



ENGINEERING WHITE PAPER / APPLICATION SELECTION GUIDE

ARINC 801 Optical Termini: Pull-Proof, Non-Pull-Proof and 900 μm Non-Pull-Proof Configurations

Mechanical load paths • Cable construction compatibility • Ferrule travel • Termination process controls • Aerospace qualification

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Executive summary

ARINC 801 establishes a compact, removable optical terminus interface built around a nominal 1.25 mm ceramic ferrule. Within that common interface, the mechanical relationship among cable jacket, aramid strength member, optical fiber, ferrule carrier and connector shell determines which terminus retention architecture should be selected. XiOptics offers all three configurations addressed in this paper: a pull-proof design for compatible loose-structure cable, a non-pull-proof design for tight-structure cable, and a dedicated 900 μm non-pull-proof configuration. [1,2]

The pull-proof design is engineered to divert an externally applied cable tensile load through the cable reinforcement into the stationary terminus body and connector retention system while preserving the spring-loaded ferrule carrier's operating travel. By contrast, a non-pull-proof design deliberately couples the tight cable termination to the movable ferrule carrier. External tension on an installed non-pull-proof cable can retract the ferrule carrier, unload the optical interface and interrupt the channel if it exceeds the controlled strain-relief envelope. Neither design is intrinsically superior: each is optimized for a different cable kinematic behavior. [1–4]

The dedicated XiOptics 900 μm configuration extends the rear bonding tube from the ferrule carrier, facilitating front- and rear-side adhesive application and positioning excess adhesive outside sensitive internal mechanisms. Its purpose is to enable reliable attachment of the 900 μm sub-jacket and reinforcement where present, while protecting spring mobility. This specific construction detail is based on XiOptics design information supplied for this paper and should be verified against the controlled product drawing and process instruction before release.

1. Background and development intent

Boeing initiated the high density, high performance, multi-channel ARINC 801 connector and terminus development around 2005 in support of the then-new 787 aircraft platform. The intended cable application was low-smoke, zero-halogen (LSZH) loose-structure optical cable. The optical fiber was permitted limited longitudinal motion within the first jacket or buffer envelope, rather than being tightly constrained to the cable outer structure. That freedom was important to a cable installation concept involving pulling cable runs through bulkheads and routing trays without disturbing connected optical interfaces.

Under that design premise, tensile installation loads could not be permitted to translate directly into displacement of the spring-loaded optical ferrule carrier. The cable jacket and strength members instead needed a direct mechanical load path through the stationary terminus housing into the connector retention features and shell. The pull-proof configuration was therefore the initial production approach in XiOptics' design and production history. The specific Boeing development chronology is historical information only supplied by XiOptics, rather than independently established by the public sources cited herein. Additional information is available from the ARINC organization.

As the ARINC 801 connector interface expanded into avionics, defense, industrial and other platforms, cable architectures diversified. Commercial availability of compact, tightly buffered and tightly jacketed optical cables created a different mechanical integration problem: their fiber and reinforcing constituents did not exhibit the relative axial travel assumed by the original pull-proof configuration. The non-pull-proof version addresses this cable architecture. Public ARINC 801 product literature from other manufacturers likewise explicitly distinguishes pull-proof/loose-structure from non-pull-proof/tight-structure configurations. [3,4]

2. The engineering distinction: load transfer versus ferrule travel

2.1 Required ferrule function

The ferrule must retain sufficient spring-controlled axial travel and contact force to maintain an acceptable physical-contact optical interface through dimensional tolerances, vibration, thermal excursions and connector mating. Loss of axial contact will immediately increase insertion loss, worsen reflection and, under sufficiently large withdrawal, open the optical path to a complete disconnect or discontinuity. Cable attachment design must not defeat the intended spring function.

2.2 Pull-proof architecture: mechanically isolated optical carrier

In the pull-proof configuration, the strength members and outer cable jacket are anchored to the stationary terminus body through the specified retention/crimp system. That body is retained by the connector. The spring-supported ferrule carrier is mechanically decoupled from the primary tensile load path, provided that cable construction allows adequate fiber/buffer movement. Cable axial loading is consequently resisted at the connector structure without commanding comparable axial motion of the optical carrier. [2–4]

Primary load path: cable jacket/aramid → rear anchoring feature → stationary terminus housing → connector retention feature → connector shell. Optical functional path: fiber → bonded ferrule → spring-loaded floating carrier. The two paths remain sufficiently isolated only when the selected loose-structure cable actually accommodates the necessary differential movement.

2.3 Non-pull-proof architecture: cable coupled to the moving carrier

With a tight-structure cable, the reinforcement, jacket/buffer and fiber are substantially coupled along the cable length. The non-pull-proof terminus attaches the cable to the moving ferrule carrier so that the cable and optical contact move together within the permissible assembly travel. This avoids imposing the original pull-proof design's requirement that fiber advance or retreat relative to a constrained outer cable structure. [2,4]

Primary load path when cable tension is applied: tight cable assembly → rear bonding region → ferrule carrier → spring/contact mechanism. Unlike the pull-proof design, the optical carrier is not isolated from an external cable pull. Accordingly, the finished connector assembly must provide suitable external strain relief and must not be installed, routed, or handled as though cable tension is carried independently by the connector shell. Loss of contact occurs only when tensile loading and resulting travel exceed the available optical engagement margin; it is a design risk, not an inevitable result of every small cable load.

2.4 Simplified load-path comparison

Design	Cable load path	Ferrule behavior under cable tension
Pull-proof / loose	Jacket and aramid → stationary body → connector shell	Carrier remains substantially isolated, assuming compatible loose cable and load within rating
Non-pull-proof / tight	Cable jacket/reinforcement → movable ferrule carrier	Carrier can be displaced rearward; optical contact may be lost under excessive tension
900 µm non-pull-proof	900 µm sub-jacket/buffer and reinforcement (if present) → extended bonding tube → movable carrier	Same non-pull-proof principle, adapted to a small cable cross-section

3. Cable construction governs selection

3.1 Loose construction and pull-proof retention

Loose-structure cable allows longitudinal accommodation between the fiber/buffer and the load-bearing outer cable structure. This differential movement is central to pull-proof functionality. If the outer cable is tensioned or axially displaced, the ferrule carrier need not follow it by the same displacement. Correct cable selection therefore requires more than labeling a jacket “loose”: verify the actual buffer architecture, allowable fiber movement, tensile and compression behavior, bend performance, jacket/reinforcement termination method, and environmental qualification. A 2024 aerospace fiber-movement test standard explicitly addresses movement of the buffered fiber relative to strength members in pull-proof optical contact systems. [5]

Advantages include external pull-force management, improved tolerance of certain installation and maintenance loading scenarios, and separation of connector mating contact from the dominant cable tensile load. Tradeoffs include a potentially narrower qualified cable selection, sensitivity to available fiber travel, additional structure/termination features, and the need to protect internal spring movement from adhesive migration.

3.2 Tight construction and conventional non-pull-proof retention

Tight jacketed cable couples the glass fiber or coated/buffered fiber more closely with its jacket and reinforcement system. The use of a non-pull-proof terminus allows the ferrule carrier and attached cable to move in concert during normal spring travel, rather than forcing independent fiber displacement against a relatively fixed cable structure. This can reduce one mechanism of fiber compressive loading or local bending produced by incompatible terminus/cable kinematics.

It is important not to claim that tight-structure cable “cannot” create microbending, glass fatigue, humidity exposure or moisture migration. Tight buffering, adhesion, shrinkage, bend radius, temperature excursions and cable design can themselves contribute to microbending or macrobending. Long-term fiber reliability depends on stress magnitude, proof testing, coating protection, flaws and environmental conditions. Likewise, moisture resistance is determined by jacket permeability, sealed terminations, cable design and exposure—not solely by choosing tight rather than loose construction. Appropriate designs can mitigate these mechanisms, but they do not eliminate them by definition.

Advantages generally include broader availability of cable constructions and sourcing options, the potential for lower material cost, straightforward attachment to the movable carrier, and compact integration. Tradeoffs include sensitivity to external tensile loads while connected, the need for well-controlled cable strain relief, and the possibility that direct cable force will interfere with ferrule engagement.

3.3 LSZH is a material classification, not a measure of fiber freedom

LSZH describes combustion-related behavior of cable materials. It does not, by itself, determine whether a cable is loose or tight, nor whether the cable is compatible with pull-proof termination. Engineers should review both fire/smoke/toxicity requirements and the separate mechanical construction drawing. For aerospace applications, cable and component selection must satisfy the governing airplane or equipment flammability requirements, which cannot be inferred solely from the LSZH designation.

4. Dedicated 900 μm non-pull-proof configuration

4.1 Application and geometry

A 900 μm buffered or sub-jacketed optical fiber is common in protected interconnect routing, internal equipment harnesses, racks and short equipment transitions. However, “900 μm ” specifies a nominal outer dimension and does not guarantee the presence of a distinct Kevlar/aramid reinforcement layer. The cable cross-section must be verified before defining its structural attachment and pull rating. XiOptics identifies a dedicated ARINC 801 900 μm configuration as distinct from its conventional non-pull-proof offering. [1,2]

4.2 Extended ferrule-carrier bonding tube

In the XiOptics configuration described for this paper, a long bonding tube extends rearward from the ferrule carrier and protrudes slightly beyond the rear of the terminus. This arrangement allows adhesive delivery at the ferrule front and at the accessible rear entrance of the extended tube. Where a compatible 900 μm construction includes an appropriate reinforcement and jacket, the intended process captures those constituents in the designated bonding region along with the optical fiber, establishing a controlled cable-to-carrier attachment.

The geometry also provides a process-containment advantage: overflow at the external rear of the extended tube can be detected and controlled without allowing that excess adhesive to enter the internal spring cavity. This is analogous in principle to the non-pull-proof

approach used with suitable approximately 2 mm jacketed cable, though the adhesive volumes, preparation lengths and bond dimensions must follow the specific 900 μm drawing.

4.3 Why adhesive location matters

ARINC 801 termini depend on an axially moving ferrule-carrier mechanism. Adhesive that extends beyond the intended bond envelope can migrate into the spring, carrier sliding surfaces or housing interface. Once cured, even a small bridge of adhesive between moving and stationary components can restrict stroke, change contact force, immobilize the carrier or create a nonconforming terminus. XiOptics' public termination guidance specifically warns that excess adhesive can lock the spring mechanism. [2]

For pull-proof termini, this risk warrants special attention because the fiber bond and movable optical carrier must remain free even though the jacket and reinforcement are separately anchored to the stationary body. For the dedicated 900 μm non-pull-proof design, the protruding rear tube can provide improved visual and process access to manage rear-side adhesive excess. This is a design/process advantage, not permission to exceed approved adhesive quantity or to omit cure and stroke verification.

5. Side-by-side engineering assessment

Criterion	Pull-proof	Non-pull-proof (tight)	900 μm non-pull-proof
Recommended cable	Qualified loose-structure	Qualified tight-structure, often 1.5–2.2 mm class	Qualified 900 μm buffered/sub-jacketed
Primary tensile-load destination	Stationary body / connector shell	Movable ferrule carrier unless externally strain-relieved	Movable ferrule carrier unless externally strain-relieved
Fiber/outer cable differential motion	Required by design	Not required as primary mechanism	Not required as primary mechanism
Cable pull while mated	Best architecture where load isolation is required, within rating	May retract ferrule / lose contact	May retract ferrule / lose contact
Bond/crimp process focus	Protect spring; separate fixed-body cable retention from mobile fiber	Bond tight cable to movable carrier; provide backshell/route strain relief	Control small bond volume; use extended rear tube; contain overflow
Cable availability	More specialized; depends on approved constructions	Often broader commercial selections	Numerous 900 μm fibers, but cable reinforcement architecture varies
Primary risk if mismatched	Tight cable cannot provide required relative fiber movement	Loose cable can move independently and undermine expected retention	Unreinforced 900 μm fiber or inadequate bond may fail mechanical duty

6. Design and application selection procedure

The correct configuration should be selected using the following order of engineering decisions rather than by ferrule diameter alone.

Step 1 — Define cable architecture.

Obtain a controlled cable cross-section and datasheet showing glass/coating/buffer structure, reinforcement, jacket dimensions, axial fiber freedom, bending and tensile limits.

Step 2 — Identify cable handling loads.

Determine installation pull force, pull direction, cable routing, field-maintenance handling, connector backshell/strain relief, and whether those loads may be applied while the optical connection is mated.

Step 3 — Select the load path.

If mechanical load must bypass the ferrule carrier, evaluate pull-proof with verified loose-structure cable. If the fiber and jacket must move as one, evaluate non-pull-proof and provide independent cable strain relief.

Step 4 — Screen 900 μm constructions.

For a 900 μm buffered/sub-jacketed fiber, assess the dedicated non-pull-proof geometry, actual reinforcement availability, adhesive bond volume and mounting/strain-relief design.

Step 5 — Verify optical travel.

Confirm spring stroke and contact force after termination, mating and representative axial cable loading. Inspect for adhesive intrusion or interference.

Step 6 — Qualify the assembled system.

Evaluate optical loss/return loss, cable retention, vibration, thermal cycling, humidity, bend sensitivity and handling loads as required by the actual ARINC 801 program and cable assembly specification.

7. Manufacturing and verification considerations

7.1 Common process controls

- Verify part-number, cable construction and ferrule bore compatibility before assembly.
- Control fiber strip length, cleanliness, insertion depth, adhesive preparation, metered dispense and cure.
- Confirm the designed strength-member/jacket capture region, without assuming jacket OD proves suitable cable construction.
- Perform endface geometry and optical inspection to the approved process.
- Verify free ferrule-carrier travel and spring return following curing and before release.

7.2 Pull-proof specific controls

- Independently verify that outer jacket and strength members are attached to the stationary structure.
- Ensure the floating fiber/ferrule assembly maintains required axial freedom; test with the actual cable.
- Prevent adhesive migration beyond the intended ferrule bonding region, especially into the internal spring.
- Apply representative installed cable loads and verify that optical contact is maintained within the qualified limits.

7.3 Non-pull-proof and 900 µm controls

- Bond the actual tight cable or 900 µm sub-jacket/reinforcement arrangement to the moving carrier according to the applicable drawing.
- Avoid rear bond geometry that obstructs contact movement, connector grommets or insertion/removal tooling.
- For the extended 900 µm tube, confirm rear adhesive visibility, overflow capture and spring cleanliness.
- Provide assembly-level strain relief so routine service or installation loads are not inadvertently applied directly to the ferrule carrier.

8. Qualification and reliability: what can and cannot be concluded

The three configurations can meet stringent aerospace environmental requirements when tested with their intended cable systems and approved termination processes. Published ARINC 801 supplier literature reports environmental and mechanical qualification ranges and explicitly offers both pull-proof and non-pull-proof variants. Such general supplier data must not be treated as an automatic qualification of a particular XiOptics part number, ferrule polish or selected cable. [3,4]

A robust application-level verification plan should measure: (a) retention under axial load with optical monitoring; (b) spring stroke/contact force before and after termination and environmental exposure; (c) insertion-loss and return-loss stability while mated and during handling; (d) temperature-induced fiber movement or shrinkage; (e) cable bend sensitivity and long-term reliability; and (f) resistance to the specified humidity, fluid and contamination environment. XiOptics has available its full qualification data package performed at an independent optical laboratory to support the design/implementation function of its termini.

Claims that tight cable categorically eliminates microbending, prevents long-term glass cracking or guarantees the absence of moisture are not defensible without specific cable-construction and environmental data. What can be stated is that a correctly paired non-pull-proof architecture avoids forcing independent fiber movement within a tight cable and that approved sealed cable designs can limit moisture ingress. The engineering analysis must remain cable-specific.

9. Application recommendations

Application situation	Preferred starting point	Condition for selection
Airframe loose-structure cable exposed to controlled installation/maintenance	Pull-proof	Demonstrated loose-cable fiber movement and qualified fixed-body load transfer

tension		
General avionics harness using tight cable with independent route/backshell strain relief	Conventional non-pull-proof	Cable moves with carrier; service pulls managed externally
Internal equipment/rack routing of 900 μm buffered fiber	Dedicated 900 μ m non-pull-proof	Verified 900 μ m construction, reinforcement/bond capability and protected routing
Tight cable that must withstand connector-level pull without optical interruption	Reconsider system architecture	Do not assume either retention variant can compensate for an incompatible cable; add strain relief or change cable design
Legacy program with approved cable/terminus combination	Maintain approved configuration pending engineering change	Intermate compatibility alone is not authorization to substitute

10. Conclusions

Pull-proof and non-pull-proof ARINC 801 termini are not competing quality grades; they implement different mechanical assumptions about the cable. Pull-proof protects ferrule engagement from externally applied cable tensile loads by anchoring the cable structure to the stationary terminus body and connector shell. This benefit relies on a cable whose internal optical fiber can accommodate the required differential motion. Non-pull-proof deliberately attaches a tight cable to the moving ferrule carrier and avoids imposing a false loose-cable motion requirement, but the optical channel can be unloaded by excessive cable pull.

The dedicated XiOptics 900 μ m non-pull-proof design extends the basic tight-cable principle to small sub-jacketed constructions. Its extended rear bonding tube is intended to improve adhesive access and containment, with particular attention to avoiding adhesive intrusion into the spring mechanism. In all cases the finished cable, termination, connector and external strain-relief arrangement must be verified as one mechanical and optical system.

Recommended selection rule: specify the actual cable cross-section and its fiber/strength-member kinematics first; then choose the terminus architecture that establishes the correct load path and preserves the required ferrule stroke. This is the most reliable basis for cost-effective, maintainable and qualified ARINC 801 optical-link integration.

References and technical basis

[1] XiOptics LLC, “ARINC 801 Termini / NXTCore Optical Terminus System,” <https://www.xioptics.com/arinc-801-termini.html> (accessed October 2026).

[2] XiOptics LLC, “Frequently Asked Questions,” questions 7, 9, 11 and 17, <https://www.xioptics.com/faq.html> (accessed October 2026).

[3] Amphenol Fiber Systems International, “ARINC 801 Fiber Optic Series,” product data, https://www.amphenol.co.jp/military/catalog/ARINC801_E.pdf.

[4] TE Connectivity, “ARINC 801 Optical Termini,” product facts, <https://www.te.com/content/dam/te-com/documents/aerospace-defense-and-marine/marine/global/fiber-documents/arinc801-termini.pdf>.

[5] EN 3745-801:2024, “Aerospace series — Fibres and cables, optical, aircraft use — Test methods — Part 801: Fibre movement under compression,” published June 2024.

[6] XiOptics engineering design history and configuration notes supplied for preparation of this paper, October 31, 2026. Used for Boeing 787 development history and dedicated 900 μ m extended-tube design details; verify against company-controlled design records prior to external release.

Engineering notice: Conceptual load paths are explanatory, not controlled assembly drawings. Qualification, interchangeability, adhesive dimensions, cable load limits and processing instructions are governed by current released XiOptics drawings, applicable ARINC 801 revision, program specifications and approved test records. No claim of Boeing endorsement or airframe qualification is implied.