



Round table - Hoses: Manufacture, qualification and safe operations

Moderated by: Luke Hutson (JIG) & Ben Harries (air BP)
Trelleborg (Jean-Noel Vincent)
Elaflex (André Bilgenroth)

JIG – 2026 June - Member's Technical Forum - Rome

Aviation Hoses & Handling

André Bilgenroth

Business Unit Director Aircraft Refueling, ELAFLEX Hamburg



TOPICS.

► Aviation Fueling Hose...

- Construction
- Hose types
- Couplings
- Assemblies

► Manufacturing Process

(presented by Jean-Noël VINCENT / Trelleborg)

► Standards & Guidelines

► Qualification Process

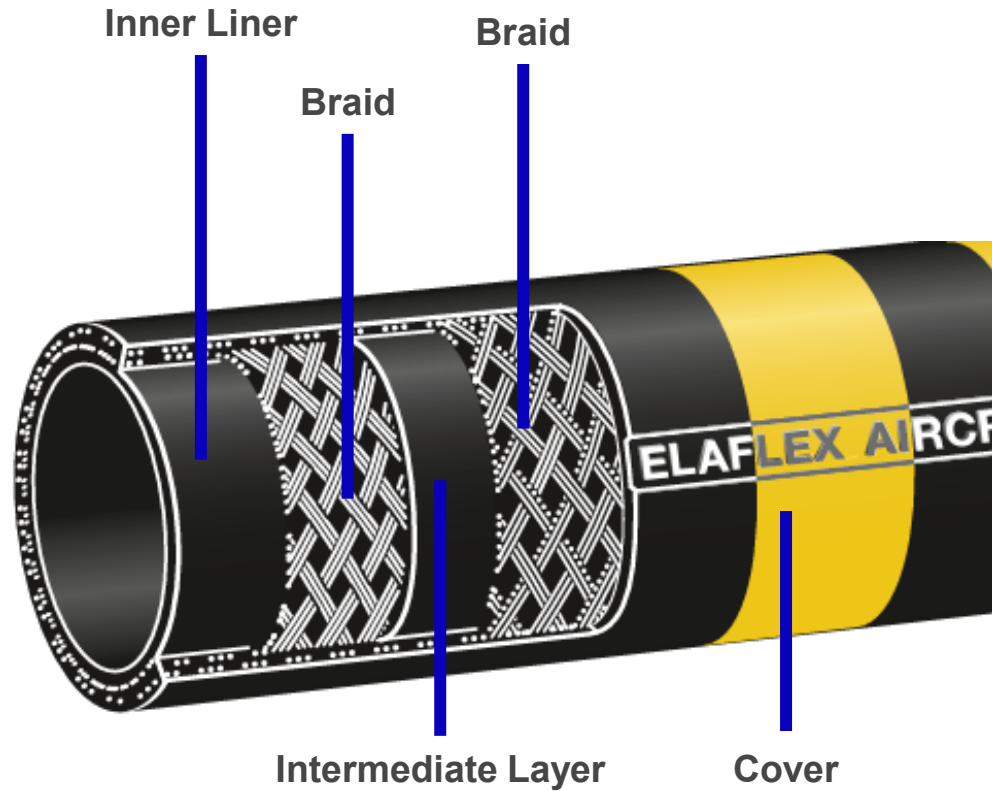
(presented by Jean-Noël VINCENT / Trelleborg)

► Aviation Fueling Hose Handling

HOSE CONSTRUCTION (Basic).



HOSE CONSTRUCTION.



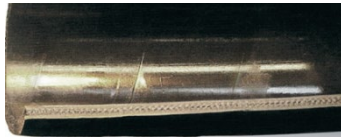
HOSE CONSTRUCTION.

The inner liner

- ▶ The lining is made of NBR rubber
- ▶ Protects the reinforcements against the fuel
- ▶ Black anti-static – resistant to all fuels
- ▶ Degrades by exposure to UV & ozone
- ▶ Preferred seamlessly extruded (picture 1) and not lapped (picture 2) to avoid seams to split open and fuel to penetrate



Seamlessly extruded



Visible seams in the inner lining

The pressure bearing reinforcement

- ▶ Should be made of quality textile yarns
- ▶ Preferred braided (picture 1) and not spirally wrapped (picture 2)
- ▶ Pressure bearing part, prevents hose from bursting
- ▶ For the best balance between hose flexibility, weight and lifetime



Braided



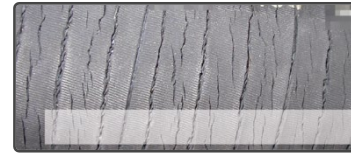
Spirally wrapped

Cover

- ▶ Is made of black electrically conductive rubber, preferred CR not NBR/PVC
- ▶ Protects against outside influences like ozone, water and abrasion
- ▶ Can be extruded seamlessly or wrapped
- ▶ Bear the marking
- ▶ All layers of the hose are bound together by **vulcanisation process**



Seamlessly extruded cover

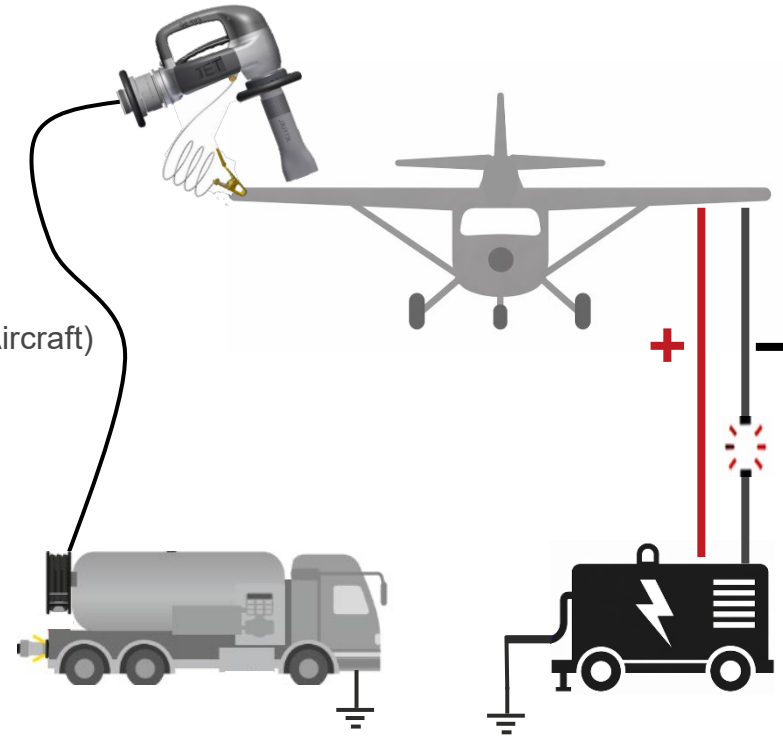


Ozone cracks

HOSE TYPES - ELECTRICAL CONTINUITY.

A hose conductive related accident in Copenhagen in the 70's, led to the major cooperation with MOC's to develop modern refueling hoses with the following parameters:

- ▶ No metallic components allowed for into plane refueling (contact with Aircraft)
 - Type C / Type F Hoses
 - For Ω -hoses resistance between 10^3 and 10^6 Ohm
- ▶ Other applications (not into plane)
 - Type E hoses
 - M-hoses resistance below 10^2 Ohm (not allowed for into plane)



At the incident in the 70's: Cable break in GPU caused electrical current in conductive hose, resulting in overheating and rubber failure

HOSE TYPES.

C-Type



hose without metallic conductors but conductive rubber compounds, available with 2 braids - **HD-C**



...or 3 braids used as Deck Hose, Reel Hose or Hydrant Intake Hose – **VHD-C**

F-Type



hose with plastic helix and conductive rubber compounds, ideal for high speed de-fueling – **PHD-F**

E-Type



hose with steel helix used as Jac Riser Hose (platform), Bridger Hose (trailer to refueler) – **TW-E**

→ NOT FOR INTO PLANE APPLICATION

SPECIFIC HOSE TYPES.

Type CT hose (`LT` = low temperature)

All aviation hoses can be made from a soft and cold flexible rubber which allows moving and bending down to temperatures of -50°C (-58°F).



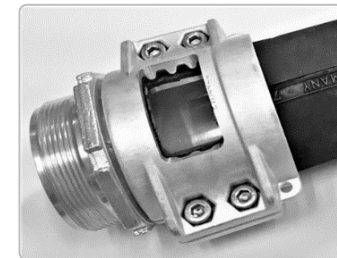
`NEON` Reflecting Hose Marking

Hoses can be provided with a neon reflex marking to improve visibility. Prevents accidents and damages caused by service vehicles.



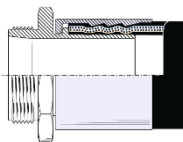
COUPLINGS.

- ▶ No slippage & Suitable to the hose
- ▶ The hose joint should never be the weakest part of a hose assembly
- ▶ Correct material and wetted parts should be free of non ferrous material
- ▶ Bear the complete marking
- ▶ Recommended to use EN 14420 standard clamps



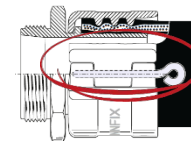
Swaged / Crimped / Permanent Couplings

- ▶ Tamper-resistant
- ▶ Non adjustable
- ▶ Non re-attachable



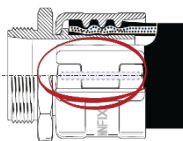
Clamp-system acc. EN 14420 pinned type, pin with head

- ▶ Tamper-resistant
- ▶ Non adjustable
- ▶ Re-attachable



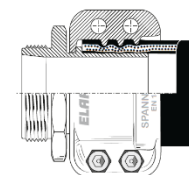
Clamp-system acc. EN 14420 pinned type, pin without head

- ▶ Tamper-resistant
- ▶ Non adjustable
- ▶ Non re-attachable



Clamp-system acc. EN 14420 bolted type

- ▶ Tamper-resistant
- ▶ Adjustable
- ▶ Re-attachable
- ▶ No special tools, only hexagon screws



HOSE ASSEMBLY.

Assembly instruction - White marking

- ▶ White marking above clamps to be applied after assembly but before pressure test



Electrical continuity test

- ▶ Assure el. conductivity is given
- ▶ high voltage OHM-Meter with 500V test voltage
- ▶ Allowed electrical resistance range is $10^3\Omega$ - $10^6\Omega$



Pressure test

- ▶ Working pressure 20 bar
- ▶ Test pressure 40 bar



Permanent marking & Test certificate

- ▶ Perm. Marking on clamps
- ▶ Test certificate with all relevant data of the hose assembly





Welcome to the World of Trelleborg

Industrial Hoses

JIG – 2026 Member's Technical Forum
Jean-Noël VINCENT – Quality Manager

Hose Manufacturing Process

Rubber Compound

Extrusion

Braiding

Cover

Vulcanization

Verification

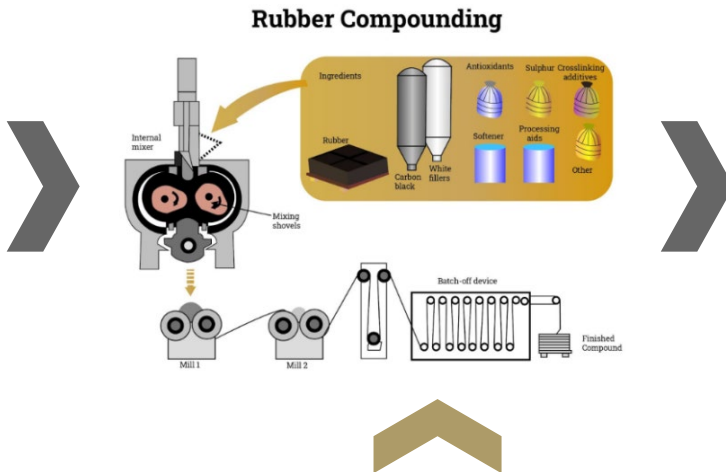


Rubber Compound

From raw materials to rubber compound

INPUT

- Additives
- Mineral Fillers
- Plasticizers
- Elastomer
- Carbon Black



KEY PROPERTIES

- Tensile Strength
- Minimum Elongation
- Fuel Soluble Matter
- Abrasion Resistance
- Resistance to Ageing
- Cold Embrittlement
- Fuel Contamination
- Fuel Discolouration

KEY PARAMETERS

Components weight control

Identification of components

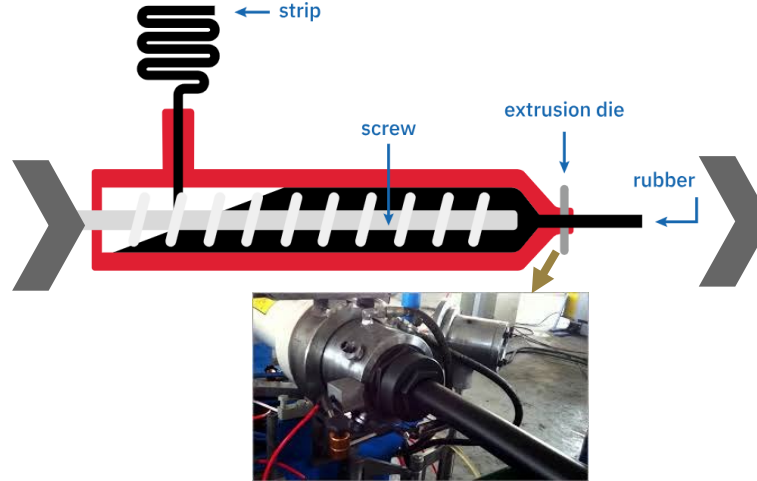
Mixing process parameters → Rotation speed, Temperature, Duration....



Extrusion

From rubber compound to inner tube – withstand conveyed fluid

- INPUT**
- Rubber strip



KEY PROPERTIES

- Inside Diameter
- Concentricity
- Tube Thickness
- Electrical resistance

KEY PARAMETERS

Temperatures (Minimum Start T°, Extrusion T°...)

Extrusion speed

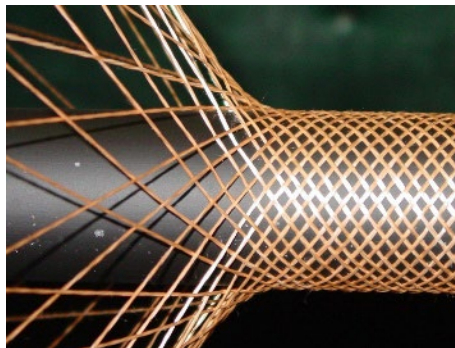


Braiding

Withstand mechanical constraints (tensile & pressure)

INPUT

- Extruded Tube
- Yarns



KEY PROPERTIES

- Proof Pressure
- Burst Pressure
- Pressure Cycling
- Kink Resistance
- Flexibility



KEY PARAMETERS

Braiding pitch

Traceability of the yarns



Cover winding

Withstand external environment aggressions

INPUT

- Braided tube
- Calendered Cover rubber compound
- Marking
- Nylon Stripe



KEY PROPERTIES

- Marking
- Adhesion
- Cover Thickness
- Ozone Resistance
- Flammability



KEY PARAMETERS

Thickness of the calendered cover rubber compound

Overlapping of rubber layers

Tension of nylon stripe



Vulcanization

When the product is turned into finished goods !

INPUT

- Hose fully build and wrapped onto nylon stripe



KEY PROPERTIES



- Adhesion
- Confirmation of all expected properties of the rubber compounds



KEY PARAMETERS

Temperature

Duration



Verification

Last check before available for customers !

INPUT

- Vulcanized hose



KEY PROPERTIES

- External Diameter
- Wall Thickness
- Marking
- Length

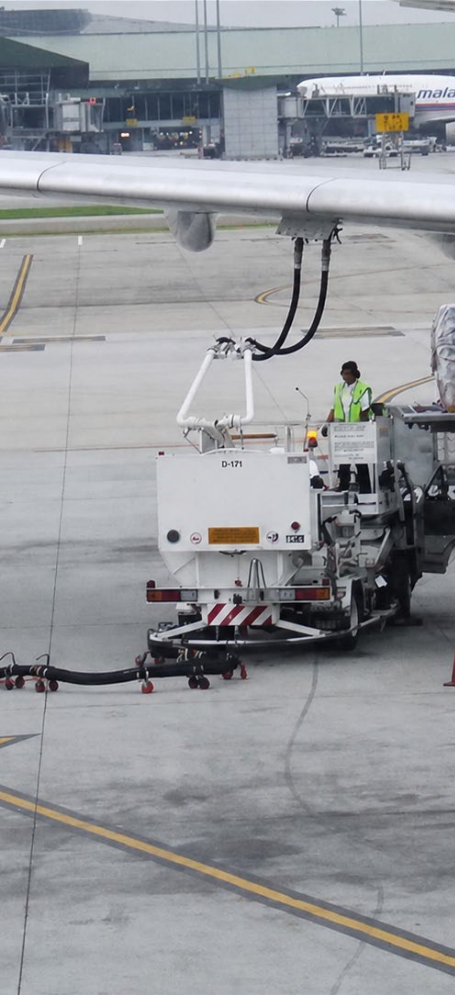


KEY PARAMETERS

Mandrel removal process parameters

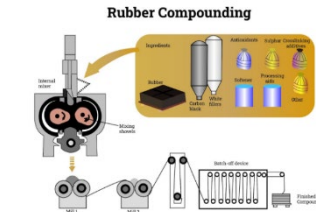
Calibration of measurement tools

Packaging instructions

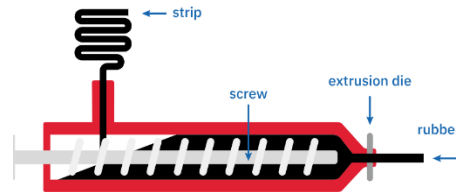


The process in 1 slide !

Thanks for your attention.



#1 COMPOUNDING



#2 EXTRUSION

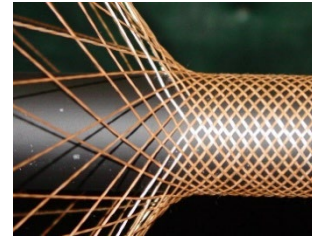
#6 VERIFICATION



#5 VULCANIZATION



#4 COVER WINDING

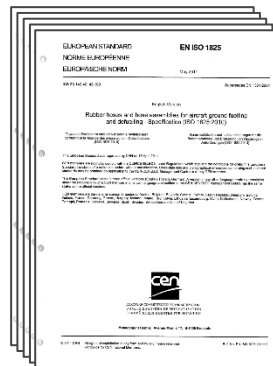


#3 BRAIDING

HOSE STANDARDS & GUIDELINES.

► ISO 1825 : 2017 / EI 1529 : 2014

- Working, test and burst pressure (20 bar / 40 bar / 80 bar)
- Categories of different hose Types (B, C, E, F)
- Sizes, measurements, weights, bending radius
- Marking of hoses and couplings
- Electrical resistance of the different Types (Ohm / M type)
- Certificates
- Fuel contamination
- Kink resistance
- Temperature range
- Abrasion resistance
- Resistance to aging
- Handling
- ...



► JIG: Issue 13

- Max. shelf storage life: **2 years**
- Max. service life, overall: **10 years**

both from date of hose manufacturing

(**and not** the date of hose fitting assembly)

- ICAO 9977 (Manual on civil aviation jet fuel supply)
- ATA 103: Standards for JET fuel control
- EI 1522: Min. req. for aviation fueling hose accessories
- EI 1530: Quality Assurance manufacturer and storage ...

Hose Qualification Process

Regulatory Frame

Qualification Requirements

Qualification Process

Qualification Output



Regulatory Framework

Beyond EU regulations, EI and JIG requirements for safe operations

- No global regulatory framework; only specific EU directives apply (ADR, PED, ATEX)
- Aviation standards effectively require **EI 1529 compliance** for refueling hoses
- **ISO 1825** serves as the baseline standard for EU regulation compliance
- Both standards cover critical features : conductivity, mechanical strength, fuel compatibility
- Manufacturers must qualify product against standards and ensure full traceability

**QUALIFICATION ACCORDING TO STANDARDS IS ESSENTIAL FOR
OPERATING AT AIRPORTS WORLDWIDE**



Qualification Requirements

EI 1529 sets stricter aviation requirements than ISO 1825

- Type qualification required (EI an ISO) through an extensive test program which can be held with internal lab of the manufacturer or externally
- Test program emphasizes
 - Mechanical Performances (Fatigue, Impulse, Bending...)
 - Fuel Compatibility
 - Ageing and Durability (Thermal ageing, ozone resistance)
 - Electrical Conductivity
- Specific attention paid to couplings design qualification

TYPE TESTING ENSURE SAFE, DURABLE, AND COMPLIANT HOSE PERFORMANCE

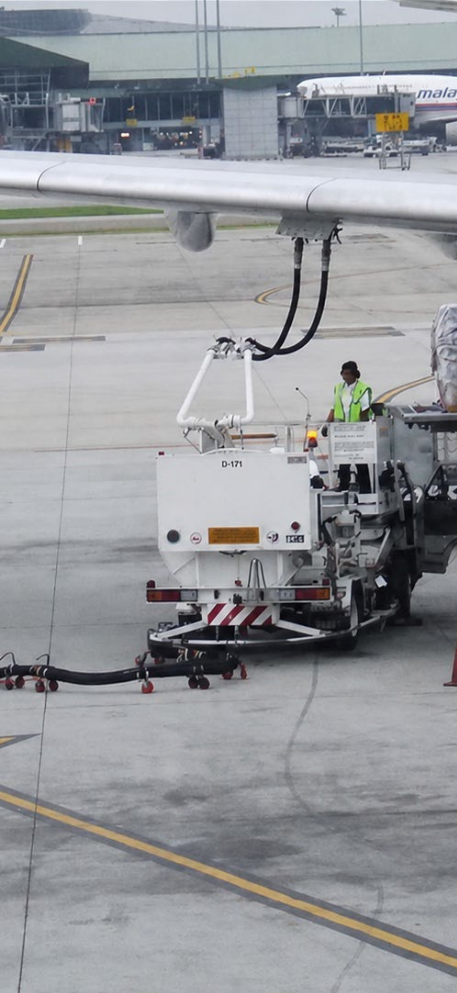


Qualification Process

Qualification ensures compliance through controlled testing and verification

- Define qualification scope : applicable standard, hose type, pressure class, end fittings.
- Perform type testing program
- Assess coupling design
- **Issue qualification dossier including full test and product traceability**
 - Attention, if there is a 3rd Party, involvement level may vary
 - Review (doc review afterward only)
 - Monitor (Random witness of an operation)
 - Witness (Attendance Mandatory)

**STRUCTURED AND TRANSPARENT QUALIFICATION ENSURES
COMPLIANT AND RELIABLE HOSE PERFORMANCE**



Qualification Output

From basic conformity to the highest certification level

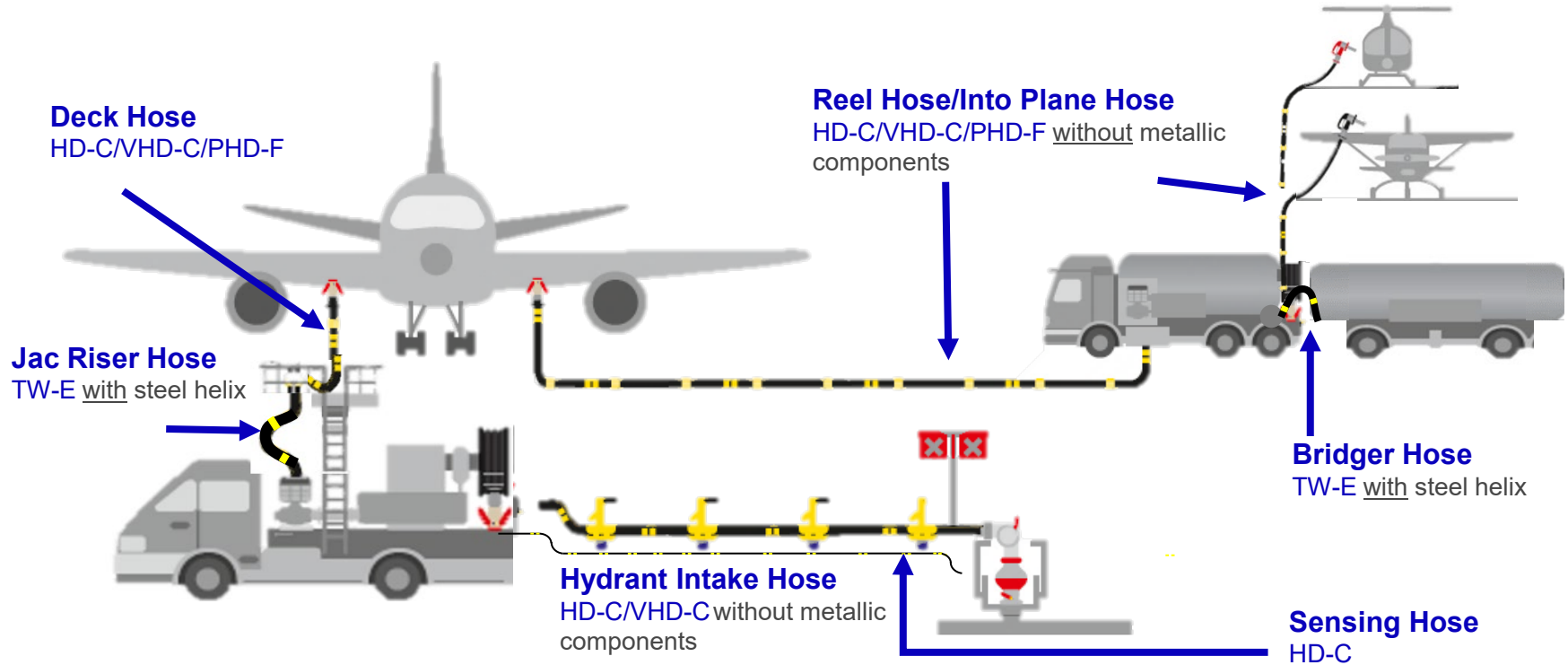
- **Self-Declaration of Conformity (Required by Standards)**
 - Internal Qualification Dossier including type test reports, product specification, manufacturing procedure, traceability records, calibration certificates
- **Declaration of Conformity established by 3rd Party**
 - Internal Qualification Dossier endorsed by 3rd Party based on surveillance level required by 3rd Party (Review, Monitor, Witness)
- **Type Approval Certificate**
 - Internal Qualification Dossier endorsed by 3rd Party
 - Approved Technical File
 - Audit Report of Manufacturing Site

ASSURANCE LEVEL INCREASES WITH INDEPENDANT VALIDATION



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HOSE HANDLING - TYPICAL HOSE ASSEMBLIES



- ✓ PHD-F and VHD-C Hose can be used in every application, even de-fueling (suction) applications
- ✗ TW-E is not allowed as Deck-/ Into Plane- / Reel Hose / Hydrant Hose as No metal components hoses may touch airplane or hydrant

HOSE HANDLING – general view

Refueling vehicles consists of two main fuel flow paths:

- a) steel piping and**
- b) rubber components: hoses and flexible expansion joints**

The hoses and flexible expansion joints absorb movement, surges, and pressure shocks!

They need to be handled and checked in accordance to applied guidelines and standards!

HOSE HANDLING - TYPICAL HOSE ASSEMBLIES

Hydrant Intake Hose & Sensing Hose



General observation concerns and recommendations

- ▶ Utilization of hose friendly hose trolleys
- ▶ Utilize pressure holding pipe systems in order to avoid excessive repetitive kinking
- ▶ Avoid using the hose as structural assembly component to hold other devices
- ▶ Avoid usage of spirals and other sleeves as they can hold stones etc. and could create sharp edges and leverage excessive forces



Not Recommended

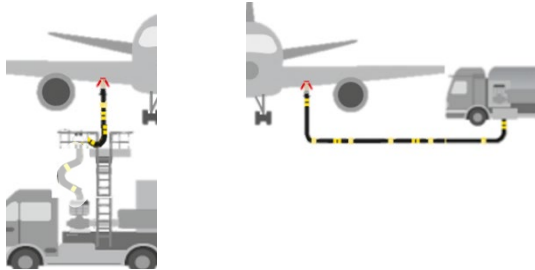


Recommended



HOSE HANDLING - TYPICAL HOSE ASSEMBLIES

Deck Hose Reel Hose



General observation concerns and recommendations

- ▶ Avoid sharp friction on fueling platform, or use protection
- ▶ Avoid usage of spirals they can hold stones etc. and could create sharp edges, additionally they reduces the effectiveness of the daily visual inspection
- ▶ Utilize “axial hose turn routines” to avoid excessive abrasion i.e. 45° turns
- ▶ Utilize hose beads for hose protection and easy hose handling for operator acc. EI1522

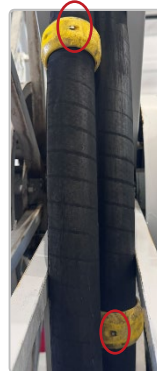


ROUTINE
INSPECTION



UV and Ozone
PROTECTION

Not Recommended



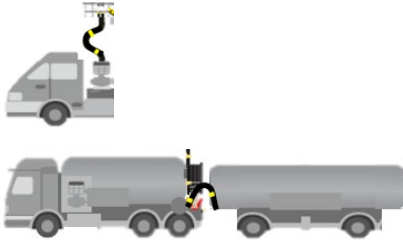
Recommended



EI1522 compliant

HOSE HANDLING - TYPICAL HOSE ASSEMBLIES

Jac Riser Hose Bridger Hose



General observation concerns and recommendations

- ▶ Utilize an installation with sufficient (big enough) bending radius, as too short hoses will lead to high forces
- ▶ Utilization of swivels – to avoid torsion forces
- ▶ Utilize “axial hose turn routines” to avoid excessive single kink load and UV exposure

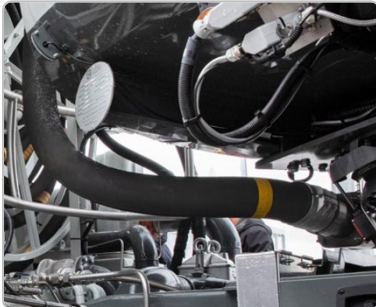


ROUTINE
INSPECTION



UV and Ozone
PROTECTION

Not Recommended



Recommended



HOSE HANDLING – Flexible Expansion Joints

Flexible Expansion Joints



General observation concerns and recommendations

- ▶ Utilize an assembly which allows to read product and production data
- ▶ Avoid painting of the rubber
- ▶ Avoid prestressed assembly → rubber expansion joint should be in “0” position – without additional forces



ROUTINE
INSPECTION

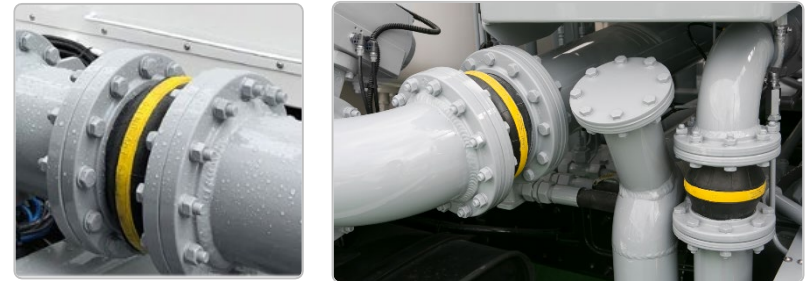


UV and Ozone
PROTECTION

Not Recommended



Recommended



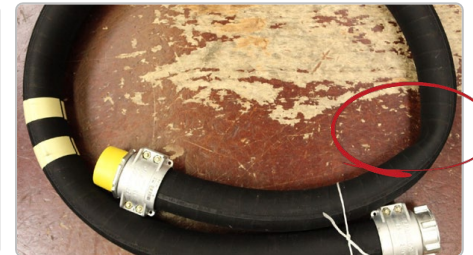
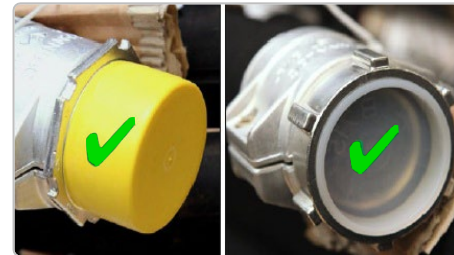
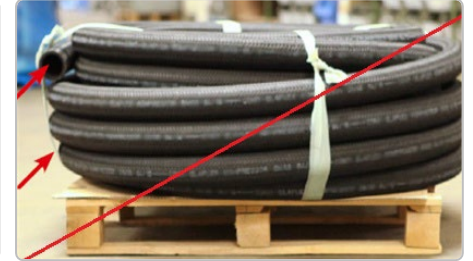
HOSE HANDLING – PACKING AND STORAGE

► PACKING

- Use safety knives only
- Do not use free-standing blades to avoid damages to the hose
- Hose coils shall be placed on pallets bigger than the coil diameter
- Close open ends with protective caps.

► STORAGE

- Store hoses in horizontal position, free of kinks, twists or compressions
- Plug the hose ends to protect the liner
- Store hoses in a cool, dry and dust-free environment.
- Avoid direct sunlight / UV light
- Protect from nearby heat sources
- Max. shelf life of aviation hoses: 2 years from date of manufacture



**THANK YOU
FOR YOUR ATTENTION!**



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Group