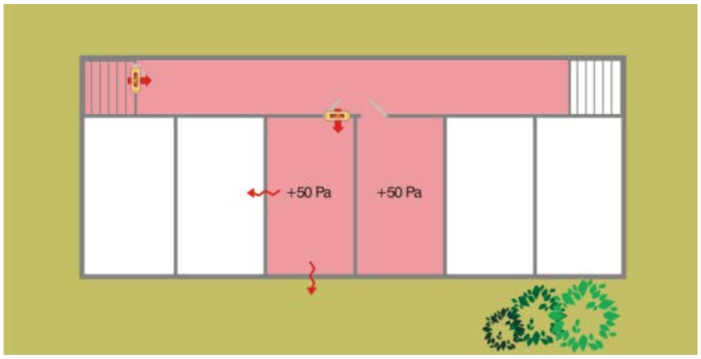
1000 CFM – 800 CFM = 200 CFM
</td>
<td>


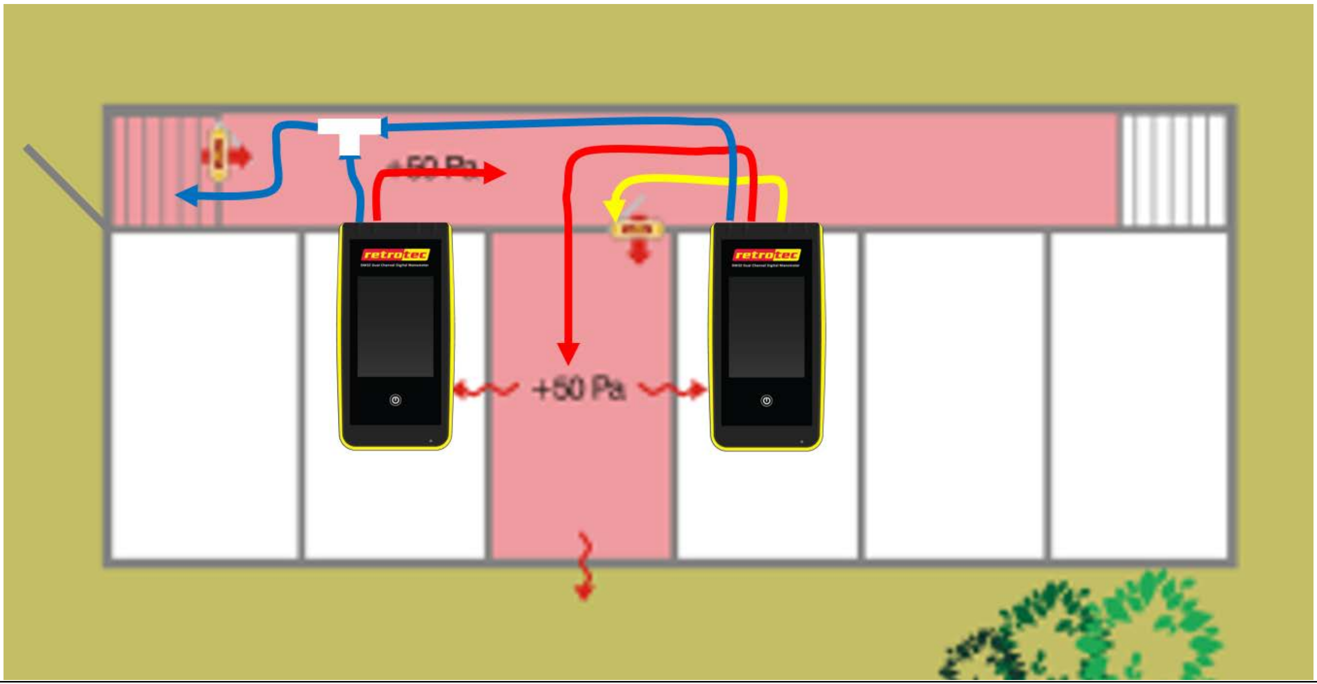
Figure 6: Measure the flow from the top floors combined
</td>
</tr>
</table>

The order of steps 1 and 2 can be interchanged. To test the leakage of the other floors, you would move the Door Fan from the 10th floor to the 8th floor and repeat the procedure.

2.2.3. Measure Leakage between rooms using pressure neutralization

The procedure below describes how leakage between rooms or apartments is measured by Pressure Neutralization.

1. Initially, the first Door Fan pressurizes a room, and its gauge will measure the flow (or leakage) across **all barriers** of a room. Record the flow, and keep the Door Fan On for the following steps.	 **Figure 7: Pressurize the first room to measure flow from the room**
2. A second Door Fan pressurizes the hallway, but now the room gauge will be measuring the flow (or leakage) across all its barriers **except its wall between the hallway** – since there is no flow between this wall due to Pressure Neutralization. The drop in flow rate (from step 1), on the room gauge, indicates the flow or leakage across the room's wall between the hallway	 **Figure 8: Use a second Door Fan to pressurize the hallway**
3. The door of an adjacent room is opened so that it is pressurized as well. Now the gauge of the originally pressured room will be measuring the flow (or leakage) across all its barriers **except its wall between the hallway and its wall to the other room**. The drop in flow rate (from step 2), on the room gauge, now indicates the flow or leakage across the wall between the two rooms.	 **Figure 9: Open a door to the adjacent room to determine flow between the rooms**



Tubing configuration for pressure neutralization.

Both gauges should be in the hallway.

All pressures are referenced to a common Blue tube which is connected to outdoors via the stairwell where at least one door should be open to outdoors. The Red tubes are measuring pressure in the hallway and the apartment respectively.

Before the hallway blower door is turned on, the **total apartment leakage** is being measured by the blower door in the apartment doorway. Then the hallway blower door is turned on.

The Left gauge and blower door establish a pressure at 50 Pa between outdoors and the hallway in this example.

The apartment blower door will have to slow down to maintan a pressure at 50 Pa between outdoors and the apartment. The pressure between the apartment and hallway wall is zero and has been neutralized. The leakage across this boundary has also been neutralized forcing the blower door mounted in the apartment doorway to read a reduced flow rate. This reduction represents the hallway to apartment portion of the previous **total apartment leakage**.

This procedure is sometimes oddly called “guarded” blower door tests which is not a technical term even though it’s sees common usage in the USA. Pressure neutralization or pressure nulling is truly the terminology of what this method depicts.

3. Options for controlling the speed of multiple fans

There are two methods of speed control for your multi-fan setup. You can either control the speed of all fans with one gauge (Common set point), or let each fan's speed be controlled with different gauges (Individual set point). There are advantages and disadvantages for each of the fan speed control methods you choose. Reasons for choosing one over the other are described in the scenarios of section 0 using FanTestic software, which provides either Common set point or Individual set point control of the fans.

3.1 Common set point control

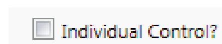
One gauge called the "Primary gauge" controls all fans. Common set point control can be accomplished by one of three methods, either manually with gauges only or using FanTestic software to control the gauges:

3.1.1. Without FanTestic software

Use a Speed Control Splitter to connect the "Primary Gauge" Speed Control Cable to multiple fans (part number: FN280 – see section 8)

Daisy chain fans together (possible if Fan Tops have two Control ports – see section 7) so their Speed Control ports can all be connected to the single "Primary Gauge".

3.1.2. With FanTestic software:

Turn Individual Control in FanTestic OFF (unchecked: 

) and have the "Primary Gauge" connected to the computer running FanTestic software.

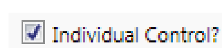
3.2 Individual set point control

Each fan has an associated gauge that is used to control that fan: one gauge controls one fan, another gauge controls another fan. Individual set point can be accomplished by one of two methods:

3.2.1. Without FanTestic software:

Connect Speed Control Cables (Ethernet style) from each gauge to each fan directly (i.e., Not using a Speed Control Splitter and not daisy chaining fans together)

3.2.2. With FanTestic software:

Turn Individual Control in FanTestic ON (checked: 

)

4. Options to set up test parameters and collect test data

For multi-fan tests, you can choose to collect data using FanTestic software or not, however it is highly recommended to do so (see section 3).

FanTestic software is developed by Retrotec to communicate directly with Retrotec Door Fan and DucTester systems for Automatic Control. It also serves the purpose of calculating results, from Automatic Tests or data entered manually, in compliance with the most recent edition of various domestic and international Standards. Target pressures and test parameters can be changed for each Automatic Test, however parameters for compliance with the Standard selected are implemented by default. For further detail on how to operate FanTestic software, please refer to *Manual-FanTestic*.

4.1 Manual Data Collection without using FanTestic

If you choose not to use FanTestic, this would be a Manual Test where you set the target pressures on the gauge(s) directly – you do not connect USB cables to a computer. If you wanted Common set point control in this case, you will need either a Speed Control Splitter or fans with dual Speed Control (Ethernet-style) ports, or a combination of the two if fans of different series are connected. More details on this are illustrated in section 7.

4.2 Automatic Data Collection Using FanTestic

Using FanTestic in a multi-fan setup allows all the data and results to be collected during an Automatic Test. If you choose to use FanTestic, you must connect USB cables from your gauges to your computer, and you need one gauge for each fan so FanTestic can control the fans.

The Individual Control function in FanTestic determines the manner in which the fans in a multi-fan setup are controlled by software. If you have ever used a Speed Control Splitter or used the daisy chaining method to connect fans together, Individual Control ON in FanTestic essentially simulates the same setup for the fans' speed control (see section), without the use of a Speed Control Splitter or Fan Tops with dual-Control ports.

To configure Individual Control in FanTestic, click Tools →Advanced Options→ Basics tab.

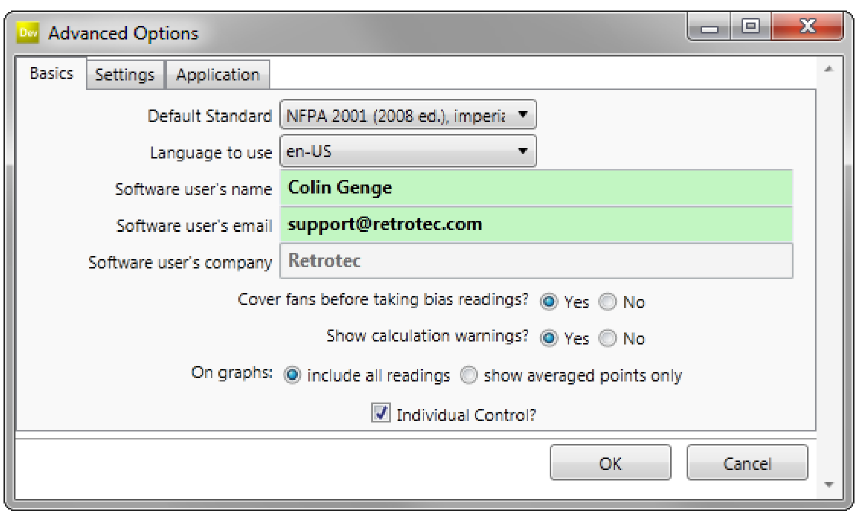


Figure 10: Check off Individual Control in the Advanced Options Window

4.2.1. How to set "Individual Control" with FanTestic Software

Individual Control ON (checked: ☑ Individual Control?): This is the default setting.

When attempting to create an Induced pressure, FanTestic will tell each gauge separately (i.e. send different speed signals to each gauge) to reach that pressure target. This would be the same as a user manually using the [Set Pressure] function on each gauge separately.

Using "Individual Control", in the same way as setting pressure manually on multiple gauges, may result in "dueling" fans where one fan takes over and runs up to a speed of 100%, while the other fan(s) decrease to 0% speed.

4.2.2. How to set "Common Control" with FanTestic Software

Individual Control OFF (unchecked: ☐ Individual Control?):

This will select the first gauge detected as a "Primary gauge". The primary gauge can be switched by the user.

When attempting to create an Induced pressure, FanTestic will tell the primary gauge to seek that target pressure. FanTestic will then read the fan speed % from the Primary gauge, and tell all other gauges to go to that speed. This effectively turns all fans into one big fan that is controlled by the pressure on Channel A of the Primary gauge. This will eliminate any "dueling" between fans, however different pressures between different zones tested may result.

Note: Running Automatic Tests in FanTestic with multiple fans requires a FanTestic Pro license.

Version	Max Fans*	Standards**	Customizable Reports in MS Word	Exportable Data to MS Excel
FanTestic Lite	1	1	✗	✗
FanTestic Pro	2	1	✓	✓
FanTestic Pro 6	6	All	✓	✓
FanTestic Pro 24	24	All	✓	✓

Figure 11: How many fans can you run with FanTestic?

5. Multiple Fan Testing Scenarios

The following are different scenarios that illustrate multi-fan testing problems, solutions to them, and how to choose whether the Individual Control setting in FanTestic software should be On or Off.

Note that the diagrams in this section display the cable connections for a DM32 gauge, which are different for a DM-2 gauge; For cable connections for a DM-2 gauge, refer to *Manual-DM-2 Operation*. Also note that the diagrams show a Control Cable connected from the gauge directly to the fan for simplicity, however if the fan is a high output fan (Retrotec 3000 series), the Control Cable will actually be connected to the Drive of the fan instead.

5.1 One Zone, Multiple Fans:

Testing a single-zone enclosure can require multiple fans.

Problem 1: Imbalanced test fan flow caused by Individual set point control shown in Figure 12.

When more than one fan is individually set to control to the same pressure, the balance of flow between the fans can shift so that some fans speed up which can cause others to slow down or stop altogether. To utilize the flow capacities of all fans, a different method of fan control must then be used to ensure the flow rates between the fans are balanced.

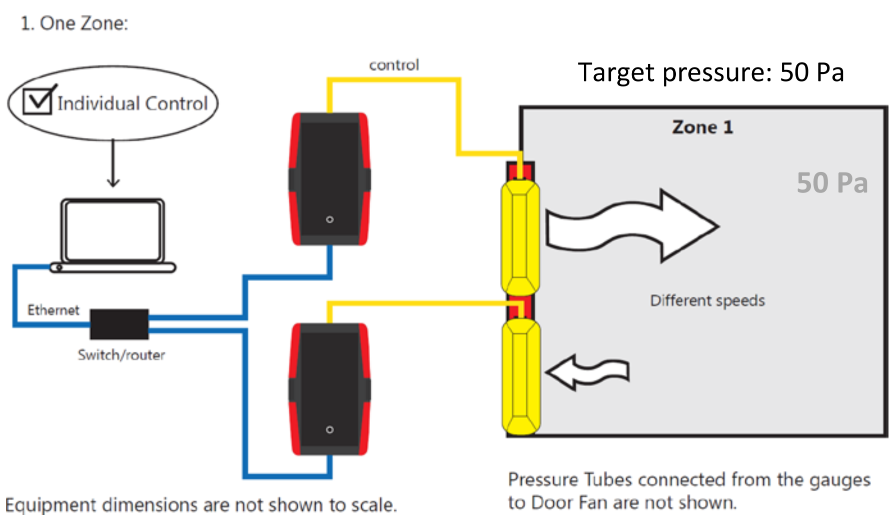
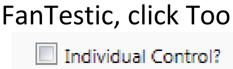


Figure 12: Problem1: Imbalanced test fan flow caused by Individual set point control

Solution 1: Use Common set point ("Individual Control" turned Off) which runs all fans at the same speed.

To perform this with FanTestic, click Tools →Advanced Options → Settings tab → leave "Individual Control" unchecked: 

Common set point control has the same effect as using a Speed Control Splitter. The primary gauge will receive a pressure target from FanTestic, and all other gauges will mimic the speed of the primary gauge, as shown in Figure 13.

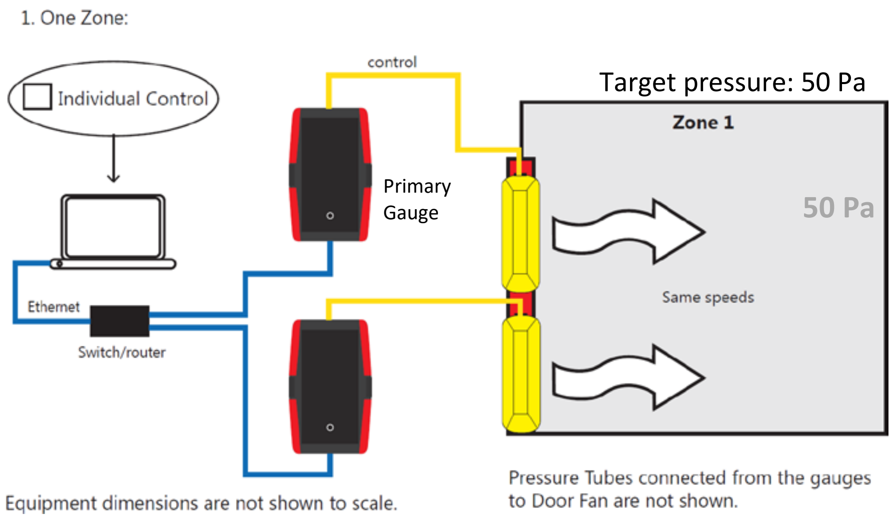


Figure 13: Solution1: Use Common set point control to balance output from fans

5.2 Multiple Zones, one fan per zone:

Testing multiple zones can require one fan on each separate zone. These zones can be adjacent rooms or separate floors.

Problem 2: Uneven building test pressures between zones can be caused by a Common set point control as shown in Figure 14. The same control signal can create uneven pressures in unconnected zones. This happens when one zone is leakier than the other.

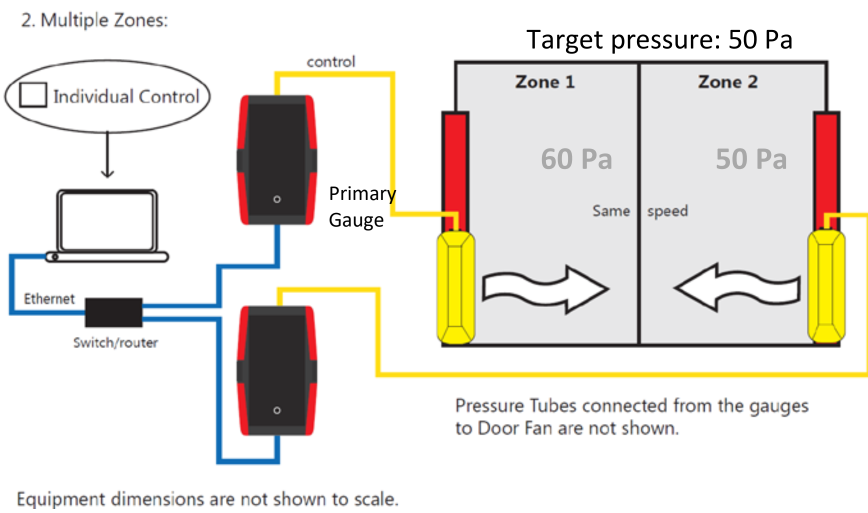


Figure 14: Problem2: Uneven pressures between zones caused by Common set point control

Solution 2: Use Individual set point control ("Individual Control" turned On).

Eliminate the problem of being unable to reach the same pressure in separate zones by controlling each fan individually with its own gauge. The solution is depicted in Figure 15.
To perform this with FanTestic, click Tools →Advanced Options → Settings tab → check "Individual Control" ☑ Individual Control?

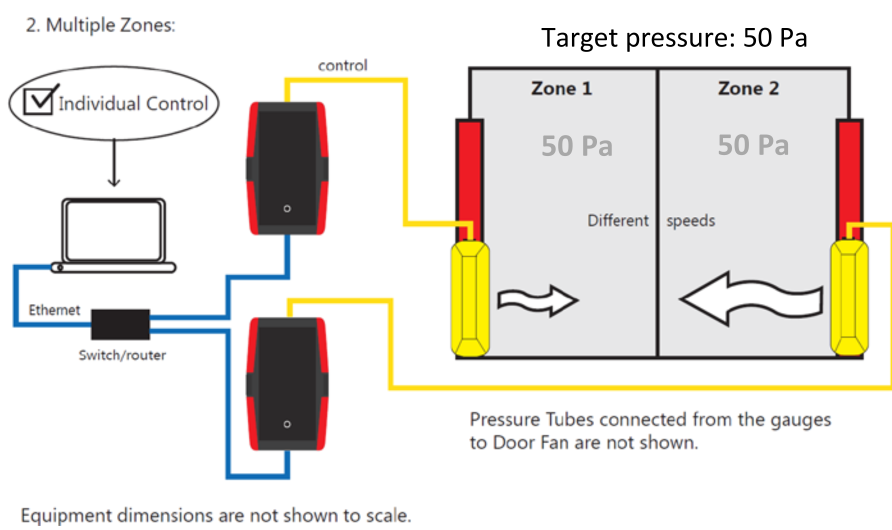


Figure 15: Solution2: Keep pressures even between zones with Individual set point control

5.3 Multiple Zones (Leaky), multiple fans per zone

Testing multiple zones can require multiple fans on each separate zone. These zones can be adjacent rooms or separate floors.

Problem 3A: Uneven building test pressures between floors can be caused by a common set point as shown in Figure 16. The same control signal can create uneven pressures in different zones. This happens when one zone is leakier than the other. In this scenario all 6 fans are going the same speed.

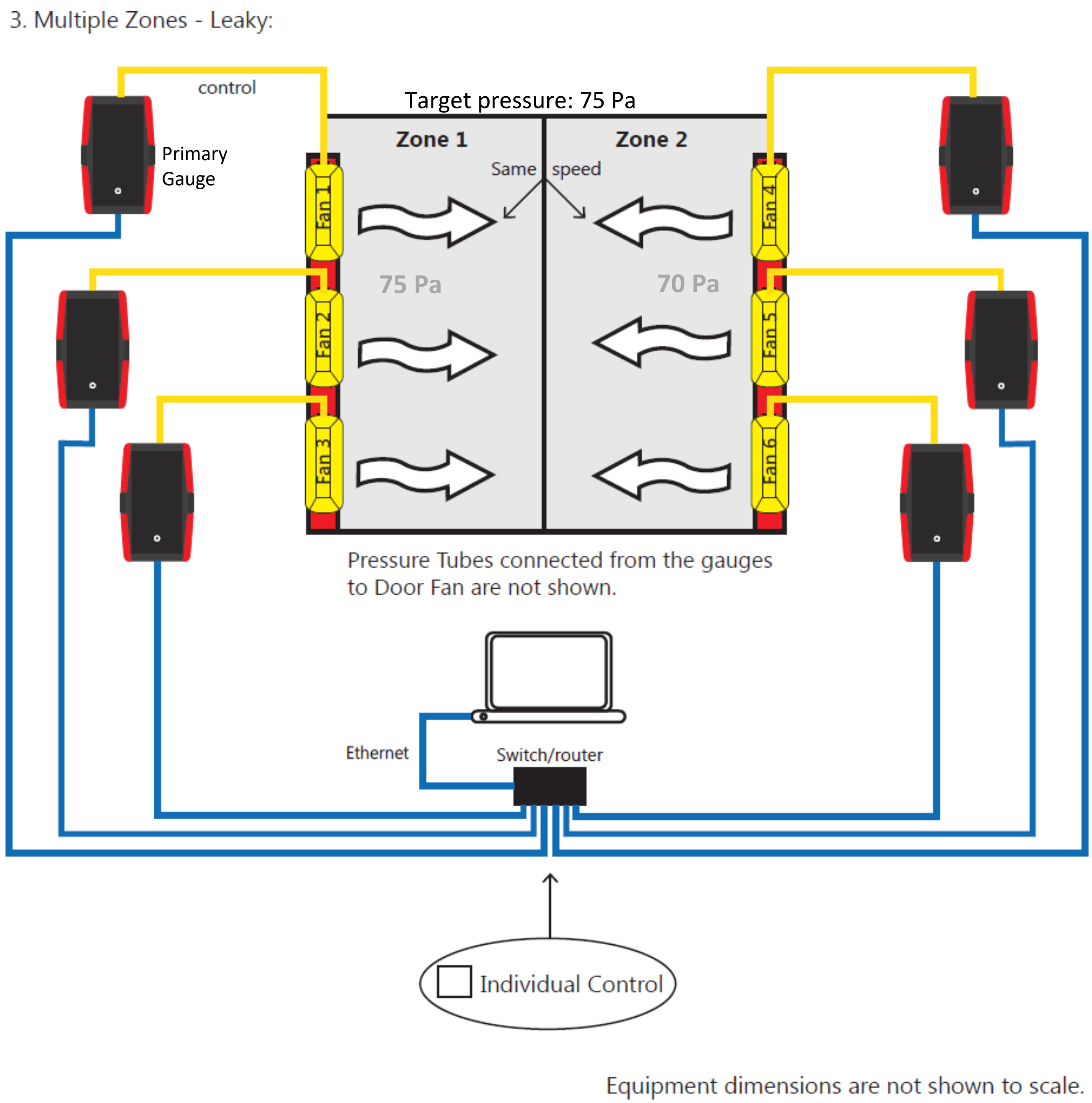


Figure 16: Problem3A: Uneven test pressures between zones caused by Common set point control of multiple fans per zone

Problem 3B: Imbalanced flow can also be caused by individual set points as shown in Figure 17. When more than one fan are individually set to control to the same pressure, the balance of flow between the fans can shift so that some fans speed up which can cause others to slow down or stop altogether. To utilize the flow capacities of all fans, a different method of fan control must then be used to ensure the flow rates between the fans are balanced. In this scenario all 6 fans are going different speeds.

3. Multiple Zones - Leaky:

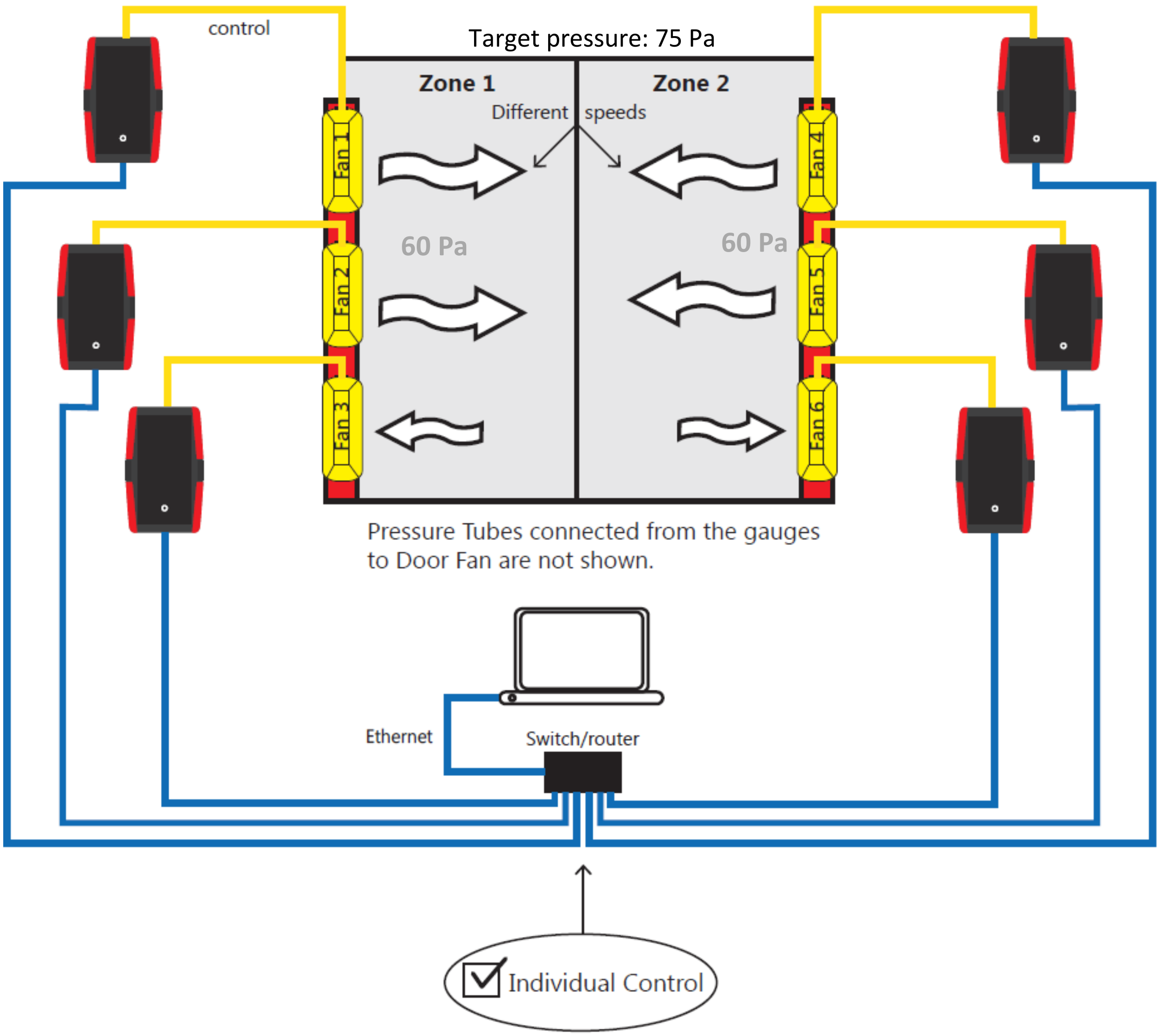


Figure 17: Problem3B: Unbalanced flow caused by Individual set point control of multiple fans per zone

In Figure 17, Fans 1, 2, 4 and 5 were close to running at 100% speed, but Fans 3 and 6 are running at 5% speed because air is flowing backwards through them. As a result, the target pressure of 75 Pa could not be reached since the full output of Fan 3 and 6 are not utilized. Imbalanced flow is often a problem for multi-point tests.

Solution to 3A and 3B: Individual set point control **between** zones (“Individual Control” turned On), and Common set point control **within** a zone, as shown in Figure 18.

1. Fans within the same zone must run at the same speed.
2. To perform this, fans in an enclosure are connected using a Speed Control Splitter or by daisy-chaining them together. There will only be one Control Cable that connects from one of the gauges to one of the fans – This gauge is called the ‘Primary Gauge’ and the other gauges have no Control Cables to their fans.
3. Fans between zones can run at different speeds.

To perform this with FanTestic, click Tools →Advanced Options → Settings tab → check “Individual Control” ☑ Individual Control?

In the example below, fans 1-3 are all running at one speed and fans 4-6 are all running at another speed.

3. Multiple Zones - Leaky:

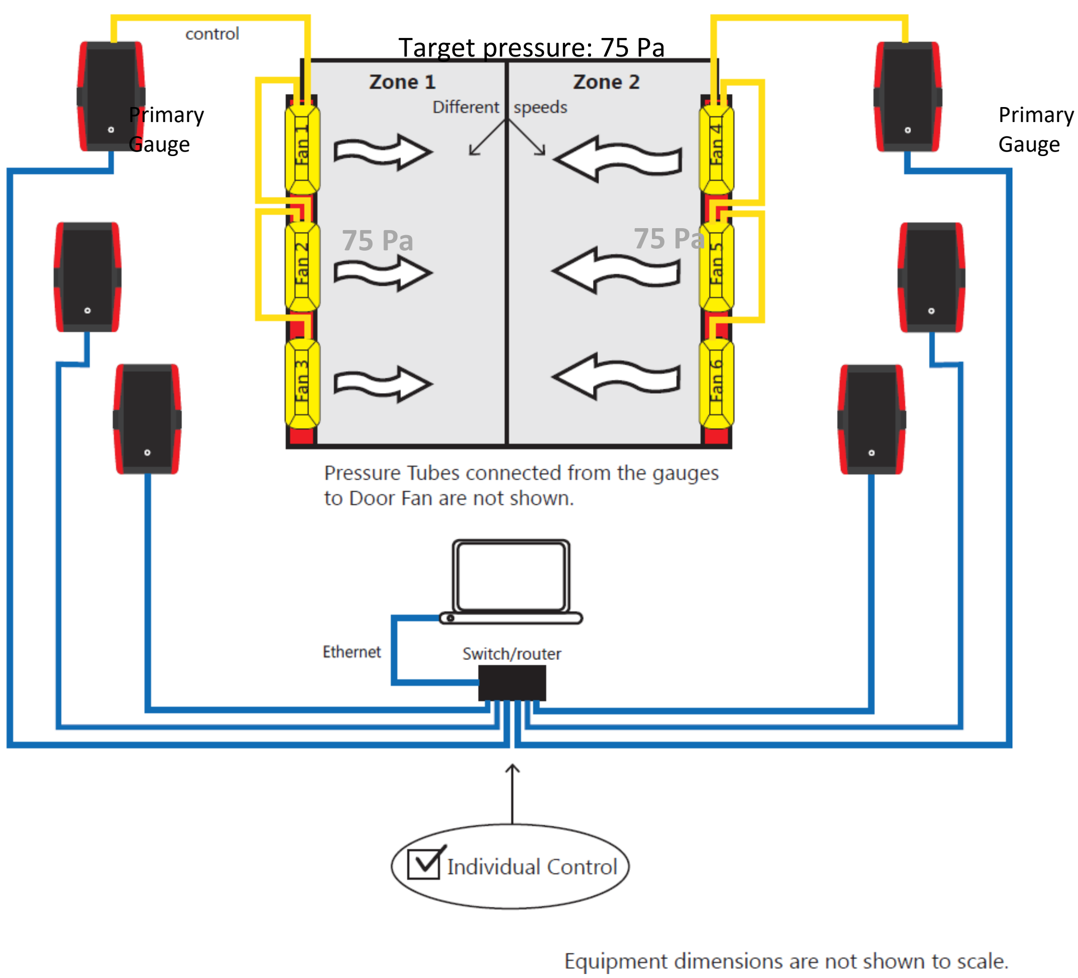


Figure 18: Solution3A and B: Balanced flow for fans within a zone, balanced pressure between zones

Note: For each zone, this diagram shows one method to control fans to the same speed by daisy chaining the fans together. An alternative method is to connect all the fans in a zone to one side of a Speed Control Splitter (FN280), and the “Primary gauge” to the other side. For detailed schematics on how fans can be controlled by a “Primary gauge”, refer to diagrams in section 7 for connections that work best.

6. Router and switch information

Routers and switches are different kinds of networking equipment, and are not interchangeable.

A switch will for the most part just pass the traffic through. Switches can be used for multiplexing so you can get multiple inputs onto one output. They can also be used as signal boosters so you can extend the length of your data connection.

A router will dynamically generate IP addresses for devices connected to it. The router will also multiplex and boost signal.

When networking, it is important to understand what piece of equipment is in charge of generating the IP address for each device. If there is a router anywhere in the network to which you are connecting gauges, that router will provide the IP addresses.

Gauges connected to a network containing a router must be set to DHCP for their IP address generation, because these gauges expect the router to tell them what IP address they will use. You have to set DHCP on the gauge itself (network settings screen>>"Mode") then the gauge will wait for the router to tell it what IP address to use.

Gauges connected to a network containing only switches must be set to Static and have a UNIQUE IP address entered, because the gauge itself will need to know its IP address in advance of connecting to the network. You have to set both of these things yourself on each gauge (network settings screen>>"Mode" and "IP Address").

For ease of configuration, I would use one router connected to the control computer and set all the gauges to DHCP. I then use switches if I need to gang gauges together at a location. For instance if we have two banks of fans at separate locations in the building, I would use a switch at each bank, and then feed one cable from each bank to the router.

It is best to use the computer you are taking to the jobsite, and use the network equipment you are taking to the jobsite to set up and test your network before you go.

Most computers are configured so that they will operate either on a network with a router (DHCP mode), or on a network where devices need to know their own IP address (Static mode) without the user having to change any settings on the computer. Be careful when plugging the devices into ports on a router. Most ports will be labeled for LAN and one will be labeled differently (WAN or Internet). Be sure to plug your control computer and devices only into LAN ports, never the Internet/WAN ports or there may be routing issues.

7. Control Cable configurations that work best

The difference between the multi-fan configurations is how you connect the Speed Control Cables. The configuration of your multi-fan setup depends on:

1. which models of Retrotec fans or Drives you are trying to connect,
2. which model of Retrotec gauges you are trying to connect, and
3. whether you want Individual or Common set point control (see section 3).

Most commonly, multi-fan setups use high output fans, so connections involving only 3300 series Retrotec fans will be described in this section.

Table 1. Summary of Control Cable configurations illustrated in this section

Fan/Drive model	Gauge model:	Set point control	Refer to:
3300	DM-2	Common	**Figure 22**
3300	DM-2	Individual	**Figure 23**
3350	DM-2	Common	**Figure 25 and Figure 26***
3350	DM-2	Individual	**Figure 27**
3300 and 3350	DM-2	"Somewhat Common"	**Figure 28**
3350	DM32	Common	**Figure 29**
3350	DM32	Individual	**Figure 30**

*Figure 26 illustrates the use of the Multi-fan Umbilical. If you have three fans, you can make use of the Retrotec Multi-fan Umbilical (part number DM241) which allows three fans to be controlled from 75 feet away with only one Umbilical, minimizing the tangle of cabling at the fans and gauges.

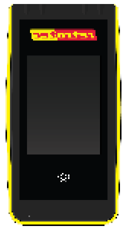
Figure 19: Multi-fan Umbilical to facilitate neat multi-fan installations

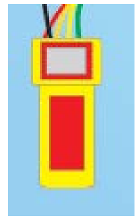
- Tube diameters are small, making this umbilical small and light.
- Small diameter tubes eliminate pressure spikes when accidently stepped on.
- You can have your gauges right next to your computer, giving you more control.
- The protective sheathing eliminates errors due to the sun shining on tubes.

While it is true that some gauges will yield errors when used with tubes over 50 feet and/or with small diameter tubes, that is not true with the Retrotec gauge. Because the Retrotec gauge has an extremely small diaphragm it is not affected even when tubes are 1000 feet long or more.

7.1 Connecting 3300 fan Drives (Pre-2012)

3300 fan Drives were manufactured before February 2012. They have 1 Speed Control Cable port, and 2 pressure ports and will work with DM-2 and DM32 gauges. You can upgrade them all to Model 3350s.





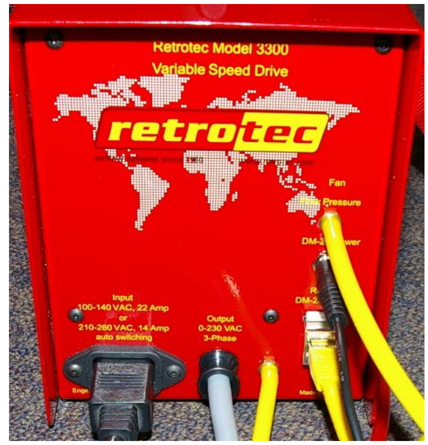


Figure 20: Cable ports on 3300 fan drives

CAUTION when mixing Model 3300 with 3350s. This connection can damage the equipment connected, including the gauge and computer. See below for correct wiring diagrams.

Figure 22 and Figure 23 show connections with the 3300 drives, **for Common set point** or **Individual set point control**. Figure 28 shows how to mix 3300 and 3350 drives, which is NOT recommended.

Figure 21: Multiple fans installed in Retrotec folding panels to test a warehouse.

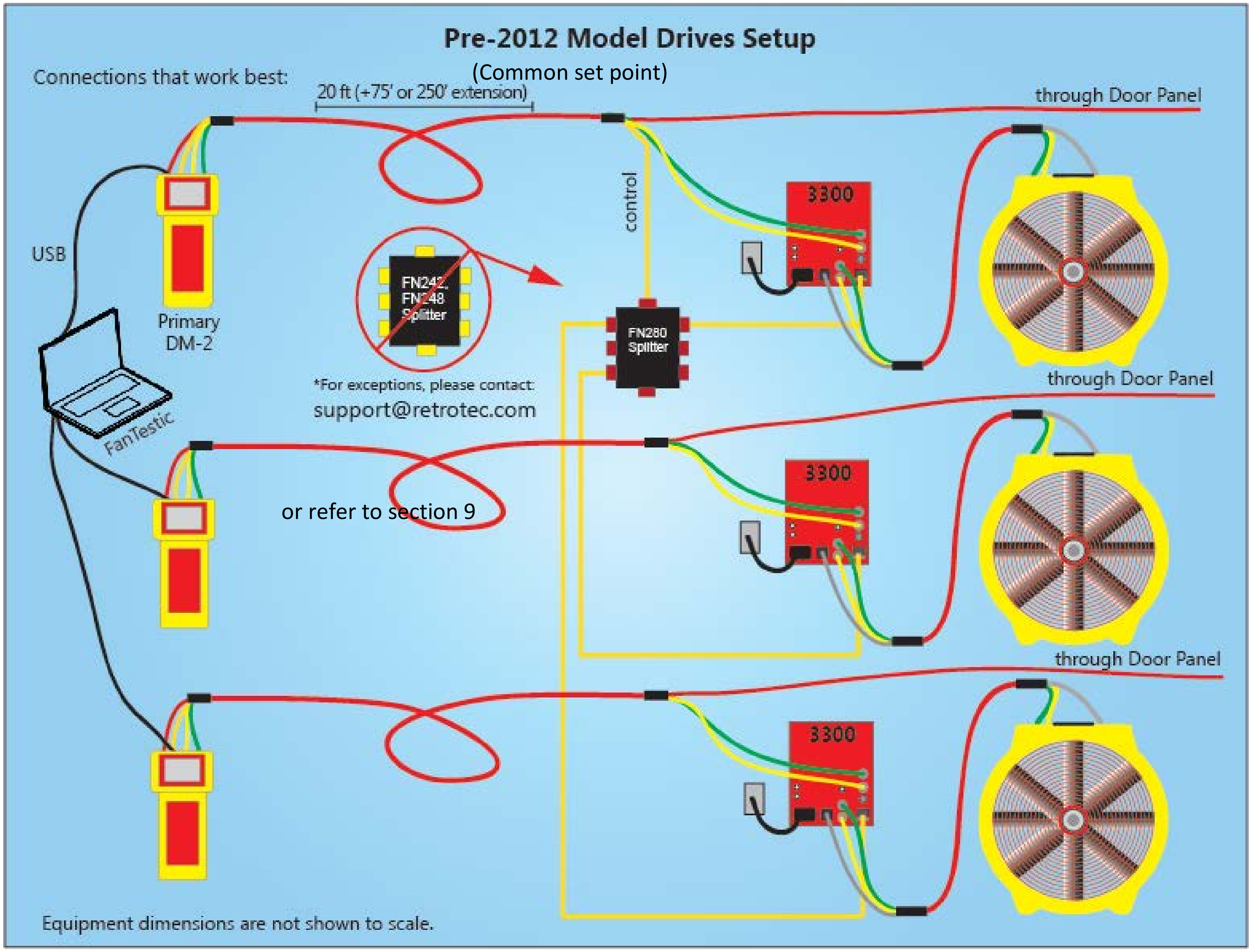


Figure 22: Connections for **Common set point control**, 3300 fan drives (Pre-2012)

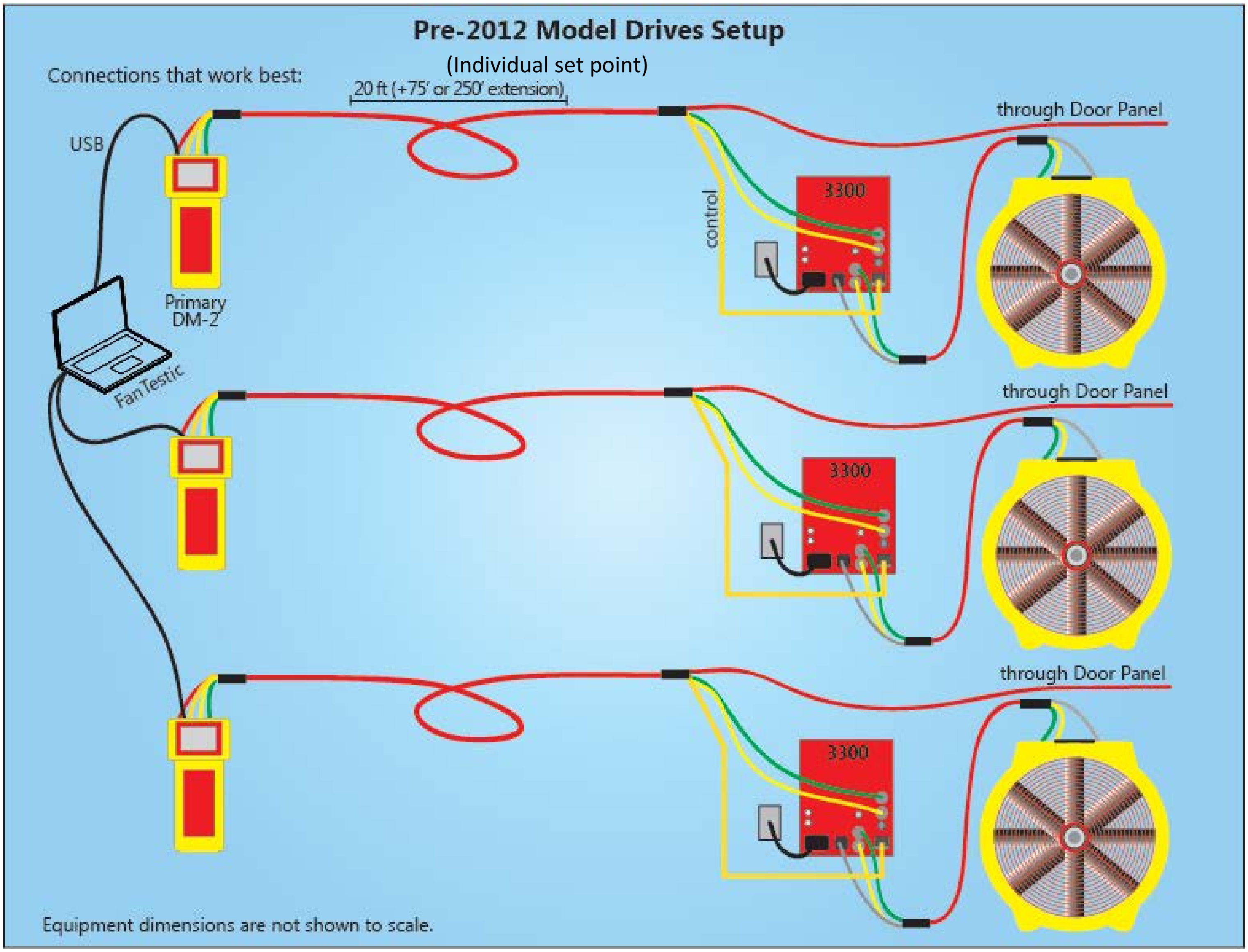


Figure 23: Connections for **Individual set point control**, 3300 fan drives (Pre-2012)

7.2 Connecting 3350 fan drives (2012 and later)

3350 fan drives were manufactured after February 2012 featured the convenience of “In” and “Out” Control Cable CAT5 connectors to daisy chain fans together, a speed control knob, maximum speed adjustment port and a large orange power switch. No pressure ports were on the drive.

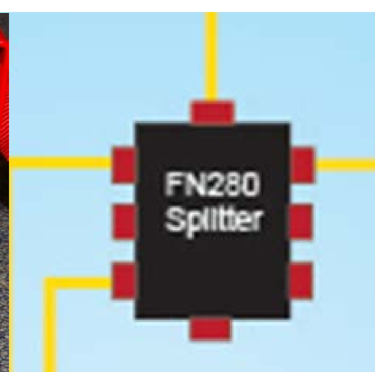
Some earlier units say “for 3000 fans” on the front but the “3350” label on the back plus the above features identify it as a Model 3350.

Figure 24: Cable ports on Model 3350 fan drives from 2012 and later.

3350 drives work with DM-2 and DM32 gauges.

Figure 25 and Figure 27 shows how to make connections for Common set point or Individual set point control. Figure 28 shows connections where 3300 and 3350 drives are both used (which is not recommended). Figure 26 shows how to use the Multi-fan Umbilical to connect 3350 drives for Common set point control.

WARNING: Connect Model 3300 and Model 3350 Drives together ONLY with the Model FN280 splitter or risk damage to your computer and drives.



DO NOT use a splitter with Yellow connectors and DO NOT daisy chain a 3300 to a 3350.

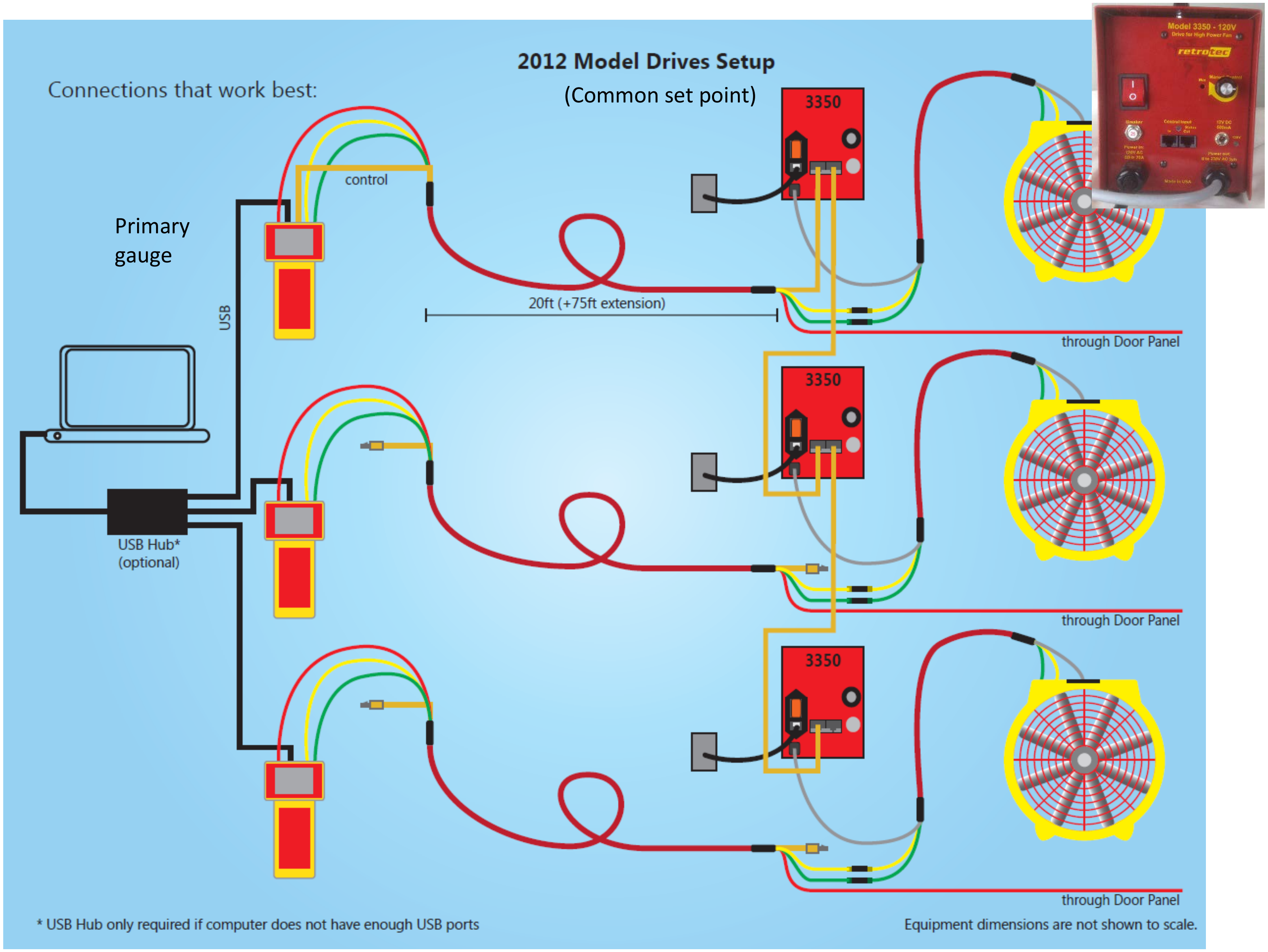


Figure 25: Connections for **Common set point control**, 3350 fan drives (2012 and later) with DM-2 gauges

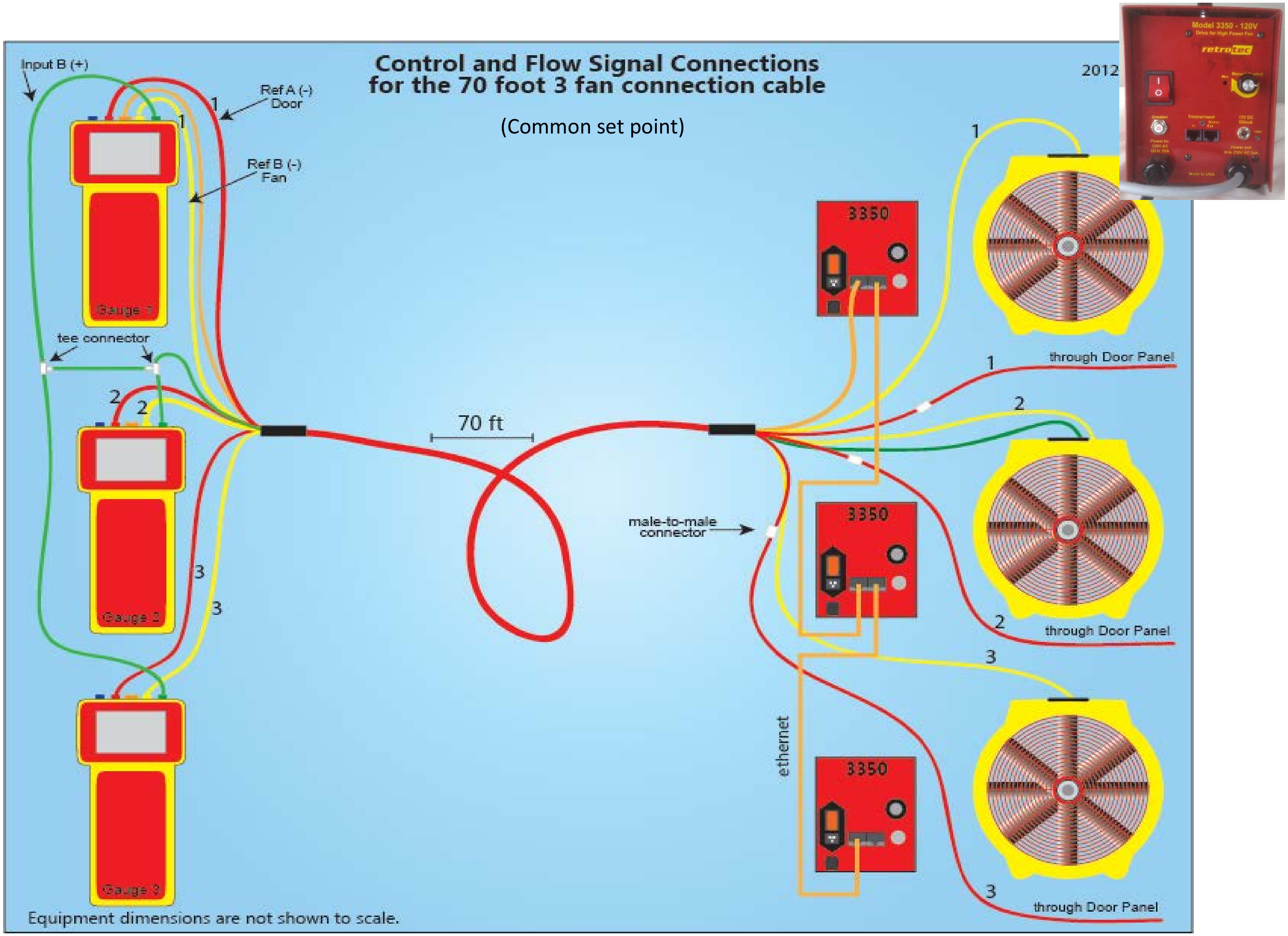


Figure 26: Connections for **Common set point control**, 3350 fan drives (2012 and later) with DM-2 gauges, using the Multi-fan Umbilical

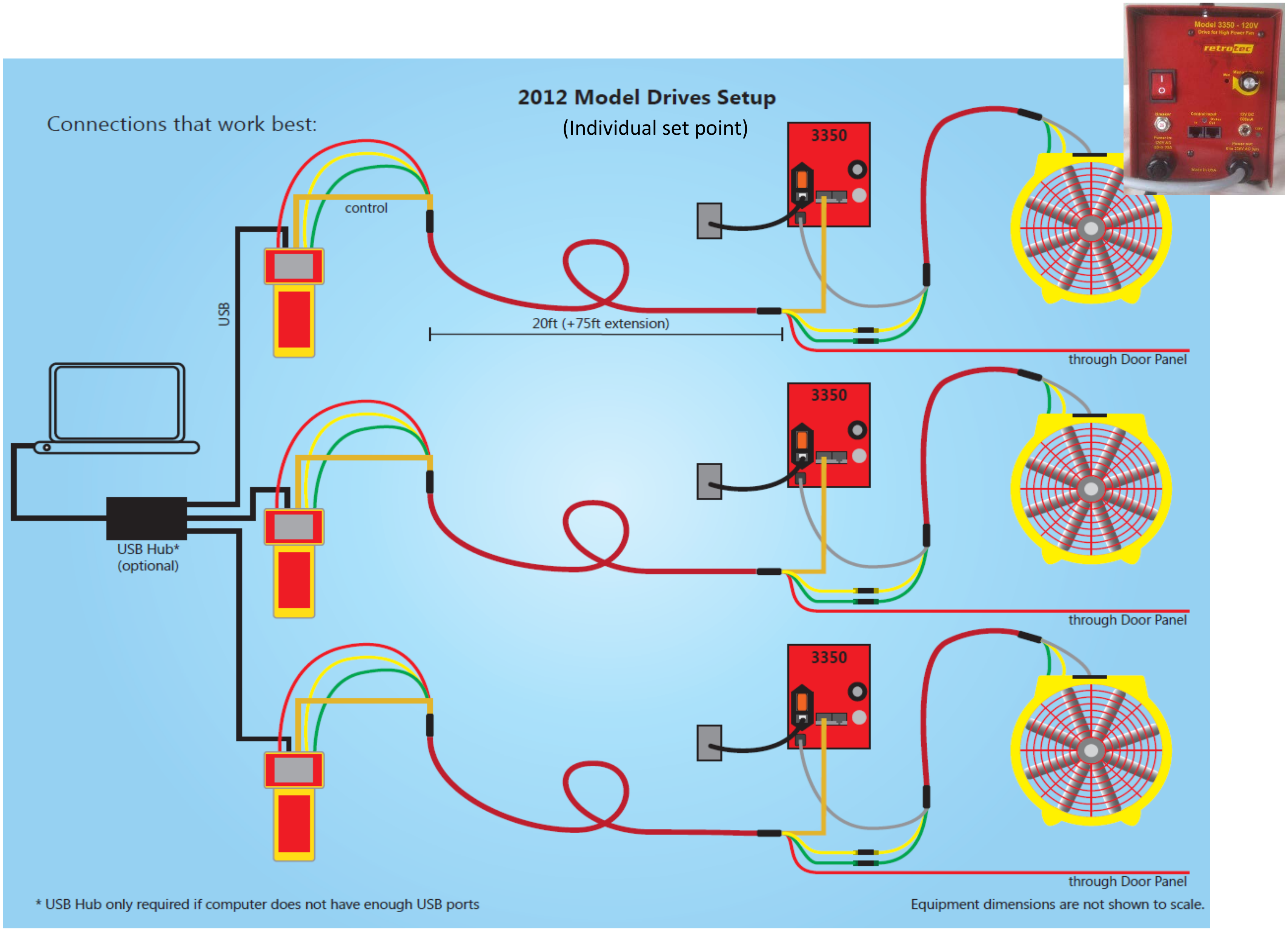


Figure 27: Connections for **Individual set point control**, 3350 fan drives (2012 and later) with DM-2 gauges

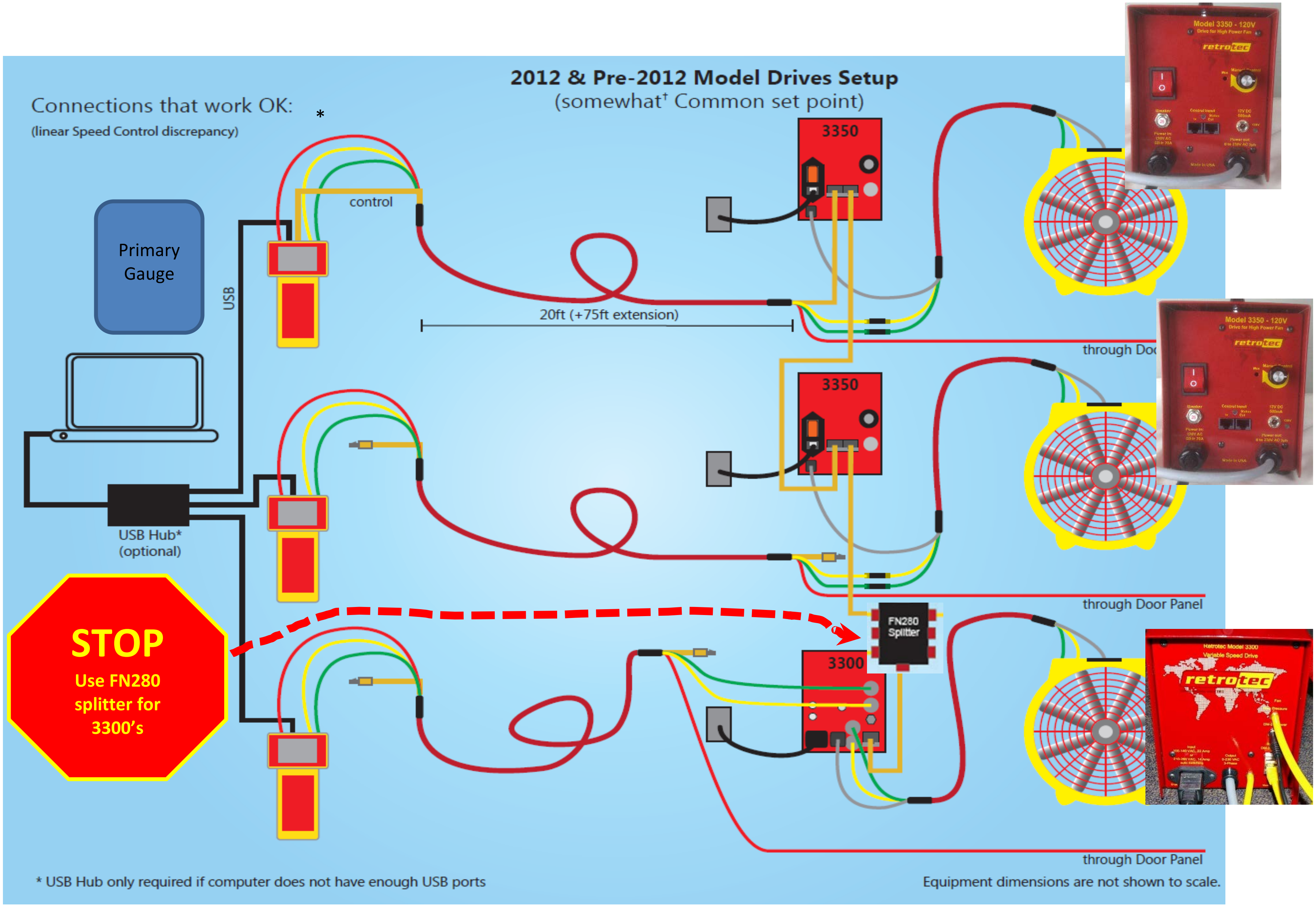


Figure 28: Connections with mix of fan 3300 and 3350 drives on DM-2 gauges must use an FN280 splitter to prevent damage to your computer.

Called "Somewhat Common" set point control because 3300 and 3350 don't respond exactly the same so flows between fans will vary but this is true whenever fan models are mixed. Caution: Connect Model 3300 and Model 3350 Drives together ONLY with the Model FN280 splitter or risk damage to your computer and drives - DO NOT daisy chain a 3300 to a 3350.

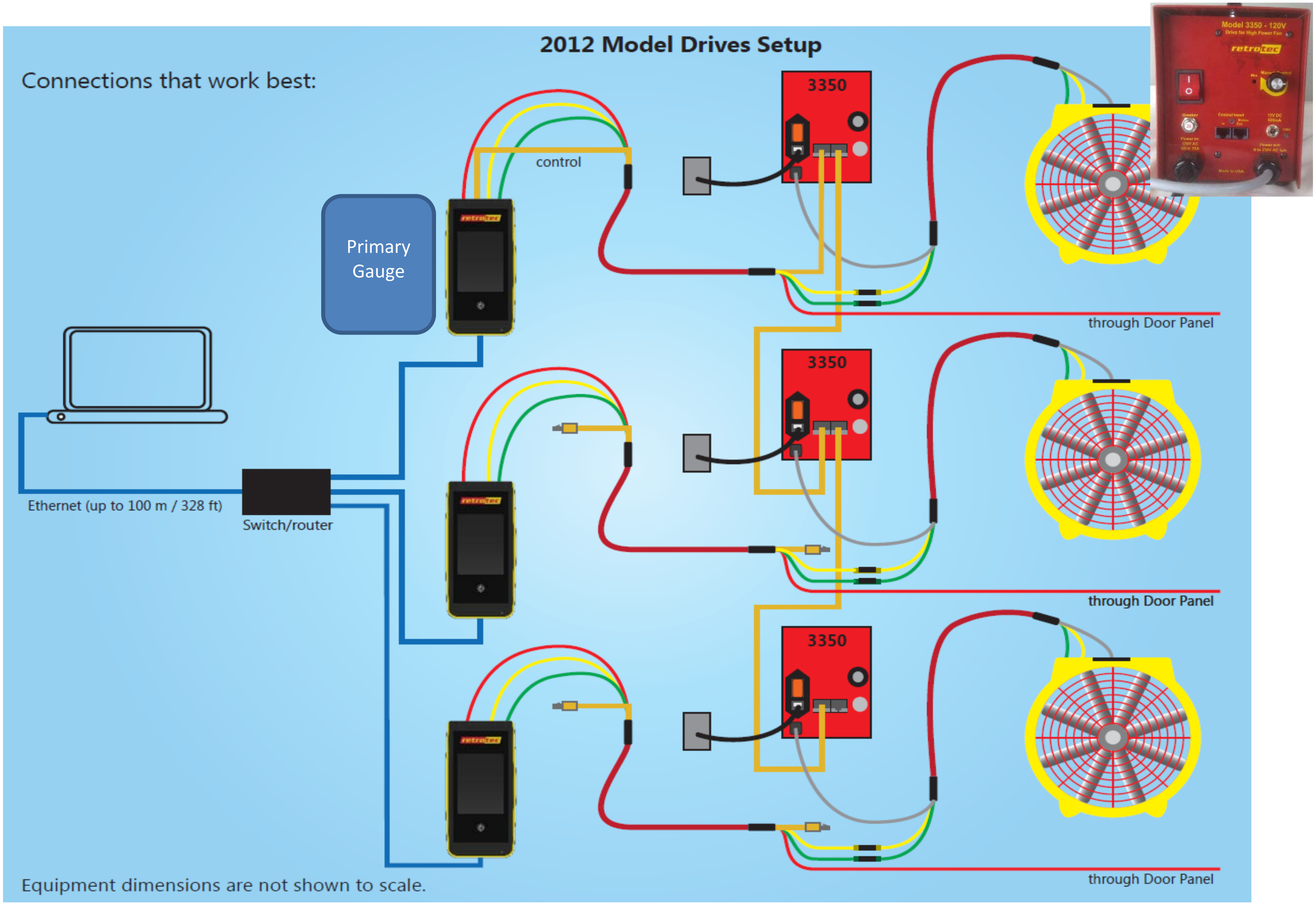


Figure 29. Connections for **Common set point control**, 3350 fan drives (2012 and later) with DM32 gauges

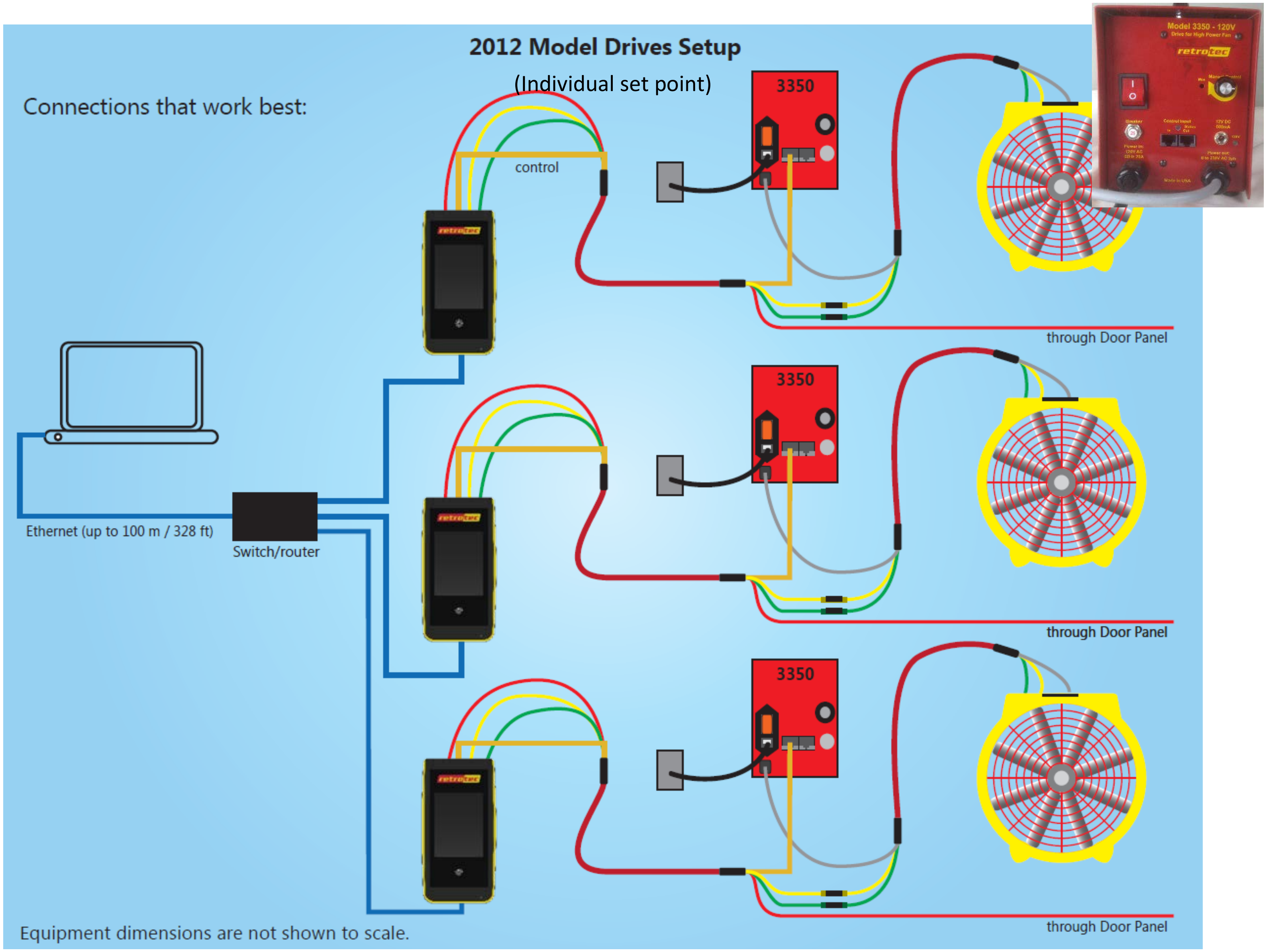


Figure 30. Connections for **Individual set point control**, 3350 fan drives (2012 and later) with DM32 gauges

8. Exterior pressure pickup locations

Various standards have different recommended locations for pressure pickups, and under specific situations. The following table lists these recommendations:

Table 2: Recommended locations for exterior pressure pickups

Exterior pressure pick-up locations from Standards	
ASTM	1 tube across the middle of each façade (NOT at corners of the building)
	Manifold and average all pressure readings using a manifold (averaged ver 10s)
	If > 3 stories, measured at more than 1 height
ATTMA	Measured at the lowest floor level of the building
	Located "some distance away" from the building envelope, out of the way of fan airflow and sheltered from wind
CGSB	Calm conditions - 1 pressure measurement outside the building is ok
	Windy - min of 4 measurements on each façade, manifold
	Gusty winds - use wind damping kit (capillary tubes, averaged over 5s)
EN13829-FR	Measure at the bottom floor level, but if tall building, measure at the top as well
	Keep exterior pressure taps out of the sun, and fitted to a T-pipe or connected to a perforated box to protect from wind
USACE	Min 1 exterior pressure tap required, but if bias pressures high, use more
	Interior pressure gauge references tied together in a manifold to read 1 pressure reading

9. Speed Control Splitter to use

Verify you have a compatible Speed Control Splitter to prevent device failures.

Problem:

The Speed Control Splitter connecting multiple Retrotec fans together may cause failure of all connected Fan Tops, Drives, or any other devices via Control (Ethernet) Cable.

Product Affected:

Any device connected to a Speed Control Splitter via Control (Ethernet-style) Cable.

Cause:

A grounding issue with defective Speed Control Splitters that were manufactured with eight wires between the Ethernet connectors (inside the Speed Control Splitter box)

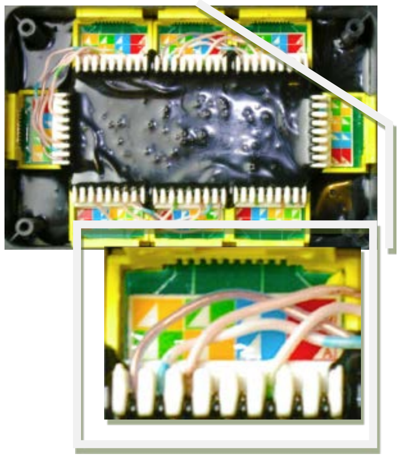
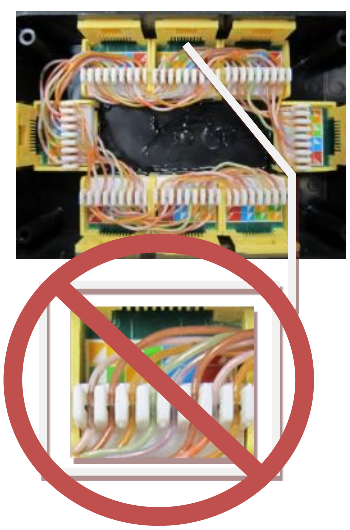
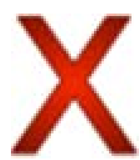
Solution:

The **FN280** Speed Control Splitter has **red** connectors, and does **not** have a problem. If you have any other Retrotec splitter, it must be opened to examine the wiring inside. If there are **eight** wires between each Ethernet connector, **DO NOT USE** this Speed Control Splitter. If there are four wires, you can continue to use the Speed Control Splitter.

Use the following chart to determine if your speed control splitter is okay to use or whether you should contact Retrotec or your reseller for a replacement.

Table 3: Speed Control Splitter Compatibility Chart

Speed Control Splitter	Compatibility
Retrotec Speed Control Splitter FN280 with red connectors. 	Okay to use without any problems. 

Speed Control Splitter	Compatibility
Retrotec Speed Control Splitter FN242/FN248 with yellow Ethernet connectors that has **four** wires.  	Okay to use without any problems. 
Retrotec Speed Control Splitter FN242/FN248 with yellow Ethernet connectors that has **eight** wires. 	DO NOT USE this Speed Control Splitter. Contact your reseller or Retrotec* to obtain a new Speed Control Splitter. 

*Contact Technical Support at support@retrotec.com or 604-732-0142 with your equipment serial numbers, to have your Speed Control Splitter replaced.

Appendix – Airtightness Requirements

Table 4: Large Building airtightness requirements based on a 4 story building, 120 x 110 x 8 ft, n=0.65

Standard	Region	Comments	Requirement	ACH50 n_{50}	CFM75 /sq ft	(m^3/hr 50)/m^2
North America						
ASHRAE 90.1	USA	Average	0.30 CFM75/sq ft	3.9	0.30	4.2
		Leaky	0.60 CFM75/sq ft	7.9	0.60	8.4
		Tight	0.10 CFM75/sq ft	1.3	0.10	1.4
LEED	USA	All 6 surfaces enclosing an apartment.	0.23 CFM50/sq ft	2.2	0.17	2.4
			1.17 (L/s 50)/m^2	3.9	0.30	4.2
USACE	USA	Large Buildings	0.25 CFM75/sq ft	3.3	0.25	3.5
		Large Buildings (proposed)	0.15 CFM75/sq ft	2.0	0.15	2.1
Washington State, Seattle Code	USA	WA Energy Code, 4 storeys or more. Positive induced pressure or both.	0.40 CFM75/sq ft	5.3	0.40	5.6
Europe						
Passivhaus	Europe		0.60 ACH50	0.60	0.050	0.64
	Austria	Naturally ventilated	3.0 ACH50	3.0	0.23	3.2
		Mechanically ventilated	1.5 ACH50	1.5	0.11	1.6
	Belgium		12 (m^3/h 50)/m^2	11	0.85	12
	Czech Republic	Common Buildings maximum	4.5 ACH50	4.5	0.34	4.8
		Low energy buildings	1.5 ACH50	1.5	0.11	1.6
		Passive houses	0.6 ACH50	0.6	0.046	0.64
		Mechanically ventilated buildings without heat recovery	1.5 ACH50	1.5	0.11	1.6
		Mechanically ventilated buildings with heat recovery	1.0 ACH50	1.0	0.076	1.1
	Denmark (current regulation)	Normal – New building	1.5 (L/s 50)/m^2	5.1	0.38	5.4
		Normal – Low energy building	1.0 (L/s 50)/m^2	3.4	0.26	3.6
		Building with high ceiling – New building	0.5 (L/s 50)/m^2	1.7	0.13	1.8
		Building with high ceiling – Low energy building	0.3 (L/s 50)/m^2	1.0	0.08	1.1
	Denmark (new regulations: 2020)	Normal – New building	0.5 (L/s 50)/m^2	1.7	0.13	1.8
		Building with high ceiling – New building	0.15 (L/s 50)/m^2	0.50	0.04	0.54
	Estonia	Small buildings, new	6.0 (m^3/h 50)/m^2	-	-	-
		Small buildings, existing	9.0 (m^3/h 50)/m^2	-	-	-
		Large buildings, new	3.0 (m^3/h 50)/m^2	-	-	-
		Large buildings, existing	6.0 (m^3/h 50)/m^2	-	-	-
	Finland	Building heat loss reference	2.0 ACH50	2.0	0.15	2.1
		Energy Performance Certificate (EPC)	4.0 ACH50	4.0	0.30	4.3
	France	Offices, hotels, educational and health care buildings	1.2 (m^3/h 4)/m^2	5.8	0.44	6.2
		Other buildings	2.5 (m^3/h 4)/m^2	12	0.92	12.9
DIN 4108-7	Germany	Naturally ventilated	3.0 (m^3/h 50)/m^2	2.8	0.21	3.0
		Mechanically ventilated	1.5 ACH50	1.5	0.11	1.6

Standard	Region	Comments		Requirement		ACH50 n_{50}	CFM75 /sq ft	$(m^3/hr\ 50)/m^2$
	Lithuania	Naturally ventilated		3.0	ACH50	3.0	0.23	3.2
		Mechanically ventilated		1.5	ACH50	1.5	0.11	1.6
	Latvia	Public and Industrial buildings		4.0	ACH50	4.0	0.30	4.3
		Ventilated Buildings		3.0	ACH50	3.0	0.23	3.2
	Norway			3.0	ACH50	3.0	0.23	3.2
	Slovenia	Naturally ventilated		3.0	ACH50	3.0	0.23	3.2
		Mechanically ventilated		2.0	ACH50	2.0	0.15	2.1
	Scotland	Current regulation		5.0	$(m^3/h\ 50)/m^2$	4.7	0.36	5.0
		New regulation		1.0	$(m^3/h\ 50)/m^2$	0.93	0.07	1.0
	Slovakia			2.0	ACH50	2.0	0.15	2.1
ATTMA TSL2	UK	Best Practice	Office – Natural Ventilation	3.0	$(m^3/h\ 50)/m^2$	2.8	0.21	3.0
			Office – Mixed Ventilation	2.5	$(m^3/h\ 50)/m^2$	2.3	0.18	2.5
			Office – AC/low energy	2.0	$(m^3/h\ 50)/m^2$	3.3	0.21	2.0
			Factories/ warehouses	2.0	$(m^3/h\ 50)/m^2$	3.3	0.21	2.0
			Supermarkets	1.0	$(m^3/h\ 50)/m^2$	0.93	0.07	1.0
			Schools	3.0	$(m^3/h\ 50)/m^2$	2.8	0.21	3.0
			Hospitals	5.0	$(m^3/h\ 50)/m^2$	4.7	0.36	5.0
			Museums / archives	1.0	$(m^3/h\ 50)/m^2$	0.93	0.07	1.0
			Cold stores	0.2	$(m^3/h\ 50)/m^2$	0.19	0.01	0.2
		Normal Practice	Office – Natural Ventilation	7.0	$(m^3/h\ 50)/m^2$	6.5	0.50	7.0
			Office – Mixed Ventilation	5.0	$(m^3/h\ 50)/m^2$	4.7	0.36	5.0
			Office – AC/low energy	5.0	$(m^3/h\ 50)/m^2$	4.7	0.36	5.0
			Factories/ warehouses	6.0	$(m^3/h\ 50)/m^2$	5.6	0.42	6.0
			Superstores	5.0	$(m^3/h\ 50)/m^2$	4.7	0.36	5.0
			Schools	9.0	$(m^3/h\ 50)/m^2$	8.4	0.64	9.0
			Hospitals	9.0	$(m^3/h\ 50)/m^2$	8.4	0.64	9.0
			Museums / archives	1.5	$(m^3/h\ 50)/m^2$	1.4	0.11	1.5
			Cold stores	0.35	$(m^3/h\ 50)/m^2$	0.33	0.03	0.35
	UK (current regulation)	New Building		10	$(m^3/h\ 50)/m^2$	11	0.55	10
		Small Building (less than 500 m^3)		15	$(m^3/h\ 50)/m^2$	16	0.82	15
		Large Building		5	$(m^3/h\ 50)/m^2$	4.7	0.36	5.0
	UK (new regulations)	With cooling requirement		3	$(m^3/h\ 50)/m^2$	2.8	0.21	3.0
		Without cooling requirement		5	$(m^3/h\ 50)/m^2$	4.7	0.36	5.0
Other regions								
Abu Dhabi Building Code (IECC)	Abu Dhabi, UAE	Commercial building test		2.0	$(L/s\ 75)/m^2$	5.2	0.39	5.5
Green Building Regulations	Dubai, UAE			10	$(m^3/h\ 50)/m^2$	9.4	0.71	10
IECC	Global			5.6	$(m^3/h\ 50)/m^2$	5.3	0.40	5.6
Energy Conservation Building Code	India			0.4	CFM75/sq ft	5.3	0.40	5.6
	Japan	Level A		7.5	ACH50	7.5	0.57	8.0

Standard	Region	Comments	Requirement		ACH50 n_{50}	CFM75 /sq ft	(m³/hr 50)/m²
		Level B	3.0	ACH50	3.0	0.23	3.2
		Level C	1.5	ACH50	1.5	0.11	1.6
QSAS	Qatar	Low	0.6	(m³/h 4)/m²	2.9	0.22	3.1
		Med	1.1	(m³/h 4)/m²	5.3	0.40	5.7
		High	2.2	(m³/h 4)/m²	11	0.81	11.4