Creative Pultrusions, Inc. Standard Minimum Visual Requirements Guide. Based on ASTM D4385-19

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Total page count - 44

Interpreting this Guide

Creative Pultrusions has developed specifications where specific defects and allowable limits are not defined by ASTM D4385-19. The controlling source for each requirement is located at the top right hand corner of each page herein to determine origin of requirement.

Defects listed in the Internationally Recognized ASTM D4385–19 Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products, will be identified using the ASTM International Source – "ASTM D4385-19".

Defects not defined in the ASTM but necessary for inclusion into the visual requirements guide, will be identified by "CPI-VS" which stands for Creative Pultrusions Inc. Visual Specification.

Each defect within this guide is accompanied with a photograph representative of the defect. Under each photograph, a statement will provide explanation as to it meeting or not meeting specification.

This guide details all known defects by description and allowable limits and is intended for all Standard Structural Profiles. The Quality Assurance Sheet for each profile will provide the requirements unique to a particular profile.

Visual Inspection

Visual Inspections are required on every part. Visually inspect 100% of the surface area, cross section and the interior of the profile as permitted.

Black Marking

Source – ASTM D4385-19

Black smudges on the surface of the pultruded product that are unremovable by cleaning, scrubbing, or wiping with solvent. This defect is cosmetic in nature and does not affect the structural serviceability.

Acceptance / Rejection Criteria

A single smudge shall fit in a 1 in. (25.4 mm) diameter circle. Multiple smudges are permitted.

Note: photo shown depicts profile not meeting the specification.

Blister

Source – ASTM D4385-19

A rounded elevation of the pultruded surface with boundaries that may be more or less sharply defined. It is possible that blisters will exist within the pultrusion as a hollow delaminated area (gas filled) under a raised potion of the surface.

Note: The rounded elevation somewhat resembles in shape a blister on the surface of the human skin.

Note: This defect is cosmetic in nature and does not affect the structural serviceability.

Acceptance / Rejection Criteria

Permitted if formed between the surfacing veil layer and balance of laminate, width is no greater than 80% of surface width but limited to 1.25 in. (31.75 mm) in diameter and length is not over 8 in. (20.32 cm). Not more than 2 per 10 ft (3.048 m) of length. Popcorn blisters less than .060 in. (1.5424 mm) in diameter and 0.010 in. (.254 mm) high are permitted. Blisters are not permitted within connection areas intended for bonding purposes.

Note: photo shown depicts profile not meeting the specification.

Source – CPI VS

Blooming Fiber

A pultrusion surface condition exhibiting a fiber prominence or fiber show that usually has a white or bleached color and a sparkling appearance.

Note: The surface generally feels rough when touched by the fingers and is of superficial thickness easily removed by buffing or light sanding.

Note: photo shown depicts profile with veil not meeting the specification.

Acceptance / Rejection Criteria

Permitted for rod and bar with all roving reinforcement. Not permitted for a mat and roving construction unless there is no surfacing veil.

Fibers must be encapsulated by resin.

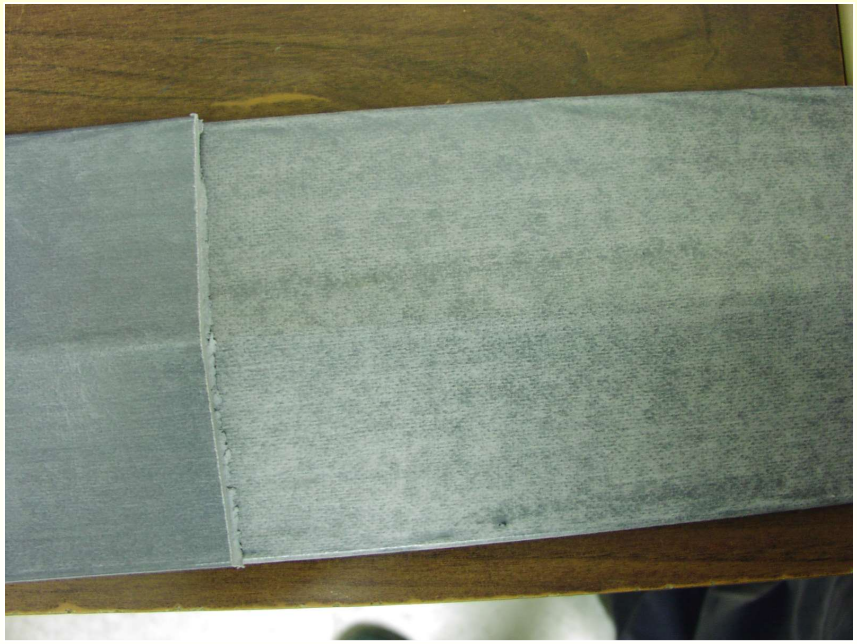
Source – CPI VS

Blooming, Under cure

A dull and bleached surface color that is evident in pultruded material not exposed to the weather.

Acceptance / Rejection Criteria
Not Permitted

Undercure can be determined By use of a Coleman Barcol Impressor. Acceptable readings should be 55-65.



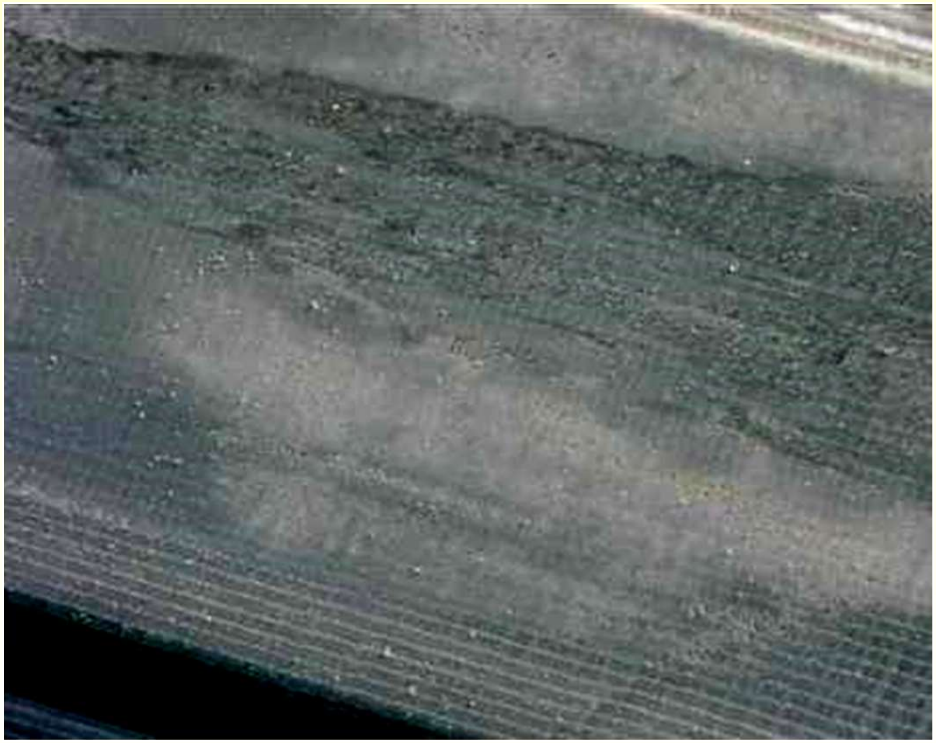
Note: photo shown depicts profile not meeting the specification.

Source – ASTM D4385-19

Burn or Thermal Decomposition

A discoloration, distortion, or destruction of the pultruded surface as a result of thermal decomposition.

Note: This defect affects the structural serviceability



Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

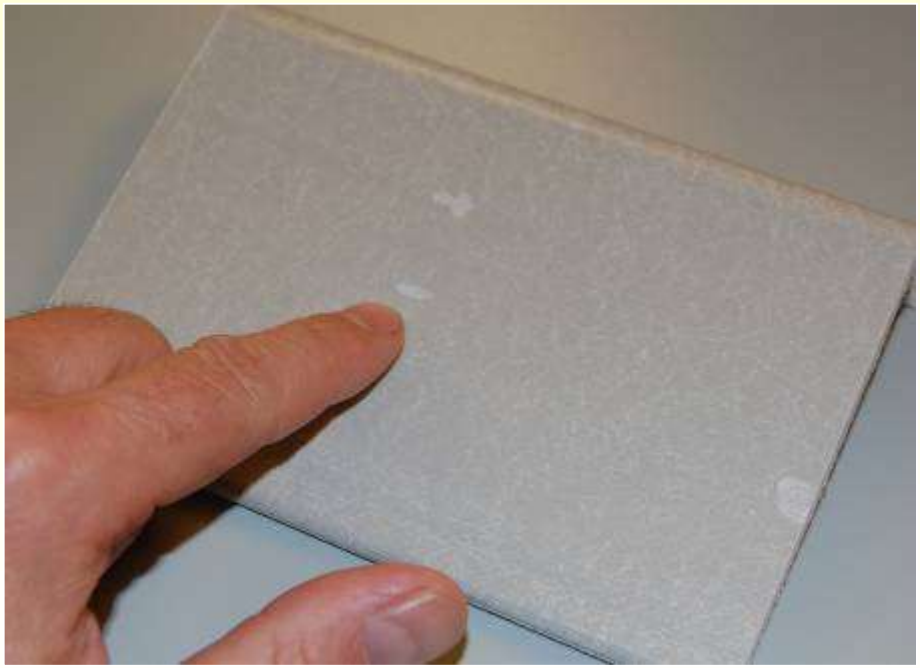
Not Acceptable

Chips (Gouges)

Source – ASTM D4385-19

Minor damage to the pultruded surface that removes material but does not cause a crack or craze.

Note: This defect is cosmetic in nature and does not affect the structural serviceability.



Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

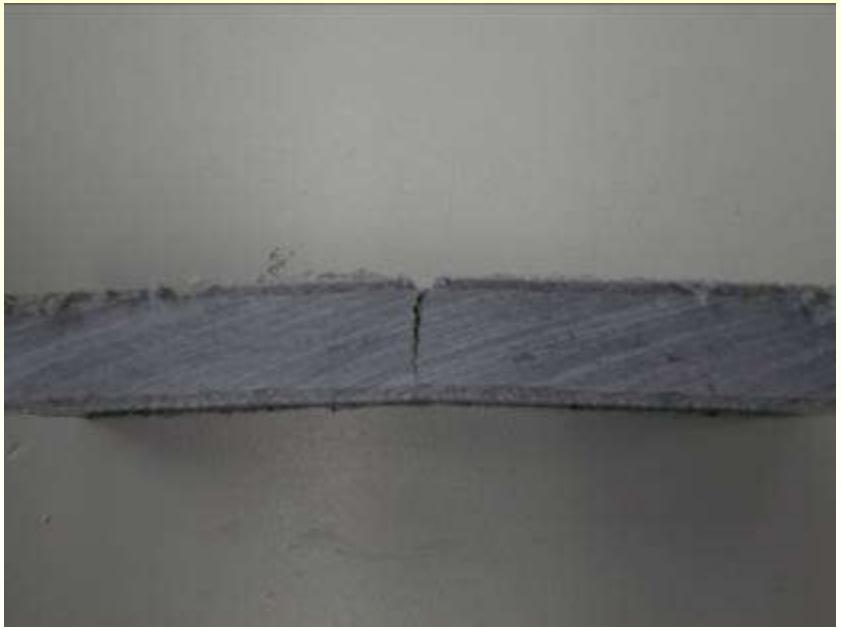
Not over .393 in. (10 mm) wide or long. Not more than five per 10 ft (3.048 m) length. Chips that penetrate past the depth of the surface veil are not permitted.

Crack

Source – ASTM D4385-19

A visual separation that occurs from the pultruded surface to the equivalent of one full ply or more of reinforcement 0.02 in. (0.508 mm). Reference Internal Shrinkage Cracks.

Note: This defect affects the structural serviceability



Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

Not Acceptable

Source – ASTM D4385-19

Crater

A small, shallow pultrusion surface imperfection.

Note: This defect is cosmetic in nature and does not affect the structural serviceability.

Acceptance / Rejection Criteria

Acceptable if it does not reduce the part thickness below the minimum specification.

Note: photo shown depicts profile meeting the specification.

Craze

Source – ASTM D4385-19

Multiple fine separation cracks at the pultruded surface not penetrating into the reinforcement nor to the equivalent depth of one ply of reinforcement.

Note: This condition is usually due to resin shrinkage during cure in resin rich areas.

Note: This defect is cosmetic in nature and does not affect the structural serviceability.

Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

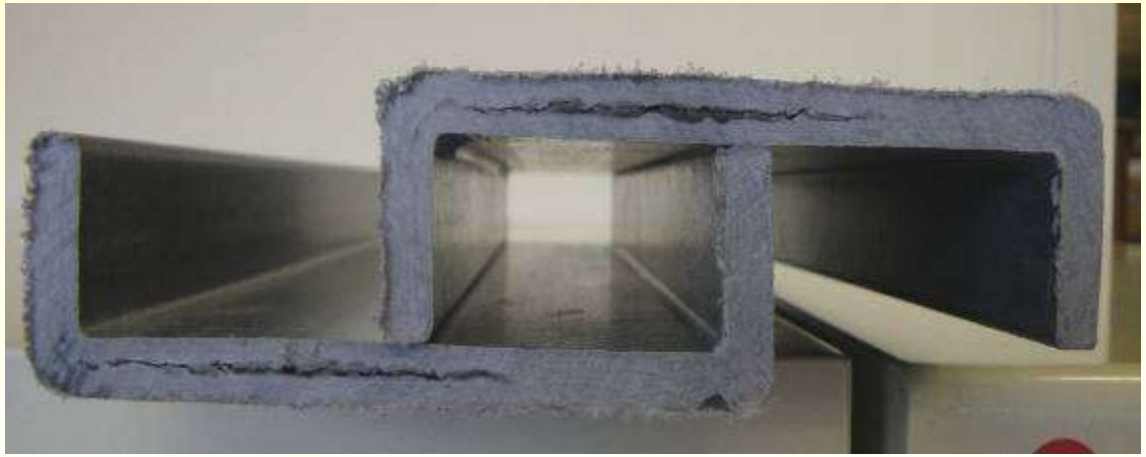
Acceptable and can be over the entire length of the part.

Delamination

Source – ASTM D4385-19

The separation of two or more layers or plies of reinforcing material within a pultrusion.

Note: This defect affects structural serviceability.



Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

Not Acceptable

Die Parting Line

Source – ASTM D4385-19

A lengthwise flash or depression on the surface of a pultruded plastic part. The die parting line is not part of the dimensional tolerance.

Note: The die parting line is associated with the area where separate pieces of the die join together to form the cavity.

Note: This defect is cosmetic in nature and does not affect structural serviceability.

Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

The line projection caused by the die parting line shall not extend past the product's surface by more than .02 in. (0.508 mm). It shall not create a sharp feeling or have loose fibers.

Discoloration

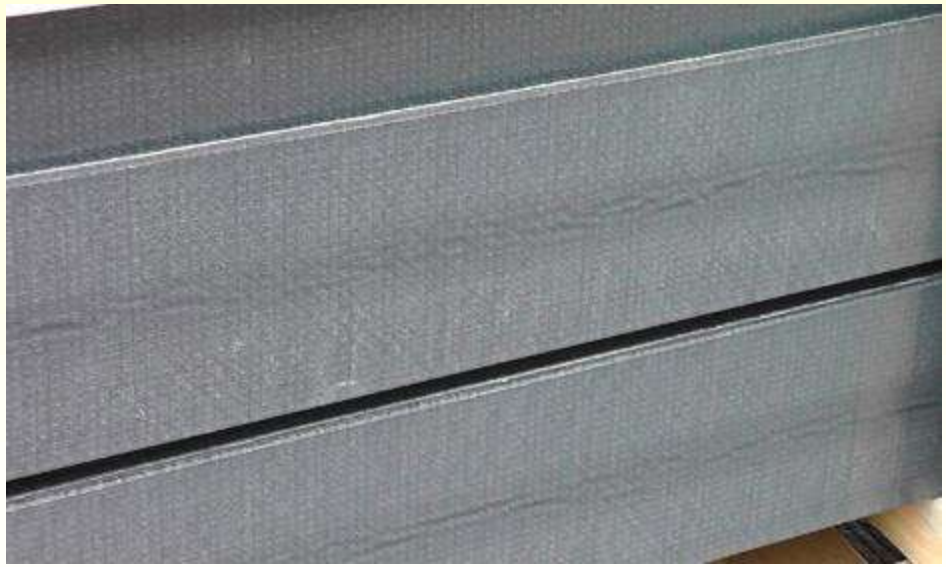
Source – ASTM D4385-19

A streak or other pattern on the surface that causes a noticeable change of color from the rest of the pultruded surface that has not been exposed to the weather.

Note: This defect is cosmetic in nature and does not affect structural serviceability.

Acceptance / Rejection Criteria

Spots of any color not over 0.75 in. (19.05 mm) in diameter or 8 per 10 ft (3.048 m) of length are permitted. Streaks or longitudinal stains permitted if not over 0.75 in. (19.05 mm) wide, 10 in. (25.4 cm) long or more than six per 10 ft. (3.048 m) of length. Continuous discolorations caused by veil overlap or resin rich areas are permitted. Mat discolorations are not rejectable.



Note: photo shown depicts profile meeting the specification.

Source – ASTM D4385-19

Dry Fiber (Lack of Resin Fill out)

A condition in which fibers are not fully saturated by resin during pultrusion.

Note: This does not Include surfacing veil.

Note: This defect affects structural serviceability.

Acceptance / Rejection Criteria

Not acceptable.

Note: photo shown depicts profile not meeting the specification.

Dullness

Source – ASTM D4385-19

A lack of normal pultruded surface gloss or shine.

Note: This condition can be caused by insufficient cure (typically in large areas) or a stop mark, (more defined and abbreviated in size), which result in a dull area on a pultruded profile.

Note: Where the condition has been determined to have been caused by insufficient cure, reference the "Insufficient Cure" section for direction and disposition. Where it has been determined as associated to a stop mark, the condition is purely cosmetic in nature and does not affect the Structural serviceability, reference "Stop Mark" section.

Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

Determine cause of condition and reference the "Insufficient Cure" section or "Stop Mark" section for direction.

Source – ASTM D4385-19

Expose Roving / Veil Slippage

The underlying layer of roving or mat not covered by surface material in a pultrusion.

Note: This defect is cosmetic in nature and does not affect the structural serviceability. Can lead to fiber blooming when exposed to sunlight.

Acceptance / Rejection Criteria

Permitted if surfacing material covers all but .4375 in (11.112 mm) from each free edge, but not to exceed 25% of the width of the surface being inspected or 10% of the circumference of a round product. It is acceptable to use carrier rovings on the inside surface of the tube. Exposed rovings in the connection areas are acceptable.

Note: photo shown depicts profile not meeting the specification.

Fiber Bridging

Source – ASTM D4385-19

Reinforcing fiber material that is found bridging across on an inside radius of a pultruded shape.

Note: This condition is caused by shrinkage stresses around such a radius during cure.

Note: This defect is cosmetic in nature and does not affect structural serviceability.

Acceptance / Rejection Criteria

Permitted if reinforcing fibers are encapsulated by resin, no corner cracks exist, and there is no evidence of delamination.

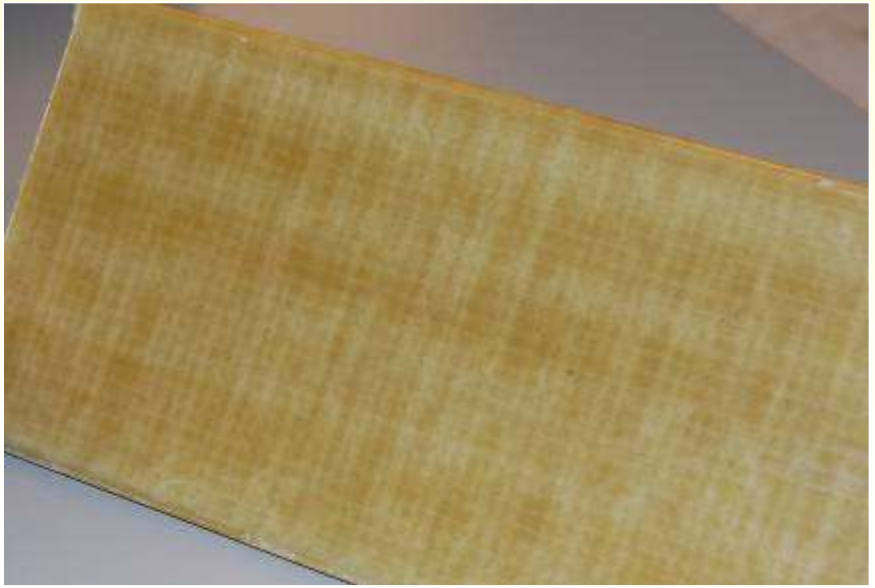
Note: photo shown depicts profile meeting the specification.

Fiber Prominence

Source – ASTM D4385-19

A visible and measurable pattern of the reinforcing material on the surface of a pultruded plastic part.

Note: This defect is cosmetic in nature and does not affect structural serviceability if fibers are encapsulated by resin.



Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

Permitted if reinforcing material is encapsulated by resin.

Folded Reinforcement

Source – ASTM D4385-19

An unintentional or unspecified misalignment of mat or fabric reinforcing material in relation to the contour of a pultruded section.

Note: It is possible that such folds will affect the surface appearance of the pultrusion and will be visible in a cut cross section of the product.

Note: It is possible that this condition is unavoidable and does affect the strength of a pultruded profile.

Note: photo shown depicts profile meeting the specification.

<u>Acceptance / Rejection Criteria</u>

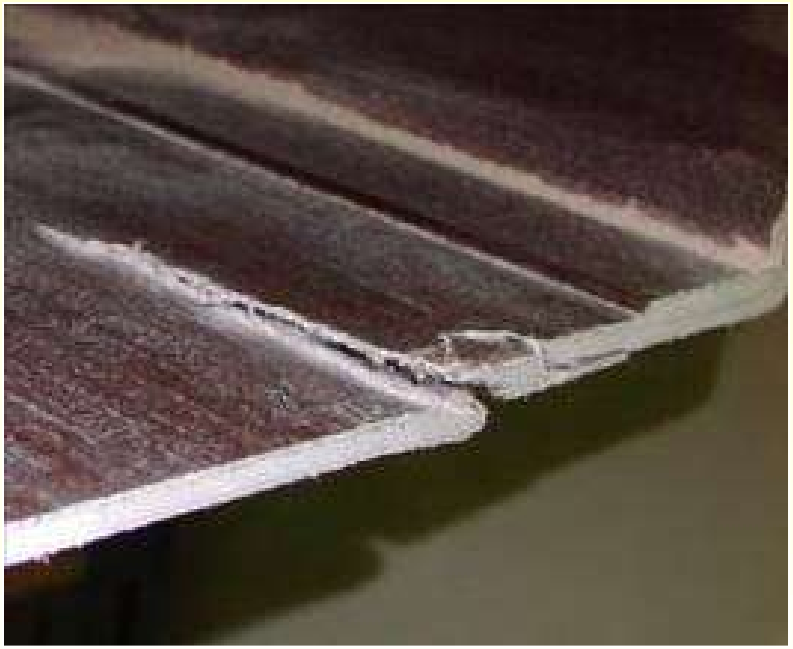
Permitted if properties meet the minimum mechanical and physical properties as published by manufacturer or properties agreed upon between pultruder and purchaser. Other visual requirements caused by mat folds must satisfy the specification.

Fracture

Source – ASTM D4385-19

Cracks, crazing, or delamination, or a combination thereof, resulting from physical damage to the pultrusion.

Note: This defect affects structural serviceability.



Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

Not acceptable

Grooving

Source – ASTM D4385-19

Long narrow grooves or depressions in a surface of a pultrusion parallel to its length.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.

Acceptance / Rejection Criteria

Permitted if material thickness reduction is not over 10% and the groove width is .125 in. (3.175 mm) or less. Grooves on opposing surfaces of the cross sectional thickness are not permitted. Intermittent and continuous grooves are acceptable as long as the profile satisfies dimensional and mechanical requirements.

Note: photo shown depicts profile meeting the specification.

Inclusion

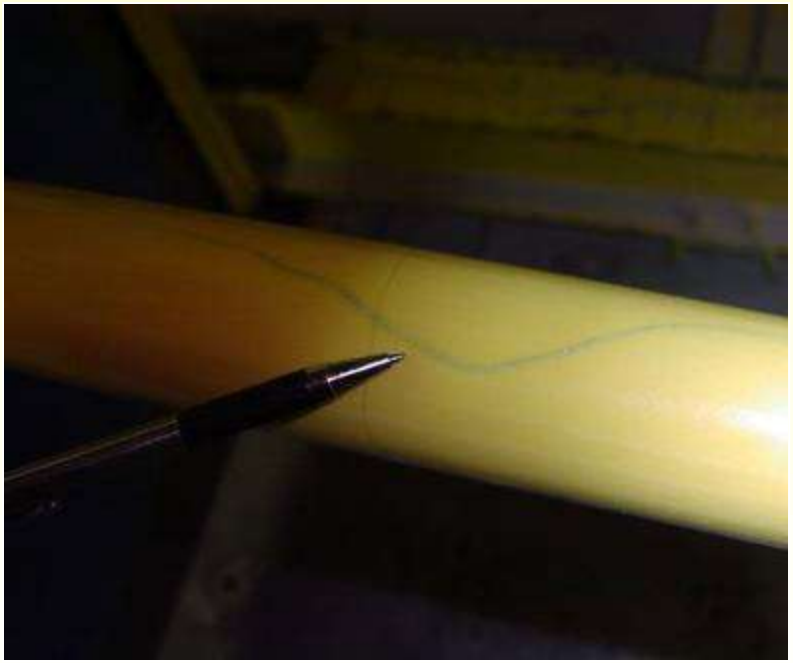
Source – ASTM D4385-19

Any foreign matter or particles that are either encapsulated or imbedded in the pultrusion.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.

Acceptance / Rejection Criteria

Permitted if product meets test requirements. None in excess of 0.50 in. (12.7 mm) in diameter or no more than six per 10 ft (3.048 m) of length. Any surface blemish created above the resin due to an inclusion shall not be permitted.



Example - Thermal wire inclusion pictured which is not acceptable

Note: photo shown depicts profile not meeting the specification.

NOTE: NO STAPLES PERMITTED WHATSOEVER.

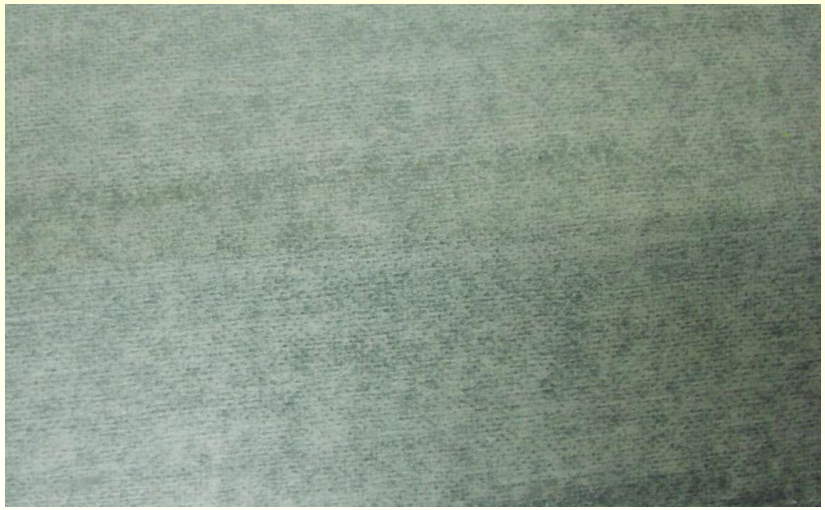
Insufficient Cure

Source – ASTM D4385-19

(also referred to as cold)

A pultrusion abnormally created by lack of, or incomplete, cross linking of the resin.

Note: This condition can usually be detected by dull surface appearance, low Barcol hardness, and low physical properties. Thick sections, cured from the outside in, can reveal insufficient cure in the center of the section even though completely cured on the surface. This condition can be caused by insufficient die temperature, improper catalyst, or pulling too fast for the die temperature.



Note: photo shown depicts profile not meeting the specification.

Note: This defect affects the structural serviceability

Acceptance / Rejection Criteria

Repair by post cure to meet test requirements and surface appearance is acceptable.

Internal Shrinkage Cracks

Source – ASTM D4385-19

Cracks in the pultrusion that are found within areas of roving reinforcement and terminate in the off axis reinforcement.

Note: This condition is caused by shrinkage strains during cure that appear in the roving portion of the pultrusion where transverse strength is low.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.

Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

Permitted without numerical limit if the crack does not reach the surface of the product or penetrate through an internal layer of the reinforcement and the product meets test requirements.

Mat Splice

Source – ASTM D4385-19

Stitching on or near the surface of the part that is utilized to splice mat reinforcements.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.

Acceptance / Rejection Criteria

Permitted if dimensions requirements are met.

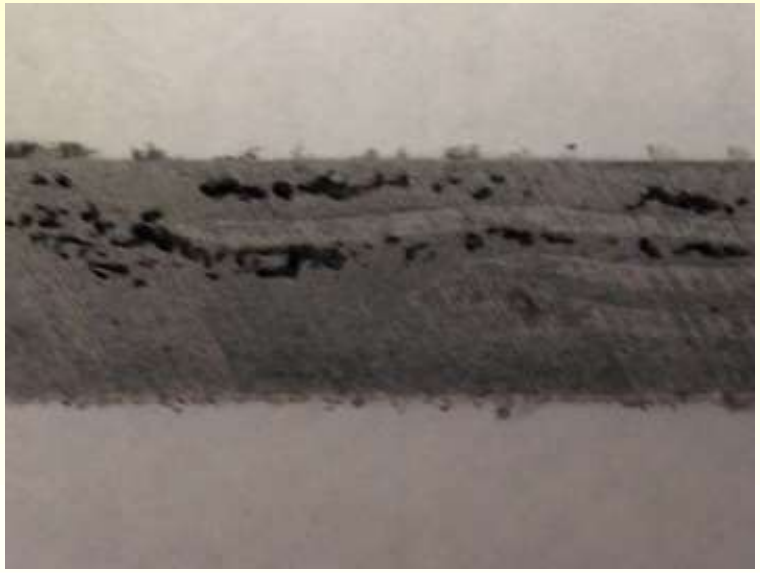
Note: photo shown depicts profile meeting the specification.

Porosity, Internal (Void)

Source – ASTM D4385-19

The presence of numerous pits or pinholes beneath the pultruded surface, usually observable only in a cut cross-section.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.



Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

No more than two pits / pinholes for every 0.0625 in. (1.6 mm) of thickness per 1.0 in. (25.4 mm) width.

Shapes exceeding the limits are acceptable if the properties including water absorption are satisfied.

Porosity, Surface (Void)

Source – ASTM D4385-19

The presence of numerous visible pits or pinholes at or near the pultruded surface.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.

Acceptance / Rejection Criteria

Permitted if pits are less than 0.030”in. (0.762 mm) in diameter and 0.02 in. (0.508 mm) deep. Maximum of 10 pits per 10 in^2 (64.5 cm^2) of area and no more than 4 % of cross sectional area per 12 in. (305 mm) of product. Any surface porosity is permitted if the customer specifies that no surfacing veil is to be used. Reference the “Resin Voids” section.

Note: photo shown depicts profile, with veil, not meeting the specification.

Source – CPI VS

Puller Track Marks

Depressions at regular intervals by excessive pull block pressure.

Acceptance / Rejection Criteria

Acceptable if the depression is less than .005” (.12mm) measured from the surface. MUST verify that the composite profile has not been cracked / fractured as a result of the puller track pressure by carefully examination of the surface and end cut of the profile.

Note: photo shown depicts profile meeting the specification.

Reinforcement Distortion

Source – ASTM D4385-19

Knotted, tangled, widely spaced, or otherwise abnormal but local irregularities in reinforcement distribution throughout the pultruded cross section.

Note: This condition usually causes noticeable changes in the local reinforcement content with crushing of the reinforcement or resin-richness in isolated areas

Note: This defect affects the structural serviceability.

Acceptance / Rejection Criteria

Permitted if defect fits in a 3 in. (76.2 mm) circle.
Multiple occurrences permitted.

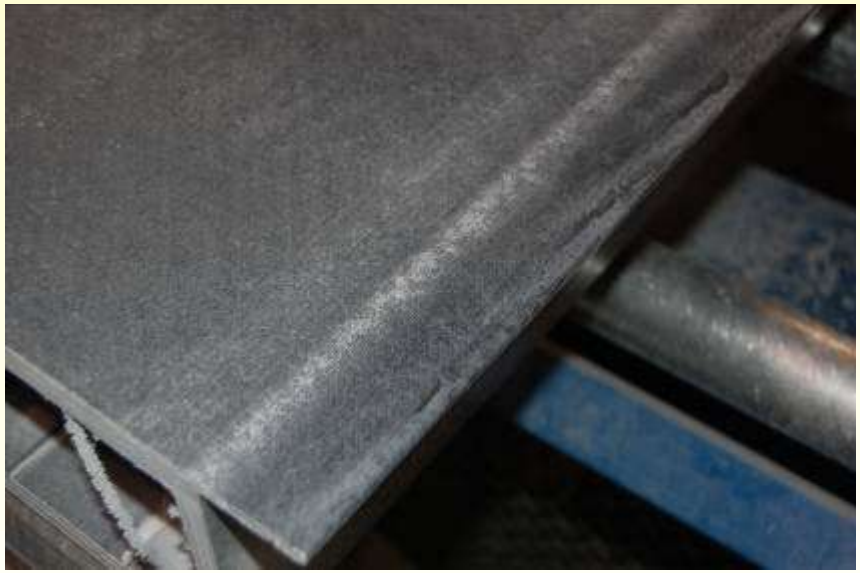
Note: photo shown depicts profile not meeting the specification.

Reinforcement Rich Area

Source – CPI VS

An over-concentration of reinforcement in the pultruded cross-section.

Note: This usually occurs where mat or other reinforcement is folded, creased or bunched in a portion of the cross section.



Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

Permitted if product meets test requirements and other visual requirements.

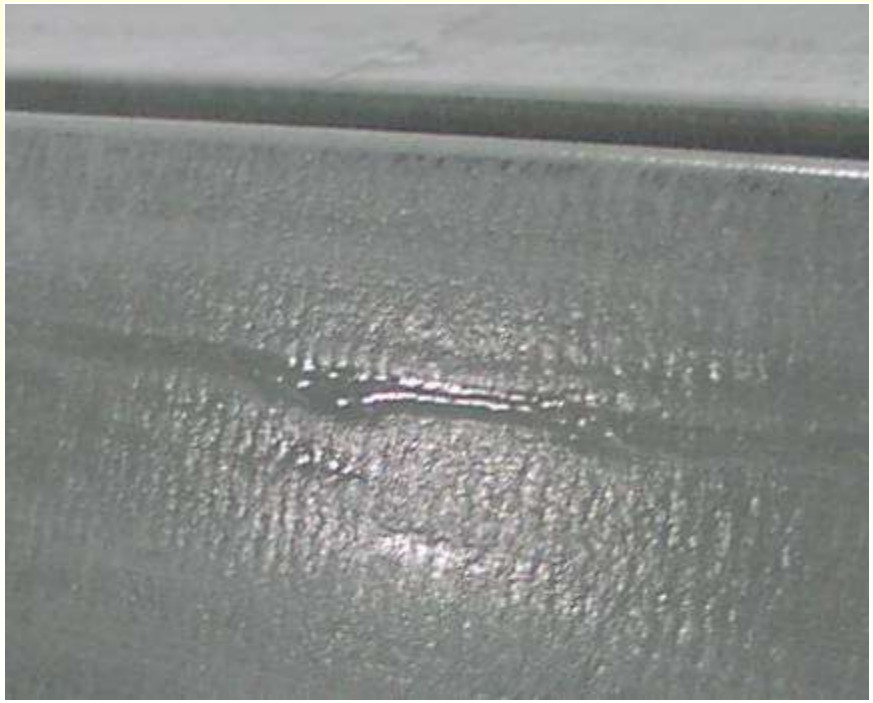
Resin-Rich Area

Source – ASTM D4385-19

An area of the pultrusion that lacks sufficient reinforcement.

Note: It is possible that the fiber pattern will not be visible.

Note: This defect is cosmetic in nature and does not affect the structural serviceability if Acceptance Criteria are met.



Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

Permitted if product meets test requirement.

Resin voids

Source – ASTM D4385-19

Resin voids appearing as multiple surface interruptions that conform to the pattern of cloth weave or continuous strand mat. These defects occur only on the surface layer of the resin in contact with the pultrusion die or mold that do not contain a veil.

Note: This defect is cosmetic in nature and does not affect structural serviceability.

Acceptance / Rejection Criteria

Acceptable on products that do not contain a surface veil.
Not acceptable on parts containing a surface veil.

Note: photo shown depicts profile meeting the specification.

Roving Knot

Source – ASTM D4385-19

A knotted or entangled section of roving found in a pultrusion.

Note: It is possible that such a knot will cause high fiber concentration locally and that it will be visible as a white or light spot on the surface of the section.

Note: This defect is cosmetic in nature and does not affect structural serviceability.

Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

Permitted if encapsulated with resin and product meets test requirements and dimensional tolerances.

Saw Burn

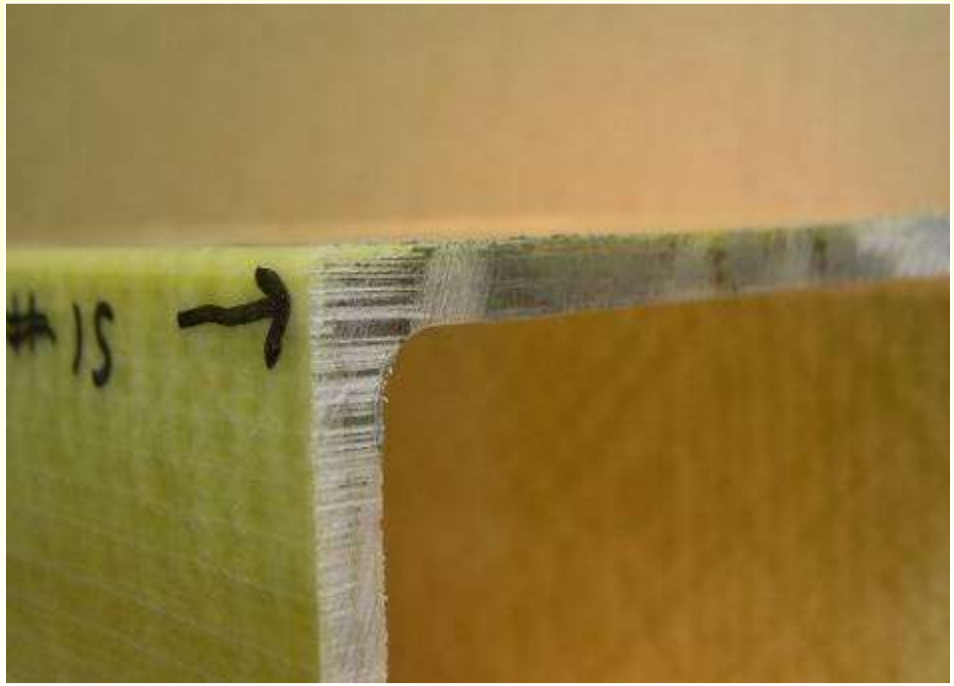
Source – ASTM D4385-19

Blackening or carbonization of a cut surface of a pultruded section.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met and not caused by dry fiber.

Acceptance / Rejection Criteria

Permitted unless caused by dry fiber



Note: photo shown depicts profile meeting the specification.

Scale

Source – ASTM D4385-19

A condition wherein resin plates or particles are on the surface of a pultrusion.

Note: Scales can often be readily removed, sometimes leaving surface voids or depressions.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.

Note: photo shown depicts profile meeting the specification.

<u>Acceptance / Rejection Criteria</u>

Permitted if removal does not expose dry fibers and dimensional tolerances are met.

Note: Repair of exposed fiber permitted if dimensional tolerances are met.

Scuffing

Source – ASTM D4385-19

Long white scrape marks on the surface of the pultrusion.

Note: This condition usually results from mechanical scraping or scratching of the pultrusion in the machine or in handling it afterwards.

Note: This defect is cosmetic in nature and does not affect structural serviceability if Acceptance Criteria are met.

Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

Permitted if not over 0.75 in. (19.05 mm) wide or 12 in. (30.48 cm) long and not over five such marks per 10 ft (3.048 m) of length. On inside radius, permitted if not over 0.125 in. (3.175 mm) wide or 6.0 in. (15.24 cm) long even if they appear intermittently along each length.

Note: It may be possible to repair if limits exceeded.

Sluffing

Source – ASTM D4385-19

A condition wherein scales peel off or become loose, either partially or entirely, from the pultrusion.

Note: This term is applied to an occurrence during the pultrusion process and is not to be confused with scraping, prying or physically removing the scale from the pultrusion. *Sluffing* is sometimes is spelled *sloughing*.

Note: This defect is cosmetic in nature and does not affect the structural serviceability if Acceptance Criteria are met.

Note: photo shown depicts profile meeting the specification.

<u>Acceptance / Rejection Criteria</u>

Repair permitted if dimensional tolerances are met.

Source – ASTM D4385-19

Shrink Mark

A dimple like depression on the surface of a pultruded shape where it has retracted from the pultrusion die, and which has well rounded edges. A shrink mark generally occurs on one surface of the part where there is a boss, flange, rib or other heavy section on the opposite surface.

Note: This defect is cosmetic in nature and does not affect structural serviceability.

Acceptance / Rejection Criteria

Permitted if dimensional tolerances are met.

Note: photo shown depicts profile meeting the specification.

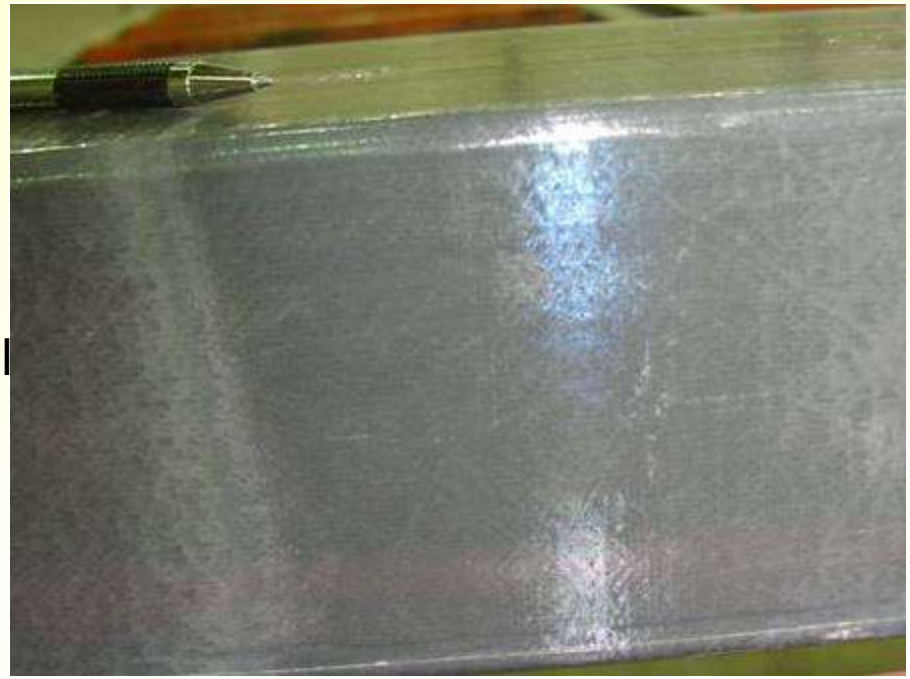
Stop Mark

Source – ASTM D4385-19

A band, either dull or glossy, on the surface, approximately 0.5 in. to 4 in. (12.7 to 101.6 mm) long and extending around the periphery of a pultruded shape.

Note: This condition is the result of an interruption in the normal continuous pulling operation.

Note: This defect is cosmetic in nature and does not affect structural serviceability unless a burn or thermal decomposition occurs. Reference the "Burn or Thermal Decomposition" section.



Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

Permitted unless a burn or thermal decomposition occurs.

Undercure

Source – ASTM D4385-19

Insufficient cross linking of polymer chains. It could be caused by inadequate process temperature and or catalyst chemistry.

Note: Undercured parts look dull and bleached without any exposure to weather or chemicals. This defect affects the structural serviceability.

Note: photo shown depicts profile not meeting the specification.

Acceptance / Rejection Criteria

Not acceptable.

Undercure can be determined By use of a Coleman Barcol Impressor. Acceptable readings should be 55-65.

Wrinkle Depression

Source – ASTM D4385-19

An undulation or series of undulations or waves on the surface of the pultruded part.

Note: This condition can occur in either the lengthwise or crosswise direction of the pultrusion and is caused by reinforcement shifting and crowding. Reference the "Folded Reinforcement" section. Wrinkles affect the flatness of the surface.

Note: This defect is cosmetic in nature and does not affect the structural serviceability if Acceptance Criteria are met.

Note: photo shown depicts profile meeting the specification.

Acceptance / Rejection Criteria

Depressions are permitted if less than 15 % of shape thickness and the minimum shape thickness and flatness specification are satisfied.

Staples

Source – CPI VS

A metal staple (or staples) used to aid in material feeding process as adding individual reinforcements into the construction stream in a pultrusion process.

Note: While this is generally the most efficient method of feeding additional materials, it is NOT acceptable to knowingly allow any metal staple(s) to be within a finished part.

Note: This defect can be either structural and / or electrical in nature and is NOT acceptable in any finished product.

Acceptance / Rejection Criteria

NONE PERMITTED

Note: photo shown depicts profile not meeting the specification.