CONFORMAL COATING PHOTOGRAPHIC GUIDE

The following are examples of typical process or user defects that may occur in production, product testing or during functional operation. Some examples are considered cosmetic defects others are functional but the need for rework should be based on the specification applied by the customer

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Simple process control checks can be a valuable tool during conformal coating. Check the wet coating thickness on the surface of the board after application. Using a wet depth gauge check the coating in two or three areas on a sample board. Ideally check more than one sample in the batch. Record the reading, location, material and process parameters for future reference

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Coating a blank test board prior to running production or using a proprietary matrix test card is the best way of checking spray process parameters are consistent. The test board or card can be inspected with a UV light for coating definition, overspray or coating run on. Process parameters like solids content, temperature, nozzle type, speed, height and pressure should be recorded

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Measuring the dry coating can be performed on a test label applied to the surface of a board prior to coating. The thickness of the dry label can be recorded, subtracting the thickness of the label provides the coating thickness in that location. The label can be retained for future reference and is ideal for engineers to review during process audits. Digital thickness measuring systems are available for logging data for SPC

With care sample coated boards can be examined quickly after coating using a UV light on a conveyor. Care needs to be taken to avoid contamination and disturbance of the coating. Surface contamination with hairs, fibres or other particulate can be a problem with a delay before curing

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When coated boards are cured in a convection or IR oven the temperature profile must be established based on the material supplier's recommendations. The profile must also be considered in relation to the coating thickness. Temperature profiling procedures should follow the techniques used for reflow soldering with the correct attachment of thermocouples. Attempts to speed up curing is a common causes of failure

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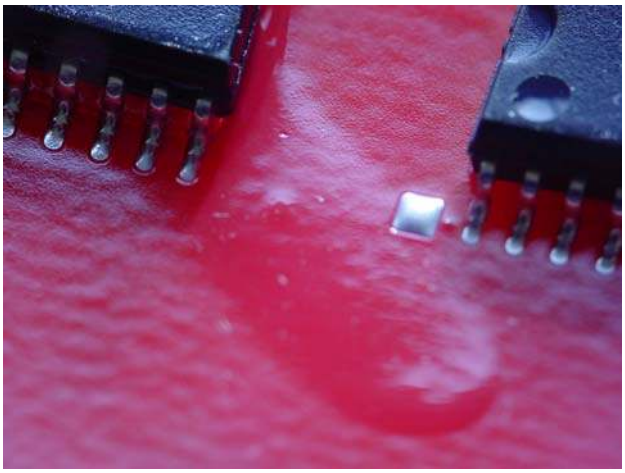
Inspect sample boards under UV lighting for complete coating coverage. Check areas of the board after removal of any masking for any local lifting or contamination. The coating should be compared with any work instructions, alternatively a golden coated board assembly should be available for reference

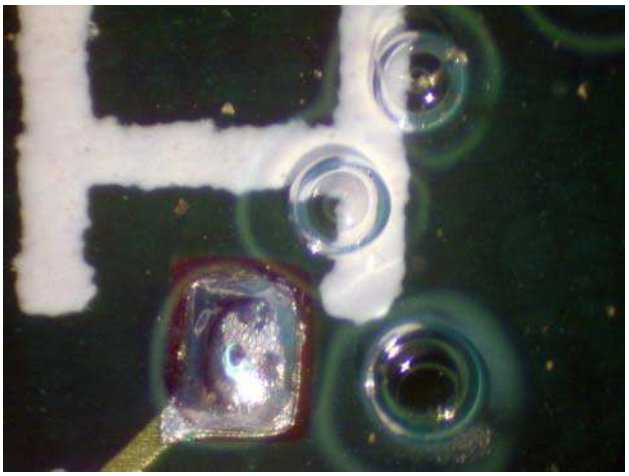
CONFORMAL COATING INSPECTION & DEFECT GUIDE

Coating Runs



Coating runs are most likely to be associated with a dip coating process. The speed of withdrawal from the coating, the solids content or coating contamination may affect coating drainage. Coating runs will indicate the direction of withdrawal from the coating. Runs can also be seen on spray coating or selective de-wetting when boards are stacked vertically for curing

Fish Eye Bubbles



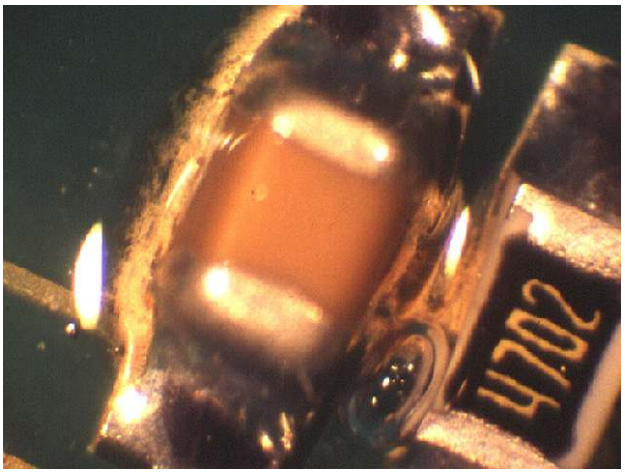
As the name suggests the bubbles resemble large fish eye balls. Often the term is just applied to normal bubbles in the surface of the coating. They can be associated with small particles of contamination in the bubbles. If the bubbles are small and not bridging terminations or adjacent tracks they are normally acceptable

Bug Eye Bubbles

Very large bubbles in the coating, most commonly seen around component bodies or through holes where expanding air or solvent has allowed bubbles to form in the coating. This is most commonly associated with a curing cycle not appropriate to the coating type or thickness

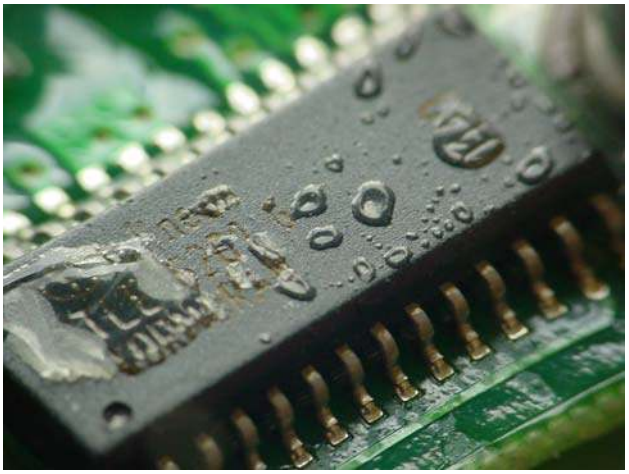
CONFORMAL COATING INSPECTION & DEFECT GUIDE

Corrosion under Coating



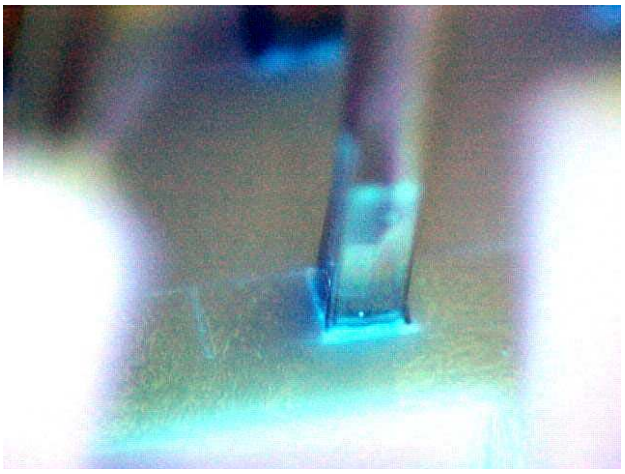
A reaction can take place under the coating on the printed board surface. A chemical reaction can lift the surface of the mask. This reaction may continue during the operation of the product at elevated temperature, applied voltage or in other extreme environmental conditions. The use of highly activated residues under the mask may also cause this reaction in a non operating environment

Non/De-Wetting



Coating has de-wetted from the surface of the plastic SOIC which is not uncommon. Plastic parts often have release agents or mould compounds on the surface which can make coating adhesion difficult to maintain or de-wet on application. The same can sometimes be seen with water based coatings

Coating Penetration on Pins



Conformal coating has penetrated through the connector body along the pins due to capillary action. The coating is visible under inspection with UV light. This may occur during dip coating if the method of masking has not been properly considered or with poor spray application

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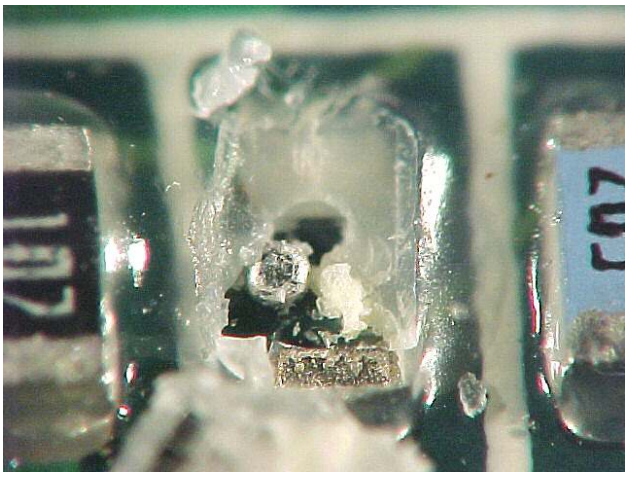
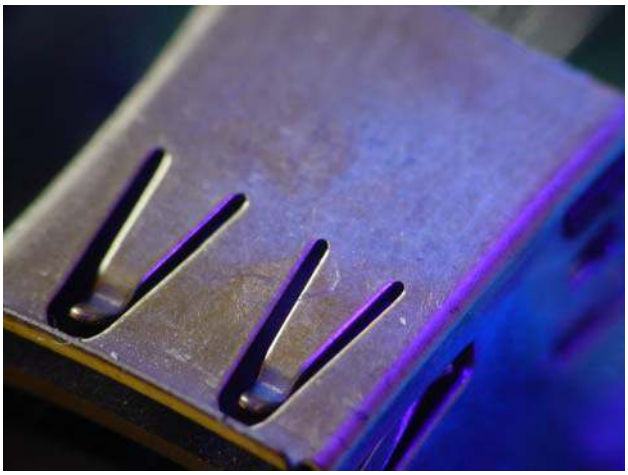
Solder Balls Under Mask



Solder balls or beads are present under the coating, they are related to the assembly process and not related to coating. Solder balls can be present on the surface of the board when a no clean process is used. If a cleaning process is used it must be capable of removing the balls. Ideally the root cause during the soldering process should be determined

Coating Contamination



Contamination on the outer surface of the connector body may be over spray, poor programming of the spray system or poor masking. Overspray of the coating is easily seen during inspection under UV light and may or may not require rework of the product

Surface Mask De-wetting

Solder mask compatibility issues with no clean flux is well known, when conformal coatings are evaluated the mask type should be defined and should not change without documented confirmation on the compatibility with the coating

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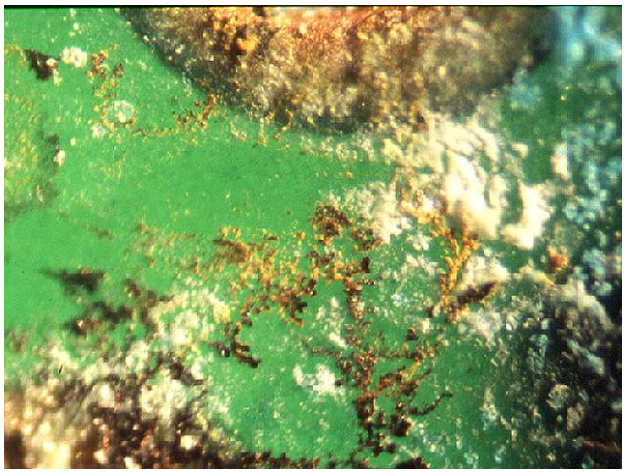
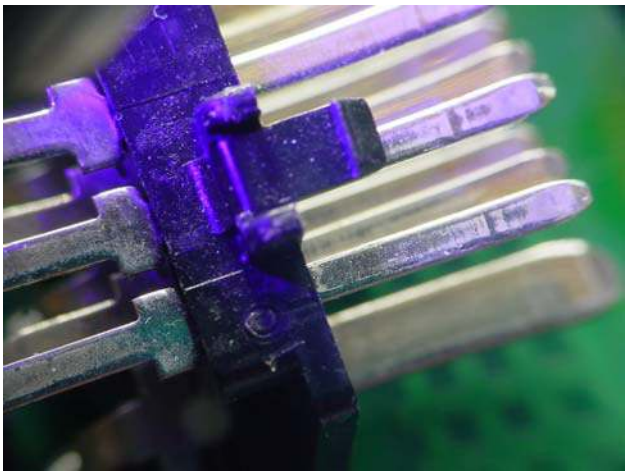
Surface Corrosion/Dendrites

Surface corrosion has taken place on the surface of the board with incomplete coating protection. The surface of the board must have had some ionic resides on the surface, the presence of this contamination, humidity and applied voltage has allowed copper dendrites to form



Coating Contamination

The connector body and contact pins show evidence of coating contamination which may affect the contact resistance of mating pins. The contamination may be the result of over spray, poor programming of the spray head or incorrect masking of the connector



Coating Lifting on QFN

Coating has separated from the surface of the plastic QFN/LGA body which is not uncommon on many plastic parts. Devices often have release agents on the surface which make coating adhesion difficult to maintain, minor loss or separation may not normally be reworked. In this case the root cause should be established

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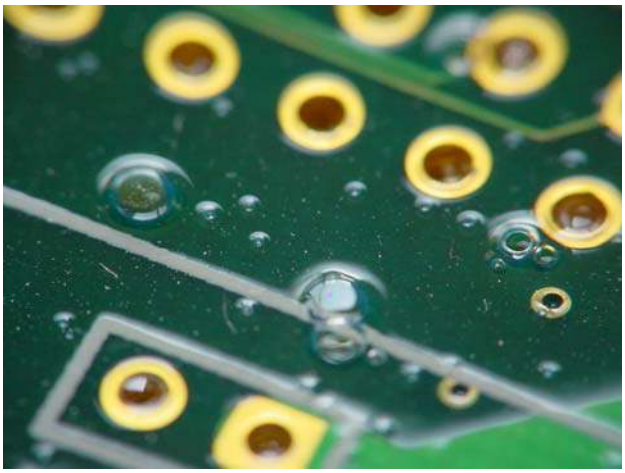
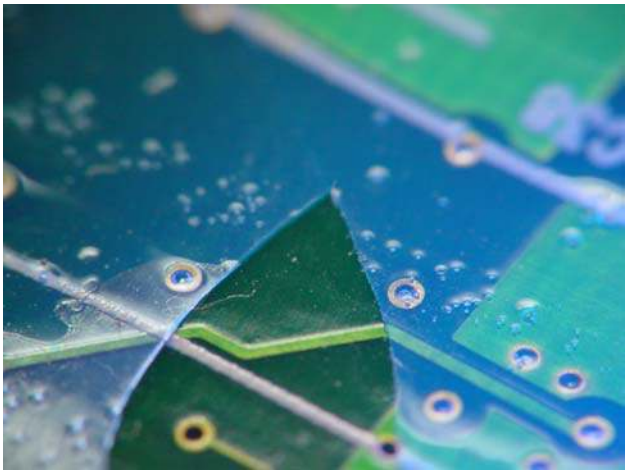
Coating Bubbles

Bubbles on the surface of the board can be a result of surface contamination; moisture on the surface or in the coating can result in bubbles during static or forced curing. Bubbles are considered a defect but are less likely to be a problem if not associated with component terminations or across conductors



Coating Delamination

Coating has separated from the surface of the board which will have been caused by contamination under the mask. Delamination can be seen as blisters, bubbles, peeling, non-wetting or, as in this case cracking/peeling. The way in which the coating separates from the board will be dependent on the type of mask, thickness, cure and point of failure



Excessive Coating Thickness

Coating thickness is defined by the process used during application. With automation consistent thickness is easier to achieve. Manual methods and rework are less likely to control thickness, although not necessarily unreliable every effort should be used to maintain thickness control to the specification

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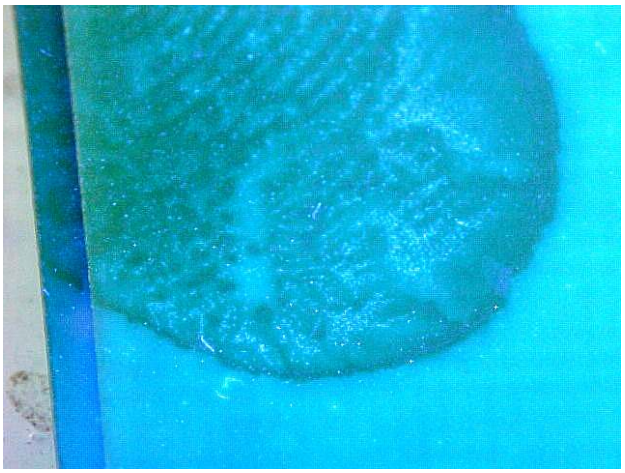
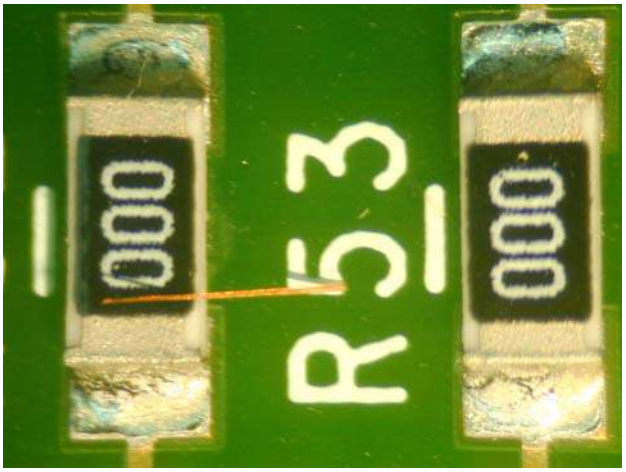
Fingerprints

All printed boards should be handled by their edges to avoid contamination. Every effort should be made to avoid manually handling coating or partly cured boards to avoid leaving residues and handling marks



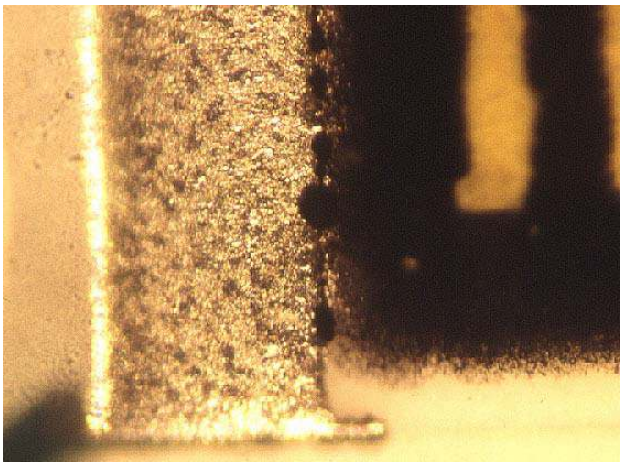
Brush Fibres

Whenever a brush is used during the removal or recoating operation fibres can be left on the surface of the board. If found every effort should be made to eliminate the source of the contamination for future assemblies. A properly cleaned board should remove all evidence of fibres but, provided they do not bridge the active circuit or terminations, are they an issue?



Sulphur Corrosion

Sulphur environment has shown corrosion to printed boards and component terminations. In the example black sulphur blooms are seen at the termination of the resistor which led to changes in resistance. Coating of assemblies may inhibit the speed of sulphur corrosion but not stop it completely



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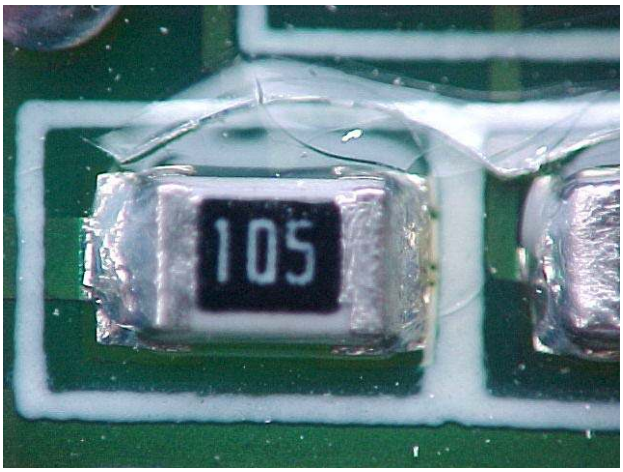
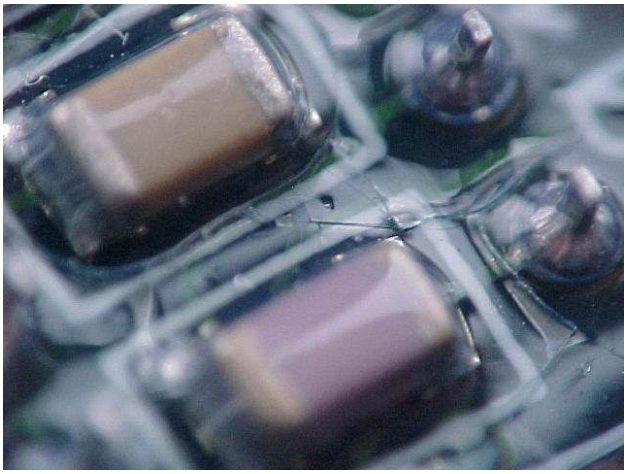
Coating Cracking

Cracking of a coating is most commonly associated with mechanical stress which could be caused by temperature cycling, expansion of residues or volatiles under the mask. Cracking of a mask may be exaggerated by a change in the mask characteristics due to thickness applied or over curing



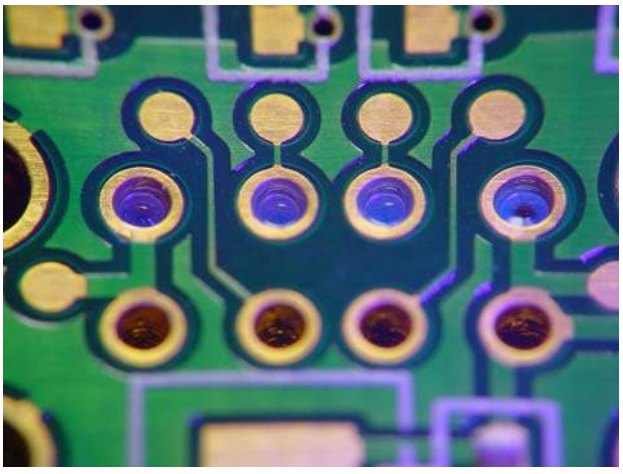
Coating Cracking

Cracking of a coating as compared to peeling is associated with a brittle material or a product that has become brittle. Care should be taken that the material is correctly selected for the application and cured in line with supplier's recommendations



Coating Penetration

The coating material has penetrated from sided one to side two along the plated through holes. Coatings can capillary through small vias and routed areas. The coating was visible during inspection with UV light, if the contamination is an issue on side two the holes should be masked correctly



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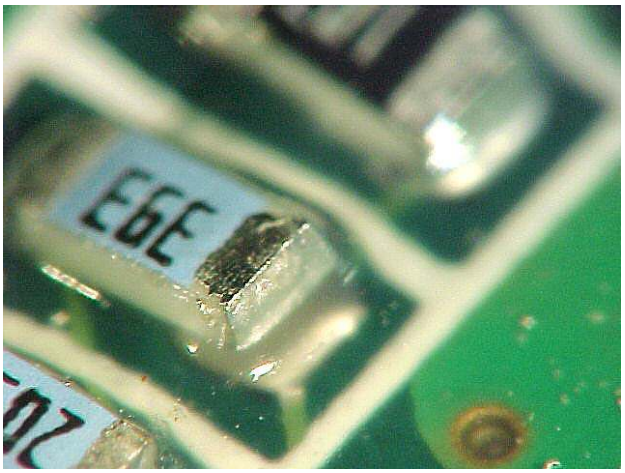
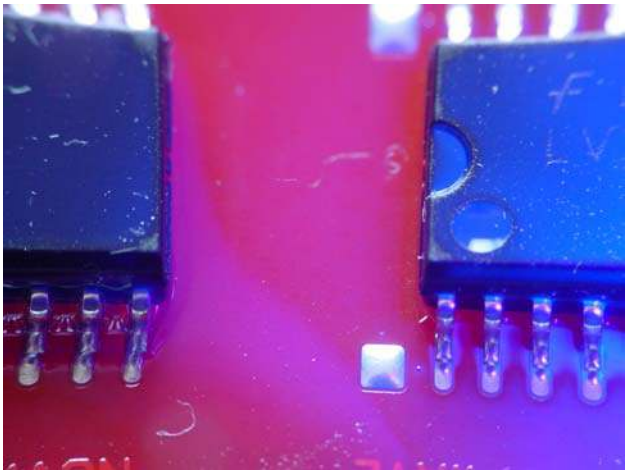
Open Solder Joint

Chip resistor was found to be open circuit, the part had lifted during reflow and the open connection not detected. The coating has successfully been applied and cured over the board assembly. Clearly this should have been detected by electrical testing prior to coating



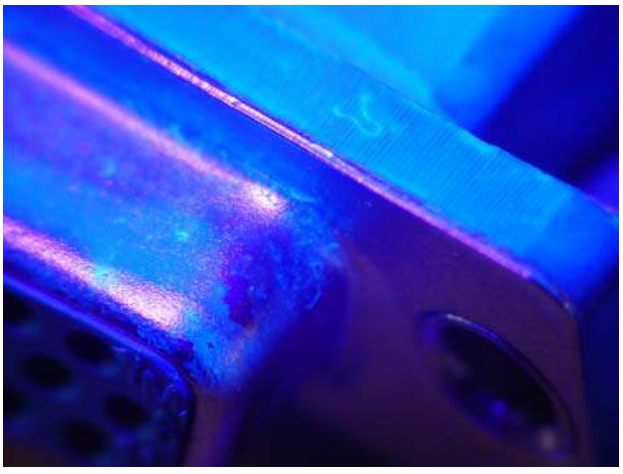
Coating Shadowing

The coating is varying in thickness due to the proximity of the two small outline devices and the process parameters used. The process used for coating should be re-examined to improve the coating consistency on what is not a demanding design



Excessive Coating Contamination

Incorrect or poor masking has resulted in contamination on the surface of the connector body. Contamination can also be related to incorrect setting of a selective spray application process



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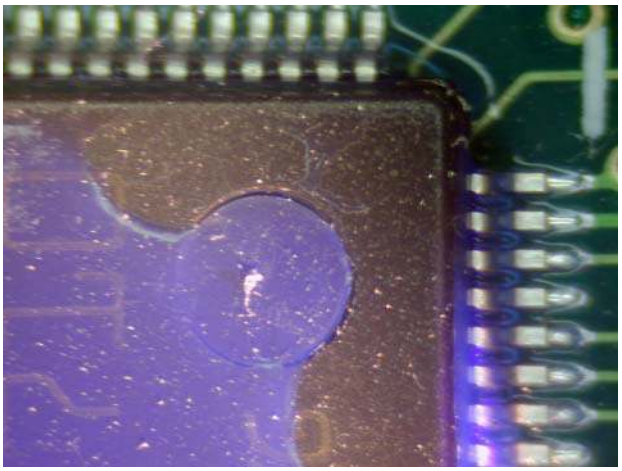
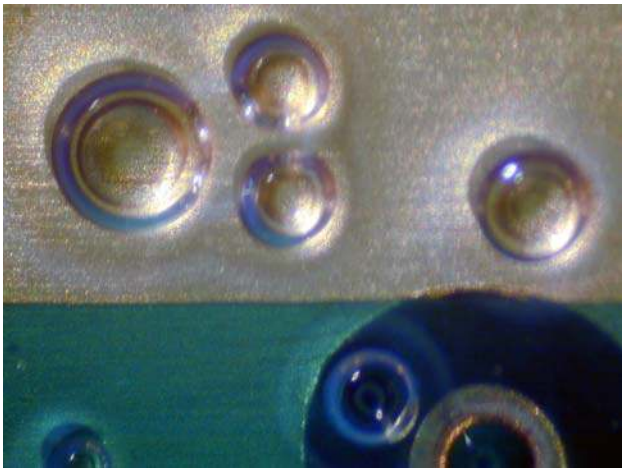
Coating Lifting/Peeling

Coating has lifted from the surface of the plastic quad flat pack body. It is well known that the adhesion to plastic devices may be poor but in this case the coating has been mechanically damaged during handling



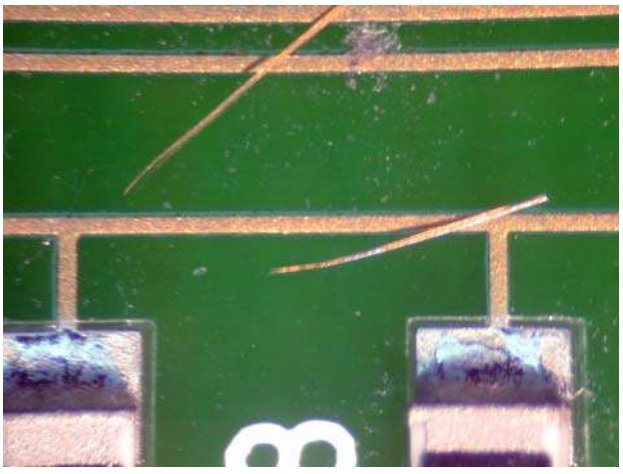
Fish Eye Bubbles

Often the term is applied to normal bubbles on the surface of a board. The larger bubbles can be associated with small particles or surface of contamination on the surface causing local non wetting an a void to form



Brush Hairs

Brush hairs are visible in the surface of the coating, the hairs may have come from a manual brush coating process or from a bush used to remove a coating during rework. Every effort should be made to prevent this occurring on future products but as the hairs do cross conductors they may not be acceptable



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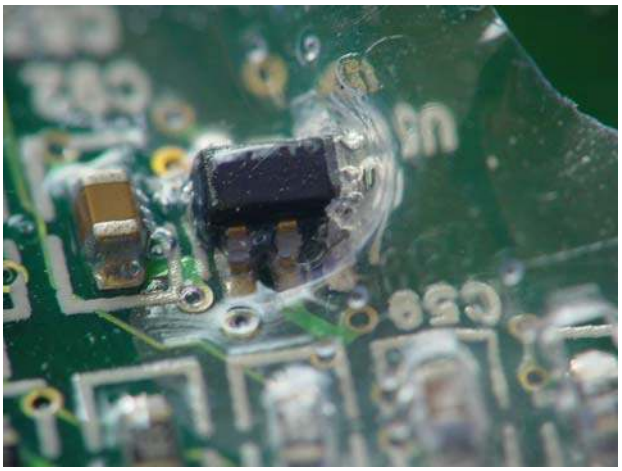
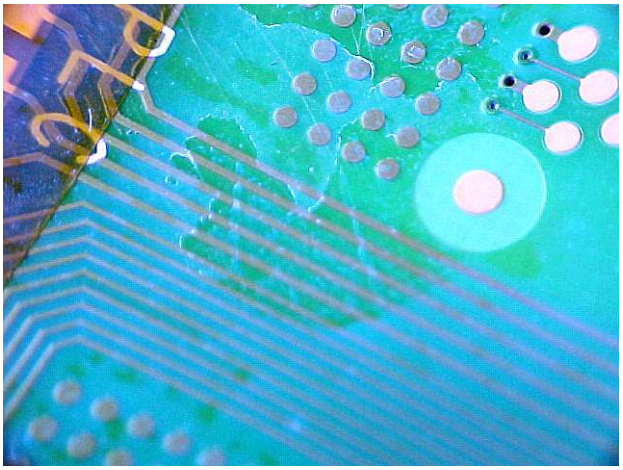
Bubbles and Coating Lift



Surface contamination under the coating around the SO package has reacted and lifted the coating. Analysis may show the type of contamination causing the corrosion to occur

Surface Contamination



Poor manual handling of the board assembly prior to coating has resulted in poor coating adhesion. Boards should always be handled by their edges after cleaning or in a no clean assembly process

Copper Dendrite Formation

Dendrite formation is seen between two conductors with back lighting. Dendrites will cause intermittent connection between adjacent points if formed at high temperature, humidity, applied voltage or where high levels of contamination are present on the surface of a board

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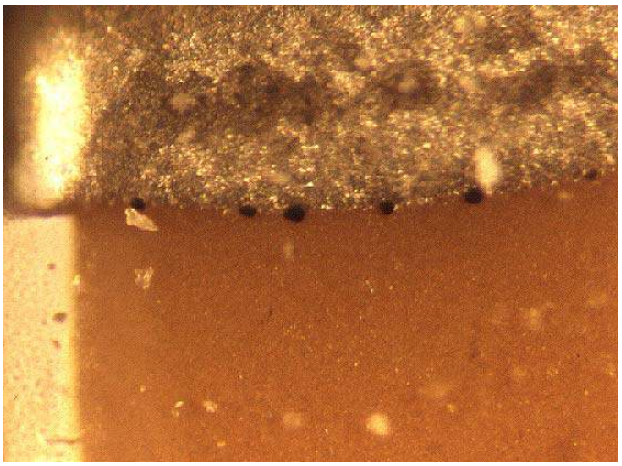
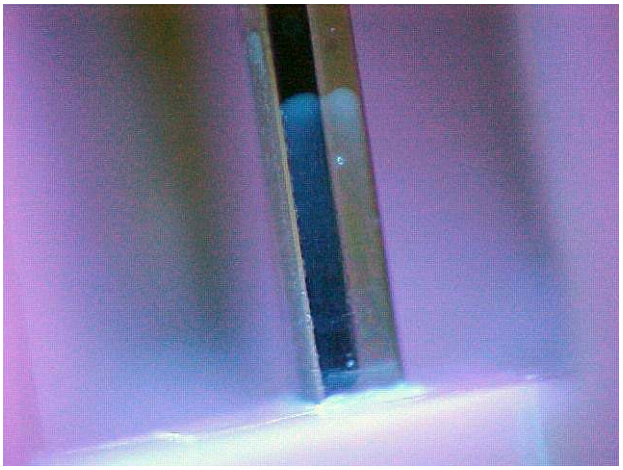
Sulphur Corrosion



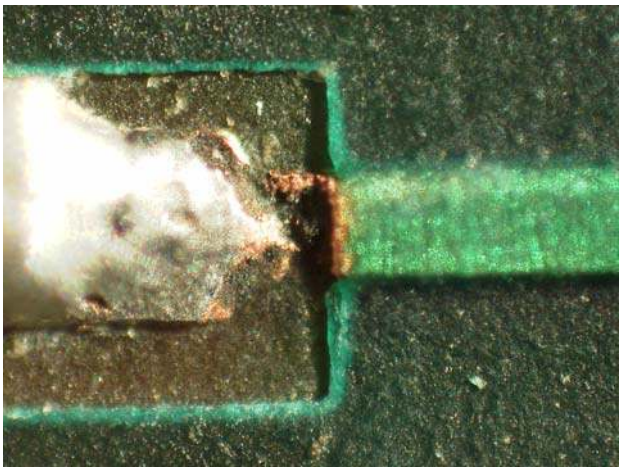
Exposure to a sulphur environment can allow black sulphur bloom to form on terminations, black marks on the silver contacts is seen under the coating. This did not lead to problems on this capacitor but connection loss on other chip resistors. Coating of assemblies may inhibit the speed of sulphur corrosion but not stop it

Coating Contamination



Inspection of the printed board assembly under UV light shows surface contamination of the connector pins. Contamination of the pins may be a result of poor masking, spray application or coating penetration through the connector body

Sulphur Corrosion



Printed circuit board copper track shows significant corrosion on an open circuit on the pad due to sulphur. A combination of exposed copper/silver surfaces in a sulphur gas has allowed corrosion to occur. Conformal coatings are known to slow down the reaction but not eliminate this happening

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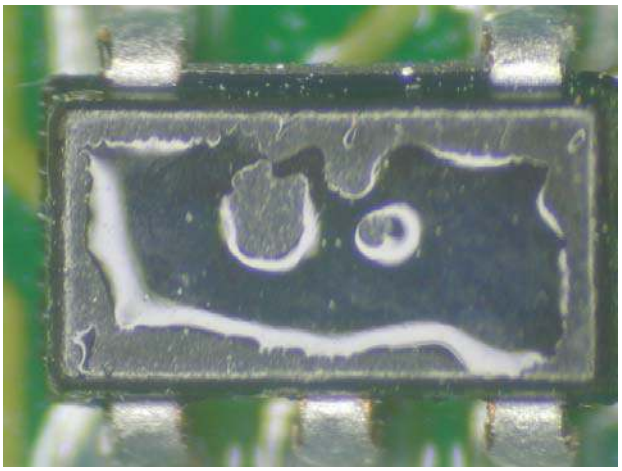
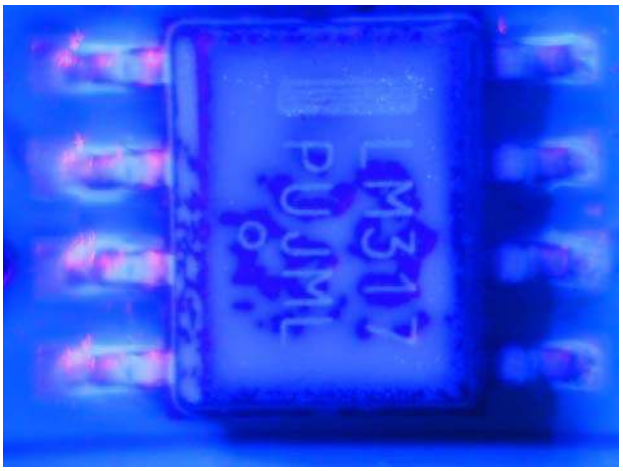
Coating De-wetting/Pullback

The coating has de-wetted/pulled back from the body on this SO package. This type of effect is most likely to be related to the surface of the component and any surface contamination. This is not uncommon and difficult to overcome in a no clean process with plastic components



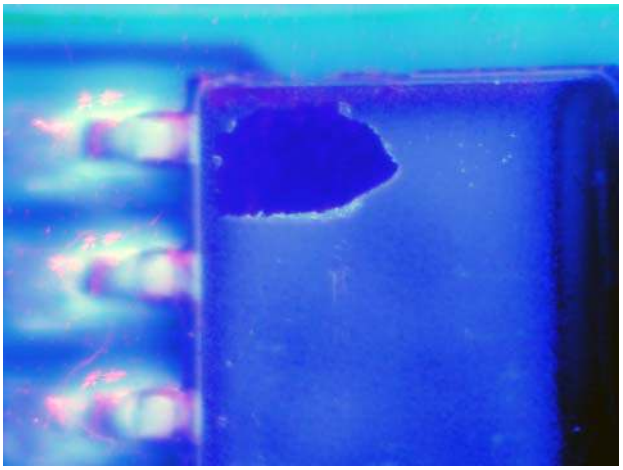
Uneven Coating Coverage

The coating thickness is uneven on the surface of the SOIC. This is most likely to be contamination on the surface of the component than a coating application defect



Chipped UV Coating

Damaged coating on a SOIC body found during UV inspection. The coating is either chipped or peeling form the surface of the plastic component



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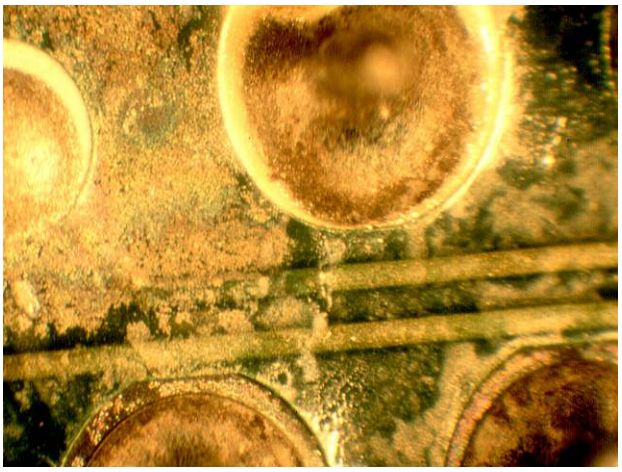
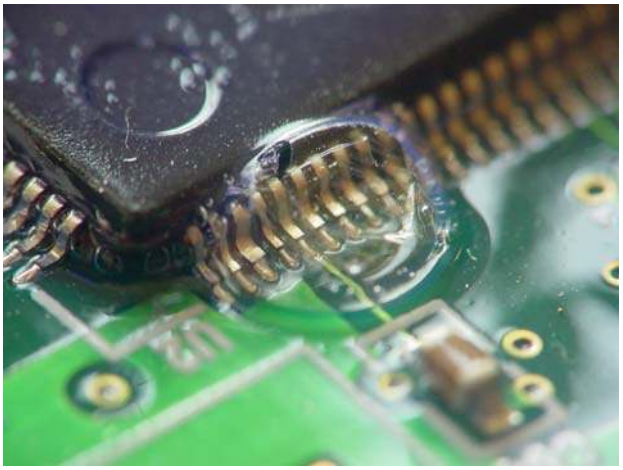
PCB Corrosion Under Coating

Excessive flux residues under the conformal coating have caused corrosion between two terminations. This is probably associated with a rework operation prior to coating. In a no clean process the complete process and all soldering materials must be evaluated with the coating



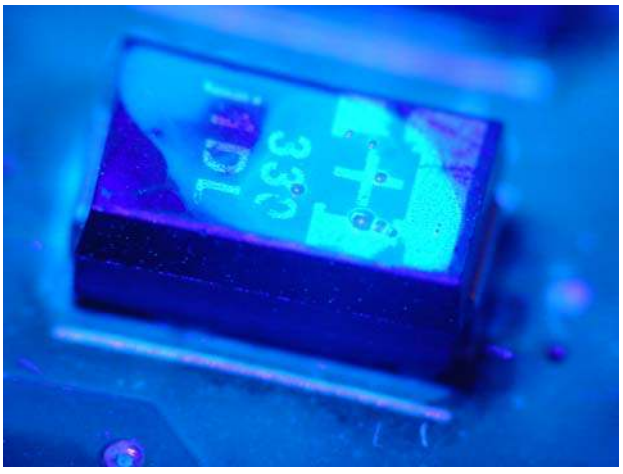
Solvent Outgassing

Bubbles around large components are often experienced after conformal coating and curing. The bubbles can be formed by trapped air or solvent expanding under the mask leaving no coating between terminations



Incomplete Coating Coverage

The coating process has not completely covered the surface of the component body. Inspection under UV light does show that all other areas have been coated



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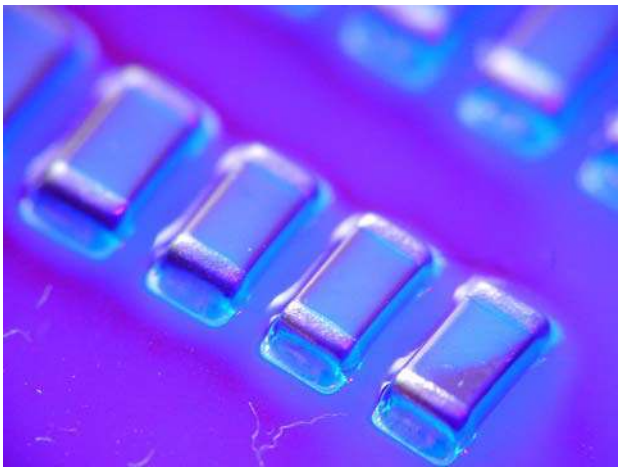
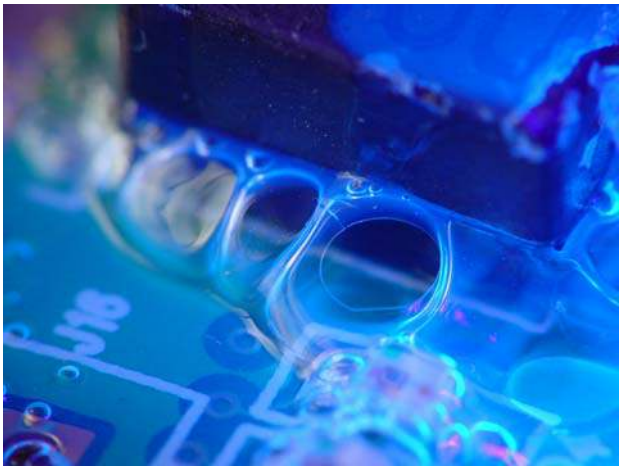
Coating Missing on Capacitor

The coating process has not completely covered the surface of one capacitor but could simply be touched up manually. Inspection under UV light does show that all other components and PCB surfaces have been coated



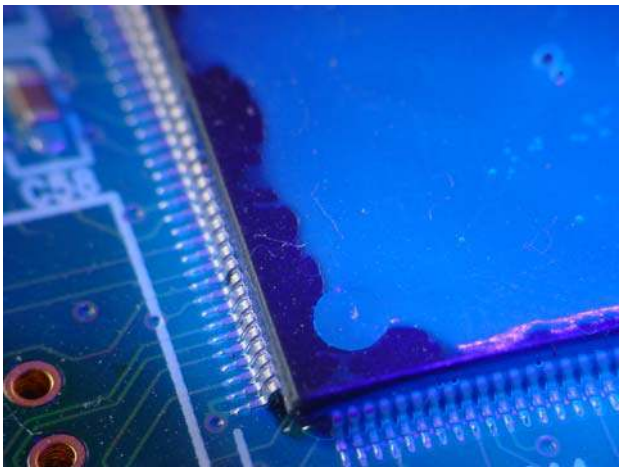
Excessive Coating Bubbles

Bubbles around large components are often experienced after conformal coating and curing. The bubbles can be formed by trapped air or solvent expanding under the mask, often this is seen during forced curing



Incomplete Coating Coverage

The coating has not completely covered the QFP and is seen under UV light inspection. The surface of the board and terminations are coated. The coating may have pulled back from the edges after application



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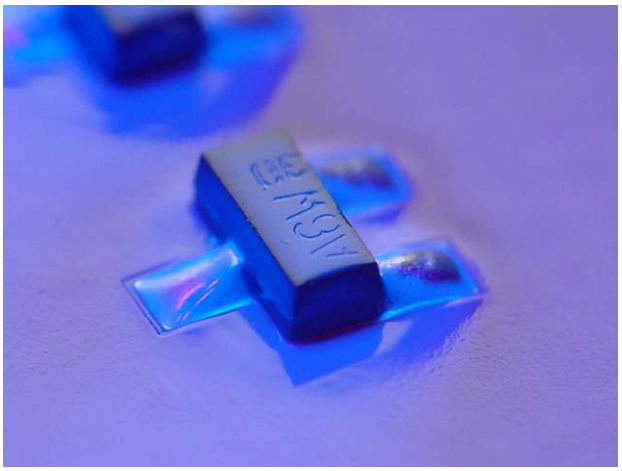
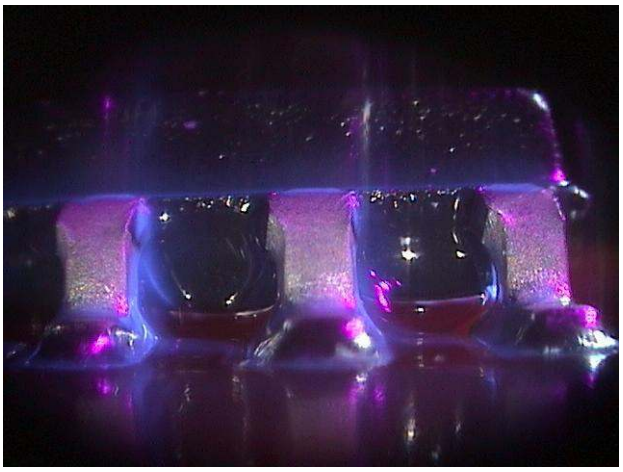
Satisfactory Coating under UV Light



Satisfactory Coating under UV Light

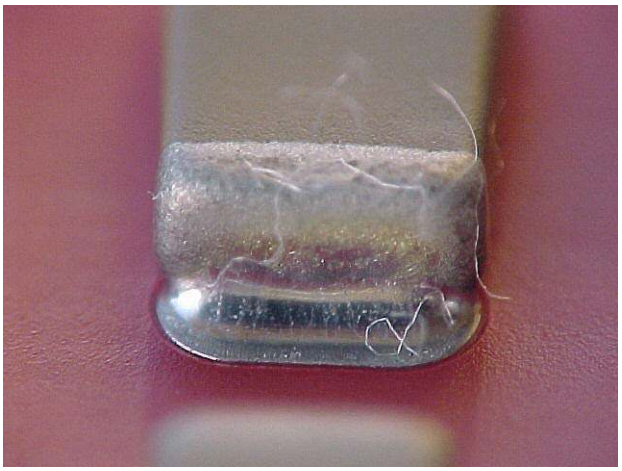
Satisfactory Coating under UV Light



CONFORMAL COATING INSPECTION & DEFECT GUIDE

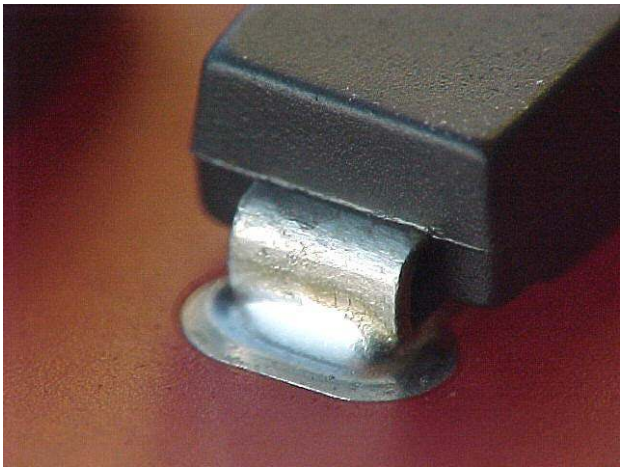
Satisfactory Coating with Parylene

The problem with this coating is there is nothing to see on this 15um layer. Correct process control and parameters defines the deposited thickness which can be confirmed with a test card. Alternatively, a label or stamp is applied to the board surface prior to coating



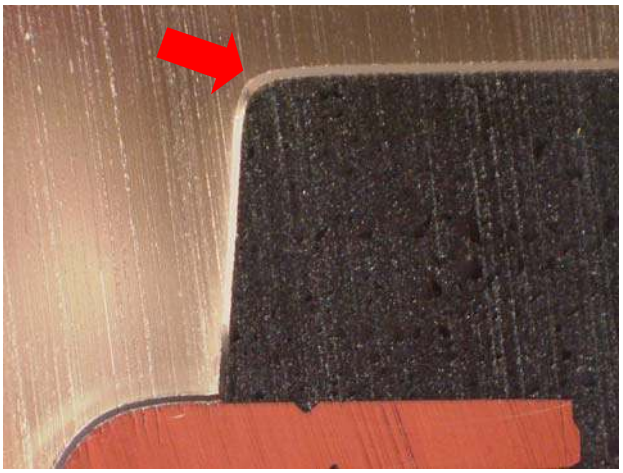
Satisfactory Coating with Parylene

The coating thickness applied to this board assembly was 30um and there is no visible evidence of the coating on the surface. Some Parylene coating do now come with a UV trace but are more expensive



Satisfactory Coating with Parylene

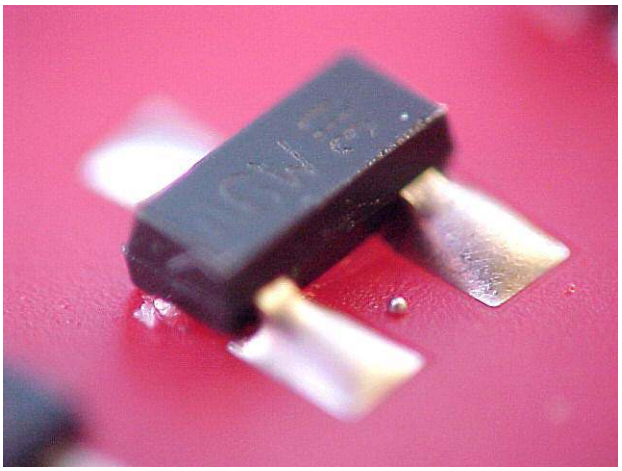
The microsection image shows the coating perfectly forming over the surface of the package and lead



CONFORMAL COATING INSPECTION & DEFECT GUIDE

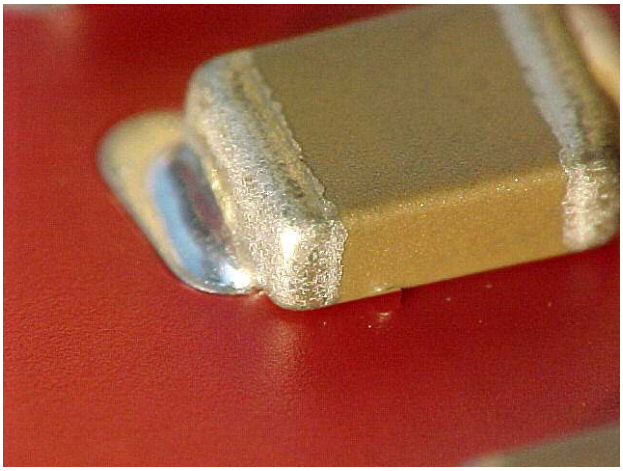
Satisfactory Coating with Parylene

The solder ball is not ideal but the coating would prevent the ball on this assembly from ever moving as defined in the IPC inspection criteria



Satisfactory Coating with Parylene

The coating thickness applied to this board assembly was 15um and there is no visible evidence of the coating on the surface. The capacitor is misplaced from the pad but still within the IPC inspection criteria



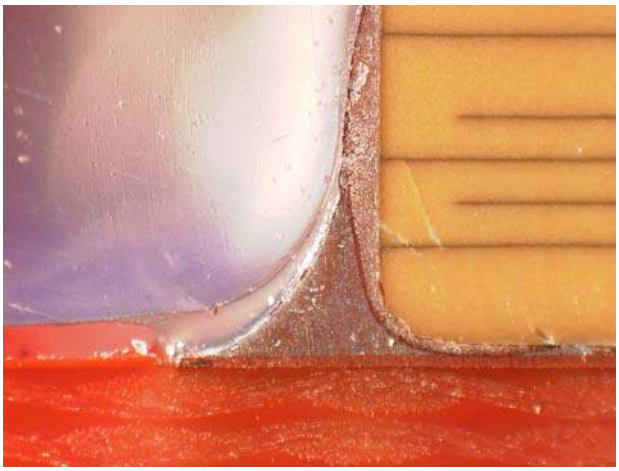
Satisfactory Coating with Parylene

The coating thickness applied to this board assembly was 15um and there is no visible evidence of the coating on the surface

CONFORMAL COATING INSPECTION & DEFECT GUIDE

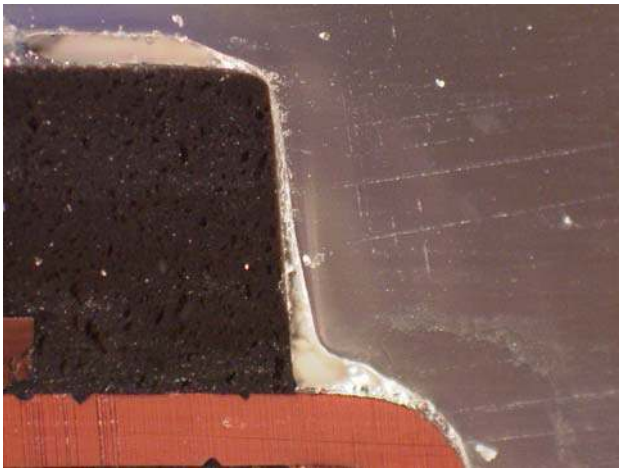
Satisfactory Coating

Microsection examination through a component termination shows the conformal coating on the surface of the mask and component body



Satisfactory Coating

Microsection examination through a component shows the coating on the body and lead of the component. The section shows the variation of coating thickness which is normal for traditional dip and spray coating

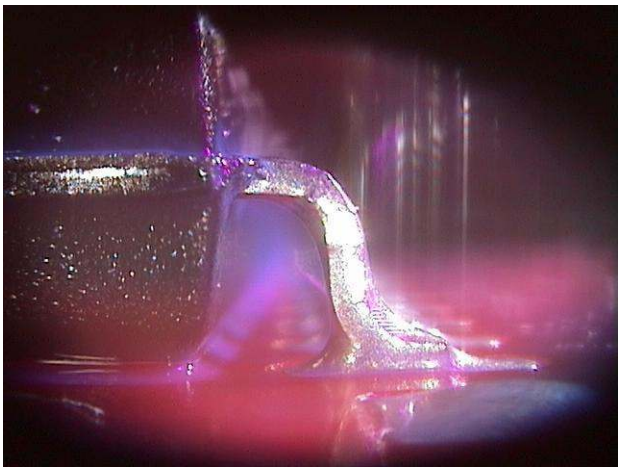


Satisfactory Coating

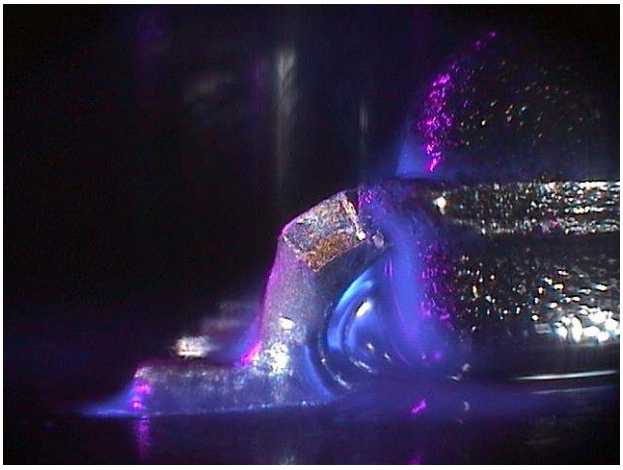
Satisfactory coating of a printed board assembly can be difficult to determine without the use of a UV light source

CONFORMAL COATING INSPECTION & DEFECT GUIDE

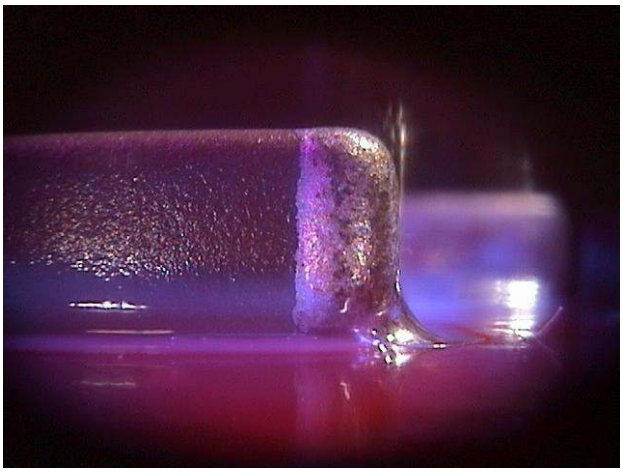
Satisfactory Coating under UV Light



Satisfactory Coating under UV Light



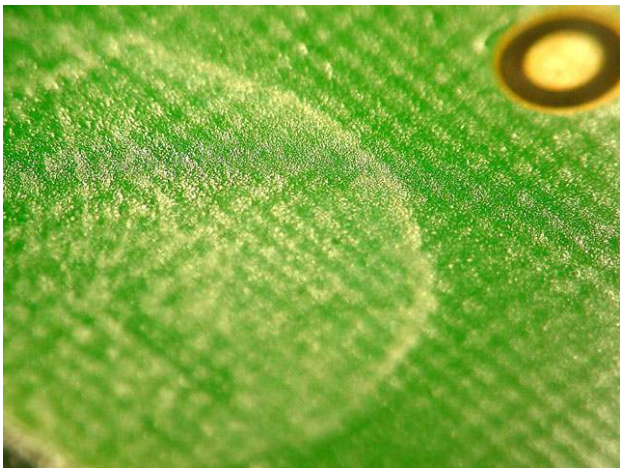
Satisfactory Coating under UV Light



CONFORMAL COATING INSPECTION & DEFECT GUIDE

Fingerprint After Coating

Printed circuit boards should be handled by their edges to avoid fingerprints. Every effort should be made to avoid handling coating or partly cured boards to avoid leaving obvious marks

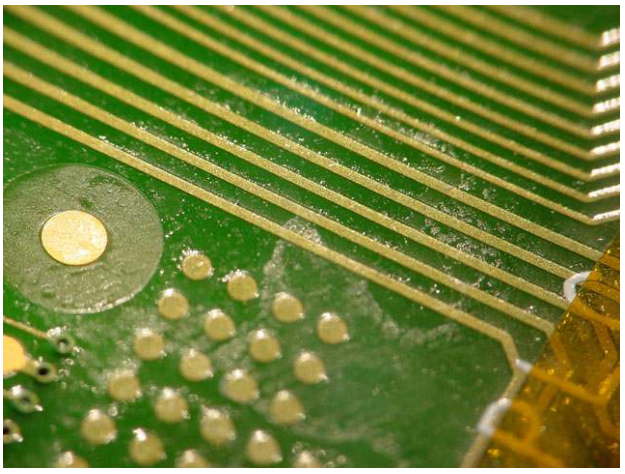


Fingerprint Before Coating

Printed boards should be handled by their edges to avoid fingerprints. The image shows the result of handling the board and leaving residues on the surface prior to coating. The finger print location is visible on the surface of the mask after curing

Surface Contamination

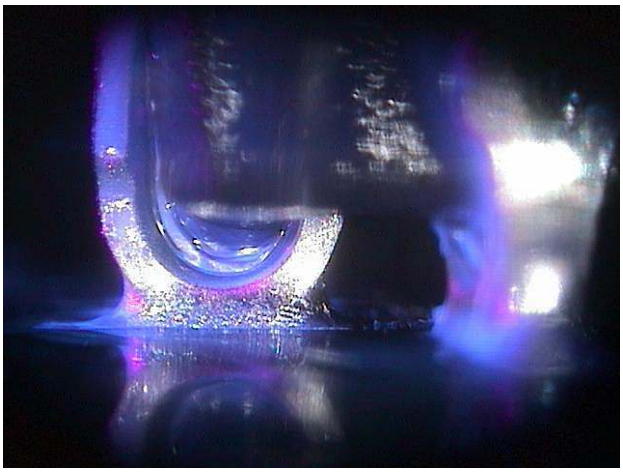
Contamination on the surface of the first off board inspected has prevented the coating wet the surface. It may be necessary to clean or re-clean the batch of boards prior to coating the batch



CONFORMAL COATING INSPECTION & DEFECT GUIDE

Satisfactory Coating under UV Light

Conformal coating on one J lead of a PLCC package

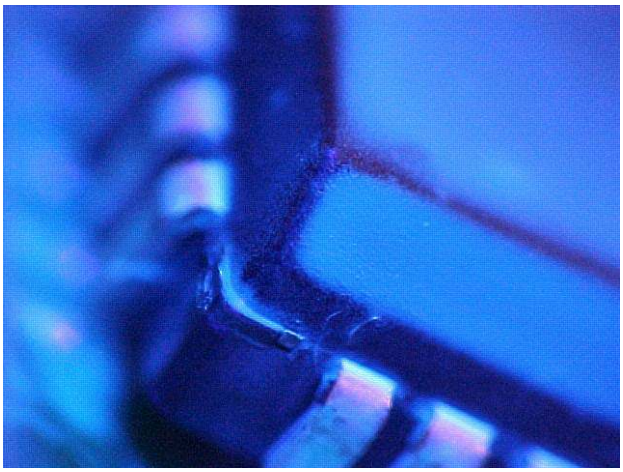


Satisfactory Coating under UV Light

Coating on PLCC J lead solder joints and package after conformal coating

Satisfactory Coating under UV Light

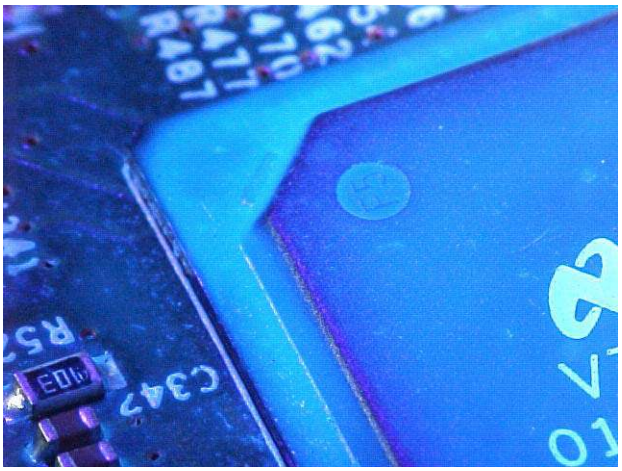
The spray coating on the surface of the board and solder joints is satisfactory but there is some evidence of pull back of the coating on the edges of the plastic component body



CONFORMAL COATING INSPECTION & DEFECT GUIDE

Coating under UV Light

BGA body is coated but there is evidence of poor coverage on the board around the package which may be related to the cleanliness of the assembly



Coating under UV Light

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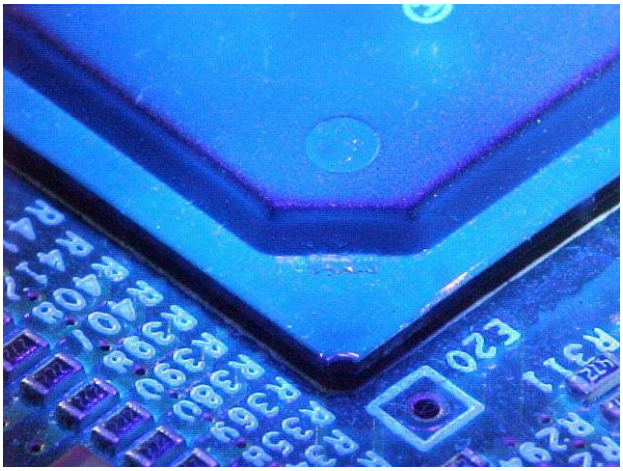


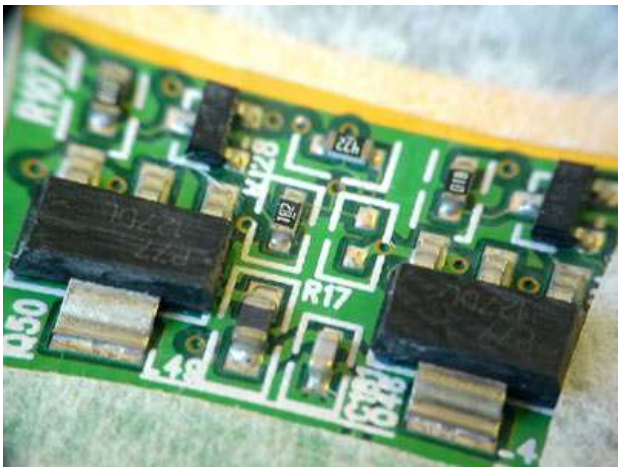
Satisfactory Coating under UV Light

Satisfactory coating on the body of the BGA and the board surface is highlighted with UV inspection. There is no evidence of the coating under the BGA on the joint areas which is not uncommon with spray coating

CONFORMAL COATING INSPECTION & DEFECT GUIDE

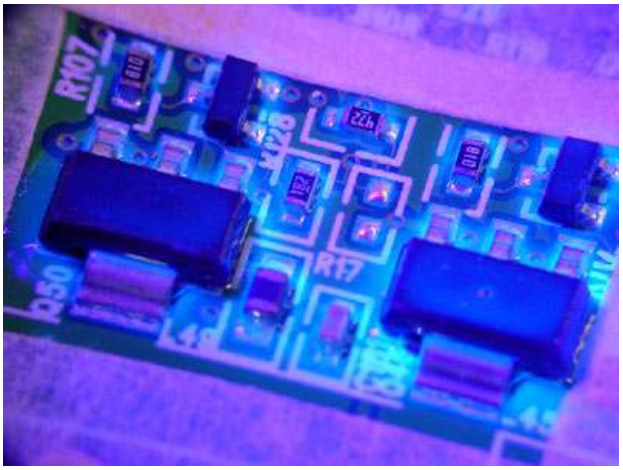
Coating prior to rework

Printed circuit board assembly with masking tape added prior to removal of the coating. The tape has been added to prevent the solvent attacking coating on other areas of the board assembly



Coating under UV Light

Partial removal of the conformal coating with solvent can be seen. There is still evidence of the coating around components and terminations



Coating under UV Light

Satisfactory coating removal can be seen on the board assembly. Some evidence of coating under the body of component remains but should not make rework difficult