Farm Machinery
Prof. V. K. Tewari
Department of Agricultural and Food Engineering
Indian Institute of Technology, Kharagpur

Lecture - 41
Testing and Certification of Spraying Equipment

Well students we discussed so far about these sprayers, we talked about the duster, we talked about the pump. We talked about the performance evolution of the different components of a sprayer. Now, as an engineer you are also responsible for the testing and certification of any spraying equipment. Somebody may ask you that I have this particular equipment you know how do you test it, you need to know certain parameters. Now, you must have heard that there are agencies, there are international standards which are followed for testing of every equipment, we had talked of earlier we had talked of testing of some other equipment.

Now, we are talking with respect to testing of a Spraying Equipment. And then certification of that as an engineer agricultural engineer or a civil engineer or an engineer who can certify this the test results of a particular equipment, which can be sold in the market which can be purchased by the consumers and can be used. There has to be some sort of uniformity in that, otherwise if they are not certified tested and certified by the right agencies I think they have no business to be in the market.

And that is why it is very essential that all equipment must be tested and certified before they are put in the market for the consumers to take. It will be better from on the part of the government or the agency to see that this is followed. And, the in that context I think this is very important aspect and session which I am taking today for Testing and Certification of Spraying Equipment.

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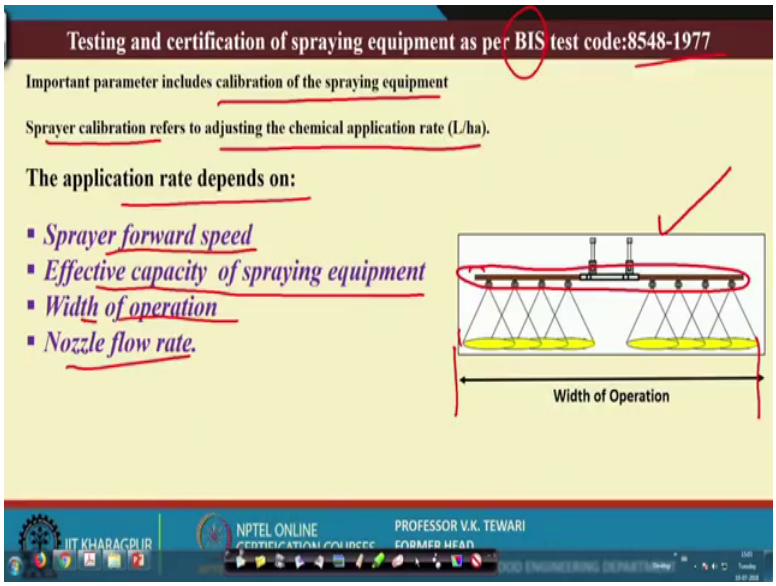

See when we talk of this what are the things that we considered in testing. See here I have given you one the diagram, this diagram over here. This diagram talks of the how these nozzles are kept on a particular boom, this is a boom here, this is one boom here. And, then how what is the location of these nozzles? What is the in a position of these nozzles? What is the spacing of these nozzles? What is the type of the nozzles? And how far the overlaps should be there?

So, that you can cover the whole area which is to be spread, this is you know and the total width of coverage is from here to there this is the width of operation which we are talking and it will cover the area which is between this. Now, then related to this only the certification because ultimately there would be a pump required which definitely has certain pressure and a certain flow rate. But, then what is important is whether the nozzle which we have given gives you the particular type particular amount of spray or not, which is important. So, when we the important parameter here is the calibration of the spraying equipment.

So, calibration is important that means, if it has specified a particular value of droplets per unit of area to be dropped and size etcetera which were said at a pressure then whether that is happening or not you need to testify that. So, when you mean by sprayer calibration refers to adjusting the chemical application rate, you with this means that. Now, what does it depend on then? This will depend on several parameters, we have all

discussed these parameters, but then there is a need to look into this as a certifying agency, as a testing agency.

So, this sprayer forward speed; at what speed the whole unit is moving if you are talking of a tractor run unit or a self propelled unit we would like to know at what rate it should it is moving or it should be moving. Or a specified by the manufacturer then the effective capacity of the spraying equipment; what is the effective capacity. Well something is written over there, but whether that capacity is really available on the ground or on the field actual field conditions are not we need to test this.

Then width of operation it may say that width operation is this, but whether that width of operation is acceptable or that width operation is up to the one which he has said which he has claimed. So, that is important the nozzle flow rate. What is the flow rate of that nozzle? Whether, it is giving a uniform all the little bit locations or there is faulty. After this you know how much time, if they this nozzle can continue with giving that is particle size of the droplets; whether the pump operates over a period of time or not, what is the longevity of this action.

Because, you are supposing it is done and then the short run test you have done that means, for a short duration you have just tested and found the two everything is fine and you say that go ahead, there will be a catch. In fact, he may say that you have tested, but then the moment it is tested for a longer duration of time you find that the problems start coming. Whether, you do not find those calibrated earlier calibrated parameters to be true they are off the track or they are off the value. So, this is very important that you need to test them on a certain specific period of time.

And then certain methods you must have you must present those values, you must have the tabulated these values and see how they compare and how their repeatability of those where values take place when the machine is working in the field. So, with respect to these parameters then we will discuss about the certification and testing and yes as I said the agency. So, the bureau of Indian standards here follows a code of IS 8548-1977. So, this is the one which is followed and I will talk of this in detail. You need to know this as an engineer, because you will like you sometimes you will be asked with the task of testing and certification of such a thing.

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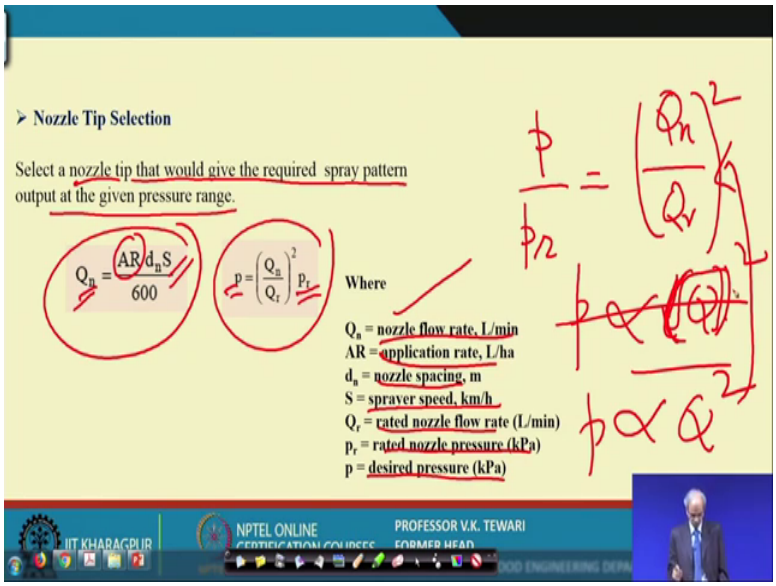

Nozzle tip selection well here we will be it nozzle; actually when you were talk nozzle what would be the tip in the sense. It is not exactly a tip like say the tip of this here, it is not like this. It will say that to what sort of pattern will be coming out when the nozzle spray comes out. So, this is one where we mean nozzle tip selection what should be the type of that. Nozzle tip selection actually, nozzle tip that would give the required spray pattern output at the given pressure range. This is meaning of the nozzle tip selection, you would like to see that whatever is the nozzle type, when I require a certain pressure or at a certain pressure whether it gives that much or not.

So, this Q here which talks of the nozzle flow rate in litre per minute, so this is this has this parameter like application rate. If you are AR is the application rate d n is the nozzle spacing, this is the spacing which has been maintained in that and S is the sprayer speed forward speed of this spray. So, you will find that this nozzle flow rate is dependent on these and then what is the p desired pressure. Desired pressure has a relationship with these of course, what are these p r is the rated nozzle pressure. So, the nozzle rated to nozzle pressure and the desired pressure has a relationship with respect to Q n and Q r, Q and S is the nozzle flow rate and Q r is the rated nozzle flow rate.

So, with respect to this virtually then you will get a relationship between p and p r is nothing, but Q n by Q r this or you can get say p is a function of the under root Q, this is what we take. Now, sorry here now p Q square, Q square so the p is a function of Q

square as you can get over here. So, this is what it is, so this we what we need to know is what is the nozzle and then what is the nozzle spacing. And, what is the pressure so, this is one which is important.

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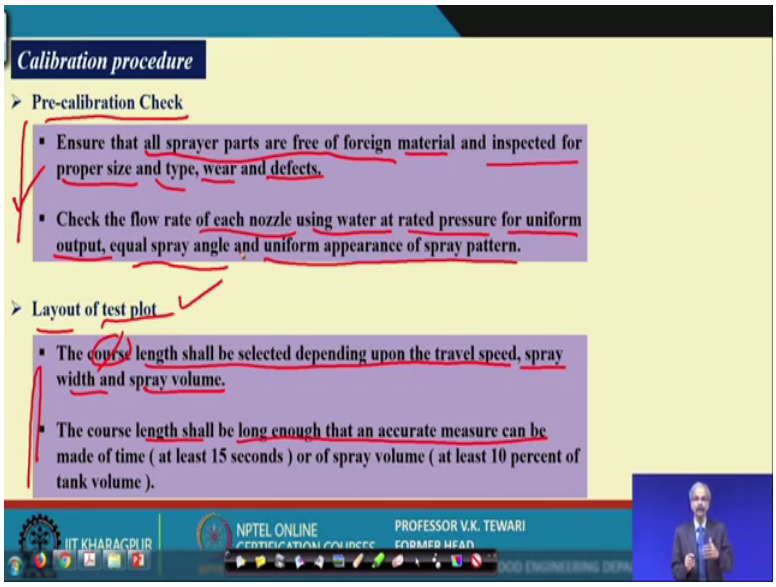

Calibration procedure, what is the calibration procedure that needs to be followed. See these procedures are well documented and what we have taken here for your information is that, this is the total a material which is there in the test code of the BIS on the one which I have said earlier. And we need to elaborate to you or enumerate to you the whole procedure and every aspect of this.

So, that you are aware of this and you will have no hesitation in testing, following the particular test code. So, pre calibration check, so the there will be pre calibration check, you see it is important. What you will check? Ensure that all sprayer parts are free of foreign material. Then inspected for proper size and type wear and effects; this is pre calibration when you are calibrated before that you must have checked.

Check the flow rate of the nozzle using water and rated pressure for uniform output, just check this thing equal in spray angle and uniform appearance of a spray pattern. So, ultimately what you get you need to have a pre checking of this which is very important. Then layout of the test plot, how do you lay out the test plot where you want to test them. See the length shall be selected depending upon the travel speed, spray width and spray volume. And, actually here the course length what he means is in fact, it is plot length.

So, what should be this will depend on see travel speed if you take a smaller one then you have to think of what how many speeds you can check that. And that is why this depends on your judgment. Generally, we would like that when you were talking about tractor run unit should have an about an acre or half a hectare at least of area for testing this. Similarly, for long enough that an accurate measurement can be taken that, I mean both are talking with respect to the plot only.

That it should be such that you have to use your own a judgment of whether you are taking a tractor run unit or a self propelled unit and see that within that range when we are changing the speed etcetera. We should be in a position to understand and take those values sufficient enough it is not that is difficult to find out the value at certain speed. Then why do not have a bigger plot, so accordingly you show you have to look into the layout of the test plot which you have at your disposal and which you want to select for testing.

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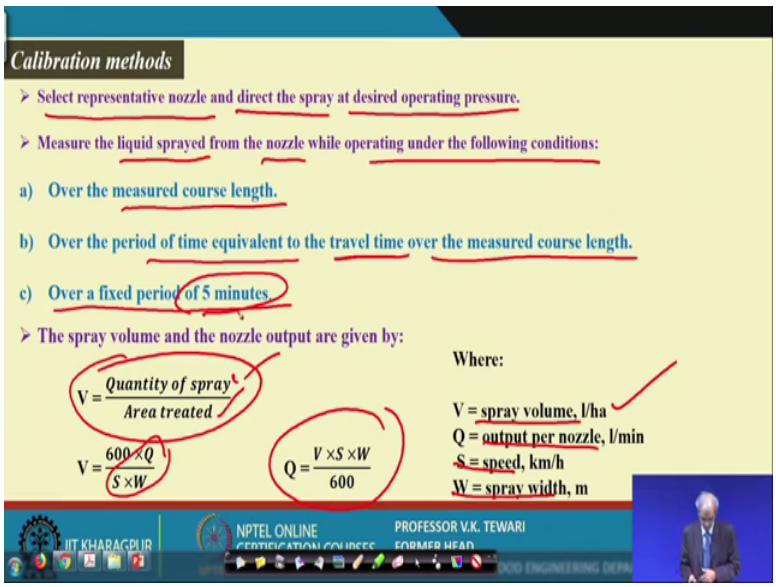

Calibration methods, then what are the calibration methods you would adopt, well these are all given over here. Select representative nozzle and direct the spray at desired operating pressure very simple. You need to make calibration methods or how do you calibrate. Select the representative nozzle the nozzle which are given to you to select one which is or anyone out of that, direct the spray. See the what is the spray which is there the desired operating pressure, desired operating pressure.

So, I had this pick up the nozzle and do this job, then measure the sprayed liquid from the nozzle while operating under the following conditions. What are those conditions? Over observed measure course length, over the length in which we are thinking, then over the period of time equivalent to the total travel time over the measured course length, well over the time you say how much time it has taken.

Then over a fixed period of say over a fixed period of 5 minutes; see it this is 1 min at least minimum value of time which is given that how much distance it should be at least. Not that 1 minute you have done and say that fine because a spray comes out a large in volume. So, you would like to see at least 5 minutes you see that and see that the whole thing happens.

Now, this spray volume and the nozzle output are given by these which are very simple in fact, quantity of spray by area treated. So, this straightaway gives you these spray volume litre per hectare here. And then these are with respect to Q W into S, where these S is the speed, W is the spray width and Q is the output per nozzle. So, ultimately you get the value of output per nozzle in terms of the speed of operation and the spray width. So, when you get these things you have you are in a process of calibration.

Now, how long you will do it? What are the values? How will you compare the values? This will come later, I mean you need to have a data collection as well with respect to this. But this is only a procedure or method for the calibration. You need to follow this, you need to have several you can say several numbers of this several times this has to be done.

Then only you can say it is not that, once you have done it you say various replications have to be done until and unless do these replications right, you will not see. Although, it is so, even that 5 minutes, but these 5 minutes he talks of the this 5 minutes maybe 5-6 times is a it must be replicated. The whole procedure which has been given here must be replicated 4 or 5 times minimum, which is a statistically they would say that would be at least 3 replications which is even there, but you must have these.

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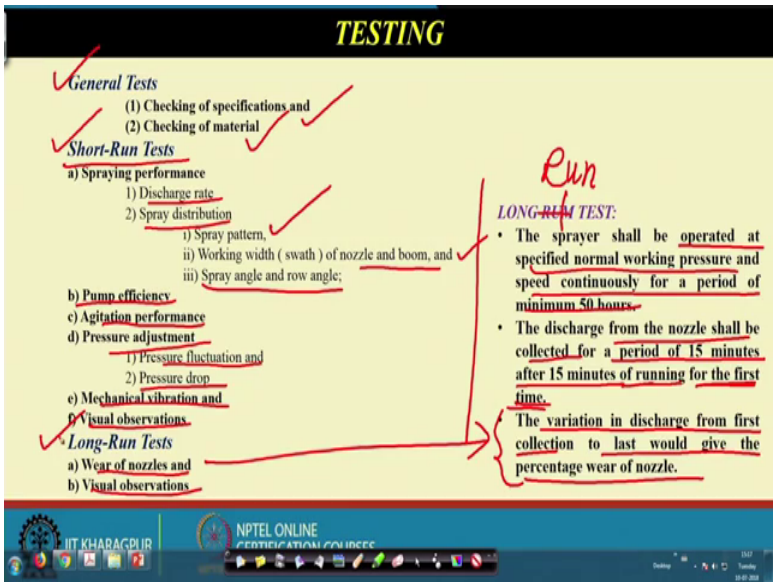

General testing with general testing is also important and I was just talking about the short run test. So, you check here the checking is the specifications which we have done earlier. Checking of the material or material construction of that sometimes manual, but observation is also possible something to check whether everything is fine or not. Then short run tests, see the short run test are also important to check initially itself before you go for actual preparation for the whole test; you must have short run tests which will also help you give an indication of see the discharge rate. It will give indication of this pressure spray distribution, that it will give spray pattern what is the spray pattern.

Then working with the swath of nozzle and the boom and the spray angle and the row angle; well these are some of the things which should do or with related to spraying performance. Then pump efficiency you must also check for a short run, what is the pump efficiency? How much is the pump delivery? It because, ultimately when you go for a longer test, when you go for the number of tests which are actually made for actual certification then it should not fail in the beginning.

So, therefore, then agitation performance if the liquid is oil immersion and that has prepared what is the level of agitation being given, whether that is ok or not. You must have a check of that and pressure adjustments, whether there is a pressure adjustment arrangement or not.

So, pressure fluctuation takes place and pressure drop what are these so, the values you must have check you must have information about this. Then mechanical vibrations and visual observations; mechanical vibrations you must also check whether the mechanical vibrations which are taking place when the system is running or when the system is started with the pump connected to the system and all that you may find that a lot of vibration takes place. So, because of the vibration itself the pattern will be disturbed, so you will not have proper testing.

So, this is about the short run test. Now, the long run test; wear of nozzles and visual observations. You need to have the wear of nozzles particularly you longer the runs will give you what is the life of this particular nozzles. It is important otherwise the nozzles, if they are those are nozzles which are not properly designed not of the proper material.

Then what will happen is that they will go away very fast and then the manufacturer the consumer has to change these nozzles and assume a situation where he is in the midst of the demand of the a spraying season and this happens. So, even one day loss is a great loss for him, so this is very important that the wear and tear etcetera, must be proper and must be tested.

So, long run test and this is r u n or a run test, long run tests. The sprayer shall be operated at specified normal working pressure and continuously for a period of minimum 50 hours. So, this is what is important that we have done this short run information is essential to go for the long run both are essential, just like a prerequisite and it is a must prerequisite before you actually launch for the long run test.

So, 50 hours at the working pressure the one which is given and the discharge from the nozzle shall be collected for a period of 15 minutes. After 15 minutes of running for the first time, at least 15 minutes remember that the nozzle this is spraying for 15 minutes. And after that only should collect that, see you can correct for every 1 minute and then say that fine we have done 15 every 1 minute and then 15 replications and say that I have done to 15 replication that is not correct.

What they want is minimum 15 minutes of running for the first time. The variation in discharge from first collection to the last would give the percentage wear of the nozzle. Now this is how you check for the nozzle when you are talking with respect to this is important. So, when you are talking of testing you see the general tests are given here.

Then the short run tests are there, then they have long run test and what do we do in this these are all given. What is the important of a long run test, yes it will give the longevity, it will give more revenue to the farmer and less downtime of that particular equipment which is using particularly in the demand of the season at that point when he is a using that equipment.

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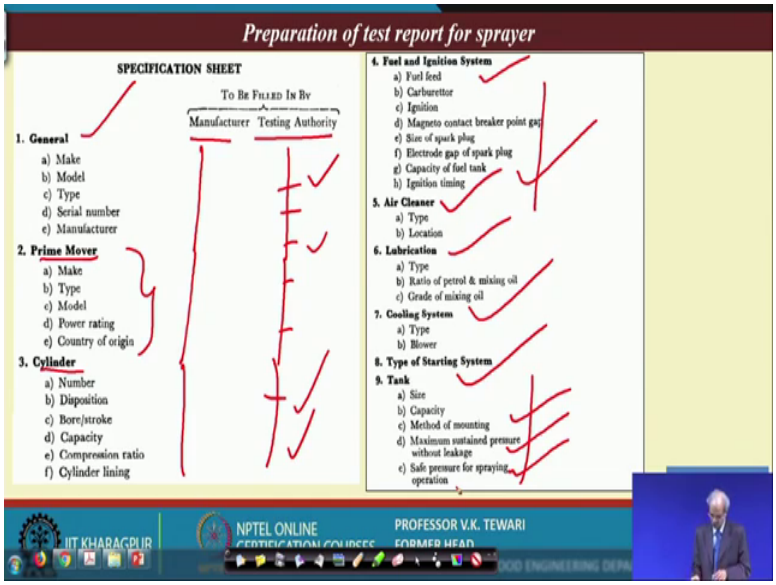

Preparation of the test report for the sprayer yeah, you have tested these after that you need to give a report to the in a to the agency or in a to the consumer or to the person who has come to you for getting it tested from you. So, as an engineer we need to give this report as well so what are the contents of this report its worth and knowing it see these are all taken from the realistic actual report on BIS codes. So, you must follow each and everything is not that we have added anything or subtracted anything we have just skipped a here, but for your knowledge we want to present it to you. So, that you will follow and understand and you will have no problem in testing an equipment.

So, the general information needs to be given to be filled in by the manufacturer and testing it authority both. The manufacturers say certain things the testing authority will say with respect to each of them whether they are fine or not. Similarly, the prime mover what is the details of the prime mover the manufacture will say something the testing agency will say they if their own performance. Their own values which they have found

out say they will say, suppose we are talking of the cylinder say with respect to prime mover if you are talking.

Then what is the cylinder number etcetera details here in the testing agency will also test this thing and say that yes everything is ticked all the brackets are test here ticked or not which is very important. So, when you are filling this you what the manufacturer has said you have to come and see that whether it is having a compliance with that or not. Not necessary that what he has said is correct you if there is something wrong or something not as per stated thing you will have to mark these. And, maybe these will be your visual observations which you will have to put in your report when you read the report, fuel and ignition system if we are talking with respect to prime mover.

So, these details need to be checked where the fuel feed where the carburetor, the ignition, the magneto size of spark capacity of the fuel tank ignition timing all details air cleaner type. What is the air cleaner type which is used? What is the level of lubrication the cooling system, the cooling system functioning or not.

See why it is important is with respect to prime mover itself because if the prime mover fails the old system even if it is perfect it will fail. So, we it is very important that you must check the prime movers specifications and prime mover is there. So, cooling system then type of the starting system which it has all the details of the size capacity method of mounting maximum sustained pressure. Then safe pressure for spraying the operation etcetera we must check this is one sheet specification sheet.

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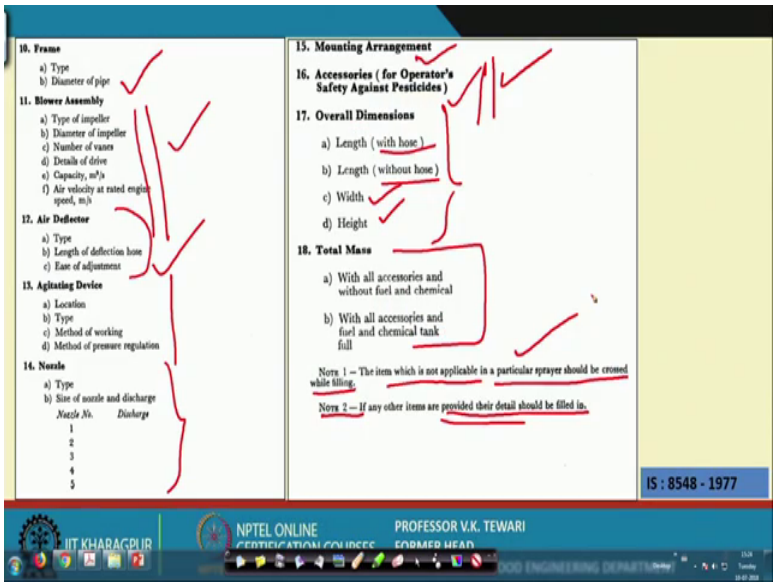

This is continuation of that you can you can see here that the details of the details of the frame. So, details of the frame must be checked the blower assembly what is the blower assembly if you have used their whether check these whether they are fine or not whether the blades are or not whether the direction is correct or not these details.

Then air deflection type length of deflection hose and their ease of adjustment whether it is proper or not this needs to be tested. Agitating device if there is a agitating device you will have to talk of the agitating device how many baffles are there, how many baffles they have claimed at, how many baffles are there what is the total length what is the total length it covers all details this speed at which it should work whether it is double to work or not.

The distances which they have marked they are a proper or not this you have to check. And then the nozzle size of course, because we have talked of the nozzle size every details of the nozzle has to be kept the in the mounting arrangement which you have put here then the accessories for operator safety against pesticides very important.

See whenever we have because these some of the equipment either it is manual or even attracted on or a self propelled human being will be involved at some point on the other. May be either he is driving it always on the tractor or he is in carrying the whole thing. So, at that point the he his safety is important if supposing there is wind it is possible that the chemical falls on him. So, what sort of the accessories the operator is given what sort

of protection he is given. So, that it doesn't come into his eyes it doesn't come into his body because there could be skin problems and all that to the operated.

So, x is what accessories they are giving with respect to this is very important. Then overall dimensions the overall dimensions are important the length they of the hose the length without hose then the width height these are very important. The overall dimensions what has been measured mentioned are there or not total mass the total mass what with all accessories and without fuel and chemical.

What is the total mass of that these are some details will have to be given see one important aspect of testing is that from all counts one has to say that yes this sprayer has been tested and certified. You cannot say only ninety percent of the items and the others say that well these are do not fall into this aspect and hence not tested not very important to be tested no that cannot be said that is why this test code follows all the details and you one must definitely go into this.

Now, here note the item which is not applicable in a particular experience should be crossed while filling if any other item are provided their details should be filled in. Yes it may happen because depending on the type of the sprayer which is given to you for testing maybe some of these will not be related maybe there may not be an engine in case of a particular type of sprayer. There could be an electrical motor, but there could not be anything its possible.

So, if your talk to say electro statics sprayer at that how will you test that so what are the other safety aspect which have to be looked into. So, those if they were not there may be an under two you would like to say did you give the details of that. And if they are not applicable you can simply like to cross them or you may just ignore those things, but you will have to consider all these details where you are talking testing and certification of a spraying equipment.

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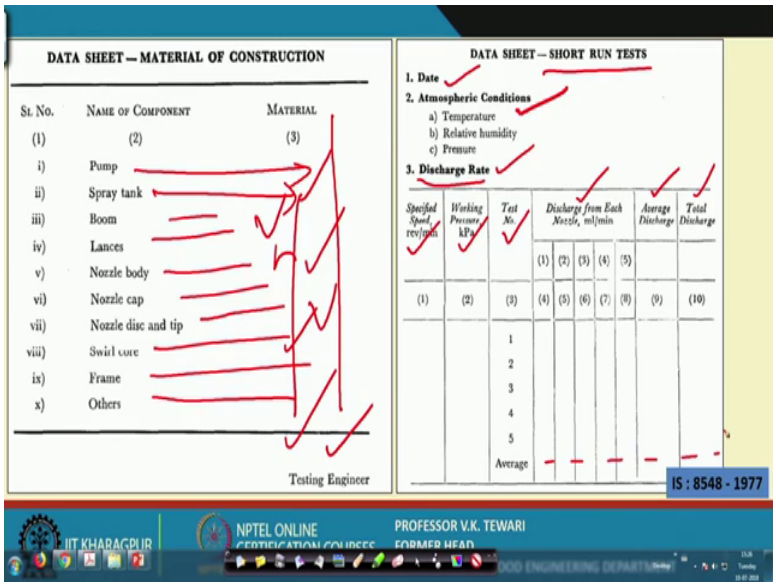

Data sheet for material of construction important you must know you must know the material of construction very important because material of construction if they are not of the right material then the longevity will be a big question mark. The here see the pump what will the material of construction for the spray tank what will the material of construction.

The boom, the lands, the nozzle body, nozzle cap, nozzle disc, tip a swirl core, frame and others all this details must be mentioned in the datasheet material what is the material construction that. In fact, this will be given by the manufacturer you can you can have a look at that. And also have a look at your facility which you have for testing or which you have for certifying that yes these are what he says are correct and accordingly you should fill up these important parameters and say that yes and then sign here that material of construction you have sign.

Data sheets for short run test yes they would like also whether you did any pre run or not it is worth knowing the certification is in she wants that the engineer must be true to himself and he must have followed this. So, if you have done a short run test you will say that why should I unnecessary waste 3-4 days in going for a short run test.

Because short run tests also required several items to be checked before you go for the long run test. So, if you have not done assuming that that is not required I think there is not correct as per the report and they were your report may not be accepted.

So, you need to look into this say here then atmospheric conditions what are their and the date at which it has been done then the discharge rate the details of you can say here. They specified speed working pressure test number which test number is this then discharge from each nozzle what is the number of nozzles you have then every discharge total discharge etcetera. Now, these the average values can be put so this is how you can represent a short run test with respect to the calibration of a particular unit.

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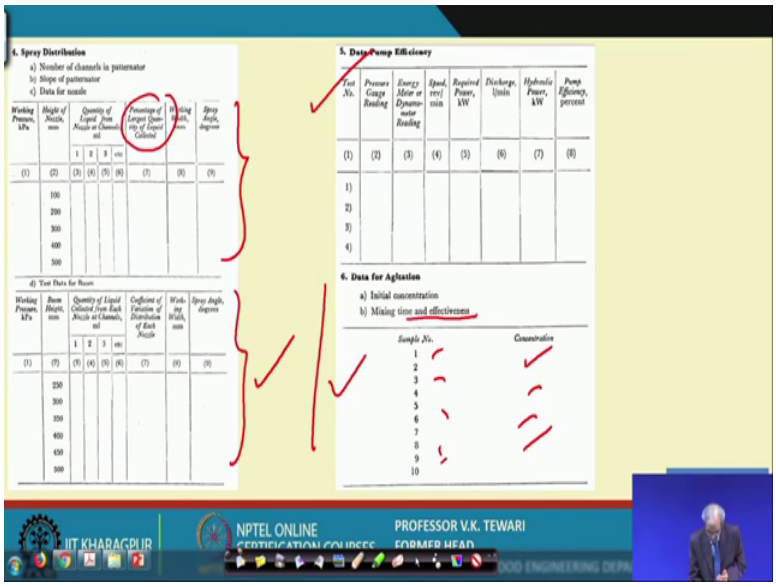

Similarly, for spray distribution details of a spray distribution are given here the data of a pump details are also given here. You can see the pressure gauge reading emergency energy meter speed revolutions per minute the required power discharge, hydraulic power, pump efficiency. Similarly the spray distribution details are given here the nozzle height of the nozzle accordingly what happens to the percentage of large quantity of liquid collected here.

Percentage of this is very important this particular parameter is very important you see percentage of largest quantity of liquid collected it is important that. When you have a certain test you would say what is the percentage of a particular one from the lowest to with the largest what is this value this will talk of the level of uniformity that you are going to get or not.

So, the test run in a for boom these are given you must put that and this is the one which you should follow for spray distribution. Uniformity with this will give whether

uniformity is fine or not and the pump efficiency as I said, data for agitation yes if the as I said that if it is for a solution which has some oil immersion and then it needs agitation.

So, what is the mixing time and effectiveness of this or not or the sample numbers you have taken and then what is the level of concentration which is there. You will have to pick up the samples out of that while the iteration is going on and check whether the concentration is uniform or not. If the consideration is not uniform that means, this agitation is not functioning properly whether a mechanical agitation or a hydraulic agitation we have talked of both in our later earlier classes.

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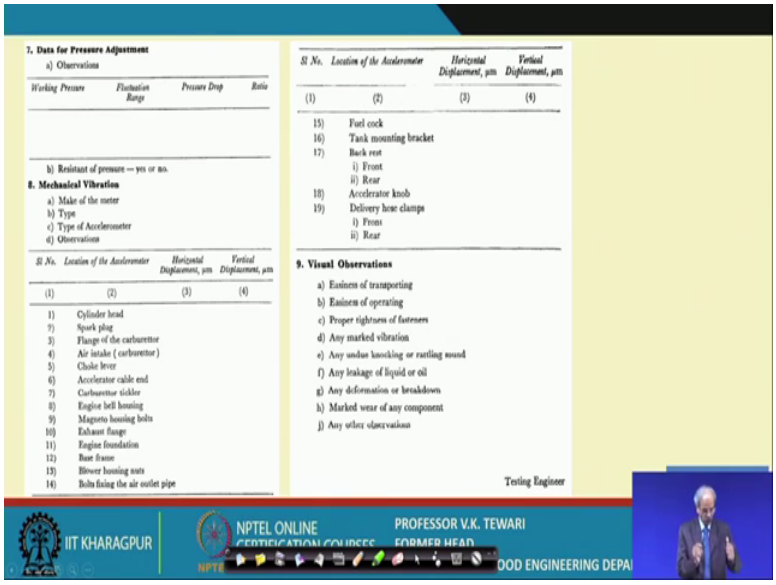

This is further details of the pressure adjustment all details mechanical vibrations then location of the accelerometer, horizontal displacement, vertical displacement, visual observations, these are all details which they which you need to do which you need to measure observe and then detailed it here in your report it is very essential. And then you need to sign here as the test engineer after the exact period of time.

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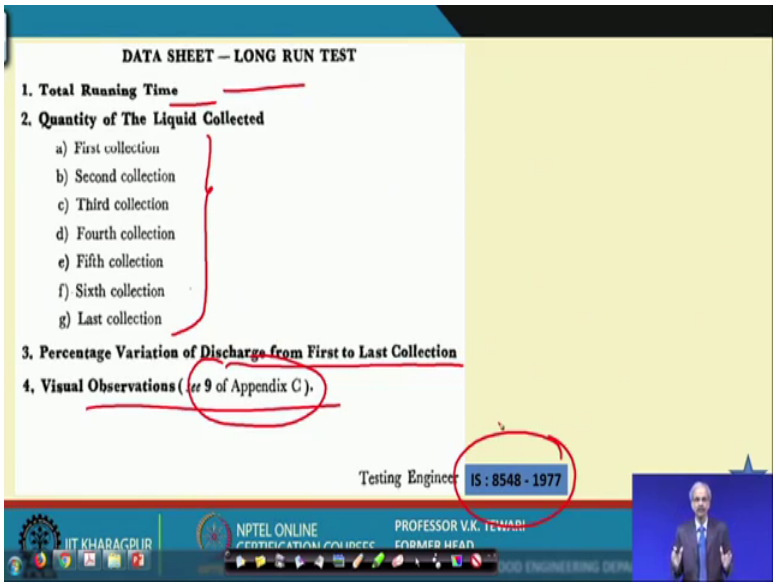

Then the datasheet long run test well as you have done for the short run test data sheet for the long run test will also have all details. You can see here the total time total running time which should be at least 50 hours which you have seen the quantity of the liquid character you can see all first, second, third, fourth, fifth, six corrections then percentage variation from discharge first to last.

And visual observations now these I think this appendix you can see if you open this test code of BIS you will get more details. We have not given here, but then we just want you that what are the details of testing a particular testing and certifying a sprayer this is what we have discussed today particularly with respect to this we have talked about the performance.

Now, we are talked of equipping you with enough information as to how to test and certify I think this will suffice, but then you need to look into details of what I have discussed with respect to the short run test and long run tests. And then it will help you in certifying and making you a better engineer as compared to this.

You can also find out faults may be that confidential information you would have to give to the manufacturer which you do know would not like to give it to the public as such sometimes that will help him and he will help it will help him to modify that. So, this is how we will complete this you will like to hear your questions as in when they come and I think we will close here.

Thank you.