



# Understand the Different Types of HVAC Ductwork with AJ Callegan

## SPEAKERS

Kendra Seymour, AJ Callegan

AC

AJ Callegan

00:00

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Kendra Seymour

00:40

Welcome to the HVAC plus D mini class series brought to you by Change the Air Foundation. This series is made possible thanks to the generosity of our sponsor, Santa Fe Dehumidifiers. We are deeply grateful for their support, which helps us continue raising awareness and providing free resources so that more families can breathe safe indoor air. A quick reminder, this 12 part mini class series offers a consumer friendly overview of common HVAC plus D topics. It is not a replacement for professional advice. You can watch the full series on our YouTube channel or by visiting [ChangeTheAirFoundation.org](http://ChangeTheAirFoundation.org), and clicking on our resources tab.

KS

Kendra Seymour

02:14

AJ, thank you so much for coming back and joining us for part two to talk about duck work.

AC

AJ Callegan

02:19

Happy to be here. Thanks for the invite. Kendra,

KS

Kendra Seymour

02:21

Why don't you go ahead and take it away.

AC

AJ Callegan

02:24

Alright, let's get started here. So I am AJ Callegan. I run ACC Building Performance out of Covington, Louisiana, which is north of New Orleans. I am a Building Science Practitioner that specializes in healthy high performance construction with a specific main focus on envelope and mechanical control. I specialize in the whole house as a system. I take the whole house as an approach. Everything I share here is going to be my professional and personal opinion expressed from my views and my specific area is where I have the most experience, obviously. So, What the duct! Duct work is a system of tubes that moves air throughout a building or heating, ventilation, air conditioning and dehumidification. The duct work is integrated into the HVAC plus D system and building. We have to stress that, the building. For proper functionality, that ductwork must be designed with the system and building in mind. Ductwork cannot exist without the rest of the system. They work together hand in hand. I'm going to drill system, and I'm going to drill the building and the house as a part of that system. Let's talk about the HVAC basics real quick. We'll just run through this. Heating is the process of adding heat. Ventilation is the process of exchanging indoor air with fresh outdoor air. Air conditioning is the process of removing heat from that air. Dehumidification is the process of removing latent heat or moisture from the air. So that is HVAC plus D. So duct work. Duct work is a system of tubes that moves air throughout a building for heating, ventilation, air conditioning and dehumidification. The duct work is integrated into the HVAC plus D system for proper functionality, the ductwork must be designed with the system and building in mind. Ductwork cannot exist without the rest of the system. They work hand in hand. So once again, let's go over the system. We have to stress the system here. Stop thinking in boxes. The system includes much more than just the indoor unit, outdoor unit and ductwork. These things are very complex. They get designed. There's a million different configurations. They come in hundreds, 1000s of pieces and parts. They have to be sourced, they have to be installed, they have to be commissioned, and they have to be maintained. And remember this. I stress this all the time. I do not need to do a design. I do not need to use best practices. I don't need to follow code. I don't even have to follow manufacturers directions to make these things work. It is critical that you follow the steps and you do it, you design it, you you install it, you execute it to a very, very high level. There's a lot at stake here. Trust me when I tell you, once again, there's no such thing as apples to apples in this industry. The system's made up of all these different parts, and duct work is only one of those parts. So there's a couple of different types of duct work. Flexible duct is the most common duct, and it's the easiest and least, least expensive to install. It has a wire helix. It kind of looks like a slinky when you look on the inside of it. It's very rough plastic liner. Given its roughness and flexibility, it is tough to clean effectively. I would argue it's impossible to clean effectively. So second is going to be hard duct. This is my preferred method. It's a rigid it's insulated on the outside, leaving a smooth bare metal, bare metal on the inside of the airstream. Given the smooth metal surface, it would be the easiest and most effective choice for cleaning. We should not have to clean the system. We should not get contaminants in it to begin with. If we have contamination in our system, that's a deficiency. We need to figure out what's causing that deficiency. So third is going to be fiberglass duct board. This is somewhat rigid. It is dense. It is foil faced. It comes in sheets and typically fabricated on site. This is another kind of entry level, builder grade type

material that I don't use personally. I don't like it. It's very flimsy. It has a short life expectancy. It's very susceptible to damage. Clients have a tendency to pile stuff on top of it and it collapses. And once it starts to degrade, it releases all these fibers into the air. So square metal duct is a rigid metal typically insulated on the inside with a fiberglass duct liner. It's similar to duct board. The fiberglass liner is extremely porous. Once it gets contaminated with microbial growth or anything, in my argument, it can't be cleaned. It's less common, and I personally don't wrap it on the outside unless I'm in a controlled environment, like an encapsulated attic or inside of the living space.

KS

Kendra Seymour

07:33

So So AJ, looking at these. These are different choices, and if you've moved into a home, you may, one have no idea what kind of duct work you have. Or, two it's not in your control, right? So unless you were retrofitting, so removing old ductwork and putting in new ductwork or building you kind of have what you have. So I'm curious, you mentioned life expectancy. How long should each of these different types last? Roughly, because I don't know if that's something people even realize that you need to factor that in long term as like a replacement cost. So can you speak to that a little bit?

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AJ Callegan

08:10

Yeah, I mean, there's a lot that goes into life expectancy. Um, obviously the harshness of the environment. If we live in Southeast Louisiana, specifically where I am, the addicts get to be 150, 160 degrees. They're exposed to rodents, degradation, I mean, just heat, moisture kills these things. And really, when you put them in that harsh of an environment, I mean, it doesn't matter which one you use, the life expectancy is going to be cut back dramatically. And once again, once they get degraded, they get full of moisture and microbial growth. I mean, it's pretty much over. Depending on the quality of execution as well. If, for instance, we do an install and we use all hard pipe wrapped on the outside, nice, neat, professional, it's not installed in a very harsh attic. That's a lifetime. It'll last the life of the house. You take that same system that's done properly, it's installed, it's executed into a very, very high level, and you put it into a harsh environment, like a vented attic, that it's going to be exposed to moisture and high heat, yeah, it's not going to last as long. It's going to have microbial growth, it's going to have condensation, so forth and so on. And then, once again, it's subjective to the homeowners as well. You put it in a place where the homeowners are going to stack a bunch of stuff on top of it, you know, yeah, we use me personally. We use all metal pipe. You could stack as much stuff as you want on top of it. You're going to tear the insulation and whatnot up on it, but it's not going to collapse. You're more builder grade type stuff, the flex duct, the duct board. I mean, once again, it's subjective. I've seen duct board probably 15 years. It's pretty much done. It's falling apart. I mean, it's so brittle, it's unbelievable. It will boggle your mind. The. Then flex duct. I mean it once again. It's subjective. If it's all done properly, you should get a good amount of time out of it, but it does have a life expectancy to it. You know, when we talk about design, design, design and quality of execution, typically, when I get called out to a house, everything is done wrong. There's nothing that I can reuse. I've been in houses that are literally a year old, and I go out the ductwork sized improperly. It's not run properly. The line sets not done properly, and on and on and on. There's nothing I can reuse there, because nothing was done right from the beginning.

KS

Kendra Seymour

10:38

Yeah, no. And I think it's one of those things that I think is worth talking about, because, you know, you mentioned several important things that if it has some sort of microbial growth which is different than settled spores, then that is a systemic issue you need to get to the bottom of. And the fiberglass duct board, and the square metal duct board with that insulation like that needs to be replaced. I've seen people attempt to clean that with like negative pressure, and then they're getting like fiberglass in the air. And that is a whole nother thing. So it's a big red flag. And then, you know, the reason I brought it up is I've seen pictures with homes, you know, over time, as as the systems are neglected and the flex duct has detached, and it's torn and ripped, and you know that obviously will need to be replaced sooner rather than later. So it sounds like the hard duck pipe. There's a reason you choose to use that is it's easier to clean. It has a longer life expectancy. But is there a trade off? Is it more expensive? Is that why it's not used quite as much as the other three.

AC

AJ Callegan

11:43

It's more expensive because it's more labor intensive. Um, hard pipe comes in five foot sections. You have to clean them, you have to tape them, you have to air seal them, you have to wrap them out in the field. You have to have specialty tools. You have to be a craftsman to install this stuff effectively. You know, where, like flex duct. I mean, you could just go in there a homeowner can do it and it work. You know, where hard pipe you're going to be hard pressed to do that with, with the effectiveness that you need to to being a rookie or homeowner, you know.

KS

Kendra Seymour

12:19

Yeah, yeah. As my dad said, Let's do it once and do it right. So sometimes it's worth spending a little bit more more money upfront to get a product that's going to perform better and last longer.

AC

AJ Callegan

12:30

Let me throw this out there too, just because, and I see this a lot, just because you have a all hard duct system, doesn't mean it's right. Was it designed? Is it sized properly? Is it run on a super high static pressure? Do we have the airflow through it? Is it delivering the air where it needs to be? So you might walk up to a system that's all hard pipe done beautifully, but if it's not doing what it's supposed to do, once again, I can't I can't do anything with it.

KS

Kendra Seymour

12:58

Yeah, I'll give a little plug too for Episode 5A and 5B with Alex Meany. 5B specifically, we talk about duct work and all those things that AJ said. So if after this episode, you want to jump ahead, we do dig into that

a little bit more. And how do you know if the rest of the system's set up right? Well, that was helpful. AJ, sorry, I didn't mean to stop your throw. Go ahead and continue.

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AJ Callegan

13:20

So speaking of Alex Meany, he is the genius when it comes to ACCA Manuals. Once again, these systems are complex. They have to be engineered. They have to be designed. We have to follow the ACCA guidelines. And this is the four basic ones for residential construction. So we have, let's just go through them real quick. ACCA, Manual J is going to calculate the BTU heat loss and heat gain in the house. And I'm not going to dig too much into this. I'm sure Alex covers this quite well. ACCA Manual S is going to calculate the system capacity to make sure it can handle the home, the home's heat load and heat gain. Manual D, this is going to be the duct design airflow mitigation. This is what we're focusing on with duct and then ACCA Manual T is going to be register, size, position and selection. I complete transparency. I don't get into Manual T all that often, except under certain circumstances. And as far as I know, ACCA Manual T is not required per code up to the 2021 IRC and ICC. I'm not familiar with the 2024 yet, so it may be required in the 2024 I don't know yet.

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Kendra Seymour

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So again, another plug for people, 5A, 5b we get into that. And those are terms you want to know and why those are important. So definitely hang on and watch 5A, 5b because Alex does a great job making that consumer friendly.

AC

AJ Callegan

14:44

So this is just some design reports from my personal projects, ACCA Manual D specifically, that's a big, long, drawn out calculation that you have to do that it gets very, very technical, which I'm not going to go into. This is just a basic foundation to show you, as the homeowner, hey, mister HVAC contractor, what are you doing to ensure my duct work is sized properly? How are you sizing this duct to feed air to this particular bedroom? And if he just says, well, a seven inch is going to blow 100 cfm, while a red flag, no, it doesn't. There's a calculation that goes goes into it you have to do the engineering on it. So when you once we get everything designed, we get an installed duct leakage is a critical step. This is one of the biggest detriments that that cause major, major deficiencies, not specifically on the AC side of the the equation, it wreaks havoc on the house itself. And people don't realize this, but it really does. So, duct tightness is critical to the performance of the system and the home and I stress home there. Get the airflow where it needs to go. We don't want to lose air that we pay to condition and pull air from the attic or interstitial space or crawl space. I tell all my clients, if it's in the crawl space, it's in the house. If it's in the attic, it's in the house. If it's in the interstitial space, it's in the house, and duct leakage is what gets it there. The tighter, the better. You cannot have a system that's too tight. Minimum code in these areas is pitiful. You do not want to shoot for minimum code. It is leaky as hell, and you are going to suffer the consequences because of it. So don't think, oh, it met code I'm good, wrong? I tell builders all the time. I tell AC guys, if you hit minimum code, shame on you. You could have done better, in my opinion. Leaky supply side

ductwork. So that's going to be the supply side. That's the positive side of the system, that's going to bleed air to the environment that it's in. So this is going to lead to a cascade effect. Mainly, my biggest issue is going to be pressure driven infiltration in the home. I'm not going to get too deep into that one, um, leaky return side. This is the negative side. This is going to be filter bypass. This, you're going to be pulling unconditioned air from the attic crawlspace, wherever the system sitting. This is going to go directly into the unit unfiltered. This is going to cause microbial growth, contamination, pretty quickly. So once again, we always wonder, why do we have this major microbial growth issue in our AC systems? This is why? Because we're pulling unconditioned, unfiltered air directly into our unit where it's cold, dark and wet. You tell me what's going to happen?

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Kendra Seymour

17:37

Yeah. AJ, so quick question then for you. So duct leakage testing is a separate service that a homeowner would pay for, right? It's not part of your standard HVAC, you know, maintenance that you maybe have twice a year. So when would you encourage a homeowner to do duct leakage testing? When? When might that pop on their radar as something they need to invest in?

AC

AJ Callegan

17:59

It depends on the situation. If you're having an issue with an existing system, do it whenever you get the guys out there, hey, let's check and see where we're at. I personally, and I get a lot of people call me down on this. If I walk up to a system and I see nothing's air sealed. Why would I want to charge my client to do a test to tell them the system's not air seal? You know what I mean? That's just an added expense, in my opinion, that the resource can go towards actually fixing the problem. But I understand test in, test out and all that. When you're new construction, it has to be done per code. So it has to be done before commissioning basically, or if you have a system replaced once again before we commission this system, before we start this blower and actually start moving air through the system, let's do a duct test and see where we are. Let's find any deficiencies before we start pulling air in that is unconditioned, unfiltered.

KS

Kendra Seymour

18:57

So let me ask you this, and if I'm jumping the gun, please just tell me. If you find that in your home, you do this testing. And hey, leaky ducks are definitely an issue here, and I'm leaking cold, conditioned air or heat into these interstitial spaces, so those places between the walls. Is there a solution? Do I have to replace all my ductwork? What does that look like?

AC

AJ Callegan

19:21

It depends on the situation, again, its situation specific. As we know, a lot of us have very complex houses. We might have three, four story houses with duct work that runs through all of these interstitial spaces and fur downs that you can't access. So there is a service, Aeroseal. I don't use it. I don't recommend it, but I

guess in a certain situation, it might be beneficial where they aerosolize a caulk type material into the system, they put the system into positive pressure, and this caulk will solidify in all the cracks, if you will, and seal it from the inside. My issue with that is, once again, quality of execution. To find a contractor that's competent enough to do it, executed in a manner that's going to be beneficial. It's super expensive. And then we're adding this extra material, chemical to our airstream, so you have to weigh the pros and cons there, you know what I mean, or the only other option you're going to have to get in there and air seal this duct work is to start pulling drywall down, pull ceilings down, pull fur downs and that sort of stuff, which is going to get super, super invasive. It's going to get super expensive, quick. So you have to, you have to weigh the pros and cons there. Um, it's, it's easy. It's so much easier to do this during construction. It really is, do your due diligence, educate yourself and get this stuff done before drywall. I mean, it is crazy to go into a house that three stories and say, oh my gosh, you you're leaking half of what you're supposed to be. You know what I mean. You're leaking half the air into the interstitial space because nobody here sealed anything. Now we have to go in and deal with this after the fact. It's good to catch it before the drywall goes in, or, better yet, hire a contractor that does it regardless. So you don't even have to, you don't have to question it. Okay? So test and balance. We need to make sure that the duct work is actually delivering the air where it needs to go. So Manual J is going to tell me, this particular neat room needs X amount of BTUs. We need to deliver 150 cubic feet of air per minute. We have a 200, we have a eight inch duct. We need to confirm with the flow hood that this duct is actually delivering the airflow needed to that room.

AC

AJ Callegan

21:51

So do looks really matter? I stress this a lot, especially to homeowners. Like you, as a homeowner, really don't know what you're looking at. However, when you walk up to something, you can see a pile of crap, when you see a pile of crap. You know what I mean? These are some really good examples of like, if I hire a contractor to come in and do a job and he leaves his garbage in my attic, you can make a pretty good assumption that everything you can see is not done properly or very well, either. Is the ductwork sized properly when we were specifically focusing on duct here, if my job, my system, looks like this, when the guys are done like I can make a pretty good accurate assumption that this stuff is not it's not designed properly. It's not flowing. Nothing was done properly here. It's likely that the cheapest bidder got the job. So keep that in mind, you have a lot. You have a huge role to play here, and it's kind of a catch 22 because don't go with the cheapest bidder. However, a lot of these bigger companies, they'll be the most expensive, and you'll get a cheap job out of them. So you have to be really careful. Okay, so let's just take a quick look at a couple of jobs here. Looks can tell us a lot. If a system looks sloppy, trash, left behind on site, flex, duct just thrown about, spaghetti explosion, nothing strapped and on and on and on. Once again, what does that tell me about everything I cannot see. I can reasonably assume that the system was not properly designed. There was no Manual J, S and D. They didn't flow nitrogen law braids and any of that good stuff. They they basically, like I said, I don't have to read the instructions. I don't have to do this stuff properly to get it to work, to get it to function. So quality of execution when you look at something, it tells you a lot about it.

KS

Kendra Seymour

23:40

So the one on the right looks a lot more together. Am I correct in that?

AC

AJ Callegan

23:43

Yeah, that's basically a before and after of a job that I did couple of years back. So don't forget, what's the biggest duct in the house? The home is part of the system, and it must be considered when addressing HVAC plus D. They must work hand in hand to promote healthy indoor air quality. If your HVAC contractor never talks about the home itself, it may be time for for a new HVAC plus d service provider. The house is the biggest system, biggest duct in that system. It's the biggest part the house has more of an effect on that system than anything else. And it blows my mind. And I mean, I was there too. We never looked at the house. We focused on the system, the AC box, and that was it. And the house plays a huge, huge role in there. Here's some examples of bad installs and the impact it has inside of the ductwork. The duct work is critical to the health of the home. It must be executed to a very high level to be effective and not cause deficiencies in the home or promote sickness and disease. So once again, this is all practical, really real world. This is actual jobs that I've been on, that I see. And I still see day in and day out because of poor, poorly executed systems. No design, very poorly installed, duct leakage, we're pulling hot, humid, unconditioned air directly into these systems. And who suffers the consequences because of this? We do. It's sad, but this is, this is the reality of the matter. And once again, I see this day in and day out, and it's, it's sickening. It really is.

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Kendra Seymour

25:29

So AJ, can I call out? I know you can't stop the the movie, but there was what looked to be a UV light in a system surrounded by microbial growth.

AC

AJ Callegan

25:42

So, yeah, ultraviolet, all these what we call pseudo air purifiers. As you can see, I'm not going to mention the name of this particular one, but it is a very popular one. The AC guys absolutely love them. They sell the hell out of them because they make a quick 1000 bucks in about five minutes. My cost on this thing's about \$300, \$400 and the AC guys, they'll sell them for 1500 all day long. And you tell me, you can see it's lit up right now. It's actually functioning. You tell me, how effective is this? You know, it's absolutely laughable. We go back to our four basic principles of indoor air quality, source control, moisture control, filtration and ventilation. Notice, I didn't say anything about photo catalytic oxidation. I didn't say anything about bipolar ionization. I didn't say anything about ultraviolet lights. I didn't say anything about needle point filtration. It's simple. KISS, keep it super simple, guys. So Ultra violate. All these things wreak havoc on indoor air quality, in my opinion, you're just adding another level of complexity that doesn't need to be there, and the potential byproducts are not worth the risk, in my opinion. Alright, so ask me how many systems I've opened up in 25 years that has no level of microbial growth, with the exception of a new unit.



Every single one, especially in our area, we live in a very hostile environment, every single one of them has some level of microbial growth in it, and I did an assessment probably three or four months ago on a brand new house. He was in there maybe three months and the homeowner said, there's no way we have microbial growth in there. And I found one little spot of microbial growth on a wire that was already starting to flourish. So imagine what that unit's going to look like year two, year four, year five, year 10, it's going to look like this pretty quickly.

KS

Kendra Seymour

27:48

So without taking us down the rabbit hole, how do we prevent microbial growth in our system? Just give us a high level messaging.

AC

AJ Callegan

27:55

So design it properly. Installation, quality of execution. My gosh, I cannot stress this enough. Filtration, do not, you have to have effective filtration stop the junk from getting in there to begin with. Okay, an effective filtration is not a one inch filter in the grill. It is a it is a media filter designed for the system as close to the system as possible, and it has to be tight with no bypass all the filter going through that system. I want to go through that filter.

KS

Kendra Seymour

28:30

So I'm going to, I'm going to give a shout out here real quick to John Ellis, because we have a whole episode coming up just on filtration that you can check out because John breaks down the different types of filtration, how they work. Because, you know, AJ, you mentioned this, you can't just stick a MERV 16 in your unit if your unit isn't designed to handle that. John will talk about why that is, and pressure drop and and what you can do. So definitely check that one out, that filtration one. Great information. It's a fantastic episode, even if you're not talking about HVACs and you just want to learn about filtration. Really applicable information there for everyone.

AC

AJ Callegan

29:08

But yeah, we can design a system to handle we're 16, no problem. But it has to be designed, like we said. So quality of execution, you have to have effective filtration and maintenance. You have to maintain these things. They're mechanical. You have to open them up. It's a cold, dark, wet environment. If you never open this thing up, I would argue, even with MERV 16 filtration, you're letting some kind of organic material get through there, and it's going to hit a wet coil. It's going to get some sort of growth on it the thing, let's catch it and clean it. Use a probiotic cleaner on it to where it eats the pathogen, and you try to prevent it as much as possible. Do your due diligence. This, this sort of stuff that we see in day and day in and day out, is just a lack of design, very poor execution, no filtration, no man. Maintenance, and this is what you

get. And the AC contractors say, well, we're going to throw a UV light on there, and it's going to it's going to promote good and indoor air quality. It's laughable. It really is. And this is what you end up with.

KS

Kendra Seymour

30:13

And I know we're wrapping up, but I do want to give one additional plug there. We have a great article on our website that's written by Becky Callegan, who happens to be AJ wife. And it's a fantastic read on what your HVAC maintenance should look like, tons of pictures, tons of tips on how to find the right company. That is a must download save for anyone who lives indoors, whether you rent or own your home.

AC

AJ Callegan

30:41

So that pretty much wraps me up. That is my very, very, very basic overview of ductwork. Duct work is critical. It gets extremely deep. I mean, we could talk all day long just on ductwork. And I'm gonna throw this in there as a survivor of microbial growth toxicity myself. I understand the critical importance of these principles, probably more than anyone you will ever speak to. It is extremely important. I've lived it. I know, I suffer the the negative implications of it, and like I am very passionate about it, and I get P0d every single day. When I see the incompetence in this industry and the effects that it has on my clients, it is unbelievable. Any questions for me?

KS

Kendra Seymour

31:31

No, sir, I think you did a fantastic job. And I want to say, I know I said my last plug was my last plug, but for everyone listening, if you haven't heard AJ story, wow, we actually produced a five minute piece on what happened to him. And you can head on over to [ChangeTheAirFoundation.org](http://ChangeTheAirFoundation.org), and you can click on our stories tab. It's called AJ's story. And AJ went from having really life altering, debilitating seizures and was being told he needed brain surgery to getting to the root cause, which was exposure to mold both at home and on the job. So when he says he understands this firsthand, folks, he does. Thank you, AJ, for your passion and for being here and

AC

AJ Callegan

32:16

My pleasure

KS

Kendra Seymour

32:17

For everyone listening. Do me a favor if you have found this helpful, hit that like and follow button. You can also head on over to [ChangeTheAirFoundation.org](http://ChangeTheAirFoundation.org), and check out our resource tab. In there, you'll see our mini classes. And while you're there, do me a favor. Sign up for our newsletter, because it really is the

best way to get great information like this directly to your inbox. Thanks so much. I hope to see you for part three, where we're going to be talking about the house as a system. So you'll definitely want to stay tuned for that episode. Thanks so much. We'll see you next time.