The Curious Definition Of "Fan Static Pressure" PART-3

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In this part we are going to examine the inlet/outlet pressure relationships of AMCA Types B and D configurations.

Let us start by looking at a Type B example in Figure-6 below.

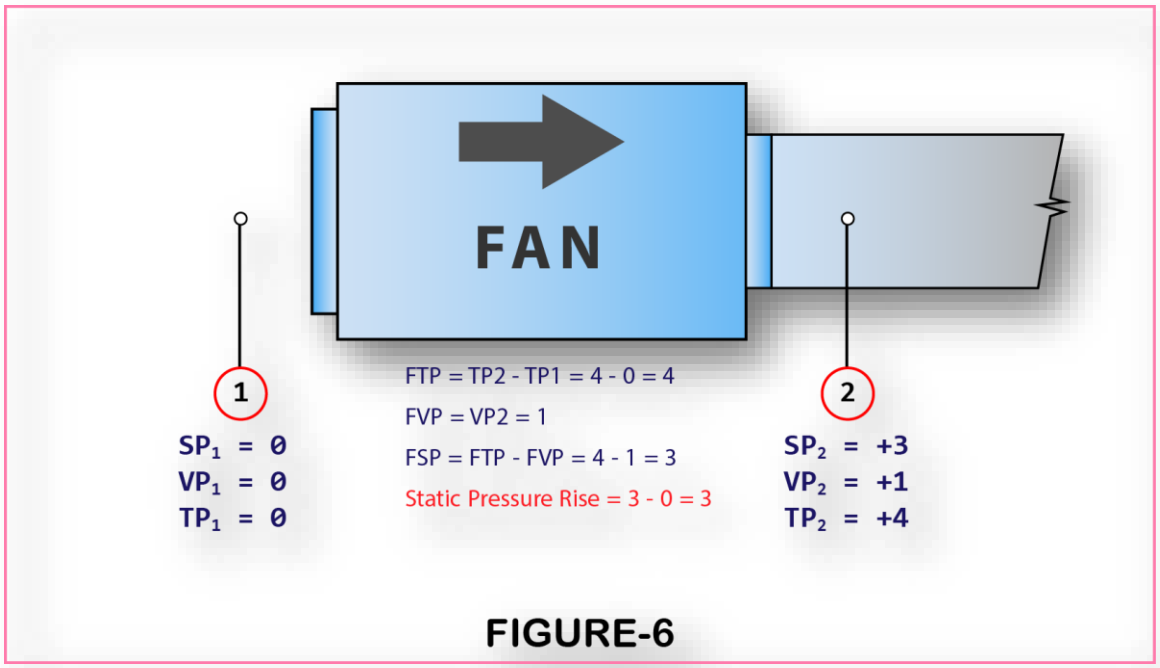

FIGURE-6

The inlet of this fan is open to the atmosphere, the outlet is ducted. You may call it a "blower" configuration. Let us apply our simple definitions of FTP and FSP and see what rules emerge in this application.

First the FTP

$FTP = TP_2 - TP_1$

But $TP_1 = 0$,

Therefore,

$$FTP = TP_2$$

Next the FSP

$FSP \equiv FTP - FVP$

From above we know that FTP = TP2 and FVP is VP2 by definition, Therefore,

$$FSP = TP_2 - VP_2$$

$$= SP_2 + VP_2 - VP_2$$

$$FSP = SP_2$$

The above analysis tells us that for the "blower" the FSP is the same as Static Pressure Rise. So this is one configuration where you can get away with not knowing the distinction between FSP and the Static Pressure Rise across the fan. Also note that the FTP is simply the Total Pressure at the fan outlet.

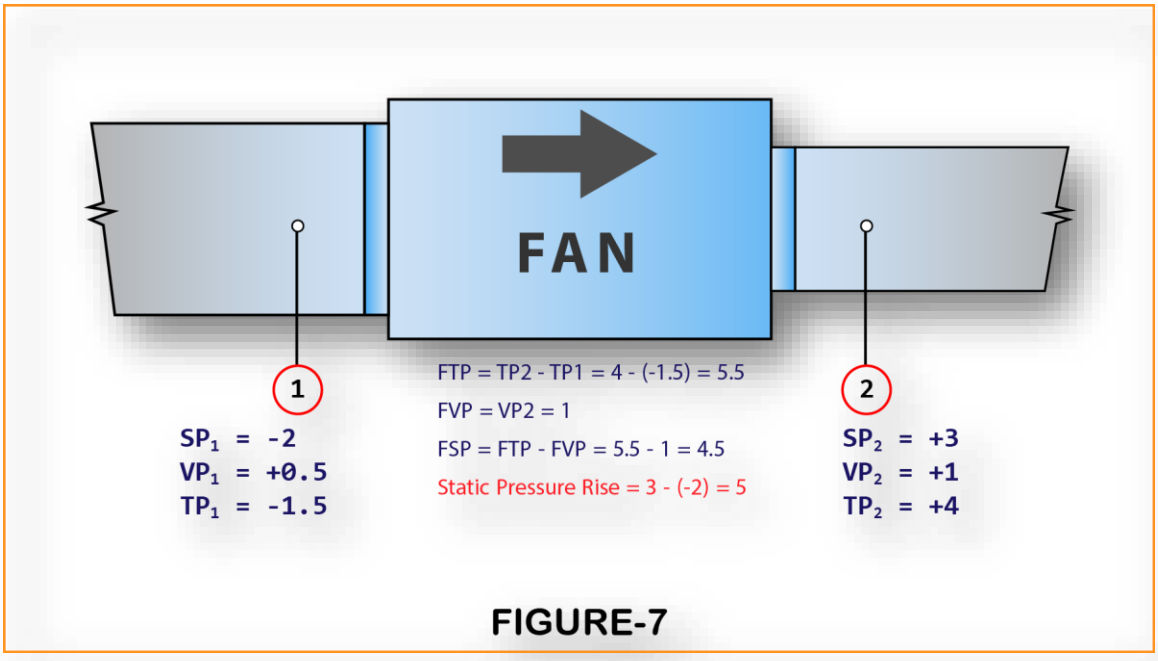

FIGURE-7

The last configuration we will look at is AMCA Type-D or "fan in the middle". Let us evaluate FTP and FSP for this type of installation.

First the FTP

$$FTP = TP_2 - TP_1$$

$$= (SP_2 + VP_2) - (SP_1 + VP1)$$

$$= (SP_2 - SP_1) + (VP_2 - VP_1)$$

Next the FSP

$$FSP \equiv FTP - FVP$$

FTP expression is given above and (FVP = VP2) by definition,

Therefore,

$$FSP = (SP_2 - SP_1) + (VP_2 - VP_1) - VP_2$$

$$= (SP_2 - SP_1) - VP_1$$

The final expressions for FTP and FSP are very interesting. Look at FTP first.

$$FTP = (SP_2 - SP_1) + (VP_2 - VP_1)$$

What this equation tells us is that, "for fan in middle", if the FAN inlet and outlet velocities are equal, FTP equals the Fan Static Pressure Rise (FSPR). (Note: Not Duct Static Pressure Rise (DSPR), unless the ducts and the fan openings are the same size.) This might be why some engineers loosely interpret the two distinct terms as equal.

For the FSP we have,

$$FSP = (SP_2 - SP_1) - VP_1$$

Here we notice that if the inlet velocity is low, say under a 1,000 FPM the FSP and the FSPR is the same. Note again that this is not necessarily DSPR unless fan and duct dimensions match.

What happens if an Engineer totals up his duct system losses (which are always Total Pressure losses) but uses a Fan Static Pressure (FSP) Table or Fan Curve? We know that,

FSP ≡ FTP – FVP

And therefore, his fan selection would be oversized by the amount of Fan Velocity Pressure. If the outlet velocity is 2,000 FPM or less then the error is a maximum of 0.25". This may not be a big deal. If you cannot distinguish between FTP and FSP, then chances are very good that you will not have paid any attention to the inlet and outlet conditions and the fan System Effect has been ignored also. So there just might be a happy ending anyway. ☺☺☺

But if you are dealing with high velocity fans, I am afraid that not knowing the difference between FTP and FSP can only have unhappy endings.☹☹☹

CONCLUSION:

If you are like me, not working for a fan manufacturer and only getting into fan selection when the project at hand requires it, you will probably forget most of these special condition equations in a very short time. And that is OK. But what you must never forget are the three key definitions highlighted at the end of Part-1 and repeated here:

1. Fan Total Pressure is defined as:
   Total Pressure at fan outlet - Total Pressure at fan inlet

2. Fan Static Pressure is defined as:
   Fan Total Pressure – Fan Velocity Pressure
   It is NOT the static pressure rise measured between the inlet duct and the outlet duct.

3. Fan Velocity Pressure is defined as:
   The Velocity Pressure at the Fan Outlet

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