TE CONNECTIVITY (TE) TUBING TROUBLESHOOTING GUIDE

The purpose of this Tubing Trouble Shooting Guide is to provide TE customers and Channel/Distribution Partners with an overview of the most common questions or concerns related to TE Appliances BU tubing products.

The Tubing Troubleshooting Guide

- Is a document with criteria regarding customer's product questions or concerns
- Provides clarifications on criteria and standardized decision making
- Contains textual inputs for answering customer's questions or concerns

Tubing Troubleshooting Guidance

Failure Mode	Detail	Basic Knowledge For Tubing
Splitting	Scratches inside tube Rough cut edges Improper Splicing Techniques HFT fiber separation Tubing selection	• Shelf life document • Tubing selection guide • Measuring single wall tubing • Customer Concern Checklist
Expanded inside diameter	Inside diameter too small Inside diameter too large Expanded wall thickness	
Printing	Printing/Pitting on label IDENT material TE printing on tubing	
Oval shape	Tube is more oval shape than round	
Cut length	Short cut length	
Longitudinal shrink	Longitudinal shrink out of specification	
Sealing/Adhesive	Seal test on caps	
Contamination/Appearance	Contamination visible within product wall Kinks/Stress Whitening/Ringing	
Dual Wall Tubing	Adhesive pulling away from the edge	
VERSAFLEX Tubing	Diameter Measurement	
Repeat	Repeat complaint	

Complaint Requirements

Details

- Review tubing size and assembly process for internal deviations from the TE recommended processes. Review TE Specifications to verify the if the concern is a product enhancement or a non-conformance to the TE Specification
- Review the packaging for any shipment damage. Take pictures for documentation of all labels and packaging. Include damage or other proof it is not damaged to provide with request to TE when necessary
- Complete the customer concern checklist to attach to the complaint and prepare samples to send once requested. TE must be able to see visual concerns and re-create performance concerns to verify the problem and diagnose root cause

Customer concern checklist

◄ Back

Inner Surface Marks that have the Potential to Cause Splitting Of The Tube

Investigation Process

- Review tubing size and assembly process to prevent interreference between the tubing and substrate during assembly

Comments

- If the substrate scrapes the wall of the tubing, especially prior to recovery, a weak point in the tubing is created and the tubing is at risk of splitting during recovery

Recommendations

- Consult TE Customer Care for product size selection
- Complete the customer concern checklist to attach to the complaint and prepare samples to send once requested. TE must be able to see visual concerns and re-create performance concerns to verify the problem and diagnose root cause

Example Part: AP-2000-NR101

◄ Back

Splitting Due To Rough Cut Edges From Customers Cutting Process

Investigation Process

- Verify the blade used to cut the product is sharp. A dull blade could cause rough cutting edges
- Check the cutting speeds of any automated cutting processes

Comments

- If the customer cuts tubing using their own equipment. TE cannot control the cut edges of the tubing to prevent splitting of the product

Recommendation

- Contact TE customer care for recommendations on cutting machines or process improvements
- Spooled tubing should be cut to create a clean, straight edge. If this edge is not straight, it could cause the tubing to split at weak points, nicks and feather edges are notorious for causing this problem

Ragged edges promote splitting

Example Part: HTAT

Back

Splitting Due To Inproper Splicing Techniques

Investigation Process

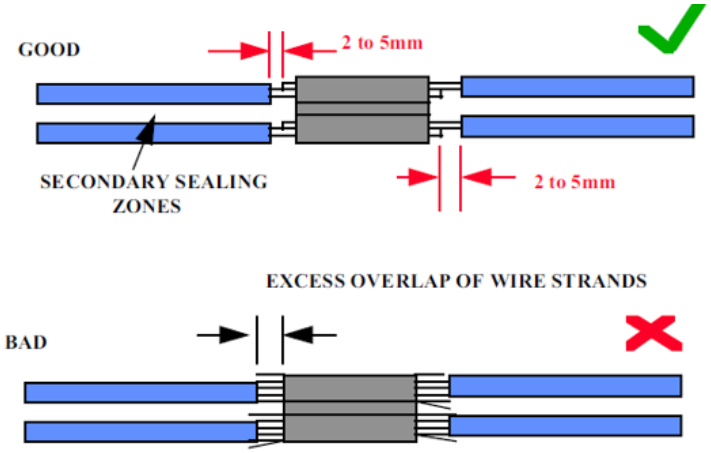
- Verify the overlap and splicing and techniques used on the wires. These should not create sharp edges or abnormalities that could cut the tube
- Check the recovered tube to verify it is smooth and there are no abnormal bumps or wires cutting into the wall of the tubing

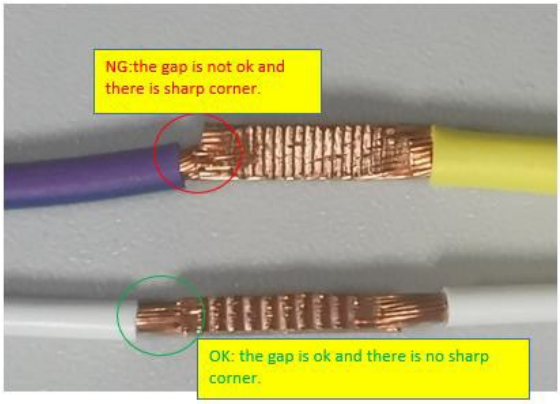
Comments

- Sharp edges or splices that have sharp edges risk cutting into the tubing which causes the tubing to split

Recommendation

- A spliced area should have a gap and the wire should be smooth preventing sharp corners. Sharp corners could cut into the tubing





◄ Back

Splitting Due To HFT Fiber Separation

Investigation Process

- Review tubing searching for any broken fibers

Comments

- Fibers are subject to move prior to recovery. After recovery, these fibers recover to the solid recovered state

Recommendation

- Verify heat is applied evenly
- Do not angle seam on outside edge of sharp bends
- Check application size is correct for the tubing used

Before Recovery

After Recovery

Example Part: HFT5000

Back

HFT Fiber Tubing Identification

Investigation Process

- Review the Visual Standard for HFT5000 Tubing
  - White marker or contamination should be less than 2CM of tubing
  - Edges should not have pulled fibers
  - Fibers can be separated but should not be cut or damaged

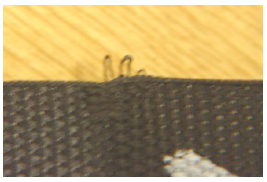
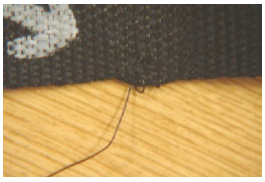
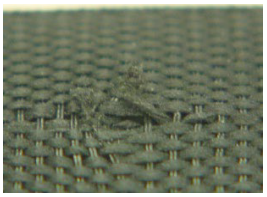
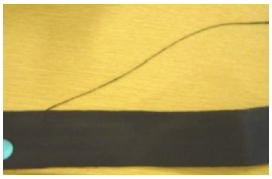
Comments

- Fibers are free to move but should not be damaged and will recover to fill in holes and other small distortions

Recommendation

- Take pictures of tubing before recovery and compare against the Visual Standard
- Review tubing after recovery for full recovery of tubing

Contamination

Acceptable	Not Acceptable
	
Weaving defect (edge)	  
Weaving defect (top/bottom  	  

◄ Back

SPLITTING DUE TO INCORRECT TUBING SIZE SELECTION

Investigation Process

- Review tubing to search for any broken on weaved tubing such as HFT or Versaflex
- Verify tubing is able to recover 20-90% of the recovery ratio

Comments

- Heat shrink tubing wants to be in the recovered state once heat is applied. If the substrate does not allow this to happen at all or has sharp edges, the tubing may split because the force trying to get to the recovered state is greater than the strength of the tube

Recommendation

- Verify heat is applied evenly
- Do not angle the seam on outside edge of sharp bends
- Reference document 1-1773904-3_Selecting_Correct_Tubing for additional criteria in selecting the correct size of tubing. If the tubing size is too small for application, this may lead to splitting

1-1773904-2_Measuring_Single_Wall_Tubing

Example Part: HFT5000

Back

EXPANDED INSIDE DIAMETER TOO SMALL

Investigation Process

- Review measurement process. The inside diameter should be measured using gage pins comparing with the correct dimensions to the specification
- Review the shipment method and minimum shrink temperatures

Comments

- The external diameter is measured for 100% of the tubing during manufacturing and is automatically marked by UV Ink and and removed if it is outside of the specification

Recommendation

- Consult TE Customer Care to select a larger tubing size for more consistent application
- Products such as VERSAFIT tubing have a low minimum recovery temperature. If temperatures reach above the specified shrink value from the catalog during shipping, the tubing is at risk of beginning to recover during transportation. We recommend other product families such as RNF for these situations
- Reference document 1-1773904-2_Measuring_Single_Wall_Tubing for additional advice in measuring single-wall tubing

1-1773904-3_Selecting_Correct_Tubing

◄ Back

Expanded Inside Diameter Too Large

Investigation Process

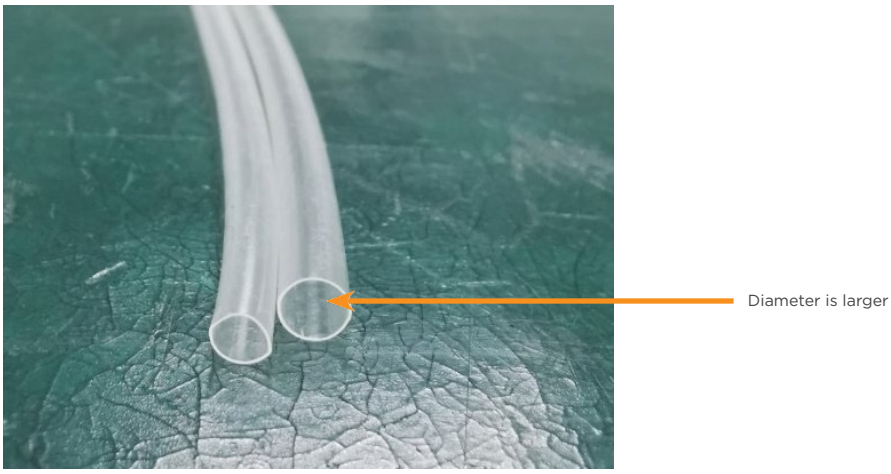
- Review all TE documentation and specifications to determine if the expanded diameter has a maximum defined

Comments

- Most tubing products do not have a maximum defined for the expanded diameter

Recommendation

- If a maximum expanded diameter is required, please contact customer care to request a customer specific part number
- A large expanded diameter does not affect the performance properties of the tubing



Example Part: RNF-100

Back

Expanded Wall Thickness Too Small

Investigation Process

- Review TE documentation and specifications to determine if the expanded wall thickness is defined
- Review the expanded tubing wall to determine if there are any abnormalities
- Recover the tubing per the TE specification to ensure other parameters such as the recovered wall thickness and the longitudinal shrink are within TE specification

Comments

- The expanded wall thickness is typically not a defined characteristic for TE heat shrink tubing. Therefore, other parameters are checked and verified that they are within the TE specification. The expanded wall thickness has a direct relationship with how much the diameter of the tube is expanded. If the expanded wall thickness indicates something else, such as recovered wall thickness or longitudinal shrink, is out of specification, then that other property would be addressed

Recommendation

- Verify heat is applied evenly
- Always check the TE specification to see if this variable is defined

◄ Back

Printing/Pitting on Label Ident Material

Low print quality of labels.

Investigation Process

- Verify printer is a TE Recommended Printer
- Save samples for TE to test in their printers

Comments

- TE tests every lot on TE printers and can only guarantee printing to the TE printers

Recommendation

- Consult TE Customer Care for a TE recommended printer
- Use of printers not recommended by TE does not guarantee the high quality printing of the label

Example Part: CM-SCE-TP

◄ Back

PRINTING ISSUE ON TUBING

There is white ink on the tubing surface, but the print is clear.

Investigation Process

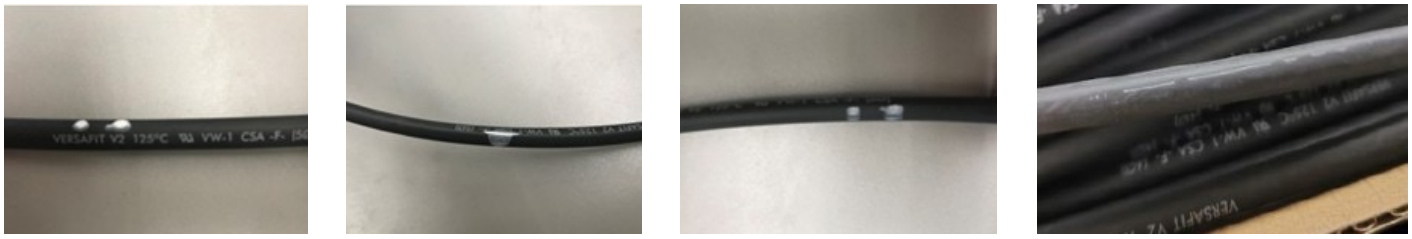
- Review the TE specifications to confirm the appearance requirement of the print

Comments

- According to the appearance requirement, this condition is acceptable as long as the print can be recognized in the smallest provided cut length

Recommendation

- Tubing can still be used if minimal package print can be recognized and there is no fit/form/function issue



Example Part: Single Wall Tubing(V2-3.0/V2-3.5/V2-5.0)

Oval Shape of Tubing

Investigation Process

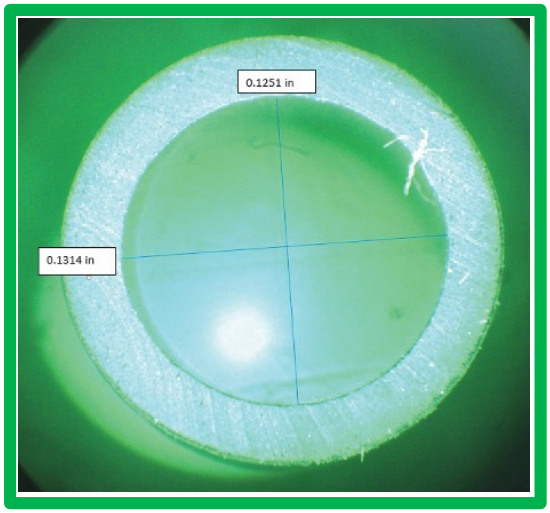
- Review TE specifications and documentation to verify if TE specifies the oval shape of the tubing. TE also runs testing on all parameters that are specified on TE specifications and documentation

Comments

- Most tubing has the ability to flex. And no tubing is a perfect circle, there is a minimal amount of ovality to each tube. The degree of ovality is not specified for most tubing products. Tubing closer to the center of a spool is under more pressure and at higher risk of a more oval shape

Recommendation

- Using sticks (4-ft cut piece) can decrease the risk of a more oval shape of the tubing



Most round tubing has some oval shape to it

Oval shape is acceptable

◄ Back

Short Cut Length

Investigation Process

- Tubing should be measured and compared to TE`s specification
- Review the process flow of material to determine if there is an opportunity for parts to be mixed or damaged

Comments

- The TE Quality inspection plan involves measuring samples from each box and recording the data manually

Recommendation

- Review packaging for abnormal damage that could indicate boxes are open and could be compromised after leaving the plant
- Review processes for potential opportunities for mixed parts
- Check production label and license tag

Example Part: SCT-NO.2-E5

Back

Product Shrinks Too Much in Length During Recovery - Longitudinal Shrinkage

Investigation Process

- TE will test this and determine if it is within or outside of TE`s specification
- TE Longitudinal Shrink Test Procedure
  - Cut tubing to 10in
  - Place tubing in oven that has already been pre-heated to a specific temperature based on TE`s specification
  - Leave tubing in oven for time specified in the TE specification
  - Remove tubing from oven and measure

Comments

- For verification of product non-conformance, unrecovered product must be supplied to TE and TE must be able to replicate the problem. If TE is unable to replicate the problem, then TE is unable to verify the problem

Recommendation

- Once a suspect piece is discovered, retain all nearby material (next 3 ft of spool) to return to TE for testing and verification of non-conformance

Example Part: ES-1

◄ Back

Cap Product Adhesive

Adhesive of cut product pulls away from the edge during recovery.

Investigation Process

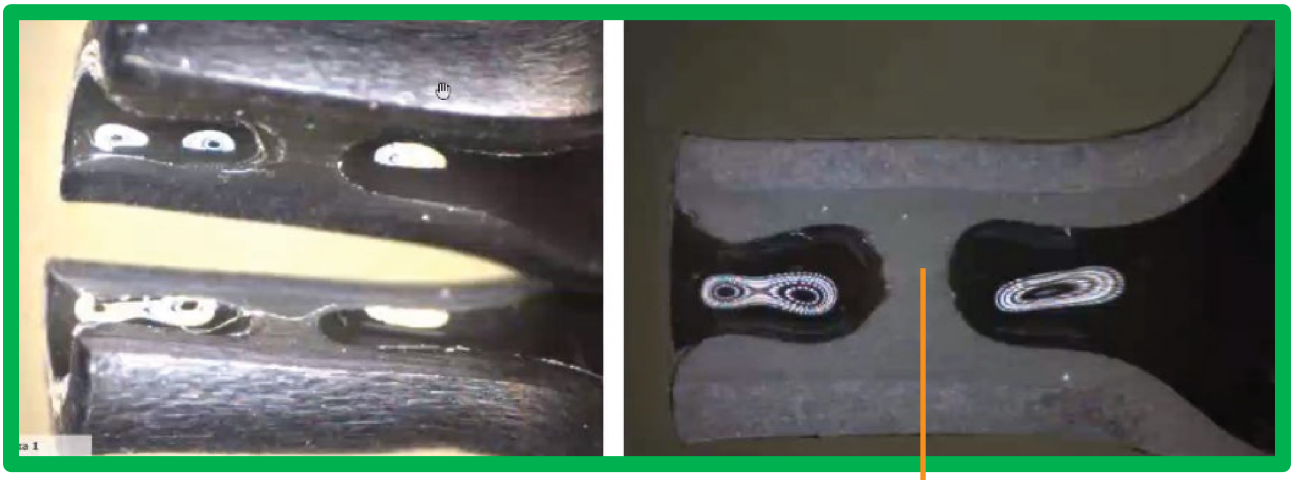
- Review parts for leak

Comments

- The adhesive within the tip of the cap may thin, but is considered acceptable as long as it is sealed and passes the leak test. An indent in the top of the cap does not necessarily mean the tube is not sealed

Recommendation

- Product must be sent to TE for investigation
- TE performs a leak test (also known as a bubble test) on the cap to determine if the material is sealed



Example Part: SCT-NO.2-E5

Adhesive covers the diameter of the tubing creating a full seal for the cap product

Back

Contamination

Investigation Process

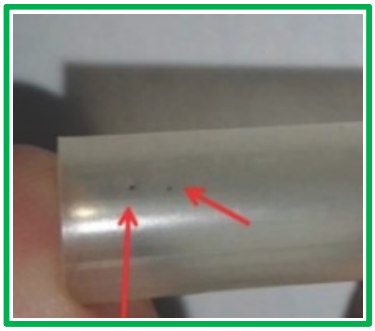
- TE investigates the product to determine if the contamination is within adhesive or on the outer surface of the tubing
  - Adhesive Layer: No concern. Continue to use tubing per TE`s specification
  - Outer surface: TE will test contaminate to determine what it is and will recover the tube to verify it does not cause splitting
- TE will recover the tube to verify it meets the other parameters listed in the TE Specification

Comments

- Some products, especially light color or clear products may show signs of contamination. In the majority of cases these are not a concern and the product will perform as expected

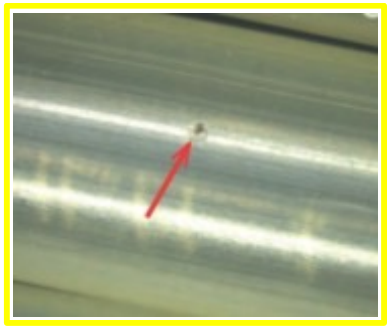
Recommendation

- If the contamination is on the outside of the tubing, TE can complete an investigation to determine the source to increase the appearance of the product using the 8D process



Contamination on inside layer of tubing. -Acceptable

Part: AP-2000



Contamination on outside layer of tubing. -Suspect

◄ Back

Kinks/ Stress Whitening/ Ringing

Investigation Process

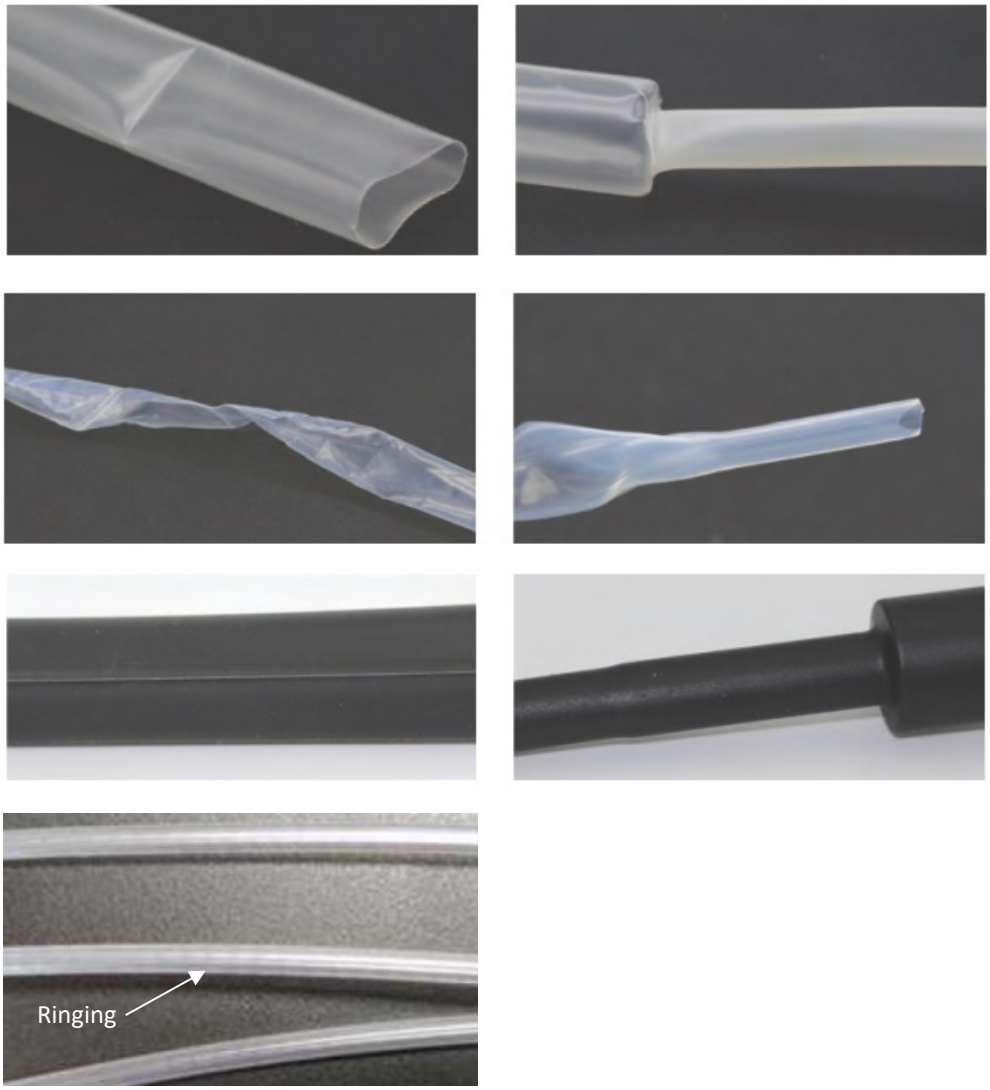
- TE investigates the there is any permanent deformation to the tubing including cracks or significant changes in wall thickness
- TE performs split testing on the parts to verify these creases do not lead to splitting

Comments

- Some products, especially thin wall products may show signs of stress in the tubing with a change in color. This discoloration is expected to perform to TE Standards. Verification may be done for other properties on the TE Specification, but discoloration caused by kinks, bends, or stress is not part of the TE Specification

Recommendation

- Tubing can be used as normal although it should be observed for signs of other nonconformities such as splitting
- TE performs a leak test (also known as a bubble test) on the cap to determine if the material is sealed



Back

Adhesive Pulling Away From Edge

Investigation Process

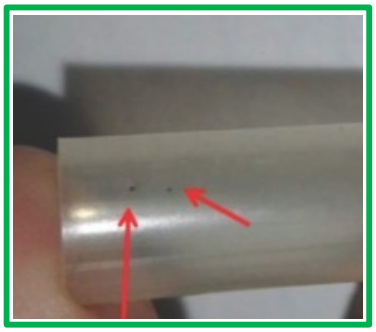
- TE investigates the product to determine if the contamination is within adhesive or on the outer surface of the tubing
  - Adhesive Layer: No concern. Continue to use tubing per TE`s specification
  - Outer surface: TE will test contaminate to determine what it is and will recover the tube to verify it does not cause splitting
- TE will recover the tube to verify it meets the other parameters listed in the TE Specification

Comments

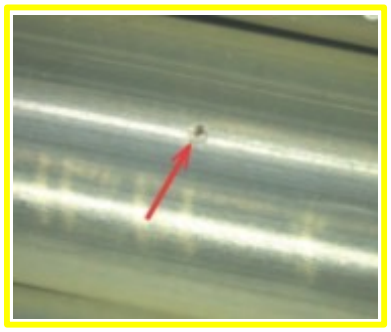
- Some products, especially light color or clear products may show signs of contamination. In the majority of cases these are not a concern and the product will perform as expected

Recommendation

- If the contamination is on the outside of the tubing, TE can complete an investigation to determine the source to increase the appearance of the product using the 8D process



Contamination on inside layer of tubing. -Acceptable



Contamination on outside layer of tubing.-Suspect

Part: AP-2000

◄ Back

VERSAFLEX Tubing

Investigation Process

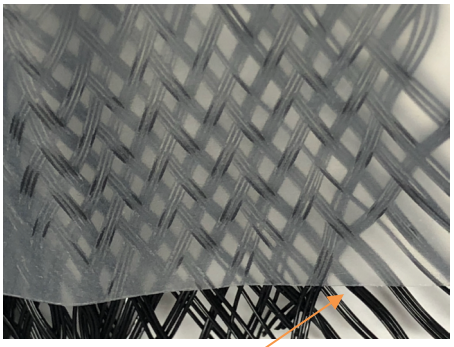
- TE investigates the product to determine if the number of Monofilaments and diameter of Monofilaments does not meet the TE Specification

Comments

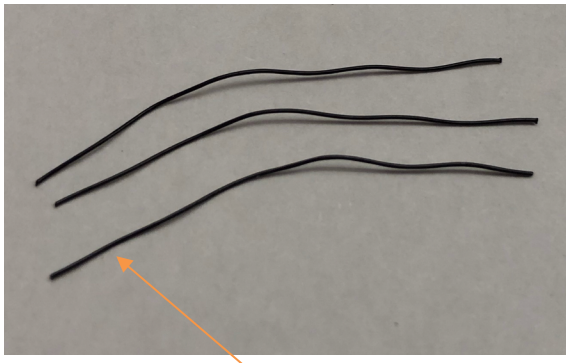
- VERSAFLEX tubing is susceptible to stretching with a wide range of variance for the diameter. TE has created a VERSAFLEX Measurement Guide to assist in proper measurement of the VERSAFLEX tubing and selection of the appropriate size for the end customer application

Recommendation

- Reference the TE VERSAFLEX measurement guide for appropriate measurement techniques
- Contact a TE Customer Care Representative for other available tubing sizes



Carrier is each set of strands



Monofilament is each single strand of material

Back

Repeat Complaints

Investigation Process

- Has this same problem been seen in the same batch and part which a claim has already been submitted. That previous TECHS number can be referenced multiple times if necessary for complete containment
- TE will recover the tube to verify it meets the other parameters listed in the TE Specification

Comments

- Once a complaint is submitted, it will be fully investigated by TE. Samples must be available, sufficient enough for TE to verify the problem and run testing to find the root cause. Once a concern is investigated and published through D5, the complaint can be identified justified or customer support. Containment must be completed for justified complaints. If orders are shipped after a complaint is justified, the root cause of incomplete containment and disposition will be investigated. If product was already at the customer, subsequent complaints can be cancelled or closed as Customer Support Response with the recommendation of addressing the containment and disposition process

Recommendation

- Containment and disposition should be addressed with each TECHS record. Verify containment procedures

◄ Back

03/22 Original