Enclosure Design of Electronics Equipment
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Lecture – 40
Off the shelf Aluminum enclosures

Hello, good day I am back. If you remember the, last lecture was all about gasketing even my some what you call little provision about the skin thickness and all that, the link has been posted. So, my suggestion is most of these are industrial practices, so whatever the industry gives us white papers or copyright with mention of their work; you should read the original and you take a stand on it because enough money has been spent on it and some of the things are specific. Now, I will take on to I am sorry; I will take you on to how to make much easier small enclosures using aluminium; what you call extrusions.

The advantage of an extrusion is that it is closed on four sides, you have a nice closed on four sides and then you need to provide an end cap on both sides that is one version of it. Another some of the other versions are to half extrusions are made with a lip, so such things are also there so you can attach those two things together and put things. Advantage being compared to die casting, it is a little cheaper and you still have a control about one dimension at least the length of it you can make it a little longer little lesser. So, you can see extrusions are available at various lengths and then the manufacturers or the enclosure packaging people try to cut it to a correct length and then assemble the end pieces.

So, I will show you two variants of it from one of the known companies; again I would like to acknowledge that it is their work. And then as a student and as a practicing engineer; better you be aware of it and again with the caution that you blindly copy those dimensions, you will go up to some point and then after that you will not get the other hardware that is required to keep it in place. Yes, it is expensive to buy those things but you can always get a quote; if you are doing it in hundreds of pieces.

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So, please look at the monitor; these are all those extruded cases. If you see here, there is something here, there is something here and then the end pieces are all attached together. But what you need to notice is, you see this beautiful you know very helpful symbol here IP65 saying it is at the protection class; that it is sealed absolutely sealed such that dust end such things will not enter the place and even if it were to fall in water temporary immersion is possible .

If you look at the one some common features about all the cells, at least in this case; you see here very nice visible fasteners are there, which are holding both the front and end panels together. And further feature is that the corners are all the reinforced in fact now I will put it here saying; aluminium case with corner guard. You would have noticed it, even within your multimeters or at home occasionally with your mobile phones; which come with a hard case. If you protect the corners, a lot of times shuttering can be prevented and overall damage can be minimized and if you are to use proper elastomers loosely which we call rubber saying, you have butiler nitrile rubber inserts; they take care of the shock a little. It is not as you full if you were to give it a shock of thirty (Refer Time: 05:22) it will be full isolated such a thing is very expensive, if not almost impossible.

Some isolation will be there so that corner damages not caused. You wanted bigger and this thing I will know start way with, you see this left side and enclosure it is; obviously,

dark and then this one is slightly better; white and then using height of it is, you have these full equipment including a front panel. I do not know, if this is just a mock up or it is a real product and you can see there is a display here and then you can see various things. This to me looks more like a model you know why, you will notice that here; there is a small typical error made by novices. Thing being, you have some input and output either it could be a socket or it could be a switch or something and sadly the labeling is below. So the moment you insert a cable or then you try to adjust and put your finger or a screwdriver or something; you will not be able to read the label.

Next time you just go around, look at all the various equipments that are there in your lab. One of the first thing you will notice is; generally people will take care of it; same way here on the right there is something here and then something else is written there and then there are beautiful graphics including an on off switch; including there is and up and down and so on like this. Magic is all this you can add to a available enclosure, so subsequently down; if I go, I will show you when I go down please look at the monitor.

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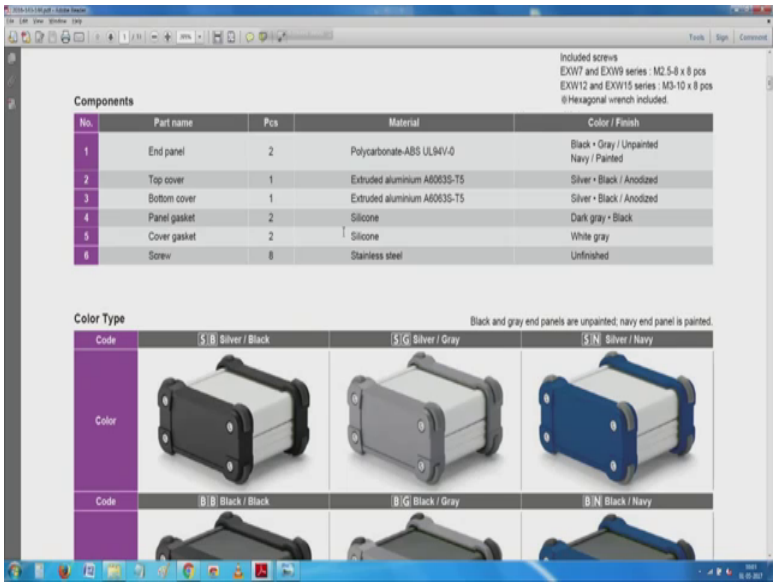

You see here some very nice description is given of all this items.

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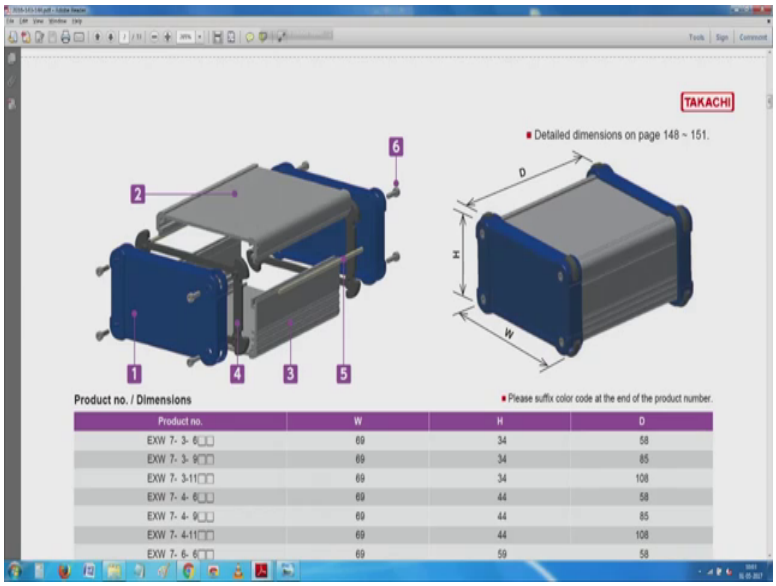

This what I wanted to show you, only a few of the very small items are probably fully extruded, but if you see this carefully; we have a bottom chancy like device here you have seen this here, I loosely call it a chancy. And then either top you have another cover and this is where the all their expertise and engineering skill and all their development and engineering inputs have gone into it. Once we close both of those things together, first thing you will notice is, it fits extremely well.

Now, if you look at the; now see here we have a two panel gaskets top and bottom covers, there is a cover gasket and then there is an end panel. Now going back to this dimension again, you see here number 5 are those gaskets; which will ensure watertight joints. Though it is an casting, I means rather it is an extrusion and it is proven to a little bit of our page and it is not as rigid as other tough materials. Provision of this gasket into this group and then the top portion overlapping into it and if you snap it in place, it becomes watertight and immiscible.

You can happily leave it under water and then other features which I would like to point out is; you see this number 4 item, it is a panel gasket something in the front and something in the back. Though there is no clamping holding item number 2 and 3 together, once you put it inside and then provide these gasket number 4 and both the sides and then put item number 1 and 2 numbers front and back panel, push together and apply sufficient tork; it becomes extremely water type.

You see here, now you will notice that this the small gaskets which are coming here; you see this, this gasket. This gasket and all they have been so carefully engineered, that this integral gasket which is used for ceiling just projects out of it and then things are perfectly fit each other, life cannot be better than this. And then you see here, even this screws which they use; they also have a proper resource here and then probably the screw hardware comes with its own set of M2.5 into 8; 8 pieces and necessary things and small hexagonal (Refer Time: 12:24) wrench is also included in it. Usually, it is my suggestion is you have a look at it and then no point in copying it. You see very important thing here is; you see the aluminium grade also is mentioned there are two numbers against it.

In an earlier lecture, I had mentioned to you about the annealing condition one is it is a 6 0 series of aluminium alloy and then T 5 is annealing grade, which makes it optimum; there is a combination of both reasonably good heat conductivity; some amount of machinability so that you can carry out operations. In case you are a; I mean an engineer who likes to make one of items. If you are to make up drawing and then pass it on to a fabricator, fabricator will know how to deal with this and then you see extreme right color in finish.

You have so many things, it would comes under color you know as the front end rear panels come with; you can have a black or grey basically if you want unpainted, that is the x material that is used for injection. Then there is a navy blue colour which has painted at; not exactly probably not exactly intended as a ship bound or navel equipment, but it is just so many thing; like you have admiralty brass and then you have olive grey schamic these are all standard things which have been associated with reliable long term equipments.

But compared to what was used in during the over time these days, the polymer mixing and then including this aluminium extrusions and all this; the technology has improved very well and then you see something about the gasket, so you have to gaskets. Panel gasket is a silicone; silicone which is dark grey or black and then the cover gasket that is the front end back gaskets come in white and grey and thing.

Most important you need to notice is if you see that aluminium extrusion comes in anodized finish. I do not know if you recollect my pointing out to you, by definition an

anodic layer is non conductive; aluminium oxide is non conductive. So, it as a small advantages one of them is accidentally you are not likely to short circuit something especially with voltage. But it is not a hard anodized thing as such there is no guarantee that you will need to; I mean, I am sorry; there is no guarantee that it will be an insulator only thing you need to think a little about is; earthing does not take place automatically. If you have to provide earthing, you need to probably mission off some small portion of the dynode declare and make some arrangement such that a earthing plug or a earthing crown washer or such things have to be attached to this.

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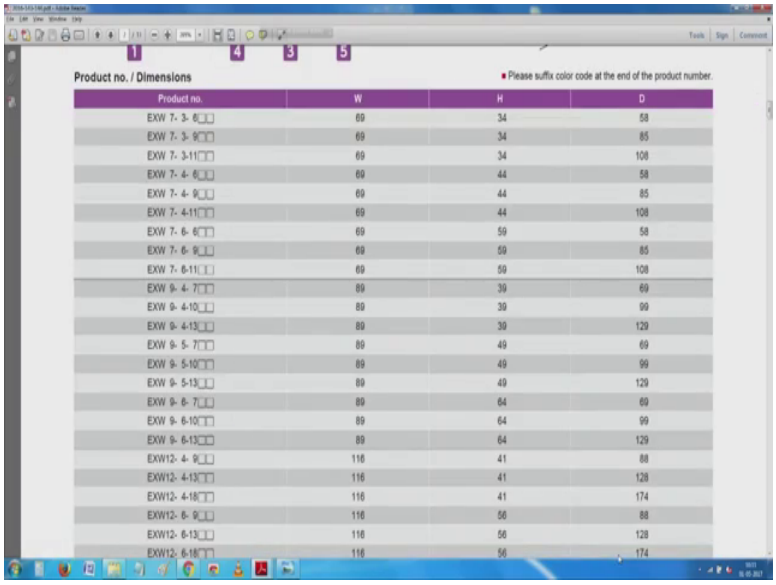

Having spent enough time, I would like to it is nothing that finishes which has given there. So, all the combinations we have shown here; if I go down further, this is the one which has been given here. So, most of the dimensions which we know are all included here this; what I had overly told you at that time, is almost like you know a generic.

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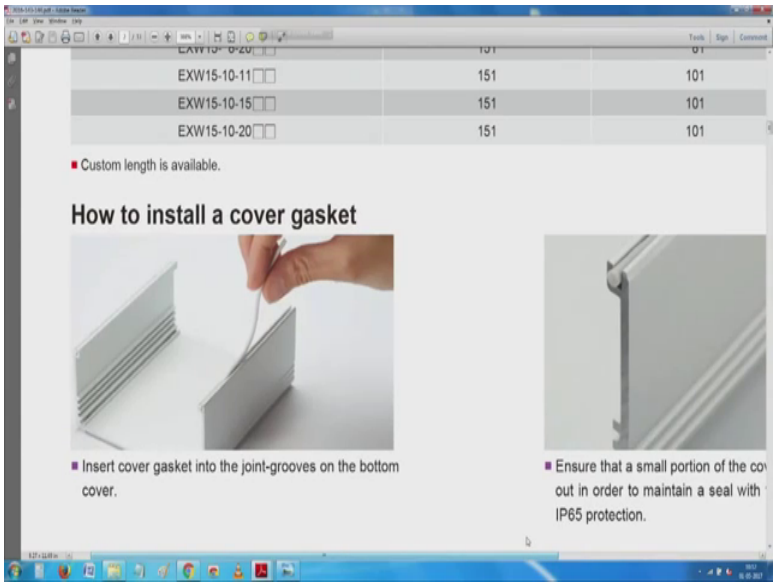

You see here a cover cascade can be installed; I forgot about this thing, what I wanted to mention which I told you earlier orally. Custom lens of the extruded panels are available, so and in fact, one of the manufacturers offers in another extender gasket on this side. So, if you have one here and one more here ok.

Let us say this is the bottom and the top is matching is a small packing which will allow you to extended by another 10 to 20 millimeters and a corresponding panel fitting with that. It is not a fire fighting or after thought, sometimes that panel on the side is probably also used for putting connectors or some other hardware including maybe; some guide so that it assembles there or for stacking purposes and all that. But remember though you can extend it like this, front panel is still a; you need to think about it.

So, combination, so then length is under our control because now you have a look at it, how to install a cover gasket it looks obvious. Insert cover gasket into the joint grooves on the bottom cover, you see here while this is simple; this is a to me it is a very very critical observation. It is not just a matter of; you know just read and forget or you know this thing. Ensure that a small portion of the cover gasket protrudes out, in order to maintain a seal with the panel gasket for 65 protection. So, we have a front panel and then the small piece has to touch there. Generally, if it all comes in the kit form; all this have been cut to length. Why this caution has been given is, it is still a compressible gasket; this compressible gasket while installing it, if you stretch it; it becomes longer.

Similarly, if you try to you know push it inside; the chances are, you will be squeezing it in without enough for protection. So, I think it is a matter of little bit I will not call it trial and error, I will still call it a good exercise.

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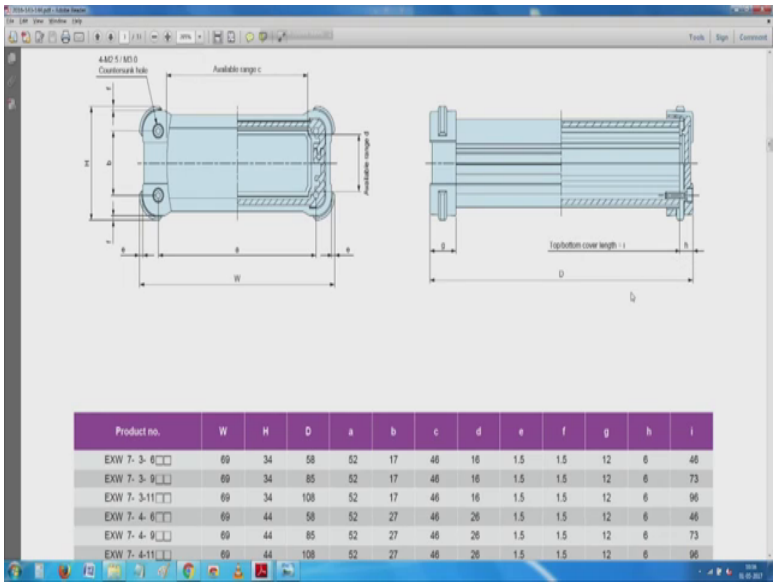

Product no.	W	H	D	a	b	c	d	e	f	g	h	i
EXW 7- 3- 6	69	34	58	52	17	46	16	1.5	1.5	12	6	46
EXW 7- 3- 9	69	34	85	52	17	46	16	1.5	1.5	12	6	73
EXW 7- 3-11	69	34	108	52	17	46	16	1.5	1.5	12	6	96
EXW 7- 4- 6	69	44	58	52	27	46	26	1.5	1.5	12	6	46
EXW 7- 4- 9	69	44	85	52	27	46	26	1.5	1.5	12	6	73
EXW 7- 4-11	69	44	108	52	27	46	26	1.5	1.5	12	6	96

Now, you see here if you see a little closer; every detail you would like to have has been included here, including how long would you like your inside elements that is including the; in case you have a printed circuit board, how long should the printed circuit board be or it is not just a question of a printed circuit board, you have so many other hardware. Occasionally, passive devices like transformers, capacitors and sometimes release and the unavoidable ubiquitous; connectors require exact space.

So, if you see here you see a little closer; nicely marked out area is there saying how much is space is available for you and then how much of it is you know can be used for populating the equipment inside; you seeing here, top bottom cover length; how much is the cover length and then how much is the space you know; very small thing; say for a height of 34 mm, a small d; I will probably it means a small height or small depth almost 18 mm is covered up in all the hardware and the cover and so on. But then it is good; this 18 mm is maintained all through, as we go down still you see here 59 to 41 and all that know; typically this is how a lot of interest has been say 45 to 64, as you go down even this is 18 mm is maintained here.

So, now you have all the necessary dimensions for you to maintain both an external footprint of your whole combined device, as well as the internally how much space is available. In general, contrary to our popular perception; you have to start with an enclosure provisionally and see how well you can package all the hardware into that. Now, it will come back to the original thing do we make the PCB or do we start with the enclosure. So; obviously, a minimum of two cycles or two iterations are needed say; so it is a good to start here to find out how much, what are the spaces that are available; then go back to your electronic breadboard which I am sure depending on your skill whether you are already confident that it will work directly from simulation mixed mode signal and analysis carried out in a package or you have physically tried out various things.

The advantage here is you have a enclosure, if you can take one which a little you know bigger than what is required; each dimension should have an extra of 10 millimeters, over all the volume you may end up with extra 20 or 25 percent more.

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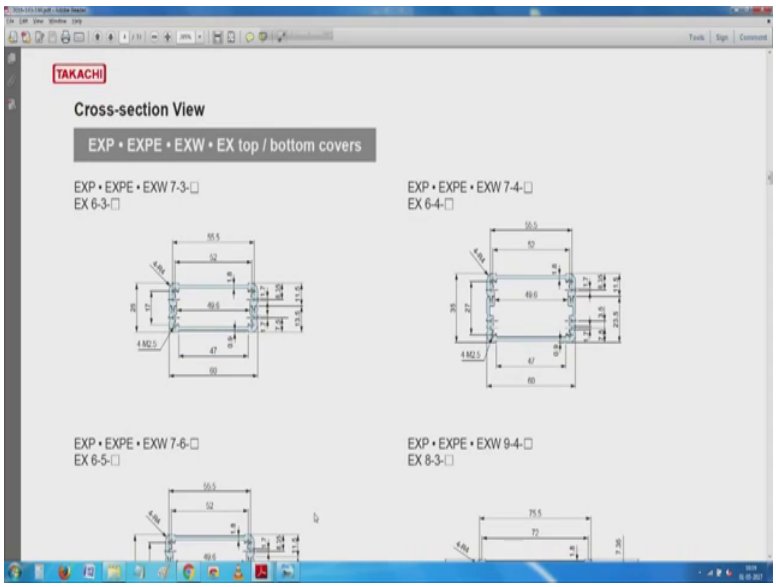

And then you can carry out almost a physical simulation how to arrange the components, once you have the physical simulation; now you can go back and have a look at all these beautiful options that you can take care of. You see here cross section view of the extrusions are given here see here, the previous table and the drawings which I have read out for you included the outside rubber feet or padding or soft things this is the actual extrusion and details inside itself.

Now, you see here 25 to 17; typically it looks like about 8 mm is the what you call build off from the lowest point here to the top most point. Now, if you have to carefully try to understand this drawing and stick within this possible around 49.6 is very; what you call tight, it is possible for you that; you see here now same thing here even this 27 to 35 about that same 8 mm is there. Similarly here also 60 to 49.6, so in this case the only difference here is slowly you see that 10 mm; a little bit of modification of the extrusion in the extruding stage, in the extrusion stage not the physically modifying it .

So, the manufacturers I expect now has spent a huge amount of effort in keeping all these things the way you want it. Say almost squarish section at the left and then further if you go down, you see here more and more interesting combinations. Any combinations in can think of is probably included here; this is why I tend to accept this as a beautiful alternative for us. You seen this, how well details are given only one small caution is; good I have come to the correct portion where I can probably continue with my evology or tirade or whatever you call it. So, far my concentration was on the total internal cross section, maybe little bit of the length.

Now, you have see how well provisions have been made such then you can mount your hardware and about mounting the hardware, one more thing is you cannot effort to mill machine the surface or go about making holes drilling or something; very unavoidable conditions like one of them as I told you was about their thing and the other thing is, you really really really have to do something operations need to be carried out on the aluminium extrusion, but generally as far as possible we avoid it. Now you have see here as small detail, a small 1.7 has been marked here. I will take you a little closer in this, you see this small line you see this as a beautiful 1.7 mm groove which runs through the length of the extrusion and then you see the pitch also.

So, that a pitch of 3.5 millimeters you have three grooves; obviously, you can put them to good use. One of the easiest is, if you have your traditional 1.6 millimeter glass epoxy or phenolic either paper or clock phenolic and so many other thing including metal clad PCBs, PWBs if you like to call they can be happily slid down the groove; good idea and then this is where I was trying to tell you also in the some conditions of, if you would like to have some continuity probably you can emory that groove; that is pass a small emory at something this is our practical experience. And then I expect that if you ask the manufacturer they probably give you massed version also. Advantage of this emorying

is, it will give you an electrical continuity including a little of grounding, but almost guaranteed continuity with the PCB.

So, looks insignificant but the reality is you have all this; seeing this here know maybe because of manufacturing tolerances it has become 1.8, so anything 1.6 plus.

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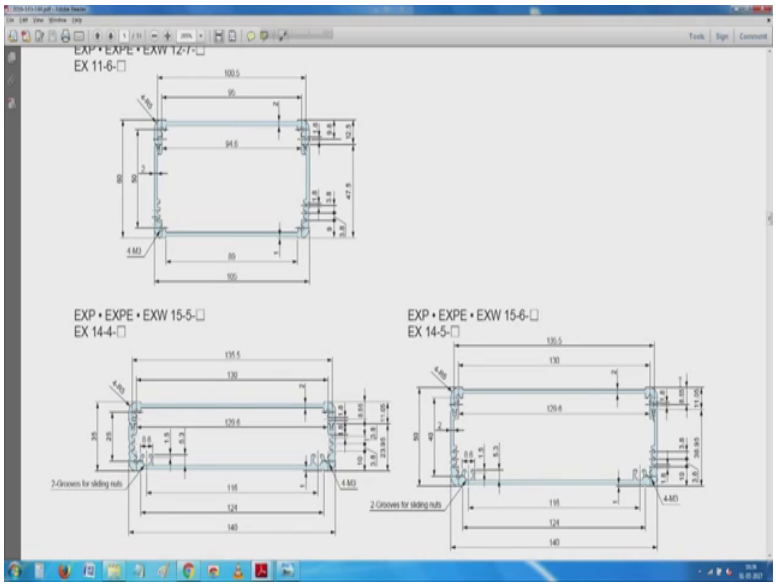

You see here as they become bigger in this box which is 90 or 80 mm gap.

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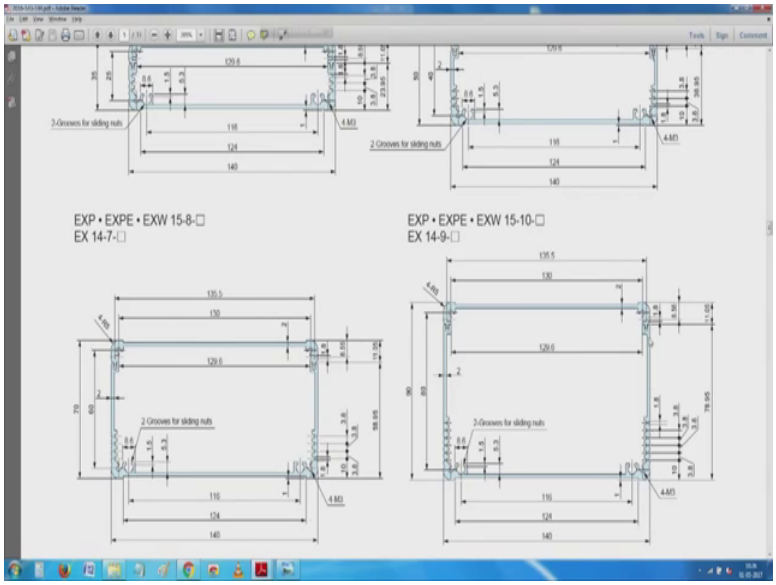

You see that wave; large number of these things are available, what do we do with this now and why a do I continue to talk about it. I continue to talk about it because we have tried to use this occasionally and then you see here that; if you were to mounts a some load bearing plate, which is also typically around 1.4 millimeters; you can mount all your heavy hardware on to that plate.

So, it is you can call it a chancy like plate and then if you properly put necessary grooves, stoppers and then maybe something to prevent them from vibrating. There is a provision very much you know, very good provision for us to mount other hardware; other than just the printed circuit boards. That is the reason they have given all these beautiful things and you see here one more, there is something called grooves for sliding nuts.

So, I will write to let I mean take it a little closer; why would we need to push things here. Obviously, if you want to mount something a little more rigidly and connected directly to the chancy which is a load bearing; recall load barring member, you have thin nuts which are just about as wide as what is required. So, you can push the nut through it and then probably assemble things directly; which is that I was talking to about that beautiful engineering which they have carried out on our behalf.

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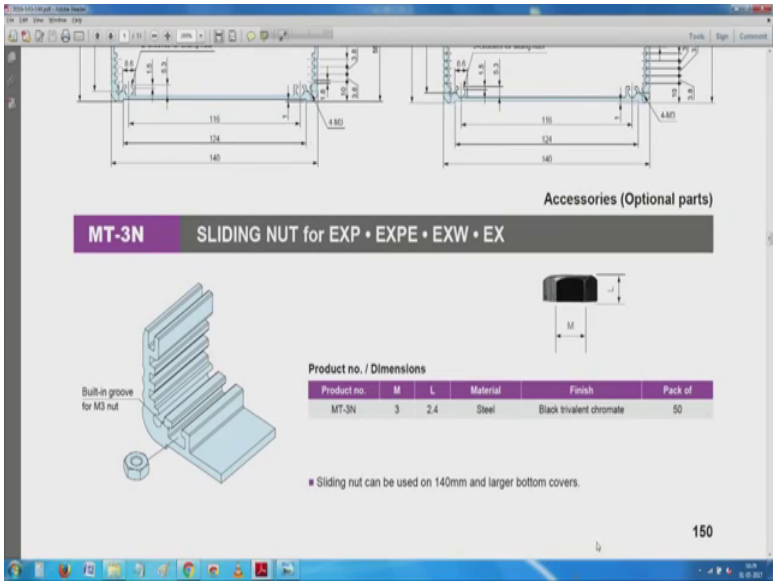

Slowly, we are coming into optional hardware which they have made it. This is where I have said their engineering or detailing skill shows through extremely well.