Noise Management & Its Control
Prof. Nachiketa Tiwari
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur

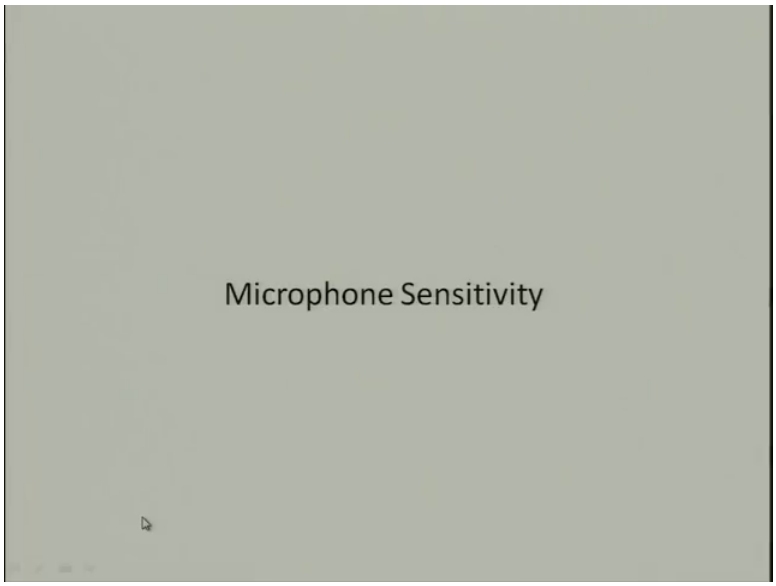
Lecture – 38
Understanding Microphone Specifications

Hello, welcome to noise control and its management. Today is the second day of the seventh week of this course and we have been discussing about what makes a microphone good from the stand point of producing good data and which help us analyze the problem more accurately and what we have discussed till so far are that there are four important parameters actually five parameters which are important in terms of figuring out whether we have a good microphone which meets our needs or not.

The first one we are discussed was linearity the second parameter we discussed was that the response spectrum or the of the microphone should be a flat one the third parameter we had discussed was that microphone should be very sensitive and we had also discussed about transient response and then the last important parameter which we have mentioned, but not discussed in somewhat detail is about directivity.

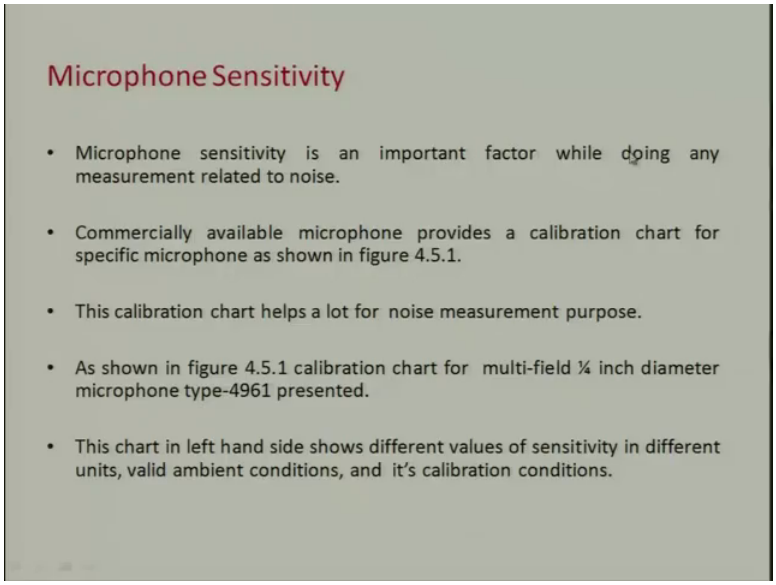
So, we will quickly recap some of these parameters and then we will talk about directivity in more detail.

(Refer Slide Time: 01:21)



So, this is the couple of slides on microphones sensitivity and how are microphones is specified in technical literature.

(Refer Slide Time: 01:31)



So, sensitivity is an important factor while doing any measurement related to noise commercial microphone provide a calibration chart.

So, we will actually see one of these charts and we will try to understand how it is represented and this chart helps a lot for noise measurement purposes. So, it is very useful and whenever we are selecting a microphone we should look at this chart carefully and see whether it meets our needs.

(Refer Slide Time: 01:57)

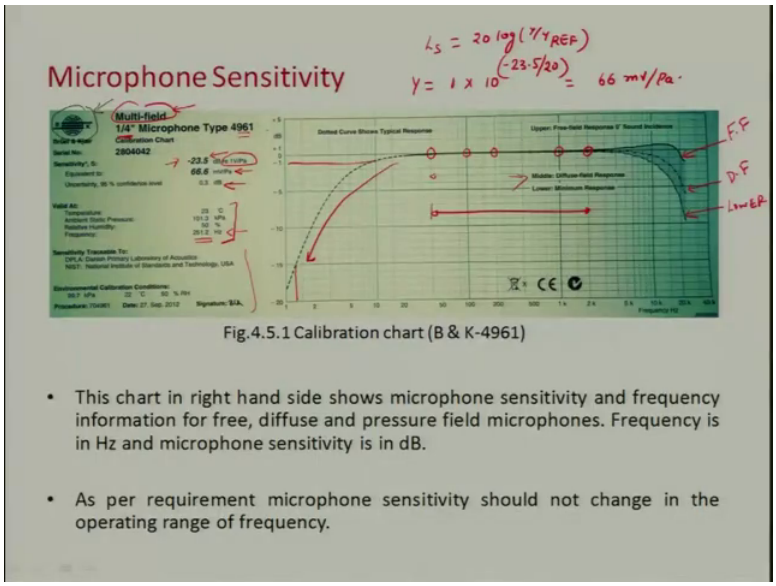


Fig.4.5.1 Calibration chart (B & K-4961)

- This chart in right hand side shows microphone sensitivity and frequency information for free, diffuse and pressure field microphones. Frequency is in Hz and microphone sensitivity is in dB.
- As per requirement microphone sensitivity should not change in the operating range of frequency.

So, this is the chart for a particular microphone this microphone is manufactured by a company called B and K.

So, this is the name of the manufacturer and it says multi field half or quarter inch microphone. So, the diameter of the microphone is one by four inch and remember we had discussed that microphones comes in 3 types pressure field microphone random incidents field microphone and free field microphones.

So, this microphone they say is multi field. So, what does that mean it means that it will work in all 3 of these fields? So, that is what it means multi field microphone and its diameter is one forth inch and why is this important we will see later and this is some number.

Then of course, there some serial number for a microphone and it says see this that its sensitivity is equal to minus 23.5 decibels and we have mentioned that one's equals whatever, but we also have to specify the value of y REF right. So, the value of y REF is mentioned here reference equals one volt per Pascal reference equals one volt per Pascal.

So, ls equals minus 23.5 decibels if we use a reference microphone such that it produces one volt per each Pascal and if you use the relation which I had explained earlier which was ls equals twenty log y by y REF and this is minus 23.5 decibels then y equals y REF which is one times 10 to the power of minus 23.5 divided by twenty

So, if you do the math it comes to 66 millivolts per Pascals. So, it says that one's equals 20 log this minus 23.5 decibels is same as saying that the microphone will generates 66.6 millivolts when it is excited by one Pascal of pressure and then of course, whenever there is an instrument it has some margin of errors.

So, the maker is saying that there is an uncertainty of 0.3 decibels which means the sensitivity could be somewhere between 23.8 and 23.2 minus 23.8 and minus 23.2 somewhere in that range and then they said that they have made all these measurements at 23 degree centigrade at that time the pressure static pressure was 1.3 kilo Pascals humidity was 50 percent and they made this calibration at by checking the microphone at 251.2 hertz.

So, they actually measured the sensitivity at 251.2 hertz, they generated a sound at 251.2 hertz and then they measured how many Pascals its producing, then they found that it produces 66 millivolts per Pascal.

So, these are the things and then of course, there are some other standards they have used and all these is there, but then they have also given a chart and it is important to look at these chart and see what it means. So, on the x axis, what they have done is they have plotted the frequency, they have plotted the frequency and on the y axis, they have put something decibels.

So, what does that mean that if this decibel is 0 for instance at hundred hertz it is 0 at 200 hertz, it is 0 at 200 at 1000 hertz, it is again 0 at 50 hertz; it is again 0. So, in this range in this range what is the sensitivity the sensitivity is minus 23.5 decibels it is flat from 50 hertz to 1000 hertz, the microphone sensitivity does not change; it remains flat and stays at how much 23.5 minus 23.5 decibels may be you can also. So, may be it goes up to 2000 hertz.

Below 50 hertz what happens to the sensitivity the sensitivity starts to drop. So, suppose I want to figure out what is the sensitivity of the microphone at 10 hertz? So, I look at this graph and at 10 hertz, this thing comes to minus 1. So, at 10 hertz the sensitivity of this microphone will be what minus 23.5 minus 1 which is minus 24.5.

Same thing here at let say 1.5 hertz, the change in sensitivity is minus 15. So, the sensitivity of the mic drops down further it becomes more insensitive and it becomes minus 23.5 minus 15 which is minus 38.5 decibels. .

So, this is; so, this is the response of the microphone and so, we had said that the response should be linear which means the response should remain constant it should be linear and it should also be flat and what we see is that the microphone has a flat frequency spectrum in this range from 50 hertz to 2000 hertz beyond 2000 hertz, it is no longer flat.

So, then we have to see what is the how does it change last thing they had said that it is a multi field microphone. So, the response of the microphone in all the 3 fields it does not change, but at higher frequencies it starts changing. So, now, they have 3 lines this is one line this is second line and this is third line and they say that the lower line which is this one this is lower.

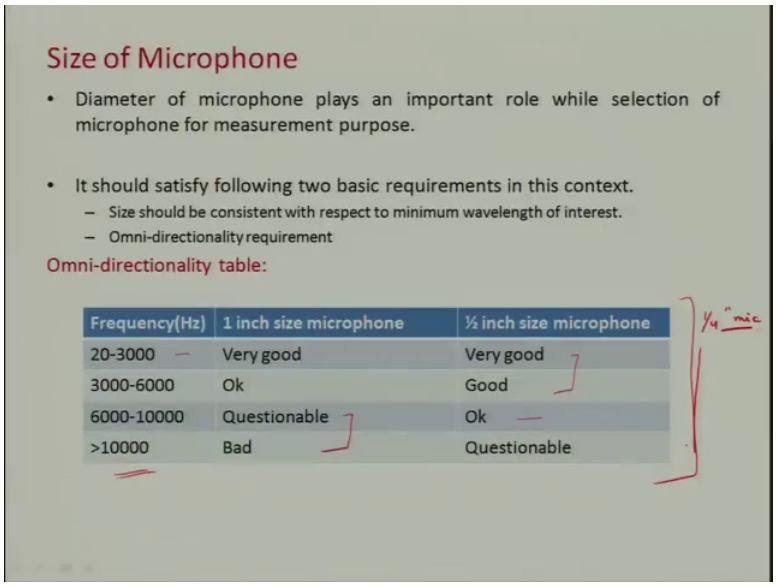
So, this is for minimum response this line is for the free field response this line is for diffuse field response because it says middle is diffused field response. So, below 2 thousand hertz we have a common line which gives the response for all the 3 fields diffuse field free field and pressure field, but for above 2000 hertz we have to see which particular line do we use.

If we are in free fields conditions then we use the upper line if we are in diffused fields then we use the middle line and so on and so forth. So, that is how we use this chart. So, it is important to understand how to use this chart because it gives us a lot of information it says lot of information.

Now, we had said that there are 5 parameters linearity frequencies response should be flat sensitivity transient response and the last thing was directivity. So, what does the directivity mean?

So, we have discussed earlier that microphones could be directional in response and what; that means, is that if you do not; if you do not choose the microphone of the right size your microphone may be sensitive to some particular direction and it may not be sensitive to other direction when does that happen.

(Refer Slide Time: 10:48)



So, this is an important slide, it says that diameter of the microphone plays an important role while selection of measurement for microphone for measurement purposes. So, microphones come they come in different sizes you can have on inch microphone a really flat mics or you can have half inch in diameter or one forth inch diameter and there are some special microphones they are even thinner, they are something like one eighth inch in diameter.

So, which size do we pick if we are interested that the microphone should be sensitive to sound from all the directions then we look at this table if we are looking for if we have a one inch microphone then it will not be it will be pretty omni directional for this frequency range 20 to 3000 hertz, but if I increase the frequency 3000 to 6000 hertz, it will start waking slightly directional.

So, in some directions, it will be more sensitive in other direction, it will not be equally sensitive if my frequency goes up further then its performance becomes really bad and beyond 10,000 hertz we should never use a one inch microphone, I will say even beyond 6000 hertz. So, what do I do? I go for a thinner microphone.

The thinner microphone half inch works pretty well up to 6000; 6 to 10 k it is kind of and beyond 10 thousand it is not good at all. So, again if I have to go up to 10 thousand then I use a one forth inch microphone and then I think I will be for the entire spectrum.

So, again depending on what frequency spectrum we think our signal will have we also have to choose the right size of the microphone because direct influence is the directional characteristics of the microphone very significantly. So, that concludes our discussion on microphones.

Starting tomorrow we will start discussing that suppose we have a problem at hand and what we are interested in suppose we are outside the room or outside in a free field environment and there is some machine which is creating noise and we want to figure out how to solve that problem then what should we do and how do we go around doing that or for that sake another problem could be that suppose you are developing a factory.

So, in a factory what do you have you have a large room and that room there could be thirty forty different machines and each machine makes some noise and you want to make sure right now there is no factory, but you are just starting to build the factory and you want to make sure that the noise levels remain manageable they do not become excessive

So, you have to do some basic calculations to figure out what kind of noise levels will be there in that room when you will have installed all these machines. So, how do you make those type of calculations. So, what we will learn in the remaining part of the week and also the next week is how do we before actually something has been made how do we estimate what kind of noise levels will be there whether we are inside the room or whether we are on the outside.

Because that is very important because once we have an idea oh that the noise level if I use these machines and this is the size of the room then it will be address location 120 decibels if I have that understanding, then I can see figure out whether I want to reduce it or I live with it or I can tolerate even higher noise.

So, this is what we planned to do in the next four lectures and also in the next week. So, with that we conclude our discussion for today and I look forward to seeing you tomorrow.

Thank you very much, bye.