Experimental Stress Analysis
Prof. K. Ramesh
Department of Applied Mechanics
Indian Institute of Technology – Madras

Lecture – 35
Soldering, Accounting for Transverse Sensitivity Effects

We have looked at in the last class; what are the surface preparations required for strain gauge bonding, then we moved on to how to draw a layout lines, then we also saw how to handle the strain gauge and we saw use of a cellophane tape helps in aligning the strain gauge to the point of interest. Then, we moved on to see how to apply the catalyst. Finally, we saw how to do a bonding.

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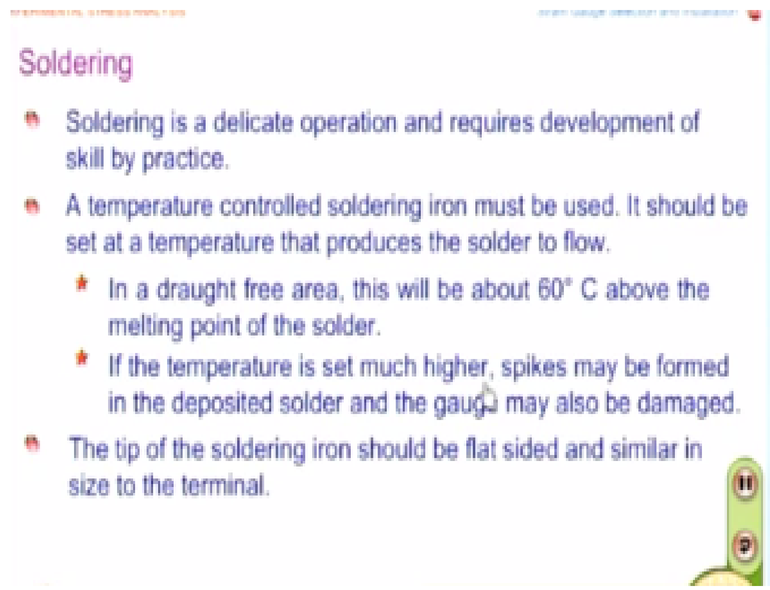

And in the example, we have looked at how to use a cyano acrylate cement and I also mention the basic procedure for surface preparation, layout lines and all other details are very similar, only the curing is different when you employ an epoxy adhesive, so you have learned a basic procedure on how to bond the strain gauge. Now, the next step is to go for soldering and as you all know, soldering is a delicate operation.

And requires development of skill by practice and one of the important requirements is; you need to use a temperature controlled soldering iron. The reason is you need to set the temperature, so that solder is ready to flow and what is mentioned is; in a draught free area, this will be about 60 degree centigrade above the melting point of the solder, you know there is also a caution is given, if you set the temperature high, what happens?

You need to have a temperature control soldering iron, so that you are able to maintain the temperature and the recommendation is you should keep it 60 degree centigrade above the melting point of the solder. If you keep the temperature high, you will have spikes formed on the soldering joints and this may also damage the strain gauge and another recommendation is; if you look at the soldering iron, they come with different tips.

The suggestion is; the tip of the soldering iron should be flat sided and similar in size to the terminal because we have seen strain gauges of different sizes available and the tabs are also depending on what is a kind of a strain gauge that you are using, so it is better when you go for the very precision strain measurement, suppose you use a strip gauge, you will have a very small tab.

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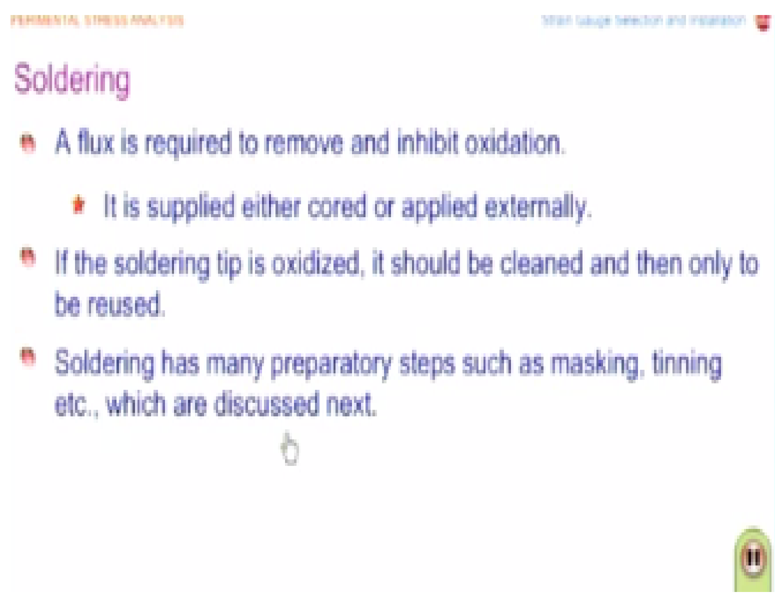

In a general purpose strain gauge, you may have a longer; larger size tab, so depending on the kind of strain gauge that you employ, it is better that you select the soldering iron appropriately and in all soldering operations, you need a flux to remove and inhibit oxidation, you can supply the flux externally or it also comes as the core to the soldering pencil, whatever the soldering material that you have, the core of it can be flux.

And we will be using only a cored soldering material, so it simplifies where application of flux and what you need to keep in mind is; if the soldering tip is oxidised, it should be clean and then only reused, so this is the process that you have to keep doing it again and again and soldering also has many preparatory steps primarily to minimise the damages, so you have masking, you have tinning, etc.

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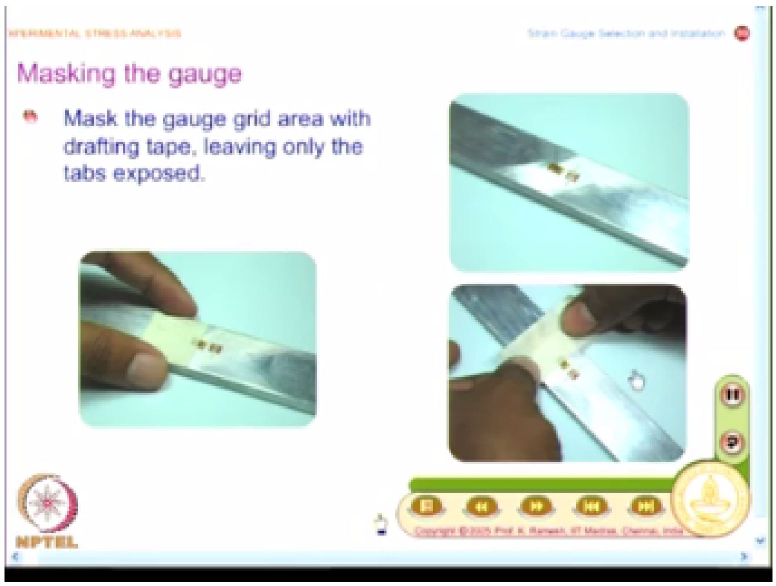

And if you are learning how to do soldering, it is better that you mask the gauge properly and this is done by a drafting tape, even this tape has to be certified by the strain gauge manufacturers, so that it is suitable for the masking the gauge.

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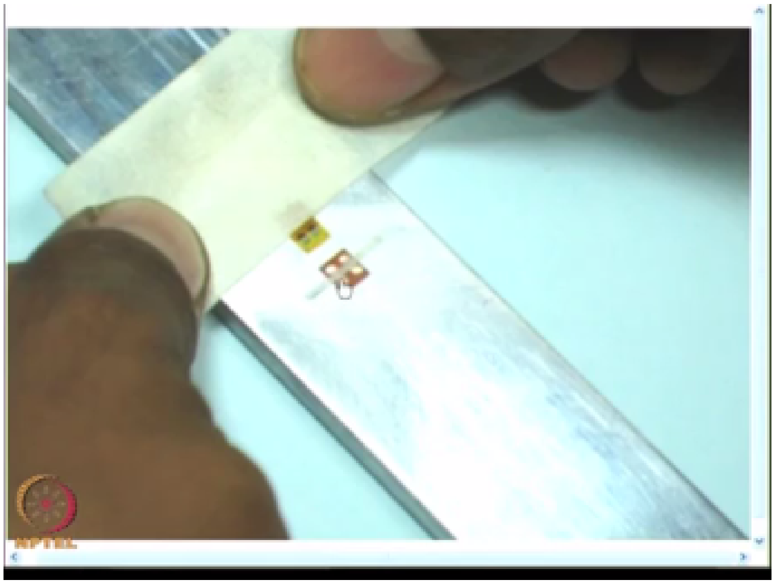

And what is shown here is to facilitate soldering, you find that grit area is covered by the masking tape and also the terminal, you need to solder at four points, these are marked and if for a beginner, you can also take one more step wherein you mask all other points only one point for soldering at a time to facilitate the learning process because even by mistake if you spread the solder, it may fall on the other tab or joined the terminals, you will see such poorly soldered joints in the next a few slides to follow.

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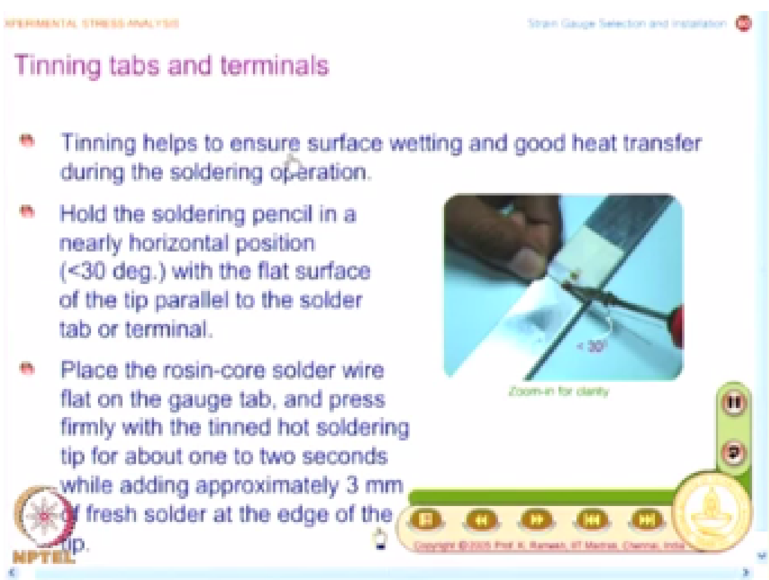

So, this happens, so in an initial stages of practising, it is desirable you do not stop here, you also mask all other areas only one point at a time for you to do the soldering and in order to facilitate soldering, you need to do what is known as tinning, you need to tin the tabs as well as the terminals and what is the role of tinning? It helps to ensure surface wetting and good heat transfer during the soldering operation.

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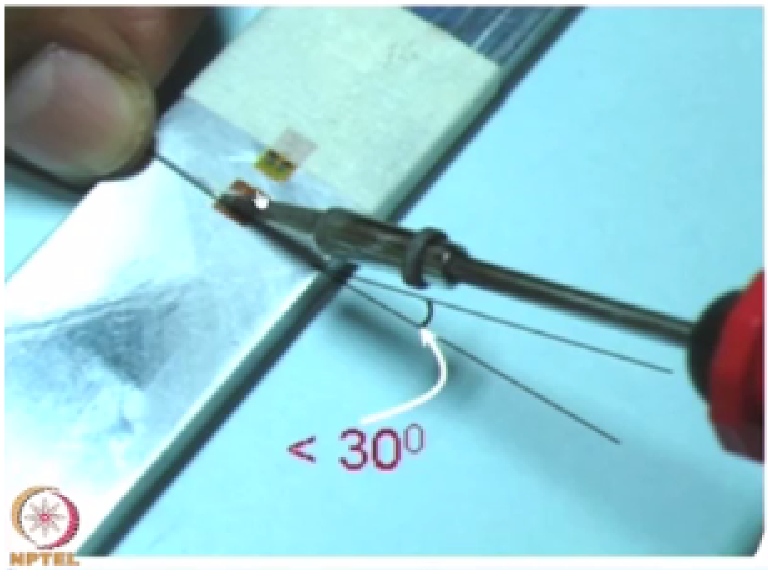

And you need to hold the soldering pencil in a nearly horizontal position with the flat surface of the tip parallel to the soldered tab or terminal and you have an example shown. I will zoom it for you and this gives you an idea, you know, you need to keep the soldering tip parallel to this and this is kept at a shallow angle of 30 degree and also notice what all the material that you feed in for soldering that is kept horizontal.

So, this is the recommended position for you to do the operation and that is what is mentioned here, so you need to place the rosin core solder wire flat on the gauge tab and press firmly with a tinned hot soldering tip for about 1 to 2 seconds while adding approximately 3 mm of fresh solder at the edge of the tip, very precise recommendations, you know, they are saying how to keep the soldering tape, they are saying how to feed in the soldering material.

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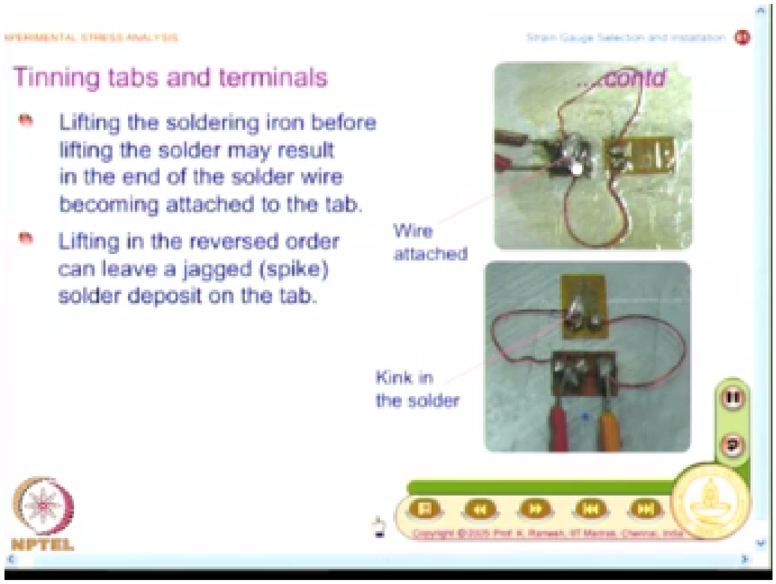

What is the angle that you have maintain, because all these minute details are required for a good soldering at the terminal and the tabs and there is also a recommendation went to lift the soldering material as well as the soldering tip. There is a particular order that you will have to do and if you do it wrongly, what happens? Lifting the soldering iron, before lifting the solder may result in the end of the solder wire becoming attached to the tab.

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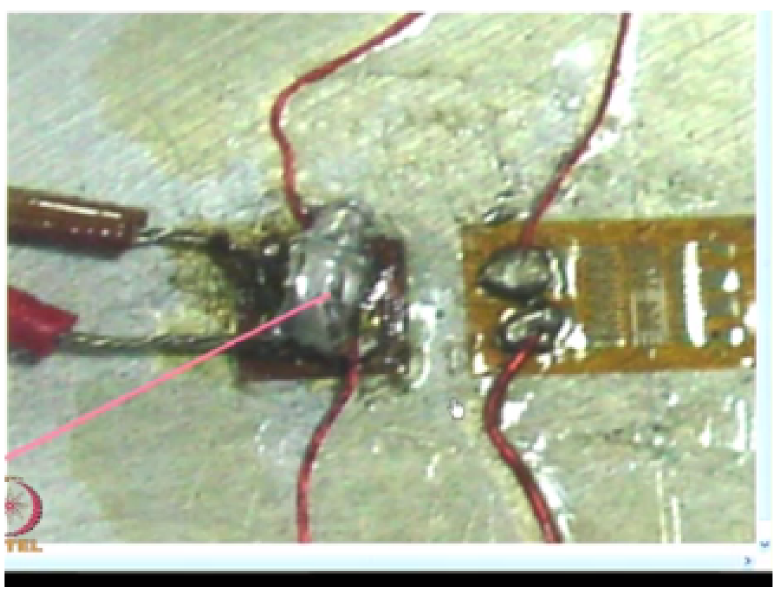

So, what will happen is; suppose, I lift the soldering iron first, then I will have the soldering material attached, you know these are all poor examples do not think that this is how the final strain gauge would be solder, these are all poor examples, these were selected from the lab experiments done by the students and you find in addition to this problem, both the terminals are joined by a improper soldering.

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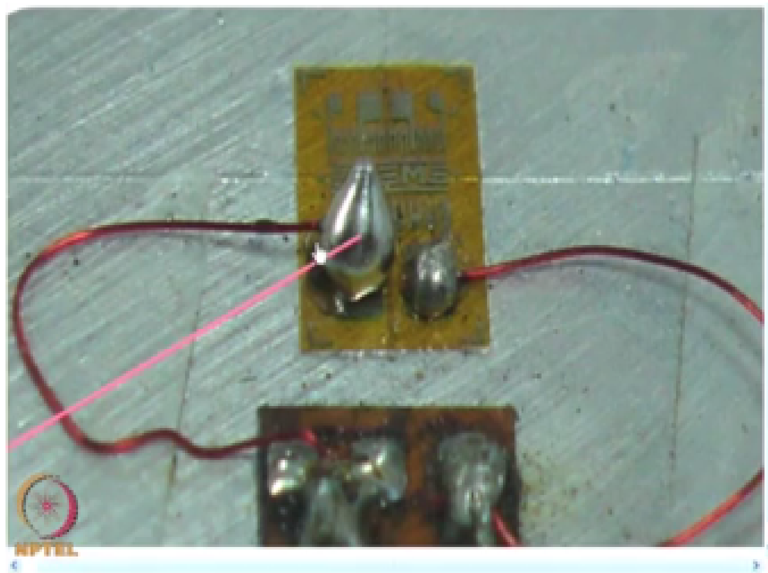

So, what is shown here is you see this soldering material attached and you have the other case; suppose, I lift the soldering material first and then lift the soldering iron, what happens is it can leave a spike on the tab, so this is what you see here. The appearance is totally different and you have a spike seen at the soldered joint. See this joint is good but this joint is bad. See, you may be wondering, when you get something like this, what mistake you have committed?

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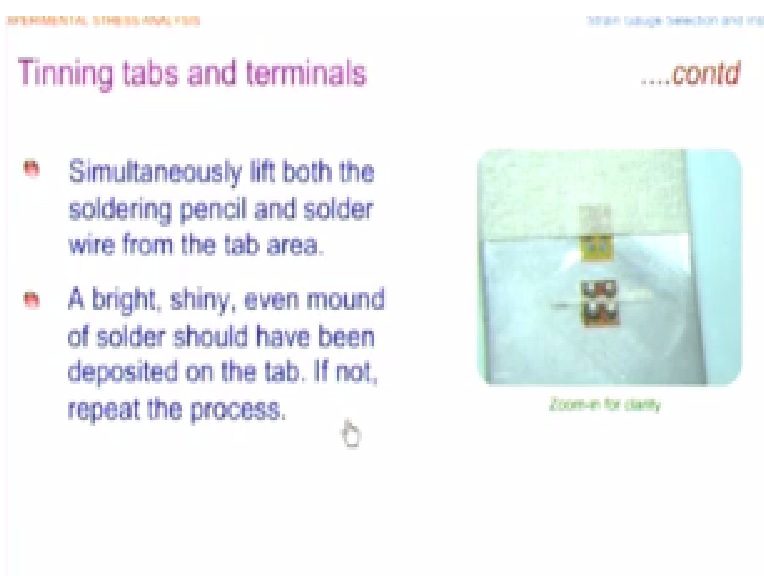

So, the manufacturers have done all these trails and have recommended what causes what, so introduction to these kinds of problems is desirable, so that you can avoid them in actual practice. So, what is the recommendation? The recommendation is lift the soldering pencil and the soldered wire from the tab area, simultaneously and if you do this, what you get? A bright shiny even mound of solder should have been deposited on the tab.

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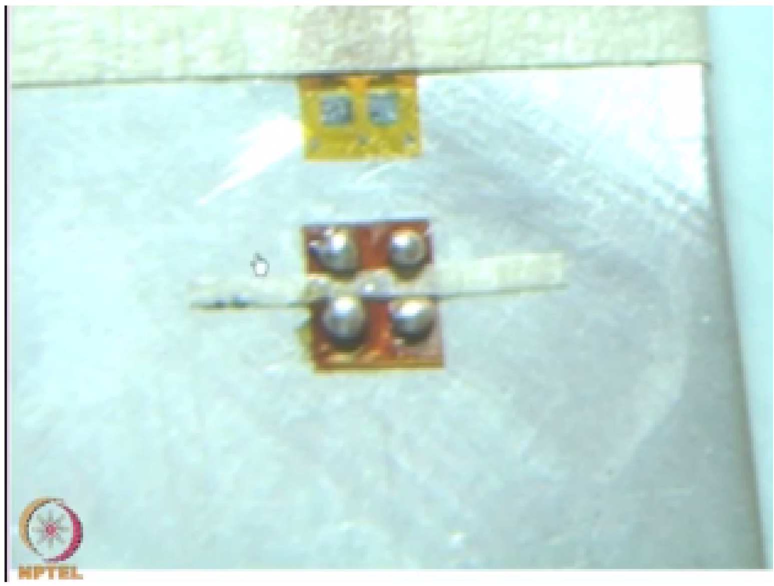

If not, repeat the process and you have a nice example, you know, you saw the counterexample earlier and now, you see how nicely the solder deposit is done at the four points, in order to get this, you need to follow a sequence and respect the recommendations.

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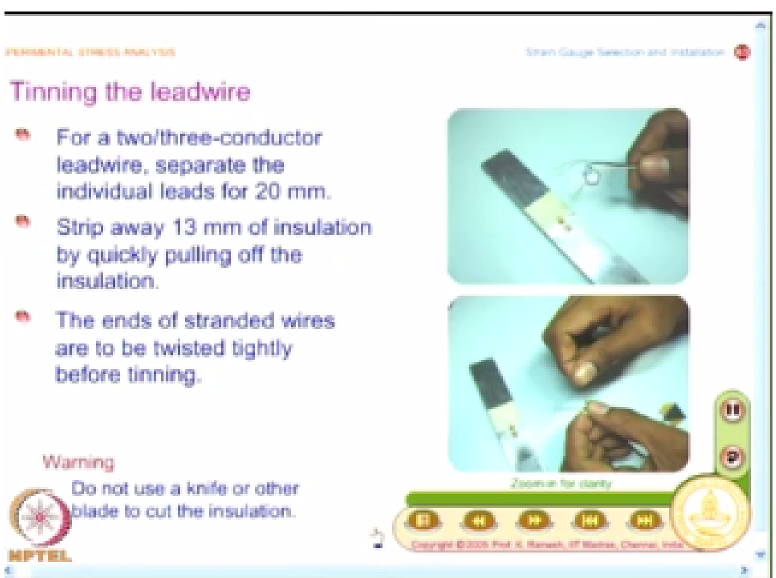

And after tinning the tabs and terminals, you need to tin the lead wires and even minute details are given, you know when you have a wire, you need to separate them first because the plastic wire will be joined and this says separate the individual leads for 20 mm, you have a recommendation do it for 20 mm, it improves your playability and aligning the lead wire, when you do the soldering.

And a next recommendation is strip away 13 mm of insulation by quickly pulling of the insulation, you know this also you need to do it carefully, there are special tools available to do this. So, the warning is do not use a knife or other blade to cut the insulation, use the proper tool and remove the insulation and to facilitate tinning, the ends of standard wires are to be twisted tightly before tinning, so all that is shown here, you can just have a look at it.

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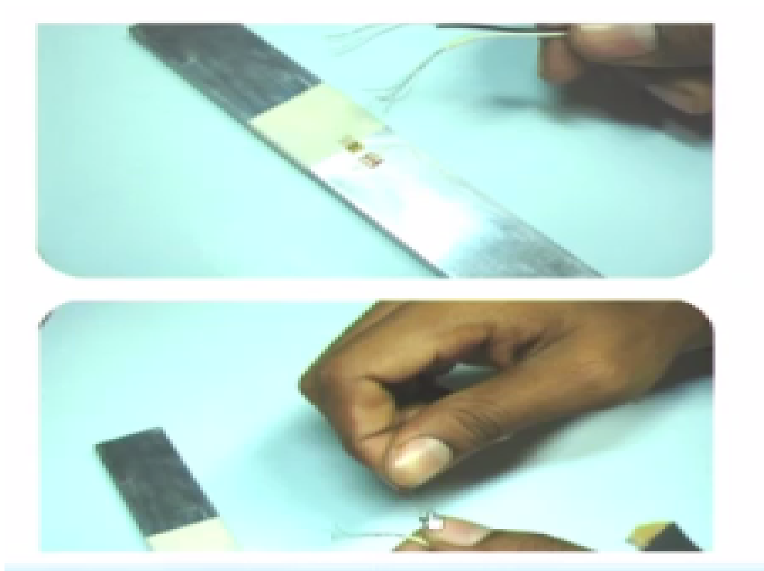

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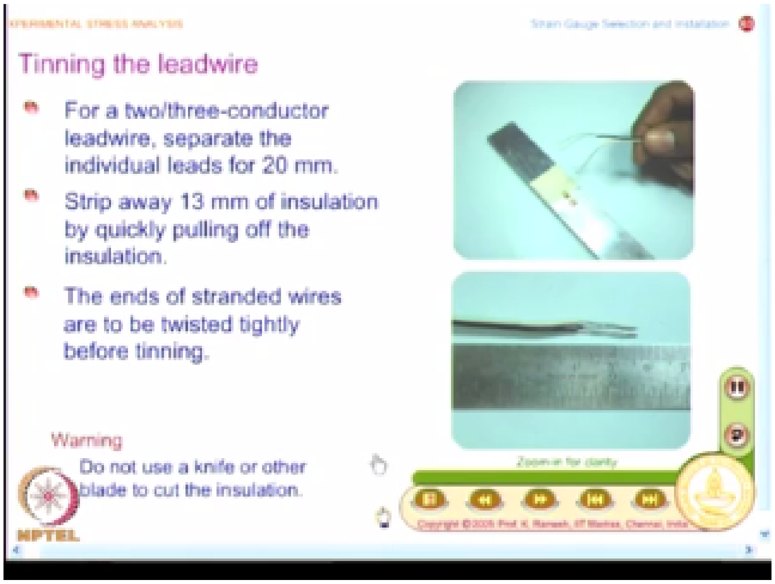

You separate the plastic and then you twist the ends of the strands then go for tinning.

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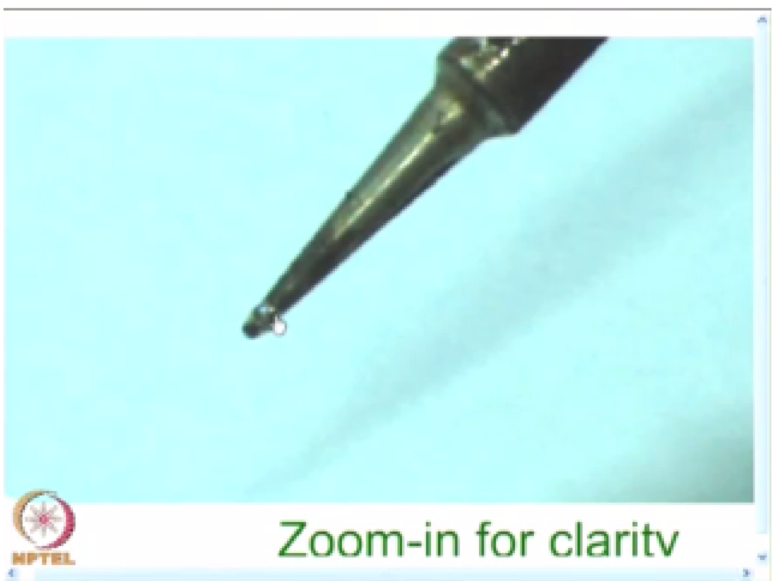

And this is very nicely shown here, I will first show this enlarged picture and what you see here is at the soldering tip, you melt the solder and you have this as a spherical drop and the recommendation is you need to have a draw with this twice the size of the wire that you are going to take.

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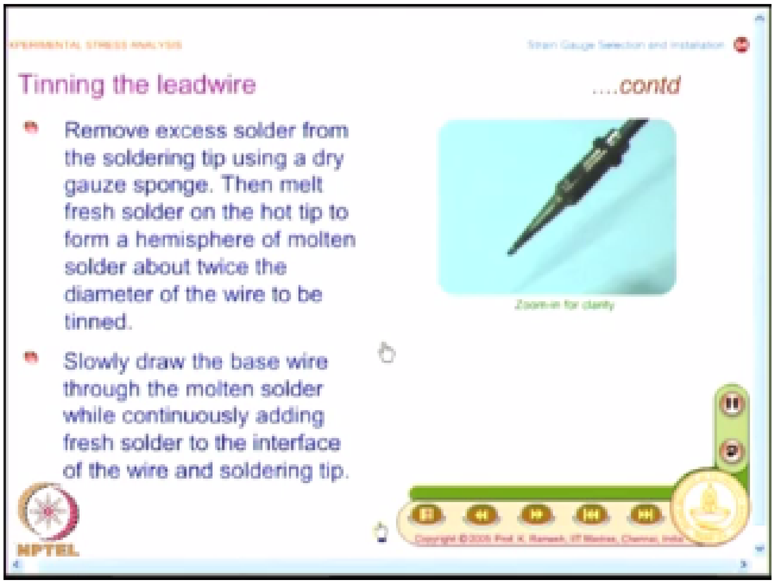

So, that is what is mentioned here, so you need to remove excess solder from the soldering tip using a dry gauze sponge, so keep the soldering tip clean, then melt fresh solder on the hot tip to form a hemisphere of molten solder about twice the diameter of the wire to be tinned. So, the recommendations are very precise and clear. Then, what you need to do; you need to slowly draw the base wire through the molten solder while continuously adding fresh solder to the interface of the wire and soldering tip.

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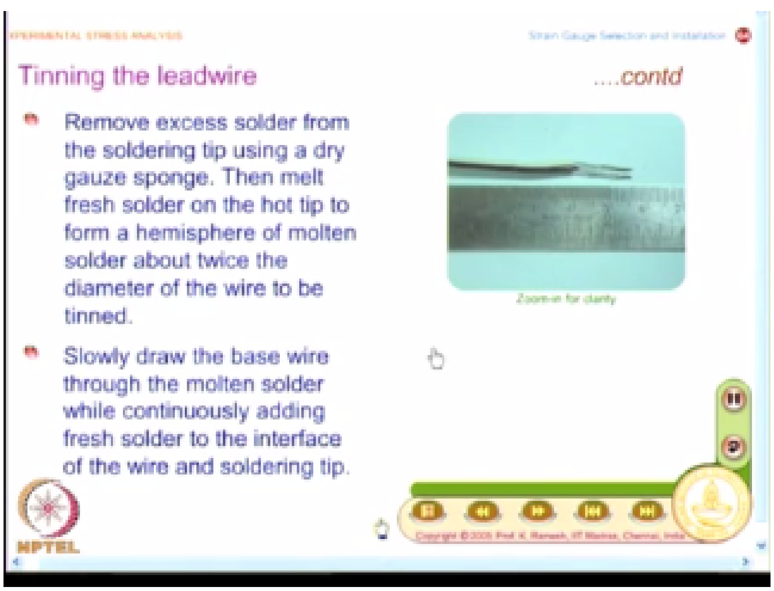

You need to feed the soldering material and the idea is you want to form a coat of solder on the twisted tips.

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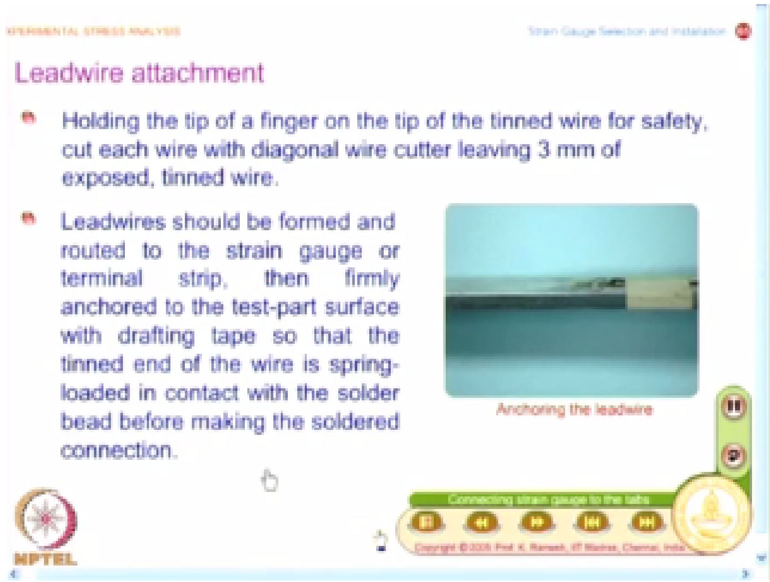

Then, what you do? You need to attach the lead wire and the recommendation is again very clear, you take only 3 mm of the twisted wire, you cut it with a diagonal wire cutter leaving 3 mm of exposed tinned wire. The reason is you know, you have to solder it on the tab or the terminal and the rest of the wire should not touch the metallic part, then you will have short circuit, so this is one recommendation.

The other recommendation is the lead wires should be formed and routed to the strain gauge or terminal strip, this is very important, you must do the routing not only this, you anchored the lead wire to the test part surface with a drafting tape, so that the tinned end of the wire is spring loaded in contact with the solder before making the soldered connection. See, the idea here is you have to do the anchoring.

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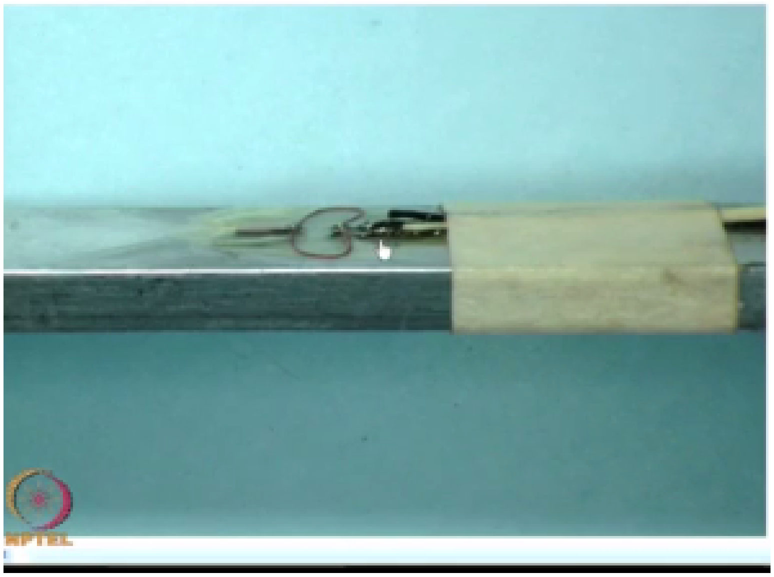

This is the final one is shown but nevertheless, you can understand the reason behind it, you anchor the lead wire and allow the exposed portion of the tinned part of the lead wire such that by applying a solder, it will join at this point, you are not allowing any low to be transferred by this that is taken by the drafting tape, the lead wires are anchored. So, you just put the solder and join the lead wire to the terminal or the tab, whichever that you are looking at.

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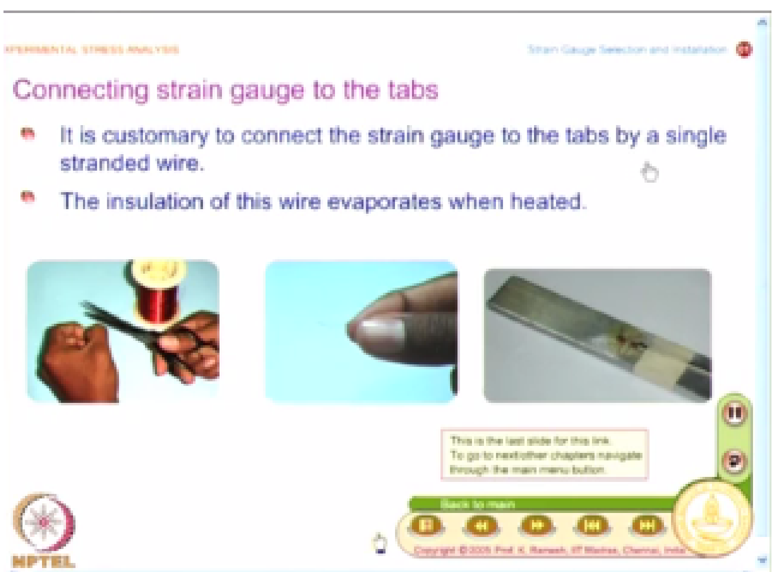

And there is also another minor detail, this is also very important because we have shown a tab of the strain gauge and the terminal. How to connect the strain gauge to the tabs? What is normally done is; you connect the strain gauge to the tabs by a single stranded wire, this is a special wire that is supplied by the manufacturer. It has a coating and the insulation of this wire evaporates, when heated.

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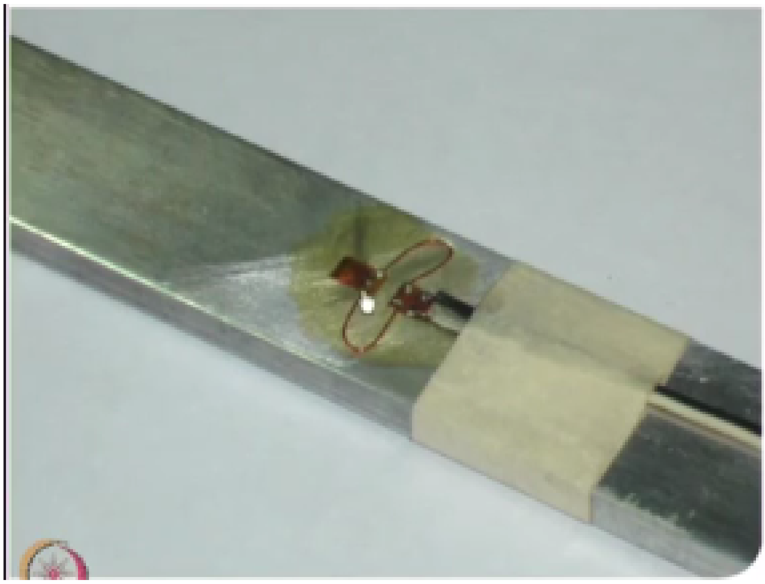

So, it is very convenient from handling point of view, so you take a small length of wire that is what shown here and I will enlarge this picture to show you how the tabs are connected to the terminals. So, you put this by a single standard wire and mind you, this is insulated, it is not a bare wire, the insulation gets removed only at the points where you heat and join with the solder.

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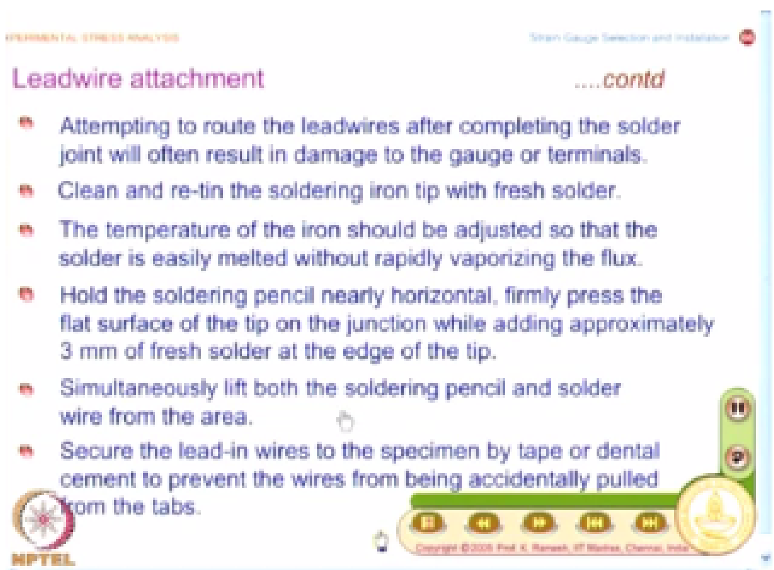

In fact, this is the complete installation, it is also a applied with the protective coating but this illustrates how do you connect the strain gauge to the terminals. We have already seen how to connect the lead wire to the terminals; we have looked at that step; the previous slide and this slide essentially mentions the steps that are required to attach the lead wire. So, every time when you do it, you need to clean and re tin the soldering iron tip with fresh solder.

And like we had seen earlier, hold the soldering pencil nearly horizontal, firmly press the flat surface of the tip on the junction while adding approximately 3 mm of fresh solder at the edge of the tip and we have seen how to remove the soldering pencil and soldering wire, you need to simultaneously lift both the soldering pencil and soldered wire from the area. So, if you do it in different orders, use saw different problems coming.

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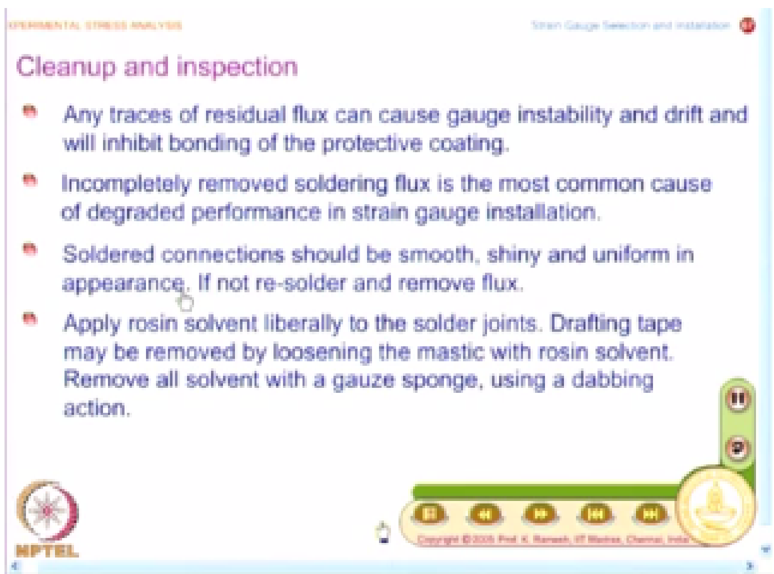

And as mentioned before, this is again emphasised, secured the lead in wires to the specimen by tape which we have already seen or you can also do by dental cement, if you are unable to put a tape to prevent the wires from being accidentally pulled from the tabs and after doing all this, you need to do a clean-up and also inspect, both are important. Any tracers of residual flux can cause gauge instability and drift and will inhibit bonding of the protective coating.

So, this is very important, see you use a flux for what; to have a congenial atmosphere for soldering to take place. After the soldering operation is over, the flux should be completely removed, you have a special solvents available to remove it and what the recommendation is; if you do not remove the soldering flux, several issues related to performance of the strain gauge is affected, if it is not completed removed.

And the important aspect is incompletely remote soldering flux is the most common cause of degraded performance in strain gauge installation. So, the recommendation is applied rosin solvent liberally to the solder joints and you can also loosen the drafting tape with rosin solvent and finally remove all solvent with the gauze sponge, you should not allow the solvent to evaporate, you should remove it with the gauze sponge using a dabbing action.

And what is that you have to look at finally? The soldering connection should be smooth, shiny and uniform in appearance, if it is not so, what to do? The recommendation is resolder and remove the flux. See, strain gauges are very expensive, so it is better that you learn soldering and in fact, strain gauge manufacturers supply you practice patterns, which are not really strain gauges, which are discarded.

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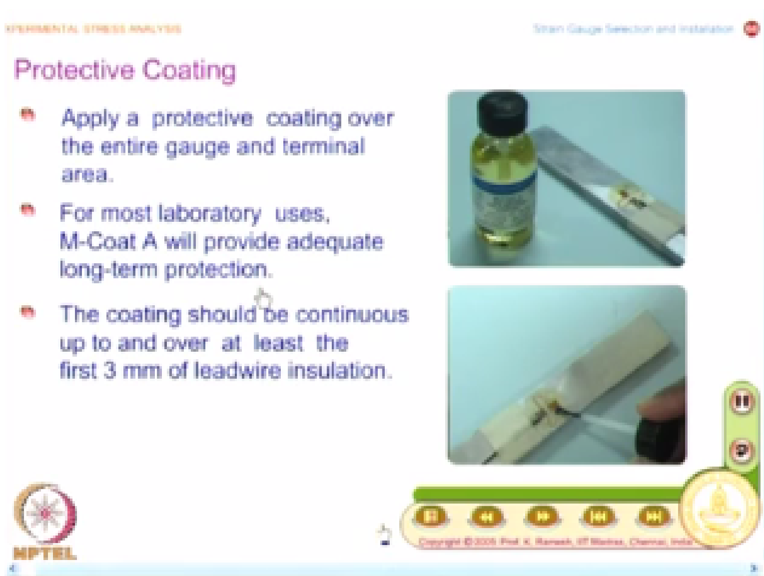

And those patterns you can use it for getting yourself trained and developed the skill, then finally go for actually pasting a strain gauge and then soldering and you know, moisture is a nuisance and this needs to be avoided and in order to protect the strain gauge installation, you need to apply a protective coating over the entire gauge and terminal area. For most laboratory uses, since we are looking at the consumables from the Vishay micro measurements, they have what is called as M coat A, which is essentially a polyurethane.

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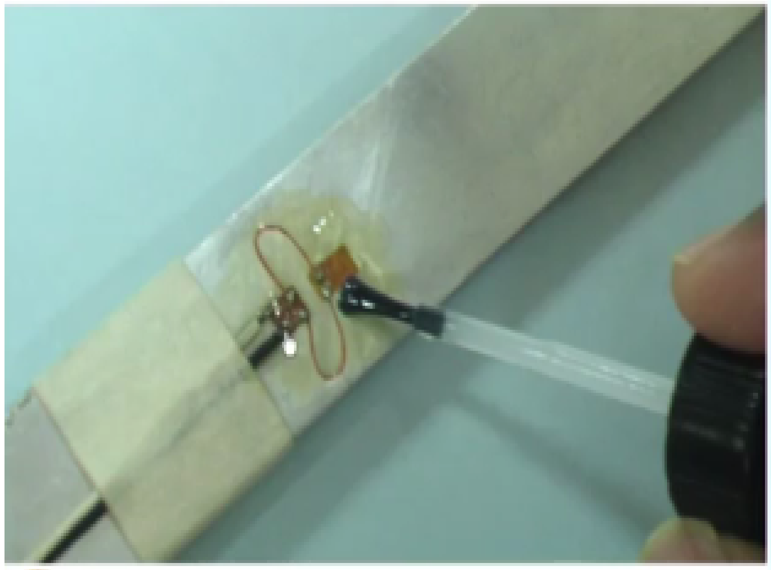

This will provide adequate long term protection and how this should be applied? A coating should be continuous and you should also apply it over the first 3 mm of lead wire installation, so that is what is shown here. So, you find that protective coating is applied, it is also continued on the lead wire portion and you can see very clearly here, you have the plastic insulation almost very close to the soldered joint.

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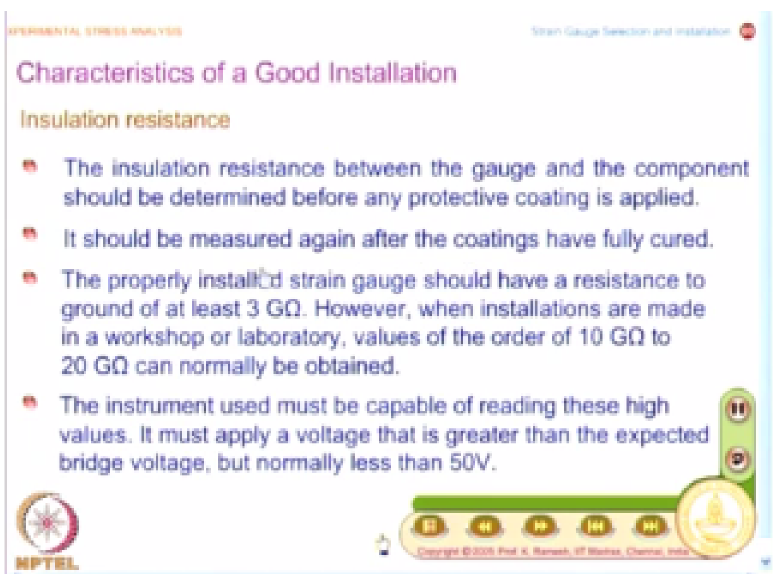

So that, there is no shorting of the terminals here, so all that needs to be looked at and we have to ensure before we make strain gauge measurement, look at the characteristics of a good installation. I have also mentioned it earlier about insulation resistance, if a good insulation is ensured, when you have a very high resistance of the order of 10 Giga ohms. What you need to do is; you need to measure the insulation resistance between the gauge and the component.

If recommendation is; you determine it before and also after any protective coating is applied and you need to do this again after the coating are fully cured. If you have 3 Giga ohms, it is sufficient, however when installations are made in a workshop or laboratory that is what we are looking at; values of the order of 10 Giga ohms to 20 Giga ohms can normally be obtained. See, this is where I said, strain gauge technique is widely used and abused technique.

And I am not sure if somebody has not gone through the systematic training on strain gauge bonding, he would not even bother to measure the insulation resistance. See, you need to measure the insulation resistance, this is very important. Not only this, you will also have to measure the gauge resistance, these are all indicators whether the strain gauge has been handled properly, is there any connectivity loss or is there any shorting of the circuit, all this need to be ensured.

And you have to measure very highly resistance values, so the instrument used must be capable of reading these high values, it is not that any multi meter can directly go on measure these high values and you should also apply an voltage that is greater than the expected bridge voltage but normally less than 50 volts that is what is the recommended and we have seen for most in strain gauge installations, you use a voltage of 3 to 5 volts.

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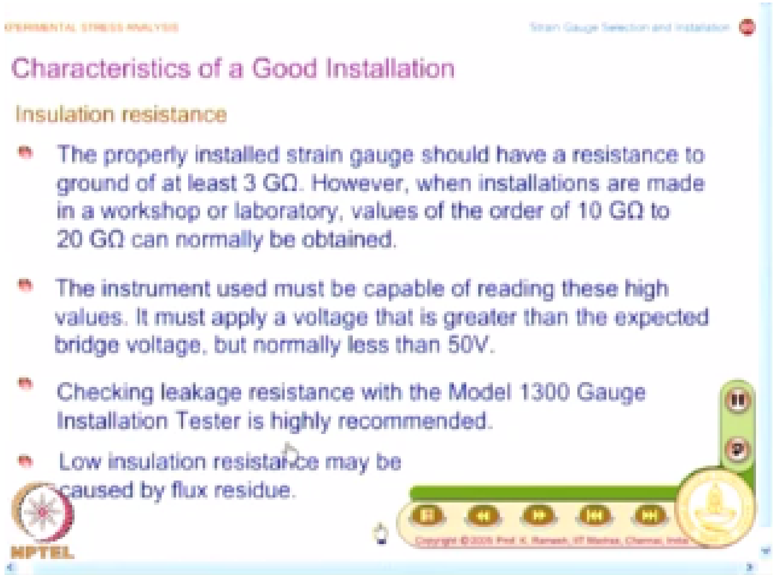

And you also have special meters available that is labelled as model 1300-gauge insulation tester, so which is highly recommended for measuring the insulation resistance and suppose, you find the insulation resistance is low, what is the cause? The cause is; it may be because of flux residue, so you have a via media. If you know, there is a flux residue, take a rosin solvent and then remove it.

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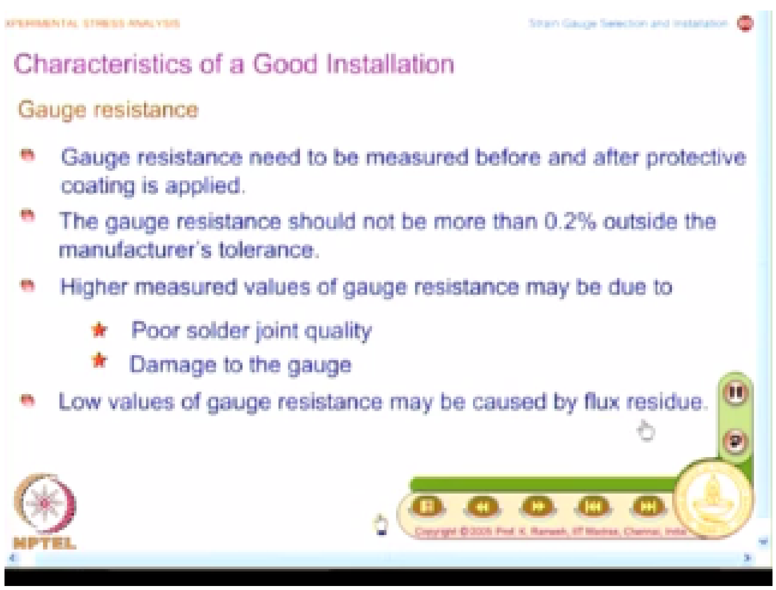

Then, again measure the insulation resistance, if it improves, then the insulation is good enough for you to make the finals strain gauge measurement. So, we have to do a insulation resistance as well as gauge resistance measurement, so this also should be measured before and after protective coating is applied. See in any strain gauge installation, when you take the strain gauge you also measure the resistance even before bonding.

And after bonding and also after protective coating is applied, all this you ensure that if we had taken a 120 ohms, it remain more or less close to 120 ohms, there are no perceptible changes in the resistance introduced and we have also seen that the gauge resistance comes with the percentage and it should be within that percentage, here it is put as 0.2%, it depends on the particular batch.

Suppose, you find the gauge resistance value measured is high, then you will have to infer this may be because of poor solder joint quality. This could be one of the reasons or the worst part is there is damaged to the gauge, you know this is very bad, you do not want to damage the gauge and a damaged gauge will not give you any meaningful strain reading and we have already seen that strain gauge is so thin, if you do not handle it properly, you may introduce certain kind of difficulties.

And we have also looked at when you are using a cellophane tape to align the strain gauge, we caution that you need to keep it at a shallow angle otherwise, you may without knowledge stretch it beyond its elastic limit and this may cause permanent deformation that can also give you problem and here again, you find, if the gauge resistance is low, it may be because of flux residue. So, flux residue can reduce the insulation resistance as well as the gauge resistance.

So, you should remove the flux completely and you know, the same trick works, you know many manufacturers thrive on consumables. So, strain gauge manufacturers also give you the kind of recommendations that you used consumables liberally, so they stay in the business absolutely no problem and from your point of view, you want to make good strain measurement, so it is better that you follow such recommendations and ensure that you have followed.

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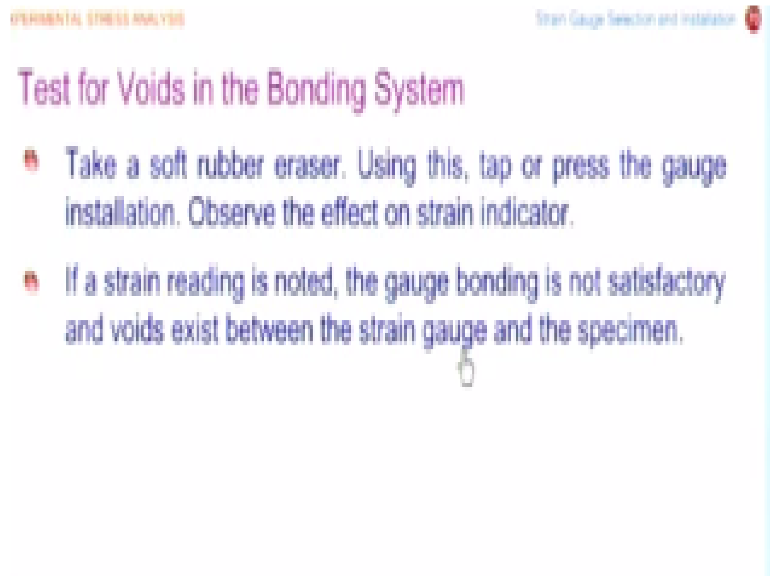

And then, you have to blame only there is a problem in your design or some other issue and you know, you will also had to be careful, have you bonded the adhesive properly? One of the common problems that you can come across is presence of voids and how to test for voids in the bonding system. It is a very simple experiment, take a soft rubber eraser, you do not want to damage the strain gauge, that is why you are taking a soft material.

Using this, tap or press the gauge installation, observe the effect on strain indicator. If strain reading is noted, the gauge bonding is not satisfactory and voids exist between the strain gauge and the specimen that is obvious. You know, if there are voids, which are very small when you press it with a rubber, you know in those positions, the strain foil will get stretched, so that makes reading on your strain meter indicate the presence of voids.

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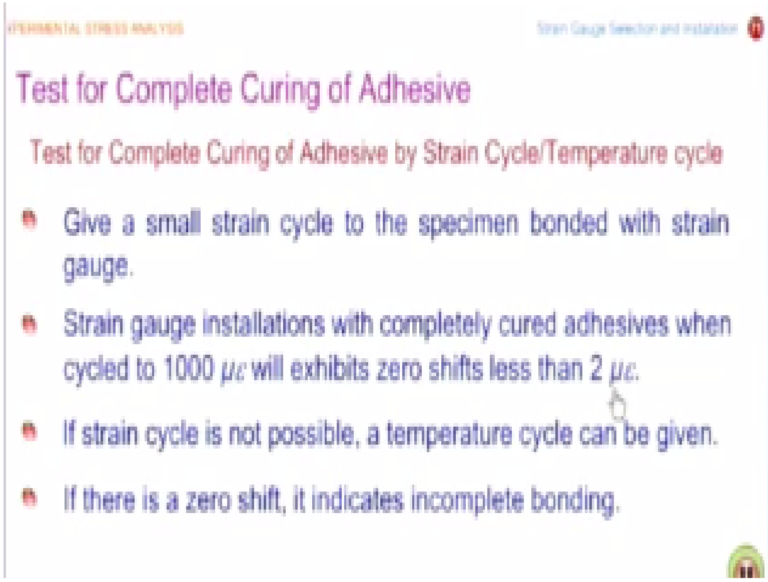

So, this is one check that you have to know. What are the other checks that you have to know? You have to see whether the adhesive has cured completely because you may be in a hurry to make measurement, so you may image jump to making measurement even before the adhesive is cured. So, how to test for this? The recommendation is go for a strain cycle, if you are unable to employ a strain cycle, employ a temperature cycle.

And we have also seen giving a strain cycle in a different context earlier, we have seen in strain gauge installation is the zero shift is significant in an initial few cycles, so you do 5 or 10 cycles before you make the actual measurement that is a different issue. Here, you are using strain cycling as a means to test whether the adhesive has cured and what is observed is the strain gauge installations with completely cured adhesives, when cycled to 1000 micro strain will exhibits 0 shifts < 2 micro strain.

So, this is the test, you go up to 1000 micro strain and observe for zero shift, if it is < 2 micro strain, then you can be assured that the adhesive has cured property. See, we have seen cyano acrylate cement and you have also said it takes hardly a minute or 2 for you to borne and allow 10 minutes for the curing of adhesive and you have to to ensure whether it is cured properly before you make the measurement.

And when you go for transducer applications, you need to wait for longer duration because epoxy takes about 24 hours and even then it is desirable that you check that the adhesive has cured. Suppose, you find, you are unable to do a strain cycle, a temperature cycle is recommended. So, if there is a zero shift, it indicates incomplete bonding, so this comes to the end of strain gauge bonding and soldering.

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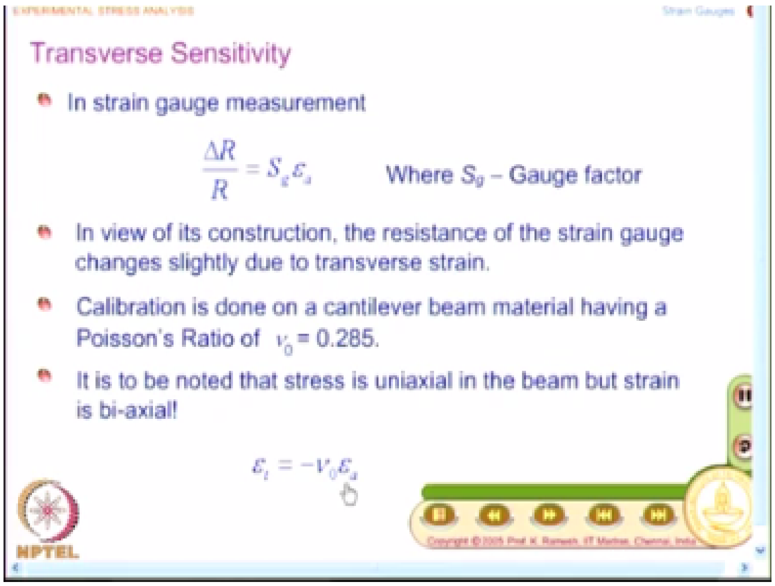

See, what we looked at is; what a simple strain gauge is, what are the constitutes, then we looked at how to select the strain gauge from the array of strain gauges from the manufacturer for a given application, then we need to know how to bond it because bonding is a very very important step and you also need to solder it for you to make any measurement. Now, we move on to finer aspects of strain gauge instrumentation.

You know, we have seen that when you take a conductor, you find the resistance of the conductor changes, when load is applied or temperature is changed. Suppose, I want to measure strain at a point, we found that you need to use at least 36 mm length of the wire and this needs to be folded and formed as grit and paste it at the point of grit. At that time, we also mention whatever the strain gauge you have because it has a finite area; it is sensitive in principle to transfer strain.

And we also saw in strain gauge construction, when you have the end loops; the end loops are made thicker, so that the resistance value is small in transverse direction, so you have tried to minimise the transverse sensitivity. Now, we have the go and look at transverse sensitivity again and find out what kind of correction factors that you need to use to minimise this effects and we have already seen that delta R/ R is given as Sg * epsilon a.

And we also seen that Sg is experimentally measured by conducting a test on a cantilever beam having a Poisson ratio of 0.285, as long as my material on which I need to make strain measurement also has the same Poisson ratio, the same Sg's value for me to get the axial strain but which is not the case, you use a material which has a different Poisson ratio than the calibrations specimen.

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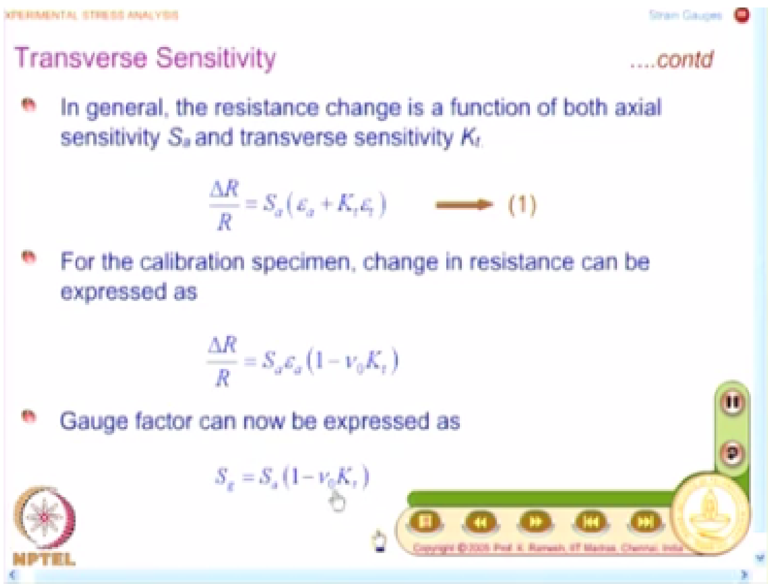

And this I have said again and again, you need to keep in mind, when stress is uniaxial, strain is biaxial in the calibration, so you have a transfer strain = - Nu0 times epsilon a, and the question is how do we account for sensitivity of the strain gauge to the transverse direction? This all equation also we have seen earlier; delta R/ R is a function of epsilon a, as well as epsilon t, you have this as delta R/ R = Sa * epsilon a + Kt * epsilon t.

And Kt is your transverse sensitivity factor, so in the case of a calibration specimen, we know what is epsilon t, because we have got this as –Nu 0 times epsilon a, so I can rewrite this expression as delta R/ R = Sa * epsilon a * 1 – Nu 0 Kt and what this expression helps me to get;

I can express the gauge factor as a function of Sa as well as Kt, so you find this gauge factor Sg = Sa, the axial sensitivity of the strain gauge multiplied by 1 - Nu 0 Kt.

And you know, you will be surprised we said our focus is to find out strain at a point, we do not have a magic material, which is like a speck, which I can put it at the point of interest and make measurement, we need to necessarily go for a grit, the moment you bring a grit, the grit is sensitive to axial strain primarily as well as a low sensitivity in the transverse direction and now, what we are going to do is; you are going to bring in a another interesting concept called apparent strain.

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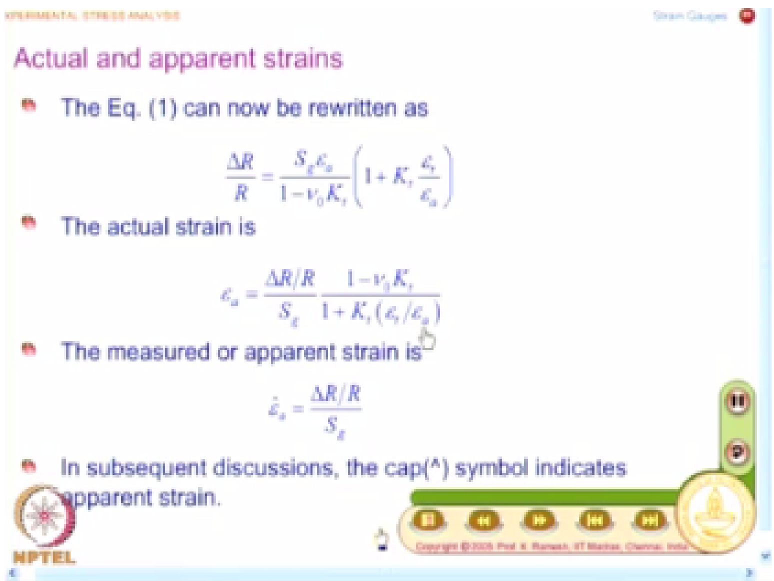

So, what we are going to do is; we are going to say whatever you measure is only apparent, we have to find out the actual strain, we have seen the expression for the gauge factor in terms of Nu 0 as well as Kt and Sa, I can replace Sa as a function of Sg and the known quantities, so I get delta R/ R = Sg epsilon a/ 1 – Nu0 Kt * 1 + Kt epsilon t/ epsilon a, I do this with their focus in mind, there are class of problems it is possible to find out that the ratio of epsilon t/ epsilon a.

So, I can have different strategies in handling transfers sensitivity effect that is why recast the equation in this form but recasting this equation by replacing Sa also has an advantage because I said that I want to bring in a concept of apparent strain as well as actual strain. Apparent strain is what your strain meter gives and that is expressed like this. I can recast this expression in a manner that epsilon a = delta R / R divided by Sg.

And we have already looked at this is the way you would be fine, what is strain but because of the influence of the transfer sensitivity effect, I can call this factor, delta R/ R divided by Sg as epsilon a cap and we labelled this as apparent strain and this is what you see in the strain meter. The strain meter directly gives you some strain value, we now say because the strain gauges in the form of grit, there is also sensitivity in the transverse direction.

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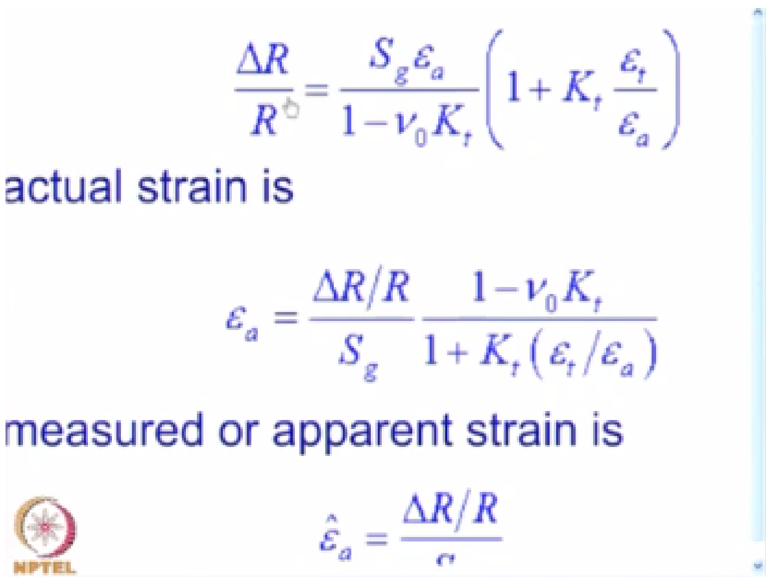

So, what you see in the strain meter is not the actual strain, it is one a apparent strain, so I have expression for actual strain, which says I have epsilon a cap, I can replace this multiplied by 1 – Nu 0 Kt/ 1+ Kt * epsilon t/ epsilon. I think, you can see this expression slightly enlarged, so what I have here is; I have the basic expression delta R/ R, express in terms of axial strain and transfer strain and you define what is actual strain.

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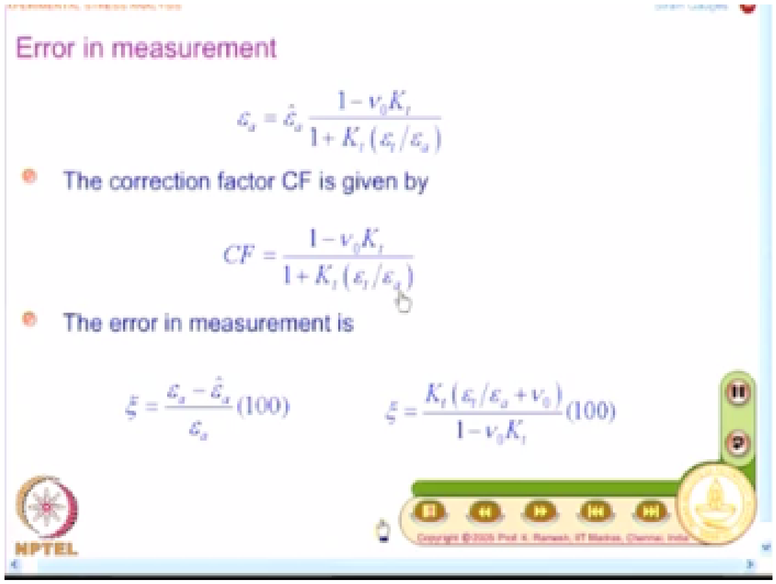

We find the actual strain is a function of apparent strain that is delta R/ R divided by Sg multiplied by a factor, so I need to have this factor in my calculations for me to get the actual strain from the apparent strain and once you have this, you can also find out the error, all the other aspects that you can do and that is what is mentioned in the next is like. So, we have the actual strain function of apparent strain multiplied by the factor and you can call this as a correction factor.

And the correction factor is 1 – nu 0 Kt/ 1+ Kt * epsilon t/ epsilon a, see you have to have the focus fine, we find that when you make it as a grit, it is also sensitive to the transfer strain and we have also been able to define what is apparent strain and what is actual strain and one of the question is; how do I go and improve my strain measurement. After understanding the problem, we should also have a via media how to correct for these transverse sensitivity errors.

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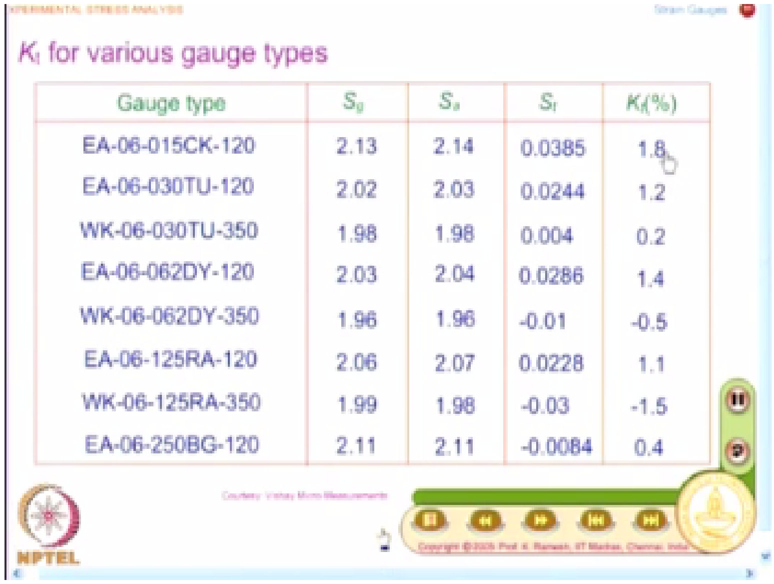

Gauge type	S_g	S_a	S_t	K_t(%)
EA-06-015CK-120	2.13	2.14	0.0385	1.8
EA-06-030TU-120	2.02	2.03	0.0244	1.2
WK-06-030TU-350	1.98	1.98	0.004	0.2
EA-06-062DY-120	2.03	2.04	0.0286	1.4
WK-06-062DY-350	1.96	1.96	-0.01	-0.5
EA-06-125RA-120	2.06	2.07	0.0228	1.1
WK-06-125RA-350	1.99	1.98	-0.03	-1.5
EA-06-250BG-120	2.11	2.11	-0.0084	0.4

And before we move on to that we also look at what are the typical transverse sensitivity that you come across. See, you need to have a focus in the case of strain gauge instrumentation; we are demanding very high accuracy of the order of 0.5 micro strain. If I have to do that then I have to look at transverse sensitivity effect and then correct for it only then I will be finally satisfied and before we get into correct in for the transverse sensitivity, let us look at the Kt values.

You can write for just 2 strain gauges and you have also seen when you have a number like this; what these numbers depict; 120 at the end depicts that this is the resistance and your 06 depicts it is the STC number and 015 gives the gauge length and this gives the gauge pattern and you have this as the carrier and A is your advance that the foil alloy of the strain gauge and what you find here is; I have the values of gauge factor listed in the first column.

And you have the axial sensitivity of the strain gauge is listed in the second column and you have the transverse sensitivity St and transfer sensitivity factor Kt and this you find it is about 2%, you know it varies from -0.52 to 1.8 in this case of these set of strain gauges and it can vary up to 10% depending on the kind of gauge configuration. The idea is to show the influences of the order of 1 to 2%, it is small, it is not very high okay but even this we want an account for that is what makes our strain gauge instrumentation more precise to measure small quantities.

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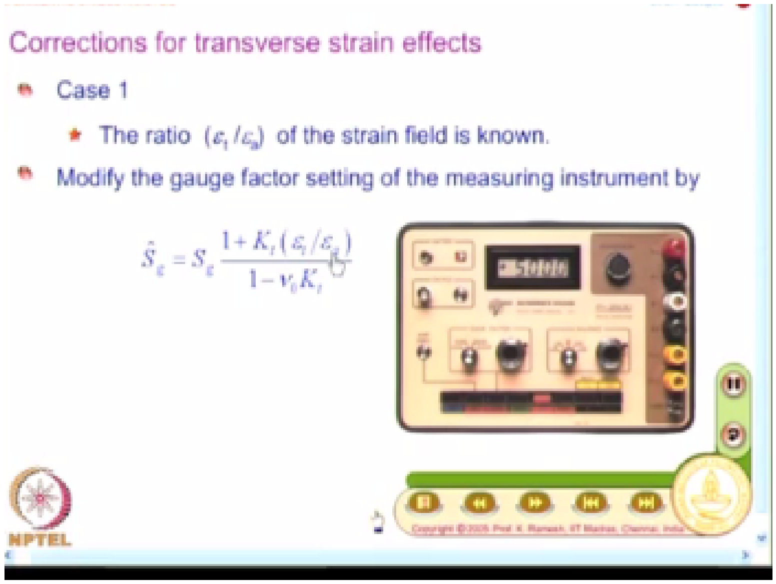

How do you do that? We can look at in terms of 2 different possibilities; in case 1, the ratio of Epsilon t/ Epsilon a is no, then my correction approach is very very simple. We have already looked at expression for the gauge factor and when you go back and recast the equation, you can also have a modified gauge factor Sg cap given as Sg * 1+ Kt * Epsilon t/ Epsilon a/ 1 – Nu0 Kt. See, you know, what is the strain gauge that you are using.

So, the strain gauge description gives you the value of Kt, numerator can be completely evaluated if you also know Epsilon t/ Epsilon a, the ratio. If I know this ratio, it is enough I find out the modified gauge factor and you know in the earlier classes, I have said when we have a strain gauge meter, it has a specific nob for setting the gauge factor or if you are using software, it will have a provision to feed in the gauge factor.

What you find here is the transverse sensitivity effect can be corrected for a class of problems, where you know the ratio of Epsilon t/ Epsilon a, then you can modify the gauge factor and feed it appropriately, that is at all you have to do. See, if the corrections are not simple, nobody will use it, only if the corrections are simple, people will also try to improve your measurement quality.

And you know, if you are not trained in strain gauge instrumentation systematically, you will only look at; I paste a strain gauge and look at the strain meter and note down the readings. Such an approach is definitely not advisable because you find there are various factors that contribute to it and when you find transverse sensitivity, even that can be corrected. When it can be corrected, why do not you correct it, so this is very important unless you take such minute steps in strain gauges' instrumentation, whatever you may share maybe way off.

So, in this class, what we have looked at was; we looked at how to do soldering of the terminals and tabs properly, so that I can connect the lead wire and we have also looked at in what sequence I have to lift the solder wire as well as the soldering iron, even changing the sequence, can give you problem on the final soldering. So, even for such simple activities, clear recommendations are provided by the manufacturer and towards the end, we also saw how to inspect the installation to see that strain gauge is properly bonded.

There is no damage to strain gauge, there is sufficient insulation resistance, then we moved on to finer aspects of strain gauge instrumentation. We have taken up the case of accounting for transverse sensitivity effects and we saw the definition of what is an apparent strain and what is an actual strain and this will continue to look at for later cases also, we look at in hydrostatic pressure, what is apparent strain in other measurement scenario also what you read from the strain meter will be labelled as apparent strain.

And that needs to be corrected suitably depending on the problem on hand to read the correct strain values. We have seen if the ratio of transfer strain to actual strain is known, then simply modifying the gauge factor can correct this error and that is why strain meter comes with a gauge factor setting nob and if you are having software that will allow you to feed in the gauge factor values suitably. Thank you.