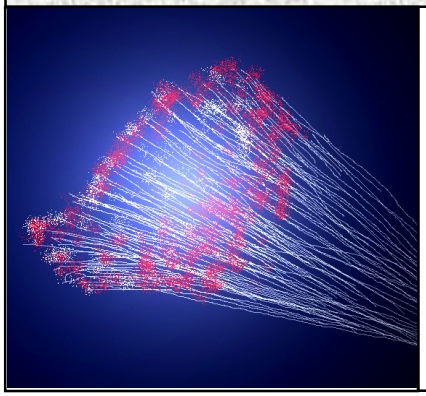
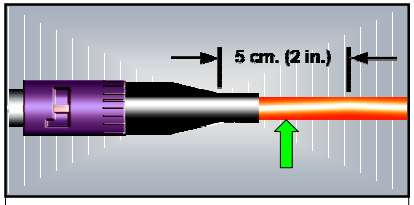


FIBER OPTICS

The term Fiber Optics (FO) is used to describe a technology which is based upon the use of a filament-shaped optical waveguide, made of a dielectric material (plastic or glass) having controlled optical reflection and refraction properties, to transmit information as light pulses rather than electrical pulses.

Fiber Optics has benefits that the traditional copper-based system does not, including low weight, electromagnetic noise immunity, and extremely high transmission speeds.



PREFERRED
AXIAL ALIGNMENT

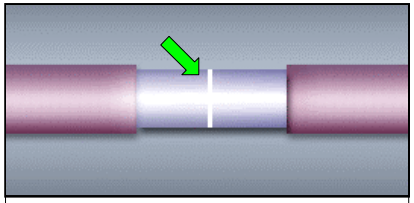
Axial alignment of the cable to the connector shall be maintained within 5 cm (2 in.) of the entry / exit from the connector body.

NASA-STD-8739.5 [10.2.7.h]

PREFERRED
BARE FIBER END FACE

End face is smooth and free from cracks, scratches, edge chips, hackles, pits, and/or other surface or sub-surface anomalies. The core is clearly discernable. Cleave angle is less than 2 degrees from perpendicular to the fiber axis.

NASA-STD-8739.5 [App. A]

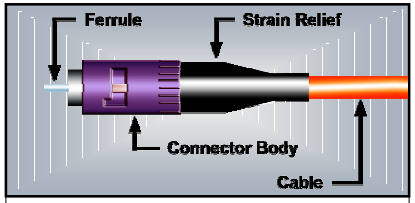


PREFERRED
CHEMICAL SPLICE

The fiber endfaces are perfectly aligned and in contact with each other. No bubbles or contamination.

Note: Chemical splices are allowed for the temporary joining of fiber optics (i.e.: test) only.

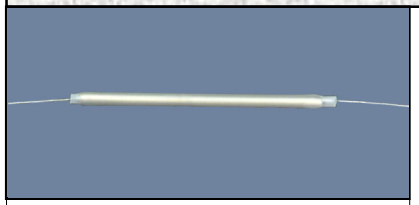
NASA-STD-8739.5 [9.2.2.c]



PREFERRED
CONNECTOR / CABLE CONFIGURATION

Connector is properly assembled, clean and damage-free. Strain-relief is properly installed, straight, tight, and damage-free. Axial alignment of the cable to the connector is maintained within 5 cm (2 in.) of the exit from the connector body.

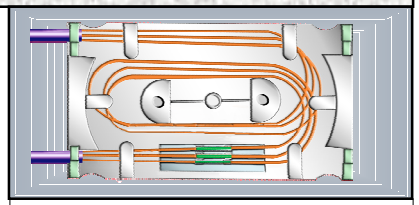
NASA-STD-8739.5 [11.3]



PREFERRED
SPLICE LOCATION

Splices shall not be located in flexure areas of the cable except when a splice is recoated and rejacketed in accordance with the manufacturer's specifications.

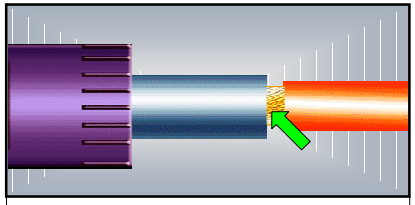
NASA-STD-8739.5 [9.2.3.a]



PREFERRED
SPLICE TRAY

Splices shall be neatly organized and marked. Service loops shall be adequate, with bend radii within specifications.

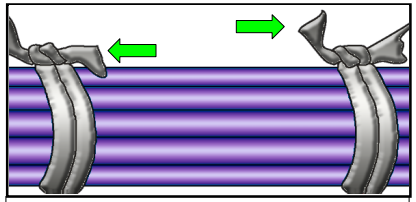
NASA-STD-8739.5 [9.3.9]



PREFERRED
STRENGTH MEMBER

Strength members shall be secured to prevent mechanical stress on the fiber.

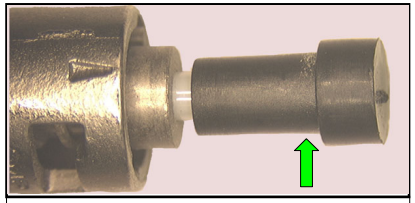
NASA-STD-8739.5 [9.2.3.c]



PREFERRED
TIE DOWNS

Optical fibers and cables shall be tied down per engineering documentation. Ties shall not pinch, deform, or stress the fiber.

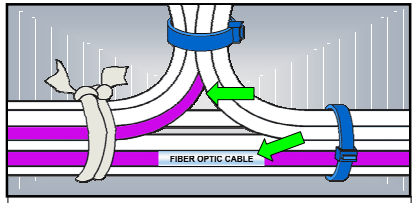
NASA-STD-8739.5 [11.4.3], [12.2.3], [12.3.4]



MANDATORY
DUST CAP

Dust caps shall be installed on all connectors when not in use. Vinyl dust caps shall not be used.

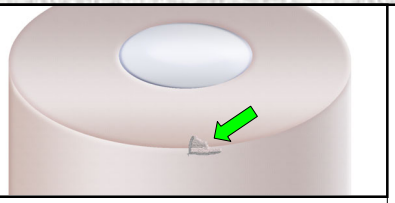
NASA-STD-8739.5 [12.2.4], [12.3.5]



MANDATORY
IDENTIFICATION

Fiber optic cables shall be identified in such a way to distinguish these cables from wire or coaxial cable. Identification methods typically used are color-coding, labeling / marking, etc.

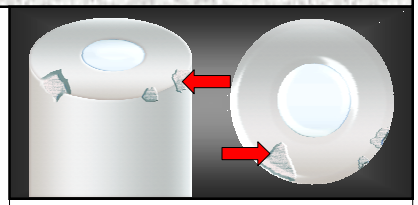
NASA-STD-8739.5 [10.2.2]



ACCEPTABLE
ENDFACE ANOMALIES
EDGE CHIPS

Edge chips are acceptable if chip maximum dimension is ≤ 3% of fiber diameter and there are less than 3 chips total. May be fixable by repolishing if connectorized.

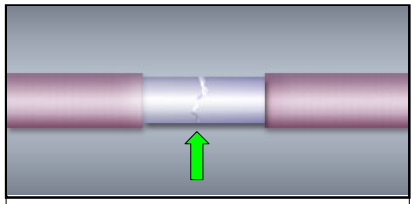
NASA-STD-8739.5 [10.2.7.e]



UNACCEPTABLE
ENDFACE ANOMALIES
EDGE CHIPS

Unacceptable if chip maximum dimension is > 3% of fiber diameter and/or there are more than 3 chips. Reject and recleave for splice termination. May be fixable by repolishing if connectorized.

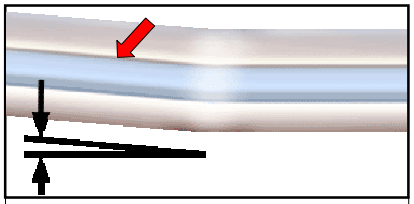
NASA-STD-8739.5 [10.2.7.e]



ACCEPTABLE
FUSION SPLICES

Mating fibers are properly aligned, but fused section is slightly distorted. No bubbles or boundary layer / diffraction zone. Optical loss is within engineering requirements.

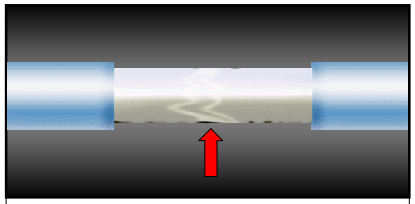
Best Workmanship Practice



UNACCEPTABLE
FUSION SPLICES
ANGULAR MISALIGNMENT

Caused by poor cleaves and/or misalignment of the mating fiber ends. High attenuation and poor mechanical properties. Scrap and reterminate.

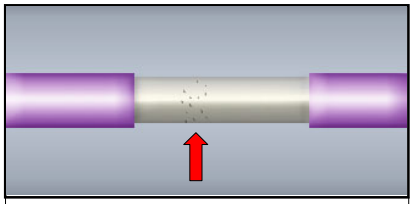
Best Workmanship Practice



UNACCEPTABLE
FUSION SPLICES
BOUNDARY LAYER / DIFFRACTION ZONE

A boundary layer or diffraction zone in a fusion splice is an indicator of an incomplete fusion process, improper cleave, and/or contamination. Scrap and reterminate.

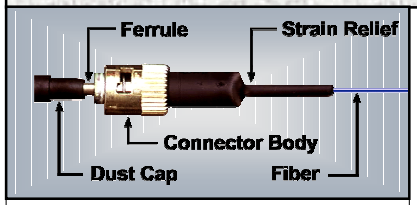
Best Workmanship Practice



UNACCEPTABLE
FUSION SPLICES
BUBBLES

Bubbles in a fusion splice are an indicator of an incomplete fusion process, improper cleave, and/or contamination. Scrap and reterminate.

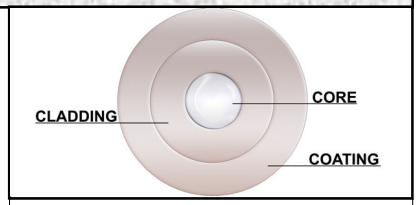
Best Workmanship Practice



PREFERRED
CONNECTOR / FIBER CONFIGURATION

The connector is properly assembled, clean and damage-free. The connector and fiber strain-relief device(s) are properly installed, straight, tight, and damage-free. Axial alignment of the fiber to the connector is maintained within specifications.

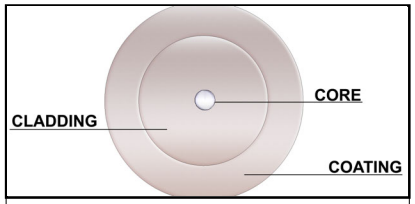
NASA-STD-8739.5 [11.3]



PREFERRED
ENDFACE (MULTI-MODE)

The endface is clean and free from cracks, scratches, edge chips, hackles, pits, and other anomalies. The fiber is concentric in the ferrule, and the epoxy ring is even. Ferrule and connector are damage-free.

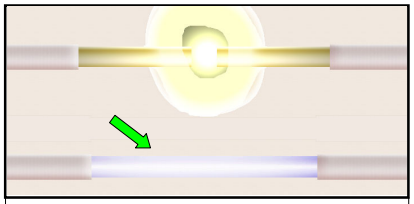
NASA-STD-8739.5 [11.3.1.c]



PREFERRED
ENDFACE (SINGLE-MODE)

The endface is clean and free from cracks, scratches, edge chips, hackles, pits, and other anomalies. The fiber is concentric in the ferrule, and the epoxy ring is even. Ferrule and connector are damage-free.

NASA-STD-8739.5 [11.3.1.c]



PREFERRED
FUSION SPLICE

The splice is perfectly aligned. Fusion zone is of uniform diameter, with no bubbles, contamination, or boundary layer evident. Splice closure is properly installed.

NASA-STD-8739.5 [9.2.2.a]

PREFERRED
MECHANICAL SPLICE

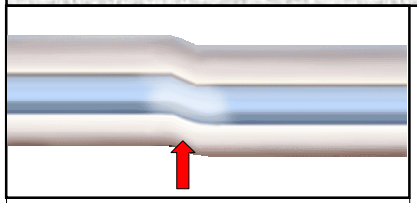
The fibers are properly inserted, aligned, and the endfaces are in contact with each other. Splice housing is properly assembled, and strain relief features are set. Mechanical splices are not for spaceflight applications.

NASA-STD-8739.5 [9.2.2.b]

PREFERRED
SPLICE CLOSURE

Splices shall be protected. If an enclosure cannot be used for a specific application, engineering documentation shall provide for other means of protection.

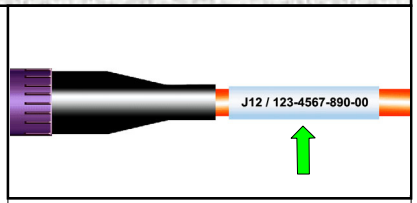
NASA-STD-8739.5 [9.2.3.b]



UNACCEPTABLE
FUSION SPLICES
LATERAL OFFSET

Caused by a lateral misalignment during the fusion process. Very high attenuation and poor mechanical properties. Scrap and reterminate.

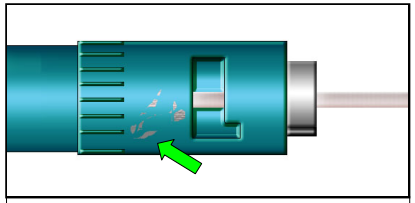
Best Workmanship Practice



ACCEPTABLE
MARKINGS

Cable connectors shall be permanently marked with mating connector designation within 15 cm (6 in.) of the connector body, or as per engineering documentation.

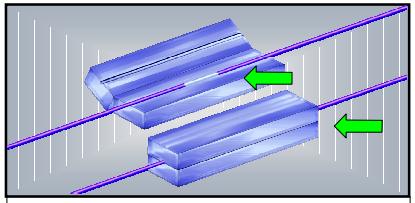
NASA-STD-8739.5 [10.2.3]



ACCEPTABLE
SCUFF MARKS

Minor scuff marks on the connector body, and/or cable jacket are acceptable, provided the damage does not impact form, fit, or function. Scuffing on the ferrule is an indicator of improper handling or excessive use.

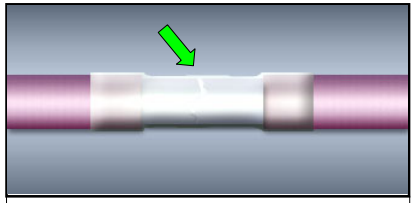
Best Workmanship Practice



ACCEPTABLE
SPLICE PROTECTOR
BUTTERFLY

Splice closure is properly installed, and strain relief features are set.

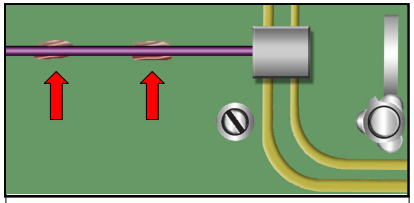
NASA-STD-8739.5 [9.2.2.a]



ACCEPTABLE
SPLICE PROTECTOR
HEAT SHRINK

Splice closure is properly located. Shrinkage is uniform and strain relief features are set. No evidence of scorching, burning, or melting.

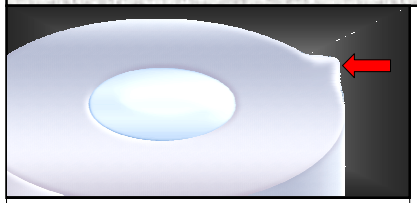
NASA-STD-8739.5 [9.2.2.a]



UNACCEPTABLE
CONFORMAL COATING / STAKING

Conformal coating or staking shall not be applied to optical fiber unless specifically required in the engineering documentation.

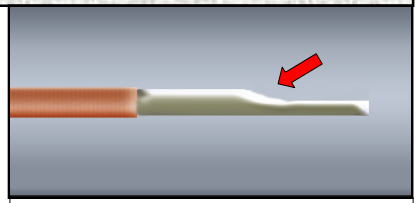
NASA-STD-8739.5 [11.4.5]



UNACCEPTABLE
ENDFACE ANOMALIES
LIP

A surface irregularity characterized by a raised fillet in the fiber edge. Reject and recleave for splice termination. May be fixable by repolishing if connectorized.

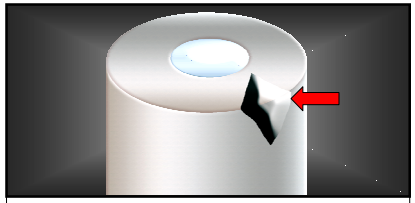
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
NECKING

Necking is the drawing (pulling) of the optical fiber to a smaller diameter during stripping. The fiber shall be trimmed and restripped.

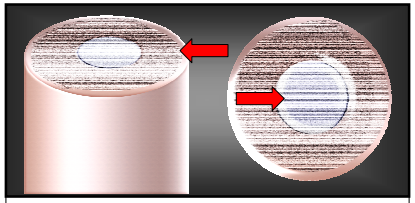
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
NOTCH

A surface irregularity characterized by a radial chip in the fiber edge. Reject and recleave for splice termination. May be fixable by repolishing if connectorized.

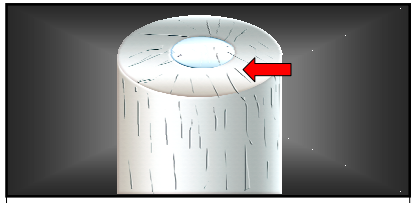
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
SCRATCHES

Reject and recleave for splice termination. May be fixable by repolishing if connectorized.

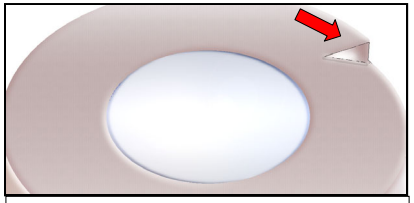
NASA-STD-8739.5 [10.2.7e]



UNACCEPTABLE
ENDFACE ANOMALIES
SHATTERED

A surface irregularity characterized by radial cracks in the core or cladding. Defect is non-repairable. The fiber / assembly shall be reterminated or scrapped.

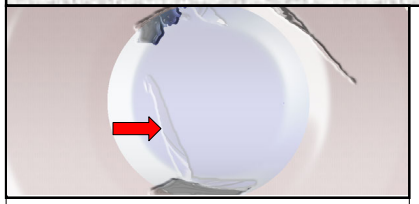
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
SPIRAL

A surface irregularity characterized by a circular (screw-shaped) cleave. Defect is non-repairable. The fiber / assembly shall be reterminated or scrapped.

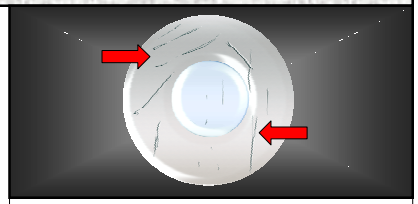
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
SUB-SURFACE CRACKS

Sub-surface cracks are only visible with core illumination, and are non-repairable. The fiber / assembly shall be reterminated or scrapped.

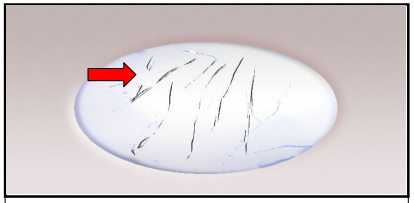
NASA-STD-8739.5 [10.2.7e]



UNACCEPTABLE
ENDFACE ANOMALIES
SURFACE CRACKS – FLIGHT HARDWARE

If cracks in a flight fiber optic assembly endface are found, the assembly shall be reterminated or scrapped. Re-polishing to fix cracks in flight hardware is prohibited.

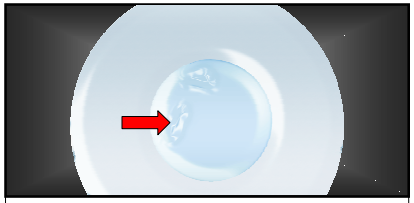
NASA-STD-8739.5 [11.3.2]



UNACCEPTABLE
ENDFACE ANOMALIES
SURFACE CRACKS – GROUND SUPPORT

If cracks in a flight fiber optic assembly endface are found, the assembly shall be reterminated or scrapped. Re-polishing to fix cracks in flight hardware is prohibited.

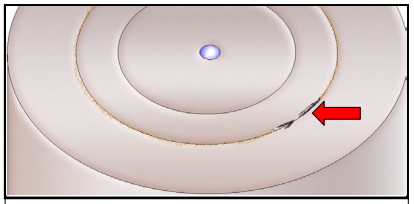
NASA-STD-8739.5 [11.3.2]



UNACCEPTABLE
ENDFACE ANOMALIES
SURFACE PITS

Repolish if in core or cladding.

NASA-STD-8739.5 [10.2.7e]



UNACCEPTABLE
EPOXY BOND LINE CRACKS

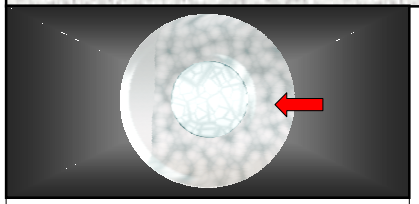
Cracks in the epoxy bond line shall be cause for rejection.

NASA-STD-8739.5 [10.3.3.c], [11.5.3.c]

UNACCEPTABLE
FERRULE DAMAGE

Cracks, damage, or deformities on the ferrule shall be cause for rejection.

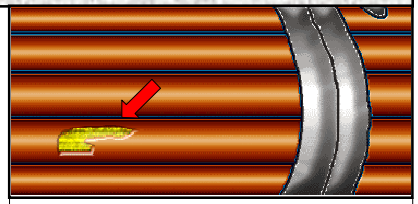
NASA-STD-8739.5 [10.2.5.c], [11.2.3.c]



UNACCEPTABLE
CONTAMINATION

Contamination is the primary cause of splicing and connectorization problems. Fingerprints and cleaning residue on the endface can significantly degrade signal quality.

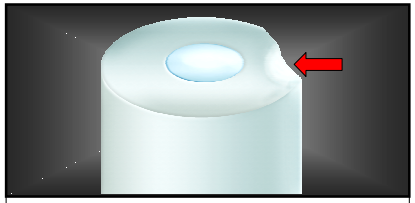
Best Workmanship Practice



UNACCEPTABLE
DAMAGE

Damage to the buffer, outer jacket, or other cable components in excess of engineering specification shall be cause for rejection.

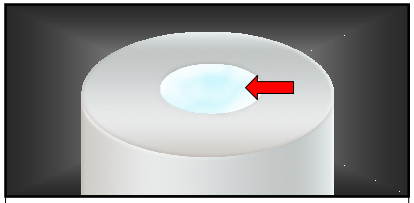
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
BREAKDOWN / ROLLOFF

A surface irregularity characterized by an angular shearing of a portion of the endface. Defect is non-repairable. The fiber / assembly shall be reterminated or scrapped.

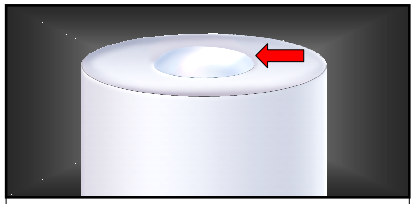
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
CONCAVE

A surface irregularity caused by excessive polishing or an improper cleave. Defect is non-repairable. The assembly / fiber shall be reterminated or scrapped.

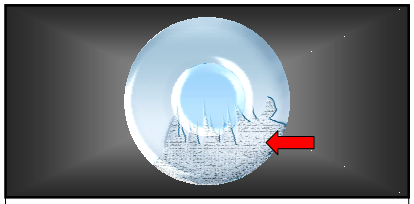
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
CONVEX

A surface irregularity caused by incomplete polishing or an improper cleave. Reject and recleave for splice termination. May be fixable by repolishing if connectorized.

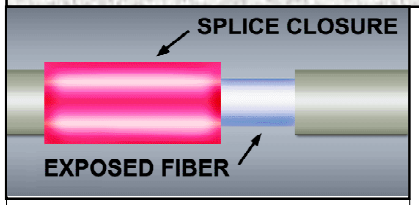
Best Workmanship Practice



UNACCEPTABLE
ENDFACE ANOMALIES
HACKLE / MIST

A surface irregularity characterized by a jagged, rippled, or stepped break in the fiber face. Reject and recleave for splice termination. May be fixable by repolishing if connectorized.

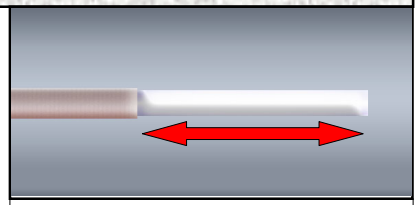
NASA-STD-8739.5 [9.2.1]



UNACCEPTABLE
IMPROPER SPLICE CLOSURE INSTALLATION

Splice closures shall be installed to provide environmental and mechanical protection to the splice section. As depicted, the splice closure does not completely cover the exposed fiber.

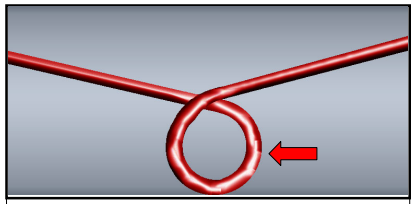
NASA-STD-8739.5 [9.2.3.b], [10.2.7.f]



UNACCEPTABLE
IMPROPER STRIP LENGTH

Fibers designated for splicing or connectorization shall exhibit the proper cable and fiber stripping dimensions. Improper stripping dimensions may reduce reliability or performance.

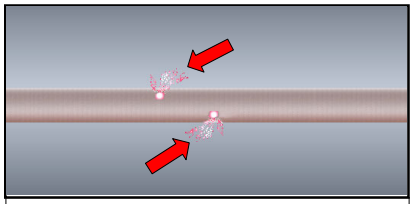
NASA-STD-8739.5 [10.2.4.a], [11.2.2.a]



UNACCEPTABLE
KINKING

Kinking produces microbends in the fiber, increasing signal attenuation and may promote breakage of the fiber.

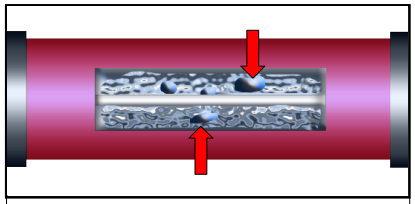
Best Workmanship Practice



UNACCEPTABLE
LEAKS

Light leakage is the result of a macrobend event in the fiber (i.e.: crack, chip, etc.), causing a disruption in the light's transmission path.

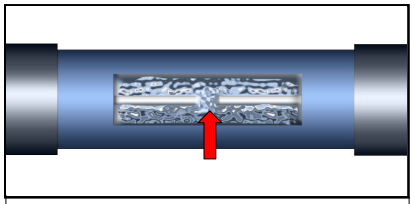
Best Workmanship Practice



UNACCEPTABLE
MECHANICAL SPLICES
BUBBLES

Bubbles in the matching gel cavity will result in a high attenuation termination. The assembly shall be reterminated or scrapped.

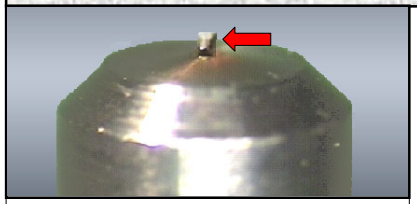
Best Workmanship Practice



UNACCEPTABLE
MECHANICAL SPLICES
END SEPARATION

Typically seen in mechanical splices where the fiber ends are not in intimate contact, or in splices in which the matching gel has been lost / removed. High attenuation / completely dark.

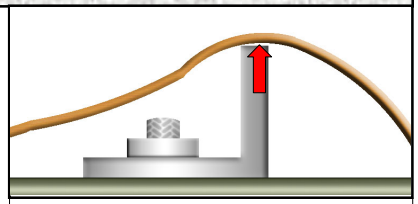
Best Workmanship Practice



UNACCEPTABLE
PISTONING

The axial movement of the fiber within the connector body/ferrule causes pistoning. Positive pistoning may be fixable by repolishing. Negative pistoning shall be cause for rejection.

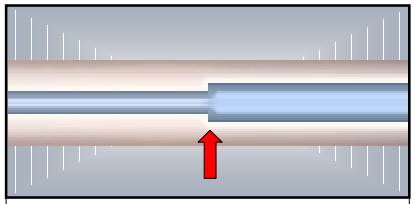
NASA-STD-8739.5 [10.3.3.b], [11.5.3.b]



UNACCEPTABLE
ROUTING

Optical fibers and cable assemblies shall not be routed over sharp edges or corners unless appropriate protection is provided.

NASA-STD-8739.5 [11.4.1], [12.2.8], [12.3.8]



UNACCEPTABLE
SPLICES, CORE MISMATCH

Core mismatch is typically caused by the splicing of two differing fiber core sizes (i.e.: 50/125 to 62.5/125). The splice can result in a power gain, or loss, depending on the direction of transmission.

Best Workmanship Practice