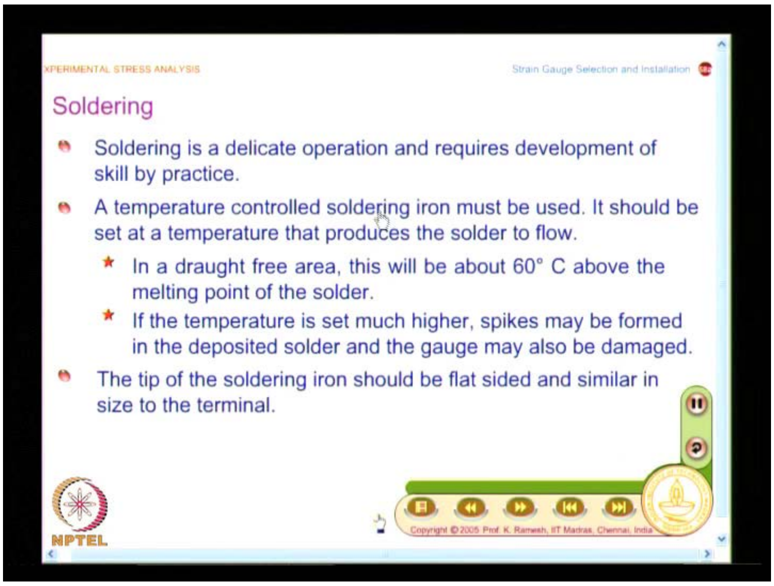
Experimental Stress Analysis

Prof .K. Ramesh
Department of Applied Mechanics
Indian Institute of Technology, Madras

Module No. # 05
Lecture No. # 38
Soldering, Accounting for Transverse Sensitivity Effects

We have looked at in the last class what are the surface preparation required for strain gauge bonding. Then, we moved on to how to draw the 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 bonding. And in the example we will looked at how to use a (( )) 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 a epoxy adhesive.

(Refer Slide Time: 01:17)

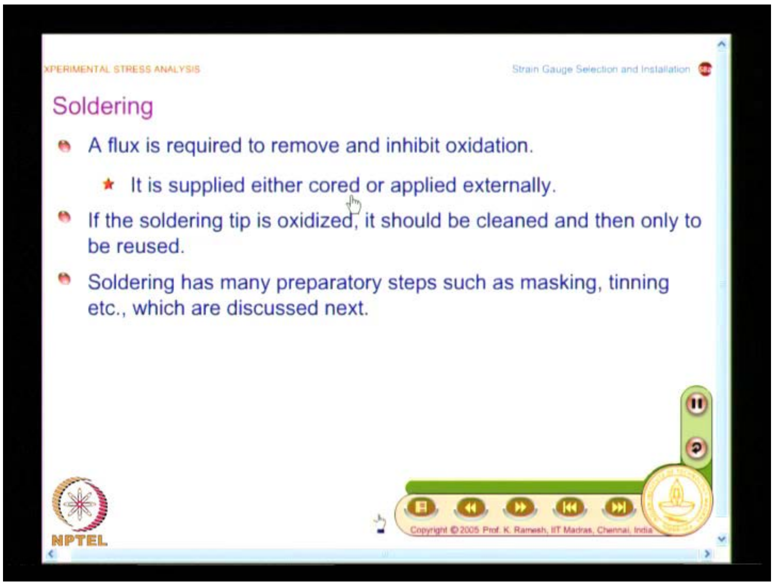


So, you have learnt a basic procedure on how to bond the strain gauge. Now, the next step is to go for soldering and as you all know soldering is a delicate operation and requires development of skill by practice. And one of the important requirements is you need to use a temperature controlled soldering iron. The reason is you need to set the temperature so that the solder is ready to flow. And what is mentioned is in a draught free area, this will be about 60 degree C 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.

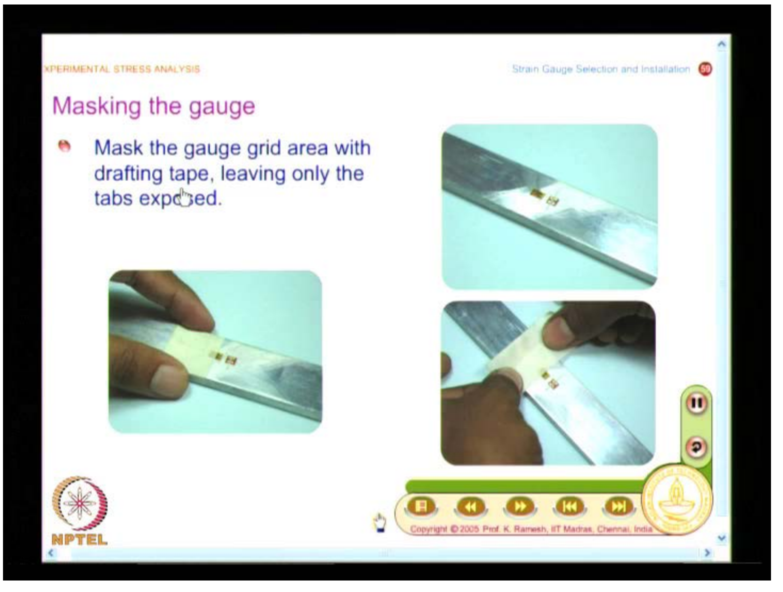
And Similar in size to the terminal because we have seen strain gauges of different sizes available and the tabs are also depending on what is the kind of strain gauge that you are using. So, it is better when you go for very precision strain measurement suppose, you use a strip gauge you will have. A very small tab and a general purpose strain gauge you may have a longer larger size tab.

(Refer Slide Time: 03:38)



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 a 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 your application of flux. And what you need to keep in mind is if the soldering tip is oxidized it should be cleaned 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 minimize the damages. So, you have masking you have tinning, etcetera.

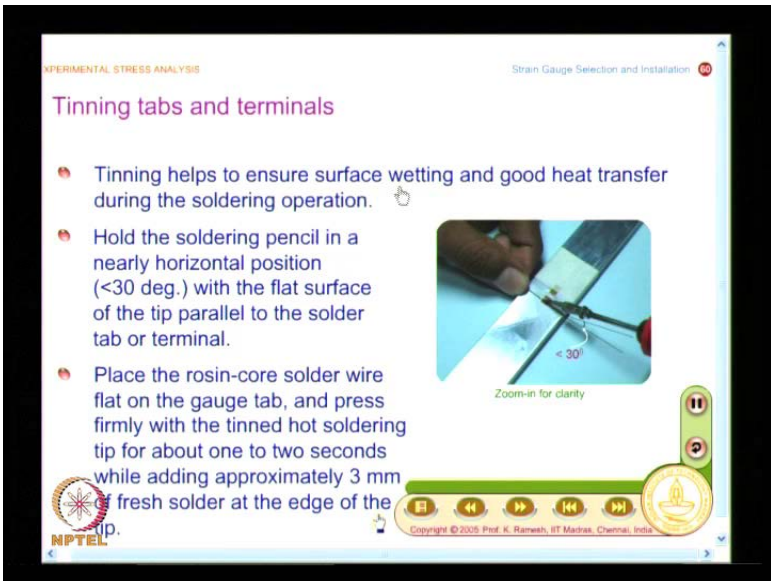
(Refer Slide Time: 05:05)



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 masking the gauge. And what is shown here is to facilitate soldering, you find that grid area is covered by the masking tape and also the terminal you need to solder at four points, these are mark. And for a beginner you can also take one more step where in you mask all other points leave 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 join the terminals. You will see such poorly soldered joints in the next few slides to follow so, this happens. So, in initial stages of practicing 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.

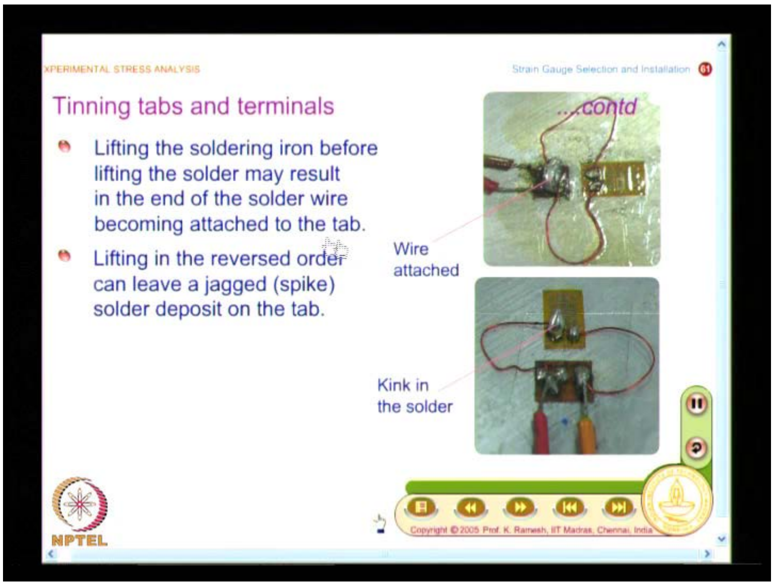
(Refer Slide Time: 06:35).



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. And you need to hold the soldering pencil in a nearly horizontal position with the flat surface of the tip, parallel to the solder 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 degrees. And also notice whatever 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 the tinned hot soldering tip for about one to two seconds while adding approximately 3 millimeter 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, what is the angle that you have to maintain because all these minute details are required for the good soldering at the terminal and the tabs.

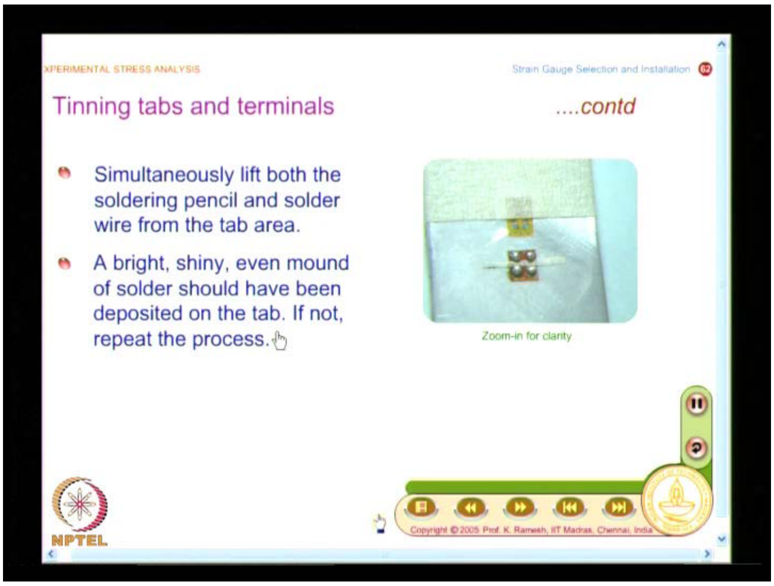
(Refer Slide Time: 09:04)



And there is also recommendation went to lift the soldering material as well as the soldering techniques. 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. So, what will happen is suppose I will 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 soldered.

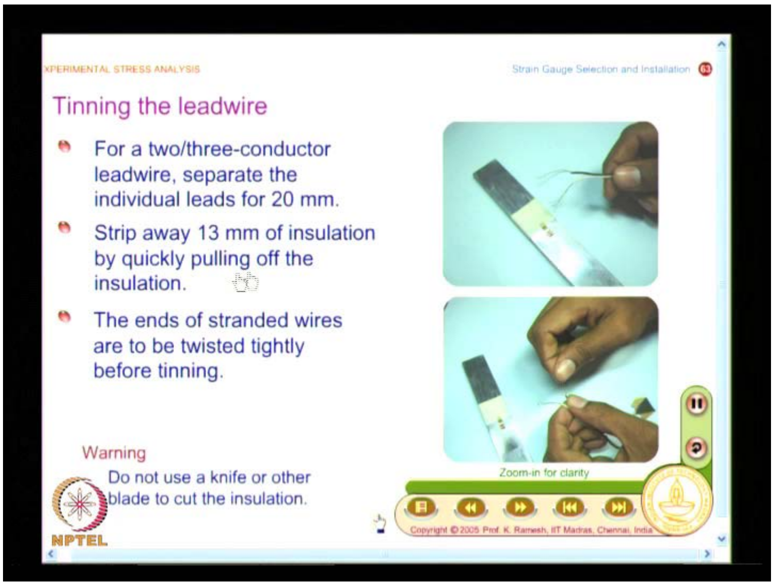
These are all poor examples this was selected from the lab experiments done by the students and you find in addition to this problem both the terminals are joined by a improper soldering. So, what is shown here is you see this soldering material attached. And you have the other case suppose, I lift the 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 soldering joint. See, this join is good, but this joint is bad. See, you may wondering when you get something like this, what mistake you have committed? So, the manufacturers have done all these trials and have recommended what causes what. So, a introduction to these kind of problems is desirable. So that you can avoid them in actual practice.

(Refer Slide Time: 11:03)



So, what is the recommendation? The recommendation is lift the soldering pencil and the solder 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 if not, repeat the process. And you have a nice example you know you saw the counter example 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.

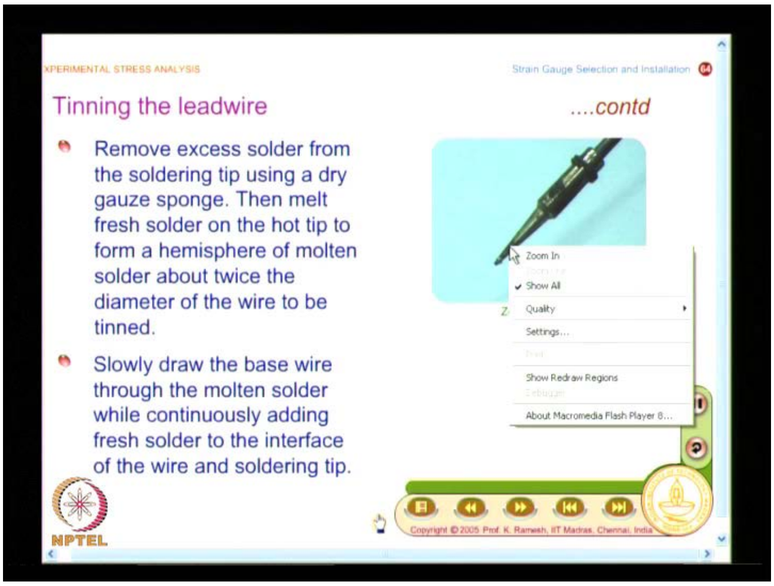
(Refer Slide Time: 11:55)



And after tinning the tabs and terminals, you need to tin the lead wire also, (( )) even minute details are given. You know when you have a wire you need to separate them first because the plastic wire will be joint and this says separate the individual leads for 20 millimeter. You have a recommendation, do it for 20 millimeter. It improves a pliability in, aligning the lead wire when you do the soldering. And the next recommendation is strip away 13 millimeter of insulation by quickly pulling off the insulation. You know this also you need to do it carefully, there are special tools available to do this.

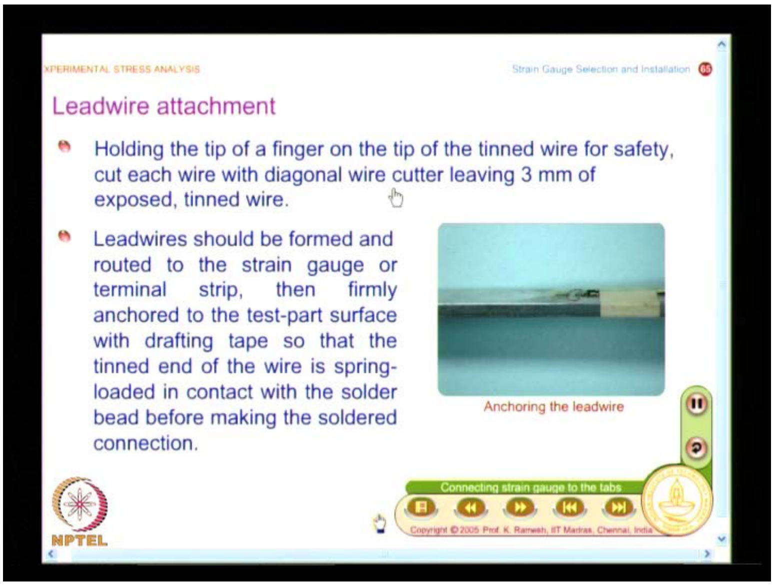
So, the warning is do not use a knife or other blade to cut the insulation. Use the proper tool and remove the insulation. And to facilitate tinning the ends of stranded wires are to be twisted tightly before tinning.

(Refer Slide Time: 13:29)



So, all that is shown here you can just have a look at it you separate the plastic and then you twist the ends of the strands, then go for tinning. (No audio from 13:24 to 13:33) 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 draw. And the recommendation is you need to have a draw which is twice the size of the wire that you are going to tin. 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. 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. You need to feed the soldering material, the idea is you want to form a coat of solder on the twisted tips.

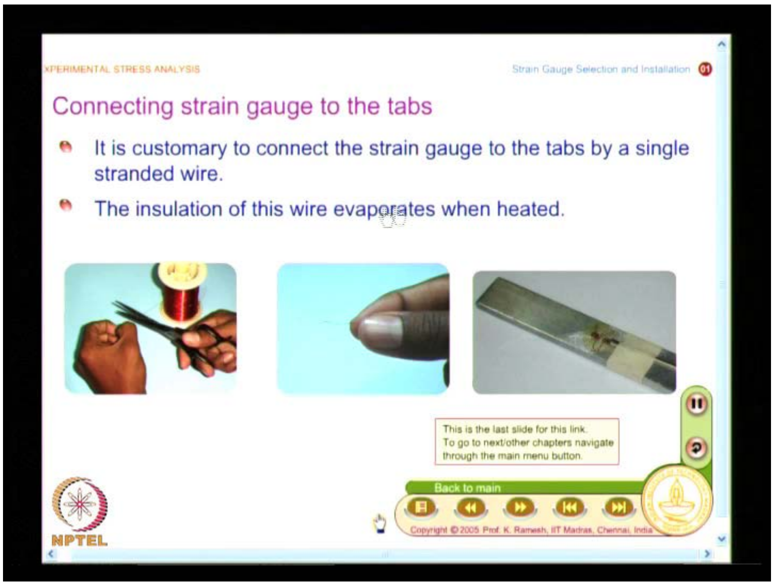
(Refer Slide Time: 15:15)



Then what you do? You need to attach the lead wire and the recommendation is again very clear. You take only 3 millimeter of the twisted wire, you cut it with the diagonal wire cutter, leaving 3 millimeter of exposed tinned wire. The reason is, you know you have to solder it on the tab or the terminal and 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 bead before making the soldered connection. See, the idea here is you have to do the anchoring, 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 apply the solder, it will join at this point. You are not allowing any load to be transferred by this. That is taken by the drafting tape the lead wires are anchored.

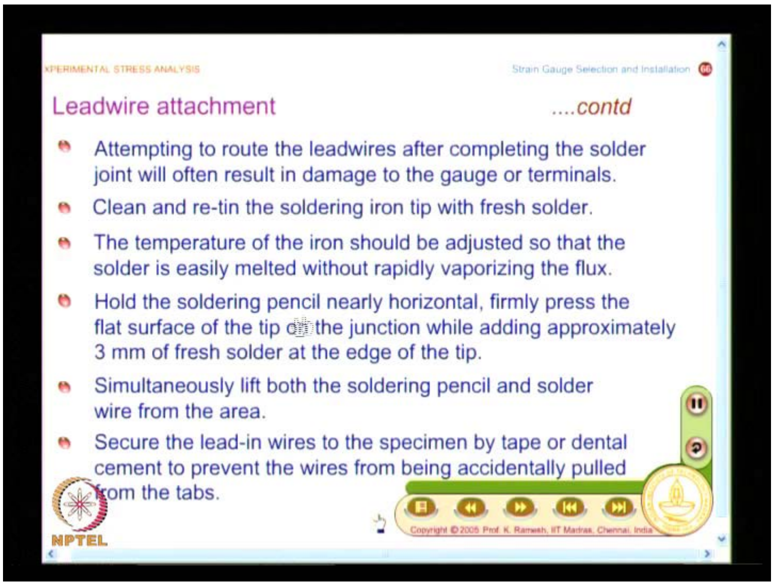
(Refer Slide Time: 17:27)



So, you just put the solder and join the lead wire to the terminal or the tab, whichever that you are looking at. And there is also another minor detail, this is also very important. Because we have shown at 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 the special wire that is applied by the manufacturer, it has a coating. And the insulation of this wire evaporates when heated.

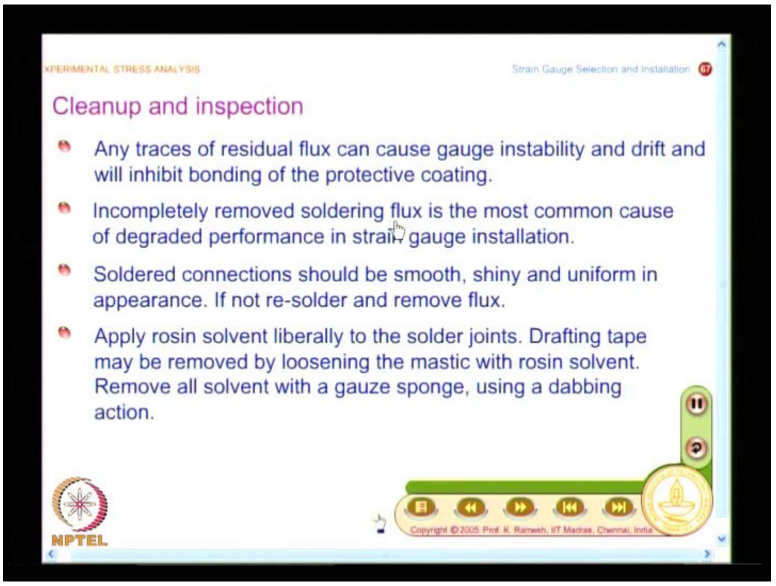
So, it is very convenient from handling point of view. So, you take a small length of wire that is what shown here. And I will enlarge this picture to show you, how the tabs are connected to the terminals. So, you put this by a single stranded wire and mind you this is insulated, this not a pair wire. It the insulation gets removed only at the points where you heat and joint it with the solder. In fact, this is the complete insulation it is also applied with protective coating, but this illustrates how do you connect the strain gauge to the terminals. We are already seen how to connect the lead wire to the terminals.

(Refer Slide Time: 19:00)



We are looked at that step in 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 millimeter 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 solder wire from the area. So, if you do it in different orders, you saw different problems coming. And as mentioned before this is again emphasized, secure 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. (No audio from 20:27 to 20:36)

(Refer Slide Time: 20:35)

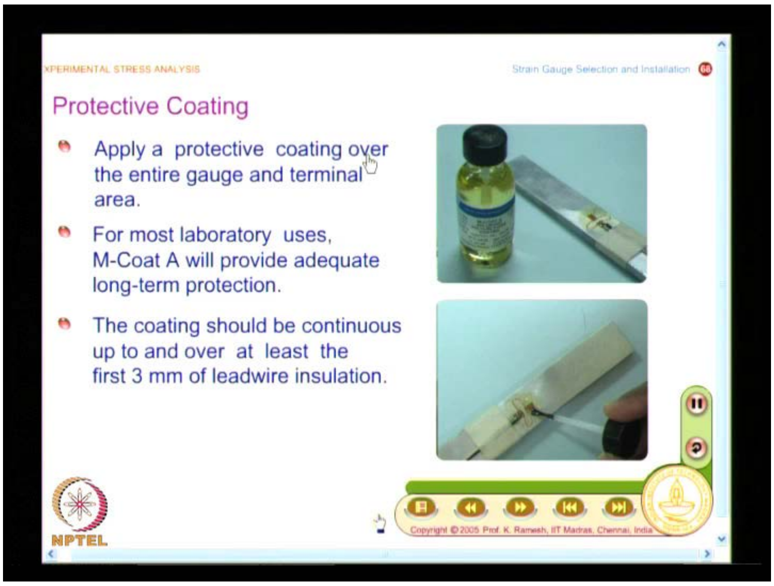


And after doing all these, you need to do a cleanup and also inspect both are important. Any traces of residual flux can cause gauge instability and drift and will inhibit bonding of the protective coating. So, this is very important see you use a flux for what to have a congenial atmosphere for soldering to take place. After the soldering operation is over, the flux should be completely removed. You have 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 completely removed. And the important aspect is incompletely removed soldering flux is the most common cause of degraded performance in strain gauge installation. So, the recommendation is apply rosin solvent liberally to the solder joints and you can also loosening the drafting tape with rosin solvent. And finally, remove all solvent with a gauze sponge. You should not allow the solvent to evaporate, you should remove it with a gauze sponge using a dabbing action. And what is that you have to look at finally, the soldering connections should be smooth, shiny and uniform in appearance. If it is not so, what to do? The recommendation is resoled 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 and those patterns you can use it for getting yourself trained and develop the skill then finally, you go for actually pasting a strain gauge and then soldering it.

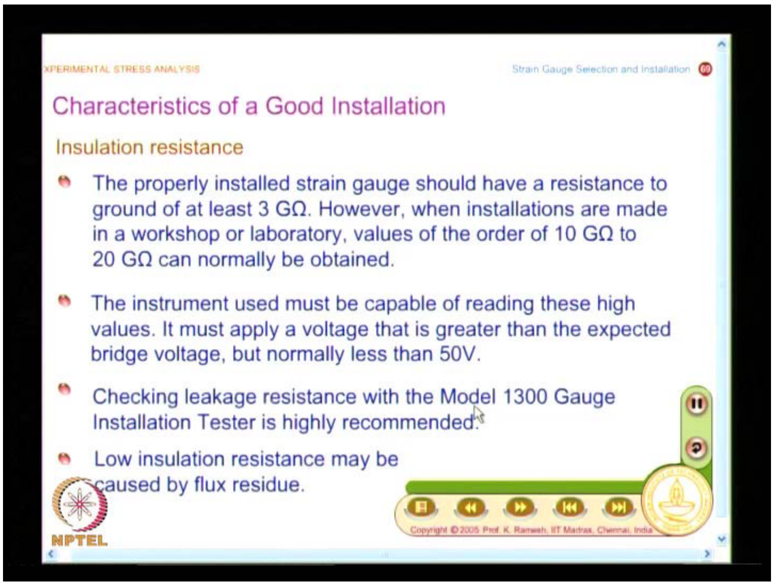
(Refer Slide Time: 23:22)



And you know is a (( )) nuisance and this needs to be avoided. And in order to protect the strain gauge insulation 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 measurements, they have what is called as M-coat A which is essentially a poly urethane. This will provide adequate long term protection. And how this should be applied? The coating should be continuous and you should also apply it over the first 3 millimeter of lead wire insulation.

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. So, that there is no shorting of the terminals here. So, all that needs to be looked at. (No audio from 24:51 to 25:04)

(Refer Slide Time: 25:03)

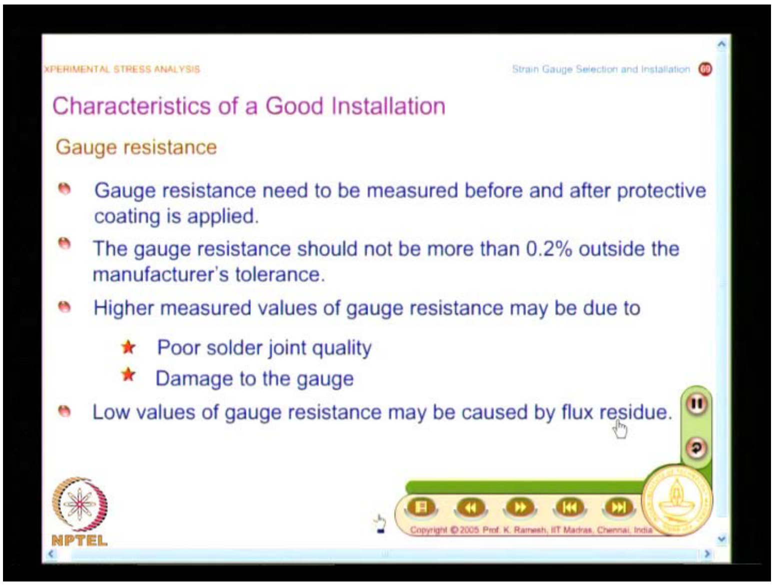


And we have to ensure before we make strain gauge measurement. Look at the characteristics of a good installation. I have also mentioned it earlier about insulation resistance. If a good installation is ensured when you have a very high resistance of the order of 10 Giga ohms. What you need to do is, you need to measure the insulation resistance between the gauge and the component. The recommendation is you determine it before and also after any protective coating is applied. And you need to do this again after the coatings have fully cured. If you have 3 Giga ohms it 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 these need to be ensured. And you have to measure very high resistance values. So, the instrument used must be capable of reading these high values. It is not that any millimeter can directly go and measure these high values. And you should also apply a voltage that is greater than the expected bridge voltage, but normally less than 50 volt that is what is recommended. And we have seen for most in strain gauge installations you use a voltage of 3 to 5 volts.

And you also have special meters available that is, labeled as model 1300, gauge installation 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. Then again measure the insulation resistance. If it improves then the insulation is good enough for you to make the final strain gauge measurement.

(Refer Slide Time: 28:50)

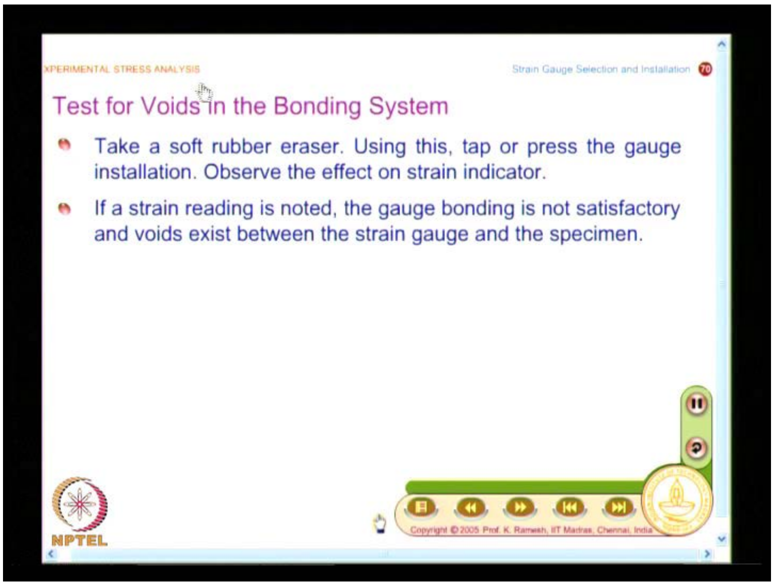


So, we have to do a insulation resistance as well as gauge resistance measurement. So, this also should be measured before and after protective coating is applied. See, in any strain gauge installation when you take the strain gauge, you also measure the resistance even before bonding. And after bonding and also after protective coating is applied. All these you ensure that if you have 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 error and it should be within that percentage.

Here it is put as 0.2 percent, 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 damage 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 it is elastic limit. And this may cause permanent deformation that can also give you problem.

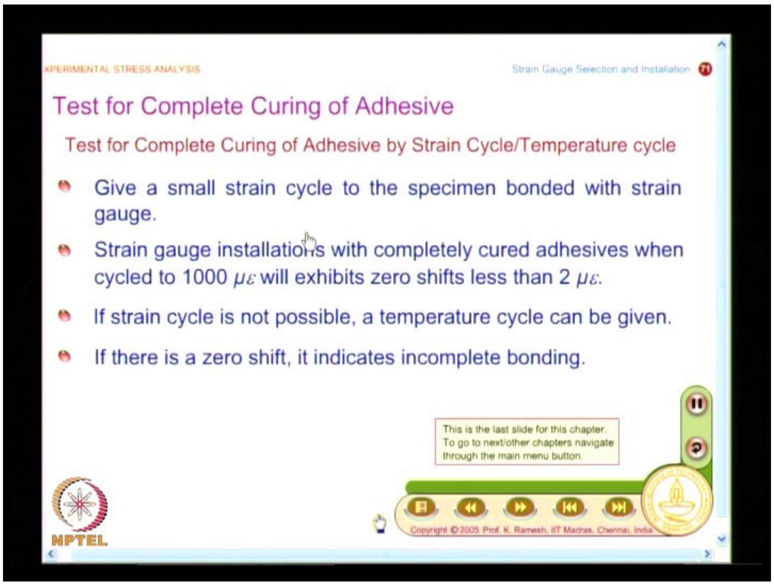
And here again you find if the gauge resistance is low, it may be because of flux residue. So, flux residue can reduce the insulation resistance as well as the gauge resistance. So, you should remove the flux completely and you know the same trick works. You know many manufacturers try want consumables. So, strain gauge manufacturer also gives you the kind of recommendations that you use consumables liberally. So, they stay in 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 and then you have to blame only there is a problem in your design or some other issue.

(Refer Slide Time: 31:42)



And you know you will also have 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 purse it with the rubber you know at those positions the strain foil will get stretched. So, that makes a reading on your strain meter indicates the presence of voids. So, this is one check that you have to do.

(Refer Slide Time: 33:10)

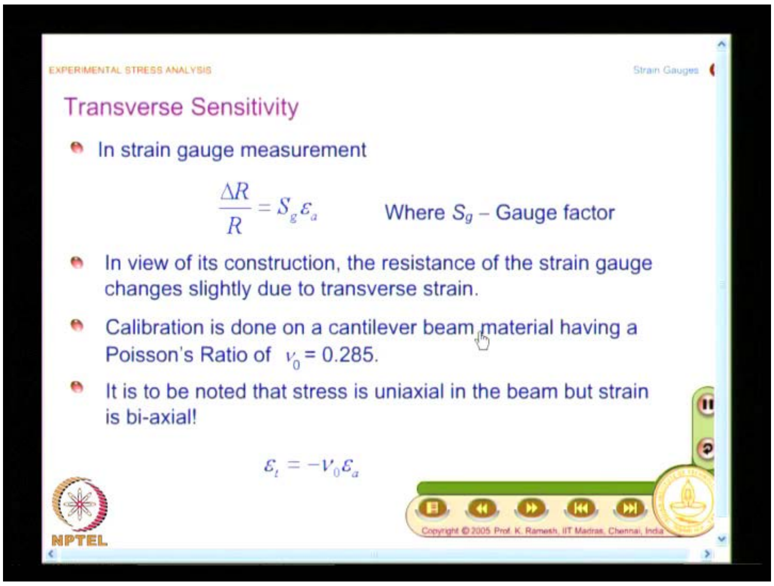


What are the other check that you have to do? You have to see whether the adhesive has cured completely. Because if you may be in a hurry to make measurement so, you may jump to making measurement even before the adhesive is cured. So, how to test for this? The recommendation I sustain cycle if you are 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 installations the zero shift is significant in a initial few cycles. So, you do five or ten 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 exhibit zero shifts less than 2 micro strain. So, this is the test. You go up to 1000 micro strain and observe for zero shift if it less than 2 micro strain then you can be assured that the adhesive has cured properly. See, we have seen cement and you have also said it takes hardly a minute or two for you to bond and allow ten minutes for the curing of the adhesive. And you have 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. See, what we are looked at is what a simple strain gauge is, what are the constituents. 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.

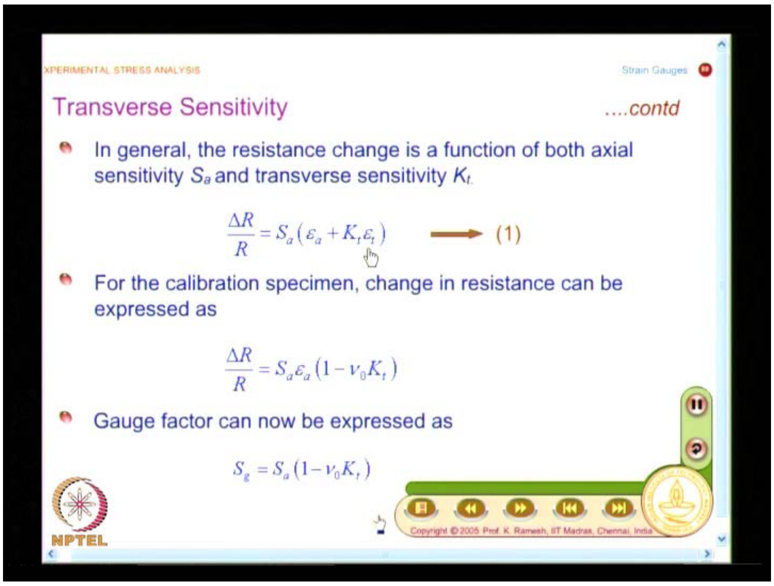
(Refer Slide Time: 36:28)



Now, we move on to final 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 thirty 6 millimeter length of the wire and this needs to be folded and formed as a grid and paste it at the point of at that time. 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 you also saw in strain gauge construction when you have the n loops the n loops are made thicker. So, that the resistance value is small in transverse direction. So, you have try to minimize the transverse sensitivity.

Now, we have to go and look at transverse sensitivity again and find out what kind of correction factors that you need to use to minimize these effects. And we have already seen that delta R by R is given as S g into epsilon a and we have also seen that S g is experimentally measured by conducting a test on a cantilever beam having a poison 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 S g is valid for me to get the axial strain, but which is not the case. You use a material which has a different poison ratio than the calibration specimen. And this I have said again and again you need to keep in mind when stress is uniaxial, strain is biaxial in the calibration table. So, you have a transverse strain equal to minus nu naught times epsilon a.

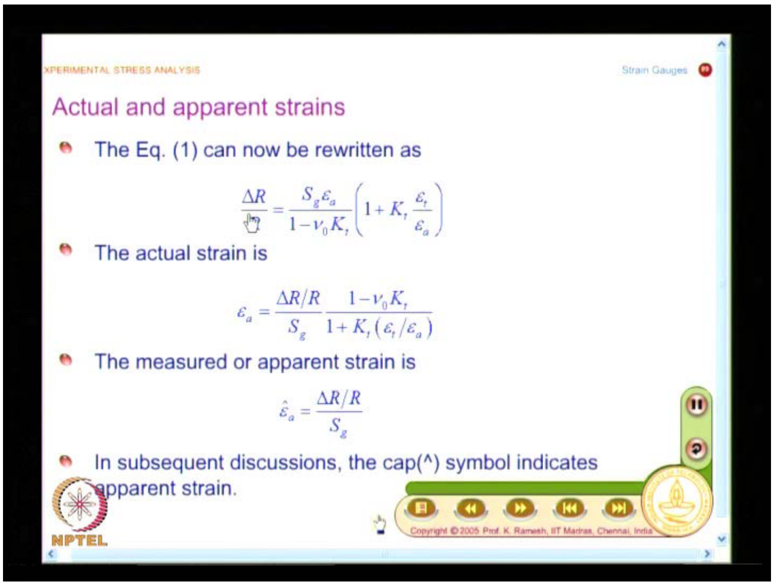
(Refer Slide Time: 39:11)



And the question is how do we account for sensitivity of the strain gauge to the transverse direction? This also equation also you have seen earlier, delta R by R is a function of epsilon a as well as epsilon t. You have this as delta R by R equal to S a into epsilon a plus K t into epsilon t and K t 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 minus nu naught times epsilon a. So, I can rewrite this expression as delta R by R equal to S a into epsilon a into 1 minus nu naught K t and what this expression helps me to get? I can express the gauge factor as a function of S a as well as K t. So, you find this gauge factor S g equal to s a the axial sensitivity of the strain gauge multiplied by 1 minus nu naught K t.

Anyhow 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 spec which I can put it at the point of interest and make measurement. We need to necessarily go for a grid. The moment you bring a grid the grid 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 we are going to bring in a another interesting concept called apparent strain.

(Refer Slide Time: 41:39)



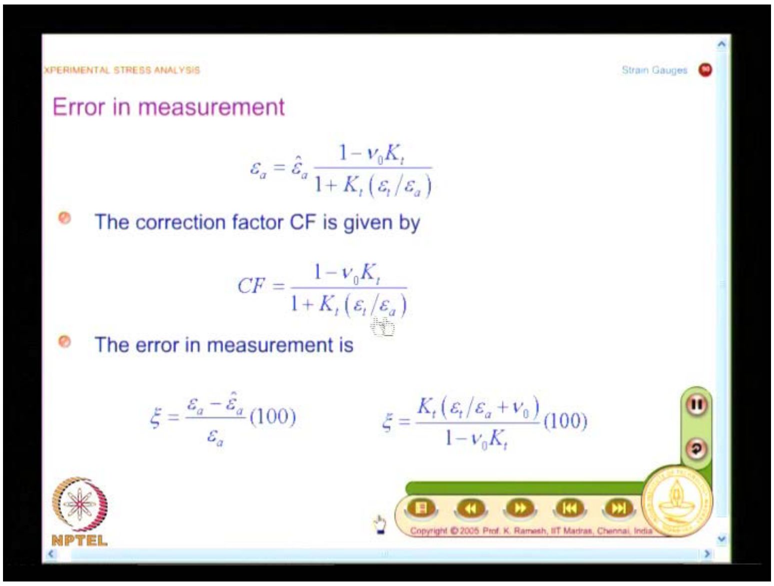
So, what we are going to do is, we are going to say whatever you measure is only apparent we have to find out the axial strain. We have seen the expression for gauge factor in terms of nu naught as well as K t and S a, I can replace S a as a function of S g and the known quantities. So, I get delta R by R equal to S g epsilon a divided by 1 minus nu naught K t into 1 plus K t epsilon t by epsilon a. I do this with a focus in mind there are class of problems it is possible to find out the ratio of epsilon t by epsilon a.

So, I can have different strategies in handling transverse sensitive effect that is why we recast the equation in this form, But recasting this equation by replacing S a also has an advantage because I said that I want to bring in a concept of apparent strain as well as axial 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 equal to delta R by R divided by S g. And we have already looked at this is the way you define what is strain, but because of the influence of the transverse sensitivity effect I can call this factor delta R by R divided by S g as epsilon a cap. And we label 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 gauge is in the form of a grid there is also sensitivity in the transverse direction. So, what you see in the strain meter is not the actual strain it is only an apparent strain. So, I have expression for actual strain which says I have epsilon a cap I can replace this multiplied by 1 minus nu naught K t divided by 1 plus K t into epsilon t by epsilon a. I think you can see this expressions slightly enlarged.

So, what I have here is, I have the basic expression delta R by R expressed in terms of axial strain and transverse strain. And you define what is actual strain, we find the actual strain is a function of apparent strain that is delta R by R divided by S g 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 slide.

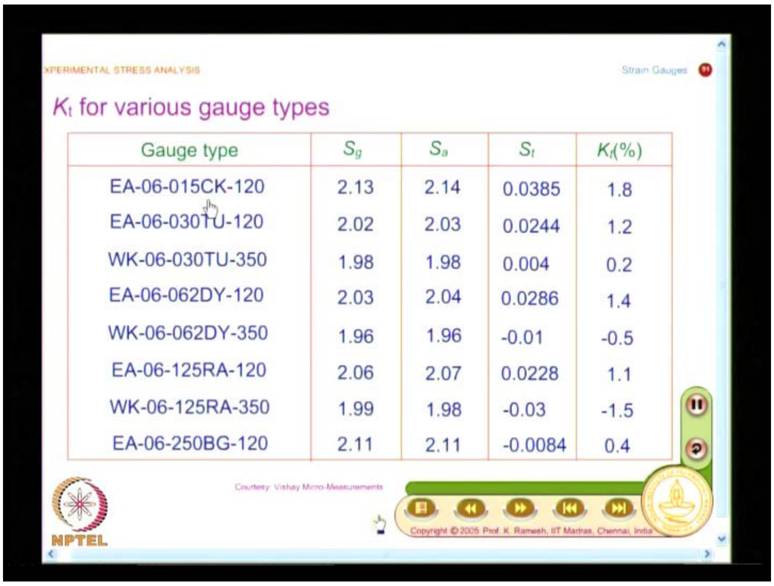
(Refer Slide Time: 45:07)



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 minus mu naught K t divided by 1 plus K t into epsilon t by epsilon a. See, you have to have the focus fine, we find that when you make it as a grid. It is also sensitive to the transverse strain and we have also been able to define what is apparent strain and what is actual strain. Now, 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.

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 for transverse sensitivity. Let us look at the K t values.

(Refer Slide Time: 46:39)

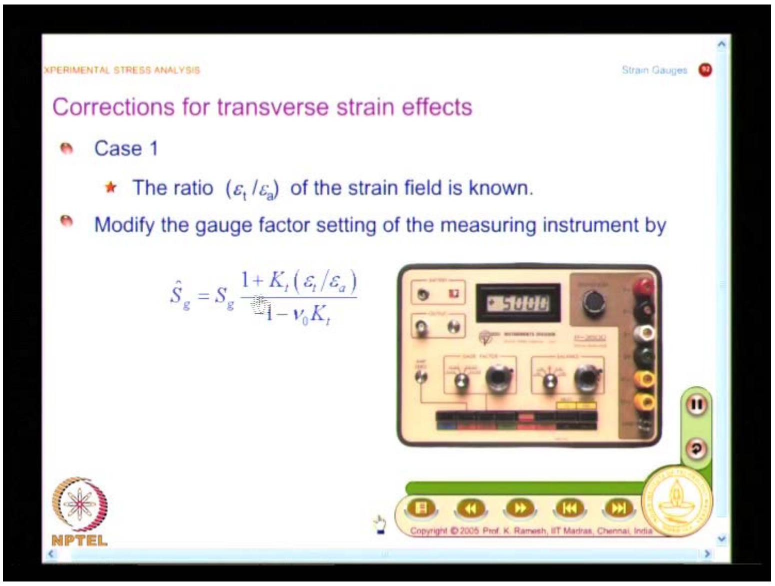


Gauge type	S_g	S_a	S_t	K_t(%)
EA-06-015CK-120	2.13	2.14	0.0385	1.8
EA-06-030TU-120	2.02	2.03	0.0244	1.2
WK-06-030TU-350	1.98	1.98	0.004	0.2
EA-06-062DY-120	2.03	2.04	0.0286	1.4
WK-06-062DY-350	1.96	1.96	-0.01	-0.5
EA-06-125RA-120	2.06	2.07	0.0228	1.1
WK-06-125RA-350	1.99	1.98	-0.03	-1.5
EA-06-250BG-120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

You can write for just two strain gauges and you have also seen when you have a number like this, what these numbers depict? The 120 at the end depicts that this is resistance and your 0 6 depicts it is the s t c number and 0 1 5 gives the gauge length and this gives the gauge pattern. And you have this as the career 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 s t and transverse sensitivity factor K t and this you find it is about 2 percent, you know it varies from minus 0.5 to 1.8 in this case of these set of strain gauges. And it can vary up to 10 percent depending on the kind of gauge configuration. The idea is to show the influence is of the order of 1 to 2 percent it is small, it is not very high. But even this we want to account for, that is what makes our strain gauge instrumentation more precise to measure small quantities, how do I do that? We can look at in terms of two different possibilities; in case one the ratio of epsilon t by epsilon a is know.

(Refer Slide Time: 48:20)



Then my correction approach is very very simple. We are already looked at expression for gauge factor and when I go back and recast the equation, you can also have a modified gauge factor S g cap given as S g into one plus K t into epsilon t by epsilon a divided by 1 minus mu naught K t. See, you know what is the strain gauge that you are using so, the strain gauge description gives you the value of K t. Numerator can be completely evaluated if you also know epsilon t by 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 knob for setting the gauge factor. Or if you are using a software it will have a provision to feed in the gauge factor. What you find here is a transverse sensitive effect can be corrected for a class of problems where you know the ratio of epsilon t divided by epsilon a. Then you can modify the gauge factor and feed it appropriately, that is 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 gauge instrumentation, whatever you measure may be way off.

So, in this class what we looked at was, we looked at how to do soldering of the terminals and tabs properly. So that I 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 final 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 will look at an hydrostatic pressure what is the apparent strain, in other measurement scenario also what you read from the strain meter will be labeled 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 transverse strain to axial strain is known then simply modifying the gauge factor can correct this error. And that is why strain meter comes with the gauge factor setting knob and if you are having your software that will allow you to feed in the gauge factor values suitably. Thank you.