



# Flexible Conduit for the Railways 2019



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# Agenda

- Why Protect Cables and what options are available?
- What is flexible conduit, system philosophy and standards
- Market Sectors where cable protection is used
- The risk of Inadequate protection
- How are you going to protect your cables?
- Rail Applications & Requirements
- Rail product manufacturer requirements
- Why use Flexicon?



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# Why protect wires and cables?

- Power and Copper or Fibre data cables from:-

- Physical -impact, crushing, abrasion, cutting, rodent
- Ingress – water or dust
- Fire protection
- Corrosion
- UV protection
- EMC – EMR/EMI
- Vibration & Shock
- Vandalism
- Lightning strikes
- HSE legislation
- Network owner specification
- OEM specification
- Cable Sag so core tension

## Physical, Ingress, corrosion and Fire

- Typical Options available for Protection (Cable management) include:

- Cable Tray or basket
- Trunking
- Conduit (plastic or steel)
- Spiral Wrap
- Over braid
- Heat Shrink
- Finger conduit
- Flexible or Pliable conduit
- Sheathing or cable ties

## Tray, Trunking and Conduit (rigid & flexible)

*Each has their place, but none of these solutions offer the versatility of*

## Flexible Conduit



# What is flexible Conduit?

- By definition (Oxford Dictionary):

- **Flexible**

- “Capable of bending easily without breaking”*

- **Conduit**

- “A tube or trough for protecting electric wiring”*

- Flexicon's definition:

- Provides protection for cables (power or data (Cu & F/O)) against potential hazards and/or environmental conditions...
  - Provides the conduit and necessary transition (glanding) to protect the cables between the electrical and/or communications equipment



# Flexible Conduits as a System...

- **Performance should be considered using a system approach**

**This means agreeing how the Conduit is going to be terminated and into what**

- Conduits on their own have 2 open ends
  - they need to be glanded to create and define a system.
- Stated IP ratings are only applicable when used with appropriate fittings.
- Products are tested and warranted as a system.
- If different Manufacturers conduits and fittings are mixed and matched, there is a potential of non performance as one manufacturer cannot guarantee the compliance of another.



# Required Standards and Approvals:-

## Flexible Conduit:-

- General conduit requirements – BS EN IEC 61386-1
- Rigid Conduit systems – BS EN IEC 61386-21
- Pliable conduit systems – BS EN IEC 61386-22
- Flexible conduit systems – BS EN IEC 61386-23
- A 12 Digit Code is used to classify the Conduit System

## Classification of conduit systems to BS EN IEC 61386

| Level | 1st digit<br>Compression<br>Strength<br>N/50mm | 2nd digit<br>Impact Strength<br>Joules at<br>min temp | 3rd digit<br>Minimum<br>Temp deg C | 4th digit<br>Maximum<br>Temp deg C | 5th digit<br>Conduit<br>Type | 6th digit<br>Electrical<br>Properties | 7th digit<br>IP Rating<br>Solids | 8th digit<br>IP Rating<br>Water | 9th digit<br>Corrosion<br>Resistance<br>(water) | 10th digit<br>Tensile<br>Strength N | 11th digit<br>Flame<br>Propagation | 12th digit<br>Suspended<br>Load N/48hr |
|-------|------------------------------------------------|-------------------------------------------------------|------------------------------------|------------------------------------|------------------------------|---------------------------------------|----------------------------------|---------------------------------|-------------------------------------------------|-------------------------------------|------------------------------------|----------------------------------------|
| 0     |                                                |                                                       |                                    |                                    |                              | None declared                         |                                  | 0                               | None declared                                   | None declared                       |                                    |                                        |
| 1     | V. Light (125)                                 | V. Light (0.5)                                        | 5                                  | 60                                 | Rigid                        | Continuous                            |                                  | 1                               | Low in & out                                    | V. Light (100)                      | Non Flame Propagating              | V. Light (20)                          |
| 2     | Light (320)                                    | Light (1)                                             | -5                                 | 90                                 | Pliable                      | Insulating                            |                                  | 2                               | Medium in & out                                 | Light (250)                         | Flame Propagating                  | Light (30)                             |
| 3     | Medium (750)                                   | Medium (2)                                            | -15                                | 105                                | Pliable self recoving        | Continuous + Insulating               | 3                                | 3                               | Medium in & high out                            | Medium (500)                        |                                    | Medium (150)                           |
| 4     | Heavy (1250)                                   | Heavy (6)                                             | -25                                | 120                                | Flexible                     |                                       | 4                                | 4                               | High in & out                                   | Heavy (1000)                        |                                    | Heavy (450)                            |
| 5     | V. Heavy (4000)                                | V. Heavy (20)                                         | -45                                | 150                                |                              |                                       | 5                                | 5                               |                                                 | V. Heavy (2500)                     |                                    | V. Heavy (850)                         |
| 6     |                                                |                                                       |                                    | 250                                |                              |                                       | 6                                | 6                               |                                                 |                                     |                                    |                                        |
| 7     |                                                |                                                       |                                    | 400                                |                              |                                       |                                  | 7                               |                                                 |                                     |                                    |                                        |



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# Market Sectors

## Rail & Transportation



- Rolling Stock
- Infrastructure

## Cable Systems Safety & Performance

- Physical Protection
- Corrosion and Ingress Protection
- Fire Performance
- Weight and/or space saving
- Dynamic Performance

## Hazardous



- Oil & Gas
- Pharmaceuticals
- Chemicals
- Food & Beverage

## OEM's & Automation



- Assembly lines
- Materials Handling

## Utilities



- Transmission & Distribution
- Generation
- Water & Waste
- Telecoms

## Construction



- Commercial Buildings
- Industrial Buildings



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# Rail applications

## Power Cars



- DMU
- High Speed
- Metro
- Tram / TrolleyBuses

## Carriages



- HVAC
- CCTV
- Lighting
- Passenger Information

## Bogies



- Power/data Cable Harness
- Auto-Couplers
- Inter-car Jumpers
- Braking Systems

## Trackside/P-Way



- Signalling
- Points control
- UTX
- TPWS

## Station Areas



- PIS (Passenger Information Systems)
- Lighting, BMS, CCTV
- Ticketing Machines



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# The Risks of inadequate Cable Protection

- **Reliability of supply and the impact to a train**

- Train delay or cancellation
- Downtime with unscheduled maintenance
- Possible damage to equipment
- Carriage services disrupted
- HVAC with customer discomfort and possible complaint
- Failure of systems, equipment – CCTV, alarms, etc.

- **Signalling**

- Service disruption and/or delays
- Downtime with unscheduled maintenance

- **Platforms**

- Risk of electric shock – to staff and/or passengers
- Failure of Security systems or passenger surveillance systems

- **At the least, service or reliability is compromised...**

**At the worst, people could be injured or killed**



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# How are you going to protect your cables?

## Why just cable and no conduit?

- 'What we did before...' i.e. a familiar and known installation procedure
- A small number of cables....just one!
- Ability to label cable sheaths outside equipment
- The environment allows easy transition from CMS to equipment



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# How are you going to protect your cables?

## Cables in conduits

- More cost effective for multi cable installations with potentially a reduced cable cost and quicker installation time
- Simple to replace damaged and add new cables
- Potentially better protection to cables than jacketing alone
- Uniform EMC protection possible (known dB level/Clean earth)
- Fibre & STP can be run with power
- No requirement for SWA glanding
- Reduced gland plate or fire barrier transitions

## Flexibles only

- Ease of route configuration, with easy cutting, no thread cutting or tube bending
- Easier storage, coils v. lengths
- Premade complete cable assemblies
- Can be retro fitted (split conduit)
- Connected equipment can move or be easily positioned
- Reduced weight of cable containment system



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# Applications & Requirements

## The UK Rail Market

- **General Rail Industry Approvals:-**

BS EN ISO

RoHS✓

REACH✓

RSSB { RISQS  
Achilles

IRIS  
Certification

- **Specifically by Application, requirement and likely end user:-**

- Infrastructure
- Rolling stock



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# Applications & Requirements

## The UK Rail Market

### ■ Infrastructure

#### ■ Stations and depots

- CCTV, lighting, BMS
- Door entry
- Lifts and escalators
- PIS

#### ■ Trackside

- Signalling
- UTX
- Points heating
- Third Rail heating

- Fire Performance
- Vandalism
- Tamperproof
- Aesthetics
- Vibration
- Ingress protection
- EMC
- Corrosion
- Tensile strength
- Fatigue life
- UV
- Vermin protection



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# Applications & Requirements

## The UK Rail Market

### ■ Infrastructure:-

- LUL S1085 – Fire Safety Performance of Materials – APR (Approved product register) database
- Network Rail - PADS
  - NR/L2/SIGELP/27421 – Flexible Conduits for Class II Based Signalling Power Distribution Systems
  - NR/L2/SIGELP/27422 – Flexible Conduit Cable Glands for Class II Based Signalling Power Distribution Systems
- Crossrail: MCR – (Materials Compliance register). Will need to comply to LUL.
- Other European Fire Performance Standards:

|                 |           |
|-----------------|-----------|
| ➤ CEI 11170     | (Italian) |
| ➤ DIN 5510      | (German)  |
| ➤ NF F 16-101/2 | (French)  |

☐ EN45545-2 class HL1, HL2, HL3  
☐ EN45545-3



# Applications & Requirements

## The UK Rail Market

- **Rolling Stock:-**

- **UK Manufacturers/Maintenance companies –**

- Bombardier, Alstom, Hitachi, Knorr Bremse, Gemini, Wabtec, Voith Turbo, Siemens, CAF.....

All have their own supplier approval process, some their own product testing standards

- LUL S1180



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# Applications & Requirements

TEST REPORT | REFERENCE « TSSC-EC-TR00025 »  
DISPLACEMENT TEST | INTERBODY CONNECTION WIRING | FLEXICON CONDUITS & FITTINGS

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48, RUE ALBERT DHALENNE  
93482 SAINT-OUEN CEDEX | FRANCE

Reference :  
TSSC-EC-TR00025

## TEST REPORT

DISPLACEMENT TEST | ROLLING STOCK  
INTERBODY CONNECTION WIRING | FLEXICON  
FPIH & FPIHR CONDUITS ↔ FPAX FITTINGS

### Document validation

| NAME             | JOB FONCTION                   | DATE       | SIGNATURE                                                                           |
|------------------|--------------------------------|------------|-------------------------------------------------------------------------------------|
| Maroun EL HAGE   | Electrical Test Center Manager | 6/18/2016  |   |
| Ludovic LEFEBVRE | Leader Produits Electriques    | 16/06/2016 |  |
| Eric HAUDEGAND   | Technical Manager Electrical   | 16/06/2016 |  |

### Document revision

| VERSION | DATE                        | COMMENT              |
|---------|-----------------------------|----------------------|
| 0       | May 19 <sup>th</sup> , 2016 | Creation of document |
|         |                             |                      |
|         |                             |                      |

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TEST REPORT | REFERENCE « TSSC-EC-TR00025 »  
DISPLACEMENT TEST | INTERBODY CONNECTION WIRING | FLEXICON CONDUITS & FITTINGS

## 9. CONCLUSION

Following the different results obtained through the test performed at the  
Test Center of ALSTOM (Saint-Ouen - France).

The two kinds of FLEXICON Conduits tested  
[FPIHR13 to FPIHR54] & [FPIH13 to FPIH54]

Meet the withstand requirements of the Displacement  
for one of the most severe configurations to-date

for electrical Links (Inter-body connections, Body-Bogie connections, etc.)  
that can be found on Rolling stock (Metro, TGV, Tramway, etc.).



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# Applications & Requirements

## The UK Rail Market

### ■ Rolling Stock:-

Summary of the Environment and requirements for the conduit system are:

- Weight
- Fire performance: (Low Fire Hazard verse Flexibility)
- Temperature performance - needing extended temperature ratings
- Demanding UV
- Vibration
- EMC
- Impact resistance
- Tensile strength
- Fatigue life - requiring extreme longevity of flexing
- The gland must have a pull strength to withstand the pressure of water expanding when freezing and ideally grip through 360Deg

### ■ Whole life cost

### ■ Reliability and safety



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# Applications & Requirements

## The UK Rail Market

### ■ Products:-



Flexicon ULTRA™



Integral Strain Relief  
(carriage applications)



Internal Braided Sleeving solutions  
(carriage applications)



LTP-LFH conduit –  
Low Fire Hazard Liquid Tight.  
Braided version available.



FPR & FPIHR conduits –  
Low Fire Hazard PA6 & 12 conduits  
Braided versions available



FSU, FPU & LFHU conduits –  
PVC, Polyurethane and Megalon  
coated conduits.  
Braided versions available



FSS and FSSBRD conduit solutions  
(infrastructure applications)



F-Clamps and Conduit Fixing Solutions



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# Applications & Requirements

The UK Rail Market

## The Ultimate Gland:-

- The World's Best Conduit Fitting
- Integrated One Piece Sealing Technology
- Key features:
  - Integrity
  - Strength
  - Assurance
- Learn More
  - Own Data sheet
  - Ultra Website
  - Animation



**FLEXICON**  
**Ultra**  
THE POWER OF ONE



Nylon or Ni plated Brass Male Threads



Short thread version Brass Male Threads

Brass Female Threads Metric / PG/UNEF



Brass Cable Glands – Lapp and Pflitsch Type (long or short thread)

Straight, 45 and 90° flanged



Brass Female Threads UNEF

Brass Male Threads Metric / PG / NPT

**NEW** Product Focus – **Flexicon Ultra™**

The Power of One – Designed for use with Flexicon's Nylon Conduit range (either fine or coarse pitch), this true one piece Flexible Conduit Fitting features Integrated Sealing Technology to offer the ultimate in Strength, Integrity and Assurance for Cable Protection.

**Integrated Sealing Technology**

The World's Best Conduit Fitting – The Power of One

Flexicon Ultra™ provides a true one piece solution, engineered to provide unrivalled performance with both fine and coarse pitch conduits.

With all round teeth to secure the conduit, Flexicon Ultra™ offers superior dynamic performance providing Integrity, Strength & Assurance in one package.

Integrity • Strength • Assurance

Features and Benefits

Offering Integrity, Strength and Assurance, Flexicon Ultra™ is the best solution for Performance & Safety Critical applications.

**Integrity:**

- One Piece – Integrated Sealing Technology
- IP68, IP69 performance
- Simple push and twist connection

**Strength:**

- 360° Strength – All round teeth
- 70kg Tensile Strength
- Anti-tamper, Dynamic & Vibration performance

**Assurance:**

- Lifetime sealing & reliability
- Independently tested to extremes
- UK Manufacturer

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# Summary of Ultra performance:-

- **Highest Tensile Strength:**
  - Up to 100kg with FPIHR conduit
- **All Round Teeth - 360°:**
  - 6 or 8 teeth positioned around 360°
- **Ingress Protection:**
  - IP66, IP67, IP68 (2Bar for 1hr, 0.1Bar for 72hours), IP69, cyclical freezing
- **One piece construction & fast fit:**
  - No parts to assemble – ready to use
  - Retained Face seal - No chance of losing components
- **Temperature Range:**
  - Minimum -50°C to Maximum +135°C
- **Anti tamper:**
  - Removal but a tool is required (flat blade screwdriver)
- **Fire Performance:**
  - Compliant with **EN 45545-2 - HL3 Internal and External**
  - Compliant with EN45545-3



## Vibration and shock tested:

- Compliant with EN 61373 Category 2

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# Summary of Rail Market Manufacturer Requirements

- Focused on Flexible Conduits and Rail market requirements
- Hold necessary Industry and standard bodies approvals
- Full Product Range – Metallic, non metallic, glanding with conduit management and necessary tooling
- Product development capability
- Assembly capability
- Local production, stocking and technical support



# Why use Flexicon?



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## 5 Great Reasons to Choose Flexicon

- Widest range of Flexible Conduits 60 different Metallic and Non-metallic systems to choose from
- True UK manufacturer - designed, developed and manufactured in the UK
- Quality products which have been independently tested and approved to the latest Standards and Approvals
- Dedicated local support - we are the experts when it comes to Flexible Conduit
- 3D CAD models of all of our products available to download from our website



Flexicon Product Literature also Available . . .



**Rail Brochure**  
demonstrating our commitment and capability for the Rail Market



**NEW Product & Solutions Guide**  
with 164 pages showing our full capabilities in Cable Protection



**Hygienic Range**  
Brochure offering smooth, easy to clean systems for specialist hygienic applications

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Cable Protection Systems for Rail

2nd Edition

IRIS<sup>TM</sup>  
Certification  
ISO/TS 22163:2017

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Cable Protection Systems for UK Rail Infrastructure

THE POWER IN CABLE PROTECTION

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# Any Questions.....

- Thank-you very much for your time and interest



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