



Volocopter Edge-Mount Bracket - Compliance Matrix

Ref: PRD 108-116088

SUMMARY:

Two bracket variants have been developed to secure cable bundles routed through an aircraft. The aim of this matrix is to list the environmental conditions and the requirements to be met to manufacture and deliver new serial injection-molded standard plastic brackets.

| Requirement | Ref | Verification Method | | | Compliance Status | Means of Compliance | Comments |
|---|-------|---------------------|----------|------|-------------------|--|--|
| | | Design | Analysis | Test | | | |
| Performance (Functional, Electrical and Mechanical Requirements, Design Constraints, Software Requirements, etc.) | | | | | | | |
| Bracket type 1 must maintain a distance of 6.9mm (nom.) between the cable and other edges or surfaces. | 1.1.1 | ✓ | | | ✓ | CAD | Distance to structure edge maintained by tab feature. |
| Bracket type 2 must maintain a distance of 12mm (nom.) between the cable and other edges or surfaces. | 1.1.2 | ✓ | | | ✓ | CAD | Distance to structure edge maintained by tab feature. |
| Brackets must not deflect by more than 0.5mm under maximum load. i.e. avoid high pressure points. | 1.2 | | ✓ | | ✗ | ANSYS Simulator | Simulated deflection for large bracket is 4.4mm during 'Y' acceleration at room temperature (crash load 20g). See report ADM-SIM-000904999_2406490_1_01. |
| Bracket geometry should minimize the risk of wire insulation abrasion | 1.3 | ✓ | | | ✓ | CAD | Suitable radii defined on model/ drawing. |
| Glass filled material (or similar) should not be in contact with cables. | 1.4 | ✓ | | | ✓ | Material selection | Selected material is not glass-filled. |
| Bracket surfaces should be smooth and free of edges or defects where they contact the cable. | 1.5 | ✓ | | | ✓ | CAD | Drawing to dictate that split lines, ejector points, injection points to be sited away from cable interaction surfaces. |
| Brackets should not contain features/parts which could be easily detached as a result of mishandling. | 1.6 | ✓ | | | ✓ | CAD | |
| Bracket type 1 must be capable of reaching the product of the maximum cable mass (0.092kg/m x 0.5m) = 0.046kg and operational acceleration (8g ultimate x 1.15 safety factor) = 6.9g at 80°C without a permanent impact on performance. | 1.7.1 | | | ✓ | ✓ | Validation test | Simulations and verification test results suggest that this level of performance can be achieved. Indicative performance to be confirmed by TE during validation phase. Note that performance will need to be validated by Volocopter using representative substrate materials and internal preparation and bonding processes. |
| Bracket type 2 must be capable of reaching the product of the maximum cable mass (0.092kg/m x 0.5m) = 0.046kg and operational acceleration (8g ultimate x 1.15 safety factor) = 6.9g at 80°C without a permanent impact on performance. | 1.7.2 | | | ✓ | ✓ | Validation test | Simulations and verification test results suggest that this level of performance can be achieved. Indicative performance to be confirmed by TE during validation phase. Note that performance will need to be validated by Volocopter using representative substrate materials and internal preparation and bonding processes. |
| Brackets must be able to withstand typical operational abuse. | 1.8 | | | ✓ | ✗ | Validation test | The impact of operational abuse is untested. |
| The maximum weight must not exceed 2g for the type 1 bracket. | 1.9.1 | ✓ | | | ✓ | CAD | |
| The maximum weight must not exceed 4g for the type 2 bracket. | 1.9.2 | ✓ | | | ✓ | CAD | |
| Features (Form, Fit, Function, Material Requirements, etc.) | | | | | | | |
| Bracket type 1 must provide mounting for cable diameters up to 15mm. | 2.1.1 | ✓ | | | ✓ | CAD | |
| Bracket type 2 must provide mounting for cable diameters up to 10mm. | 2.1.2 | ✓ | | | ✓ | CAD | |
| Brackets should support cable tie mounting according to MSS367 and NS495401. | 2.2 | ✓ | | | ✓ | CAD | Maximum cable tie width of 3.5mm agreed with customer (see email from S.Gunasekaran on 05/01/24) |
| Brackets must be compatible with CB200 adhesive for bonding to composite/ metallic structure. | 2.3 | ✓ | | | ✓ | Material selection | Installation trials performed by customer. |
| Brackets must fit within defined structure geometries. | 2.4 | ✓ | | | ✓ | CAD | |
| It must be possible to install two brackets back-to-back on a 1mm (min) thick element. | 2.5 | ✓ | | | ✓ | CAD | Back-to-back bracket configuration modelled. |
| Reliability (Product Usage, Lifetime Performance, etc.) | | | | | | | |
| Storage Life - All components shall sustain a minimum complete storage period of 5 years without any need for periodic inspection and/or treatment and/or maintenance. | 3.1 | ✓ | | | ✓ | Material selection | |
| Operational Service Life - See 5.3. | 3.2 | ✓ | | | ✓ | Material selection | |
| Conformance, Compliance and Consistency (Industry Standards, Customer Documentation, Acceptance Testing, Post Application Testing) | | | | | | | |
| Fungus Resistance per DO-160, Section 13. | 4.1 | | ✓ | | ✓ | By analysis of historical test data | Material plaques tested and meet requirement. |
| Flammability per FAA Title 14 CFR Part 25, Appendix F, part I (a) (1) (iv), Horizontal. | 4.2 | | ✓ | | ✓ | By analysis of historical test data | Material plaques tested and meet requirement. |
| Moisture Conditioning, per SAE AS23190, paragraphs 3.5.1 and 4.7.2. | 4.3 | | | ✓ | ✗ | Validation test | The impact of moisture conditioning on this bracket is untested. |
| Non-Destructive Tensile Strength after Life Cycle, after Fluid Immersion and after Corrosion. | 4.4 | | | ✓ | ✗ | Validation test | The impact of the non-destructive tensile strength test on this bracket is untested. Note that the validation test programme will be limited to pull testing (without pre-conditioning). |
| Destructive Tensile Strength after Moisture Conditioning, per SAE AS23190, paragraphs 3.5.2 and 4.7.3. | 4.5 | | | ✓ | ✗ | Validation test | The impact of the destructive tensile strength test on this bracket is untested. Note that the validation test programme will be limited to pull testing (without pre-conditioning). |
| Life Cycle, per SAE AS23190, paragraphs 3.5.3 and 4.7.4. | 4.6 | | | ✓ | ✗ | Validation test | The impact of the life cycle test on the bracket is untested. |
| Vibration Test, per SAE AS23190, paragraphs 3.5.3.1 and 4.7.4.1. | 4.7 | | | ✓ | ✗ | Validation test | The impact of vibration on the bracket is untested. |
| Temperature Cycling, per SAE AS23190, paragraphs 3.5.3.2 and 4.7.4.2 with the exception that the maximum temperature will be 85°C. | 4.8 | | | ✓ | ✗ | Validation test | The impact of temperature cycling on the bracket is untested. |
| Fluid Immersion, per SAE AS23190, paragraph 3.5.4 and 4.7.5. | 4.9 | | | ✓ | ✗ | Validation test | The impact of fluid immersion on the bracket is untested. |
| Corrosion, per SAE AS23190, paragraphs 3.5.5 and 4.7.6. | 4.10 | ✓ | | | ✓ | Based on prior experience | The impact of salt fog on the bracket material is anticipated to be negligible based on prior experience of this material. This test has not been included in the validation test programme. |
| Identification of Product Legibility after Life Cycle, per SAE AS23190, paragraphs 3.5.6 and 4.7.4, after Fluid Immersion, per SAE AS23190, paragraphs 3.5.6 and 4.7.7. | 4.11 | ✓ | | | ✓ | Based on prior experience | The impact on identification of product legibility is anticipated to be negligible as the information will be moulded on the product. This test has not been included in the validation test programme. |
| Diametral Retention Test, per SAE AS 23190/48 paragraph 11(b). | 4.12 | | | | N/A | Test is not applicable to bracket type | Test is not applicable to bracket type. Diametral retention test specific to P-clip products. |
| Durability (Operating Environment) | | | | | | | |
| Brackets must withstand operating temperature range of -55C to +120C. | 5.1 | | | ✓ | ✗ | Validation test | Compliance is dependent on the magnitude of the applied load during temperature exposure. Pull tests to be performed at temperature extremes. |
| Brackets must withstand a 6 minute exposure to a temperature of +180C. | 5.2 | | | ✓ | ✗ | Validation test | Maximum service temperature of adhesive is 120°C, however a short duration at 180°C may be acceptable depending on the magnitude of the applied load during temperature exposure and the method of heat application e.g. it is unlikely that the adhesive will be exposed to this temperature if the supported cable is used as the heat source. |
| Operational Service Life - shall be designed for a life of 20 years, 40,000 flight hours or 20,000 flight cycles. | 5.3 | | | ✓ | ✗ | HALT test | The impact of operational service life on the bracket is untested. |
| Serviceability (Installation, Handling, Application Requirements, Application Tooling, Transportation, Storage, Packaging, Disposable Components, and Spare Parts) | | | | | | | |
| Bracket should facilitate easy installation to structure by a single operator. | 6.1 | ✓ | | | ✓ | DFA | Customer is responsible for ensuring that bonding process can be performed by a single operator. |
| Bracket should facilitate easy installation of cable by a single operator. | 6.2 | ✓ | | | ✓ | DFA | Installation trials performed by customer. |
| Bracket should facilitate easy removal of cable by a single operator. | 6.3 | ✓ | | | ✓ | DFA | Installation trials performed by customer. |
| Bracket installation process should support a curing time of 24 hours. | 6.4 | ✓ | | | ✓ | DFA | Customer is responsible for fixturing of the component during curing. |
| Bracket installation process should not increase the temperature of the CFRP substrate above 80°C. | 6.5 | ✓ | | | ✓ | DFA | Customer is responsible for ensuring that selected adhesive does not require heating in excess of 80°C for curing. |
| Bracket installation process and operation should not require special tools. | 6.6 | ✓ | | | ✓ | DFA | Customer is responsible for ensuring that bonding process does not require special tools. |
| Aesthetics | | | | | | | |
| The parts will require the following markings: - TE Part Description - Date Code - Lot / Batch Number (included on bulk packaging, not on product) | 7.1 | ✓ | | | ✓ | CAD | Product marking area to be defined on the drawing. |
| Ergonomics | | | | | | | |
| Bracket should be designed for manufacture and assembly. | 8.1 | ✓ | | | ✓ | DFM/DFA | |
| Safety (Regulatory Compliance) | | | | | | | |
| No risk of operator injury. | 9.1 | ✓ | | | ✓ | CAD | |
| Green Product Design - use form S370 GreenPD checklist | | | | | | | |
| Needs to be RoHS substance compliant (for complete list of exemptions - see TEC-138-705) | 10.1 | ✓ | | | ✓ | Material selection | |
| The product may not contain any REACH Substances of Very High Concern (SVHC) listed on the REACH Candidate List or on the REACH Authorisation List (all substances from the Authorisation List are included in the Candidate List). | 10.2 | ✓ | | | ✓ | Material selection | |
| The product needs to be free of (applications of) substances that are listed on the REACH Authorisation List. | 10.3 | ✓ | | | ✓ | Material selection | |
| Apply low halogen thresholds from TEC-138-705 (see Annex A - TE hazardous substances list). | 10.4 | ✓ | | | ✓ | Material selection | |