



INERTRA™ System Integration Overview

OEM Integration Context for Retention & Flow Architecture Licensing

Integration guidance for OEM product teams evaluating INERTRA™ Retention and Flow architectures for incorporation into new or existing platforms. Covers integration considerations, qualification framework, validation responsibilities, environment mapping, and licensing process. Supplemental engineering materials available under NDA.

PATENTS: US9422969B2 • US8398349B2 • US8226158B1
Issued United States Patents — Ireland Design Company, LLC

INTENDED AUDIENCE: OEM Product Engineering · Systems Integration Leads · Program Management

01 — SCOPE OF THIS DOCUMENT

Integration Architecture Overview

This document is intended for OEM product teams, systems engineers, and program integration leads evaluating INERTRA™ retention and flow architectures for incorporation into new or existing product platforms. It addresses integration context, interface design considerations, qualification framework, and the licensing pathway to implementation.

Supplemental integration drawings, constraint geometry specifications, and application-specific engineering materials are available under executed mutual NDA with qualified integration partners.

Primary Audience	OEM product engineering teams · Systems integration leads · Program managers responsible for interface architecture decisions
Document Scope	Introductory integration context only. Not a complete design specification. Detailed materials available under NDA with qualified commercial counterparties.
What This Covers	INERTRA™ architecture families · Integration considerations · Qualification framework · Environment mapping · Licensing process for OEM integration programs
What Requires NDA	Constraint geometry specifications · Detailed engineering drawings · Material compatibility data · Application-specific claim mapping · Confidential technical exchange

ARCHITECTURE FAMILIES AT A GLANCE

<h2>Retenti on</h2> <p>ROTATIONAL CONSTRAINT EMBEDDED IN INTERFACE</p>	<h2>Flow</h2> <p>PASSIVE VAPOR & MIST DISPERSION CONTROL</p>	<h2>3</h2> <p>ISSUED U.S. PATENTS IN PORTFOLIO</p>	<h2>OEM</h2> <p>QUALIFIED INTEGRATION PARTNERS ONLY</p>
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02 — INERTRA™ RETENTION — INTEGRATION CONTEXT

Embedding Rotational Constraint at the Interface Level

INERTRA™ Retention addresses the fundamental failure mode of vibration-driven preload loss by introducing structural constraint geometry directly into the bolted joint interface. The architecture is designed to maintain clamp load stability across extended duty cycles in vibration-intensive, cyclic load environments — without secondary locking systems or chemical adhesives.

Integration Considerations for OEM Programs

Interface Geometry	INERTRA™ Retention is embedded at the joint interface level. Integration requires review of mating surface geometry, load path configuration, and clearance envelope. Specific constraint geometry is detailed in confidential engineering materials under NDA.
Load Path Compatibility	Architecture is designed for primary load-bearing interfaces subject to torque, vibration, and cyclic loading. Duty cycle characterization (amplitude, frequency, thermal range) is required for integration fit assessment.
Material Considerations	No chemical compounds are required for INERTRA™ Retention function. Compatible with standard metallic fastener materials. Biocompatibility review is appropriate for medical and implant integration contexts. Material compatibility data available under NDA.
Serviceability Requirements	Architecture supports controlled disengagement and reinstallation consistent with standard field service procedures. Does not require destructive removal. Service interval and torque sequence protocol to be defined per application.
Packaging & Envelope	Integration geometry is interface-level — generally compatible with existing bolt patterns and joint configurations. Specific envelope constraints are addressed in confidential engineering materials during qualified evaluation.
Qualification Framework	Validation testing design (vibration profile, load cycle count, acceptance criteria) is the responsibility of the licensee and must comply with applicable standards: AS9100, MIL-SPEC, ISO 13485, FRA, or program-specific qualification requirements.

Environment Mapping — Retention Architecture

WIND ENERGY

Nacelle flange, hub-to-shaft, tower section interfaces. Crane access constraints define maintenance economics. Duty cycle: 20+ year service life at continuous cyclic torque.

HEAVY EQUIPMENT & MILITARY

Mining drivetrain, construction equipment, military ground vehicle interfaces. Shock and vibration-intensive. MIL-SPEC governs. Serviceability is a readiness constraint.

RAIL & BOGIE SYSTEMS

Bogie frame, wheel assembly, and axle interfaces. Millions of oscillatory cycles per year. FRA governs maintenance intervals and retention requirements.

INDUSTRIAL DRIVES

Gearbox flanges, motor mounts, precision drive assemblies. High-frequency resonance. Preload loss degrades positional accuracy and OEE performance.

AEROSPACE STRUCTURAL

High-reliability interfaces under combined loading. AS9100 / DO-160 qualification. Serviceability and NDE access constraints apply.

BIOMECHANICAL / MEDICAL

Orthopedic fixation, modular implant interfaces. ~1M physiological cycles per year. FDA 510(k)/PMA pathway. ISO 13485. No chemical retention acceptable.

Passive Vapor & Disturbance Control Integration

INERTRA™ Flow uses geometry-directed channeling to regulate vapor and disturbance behavior in motion-driven environments. Integration is structural — the architecture is incorporated into vehicle geometry rather than added as an external system. Performance is passive: no active components, no power input, no service intervention required.

Integration Considerations — Flow Architecture

Integration Approach	Geometry-directed channeling integrated into wheel well, underbody, or adjacent structural surfaces. No active components. No electrical or pneumatic connection. Specific channel geometry available under NDA.
Operating Environment	Commercial highway transport, rail, and mobile equipment operating in wet-weather or fluid-adjacent environments. Performance characterized by vehicle speed, wheel configuration, and tire-aerodynamic interaction.
Service Requirements	Passive architecture has no service requirement from the INERTRA™ system itself. Inspection and maintenance of adjacent structures follow vehicle-level service schedules as defined by the OEM integration program.
Weight & Power	No power consumption. Weight impact limited to structural integration of channeling geometry. No hydraulic, pneumatic, or electrical routing required.
Regulatory Context	Commercial vehicle spray suppression requirements vary by jurisdiction and vehicle classification. Licensee is responsible for all regulatory compliance, testing, and certification relevant to the integration program.

DUAL-ARCHITECTURE PROGRAMS

Combined Retention + Flow Integration

Commercial transport and rail platforms may have applications for both INERTRA™ families simultaneously — Retention for bogie, axle, and chassis interface integrity, and Flow for wheel-generated spray and vapor dispersion. Licensing for combined-architecture programs is structured per application with field-of-use definitions scoped to each system element.

04 — QUALIFICATION FRAMEWORK

OEM Validation Responsibilities

IDC does not perform product validation, testing, or certification. All integration validation, regulatory compliance, and qualification testing are the responsibility of the licensee. IDC can support evaluation through confidential technical materials and engineering dialogue with qualified integration partners under NDA.

Validation Framework by Industry

INDUSTRY	KEY STANDARDS	VALIDATION RESPONSIBILITY
Wind Energy	IEC 61400, GL/DNV guidelines, OEM-specific	Licensee — vibration profile, load cycle, field validation
Heavy Equip. / Military	MIL-STD-810, MIL-DTL series, OEM program spec	Licensee — environmental test, retention qualification
Rail	FRA requirements, EN 13749, program-specific	Licensee — bogie validation, service interval protocol
Industrial / Automation	ISO 16063, OEM program quality standards	Licensee — cycle test, repeatability validation
Aerospace / Defense	AS9100, DO-160, MIL-A-8625, program DDD	Licensee — qualification test plan, DV/PV testing
Medical / Biomechanical	ISO 13485, FDA 510(k)/PMA, ASTM F2077	Licensee — bench validation, biocompatibility, regulatory submission

05 — INTEGRATION LICENSING PROCESS

From Evaluation to License Execution

Licensing for OEM integration programs follows a structured process designed to protect both parties and ensure every licensed integration is technically and commercially well-defined.

01 INITIAL FIT	02 NDA EXECUTION	03 TECHNICAL DILIGENCE	04 LICENSE AGREEMENT
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Submit inquiry with application context: interface description, operating environment, failure mode, evaluation timeline.	Mutual NDA executed. Confidential claim mapping, engineering drawings, and detailed materials exchanged.	OEM team evaluates fit against program constraints: duty cycle, vibration profile, integration geometry, qualification plan.	Field-of-use license structured to application: industry, product category, integration scope, commercialization path.
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INITIATE INTEGRATION EVALUATION

Submit an Integration Inquiry

The strongest integration inquiries include: a defined application interface, an operating environment description (vibration profile, cycle count, thermal range), the failure mode or service cost being addressed, and an internal engineering evaluation path.

Contact	info@ireland-design.com
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Patents	US9422969B2 (Medical/Regulated) · US8398349B2 (Industrial/Structural) · US8226158B1 (Transportation/Flow)
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