

IFIC  
01/06/2017

# Calibration and cable

A. Cervera

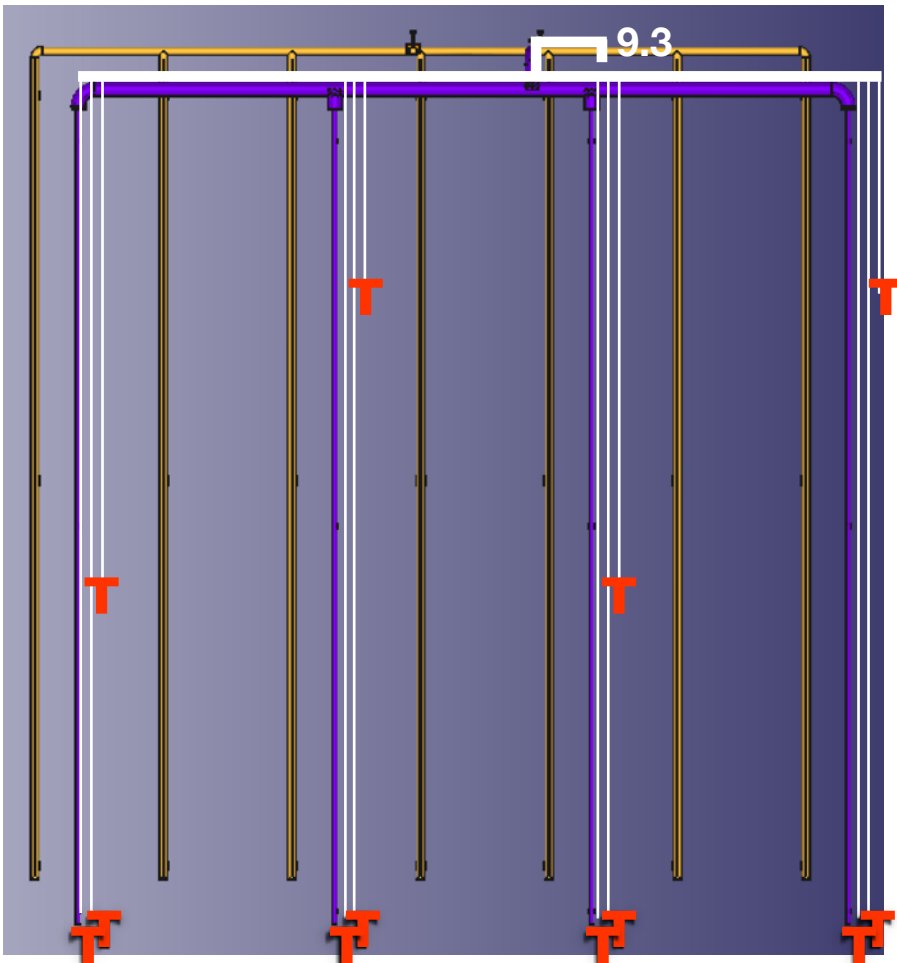
IFIC - (CSIC & Univ. Valencia)

**bottom pipes**

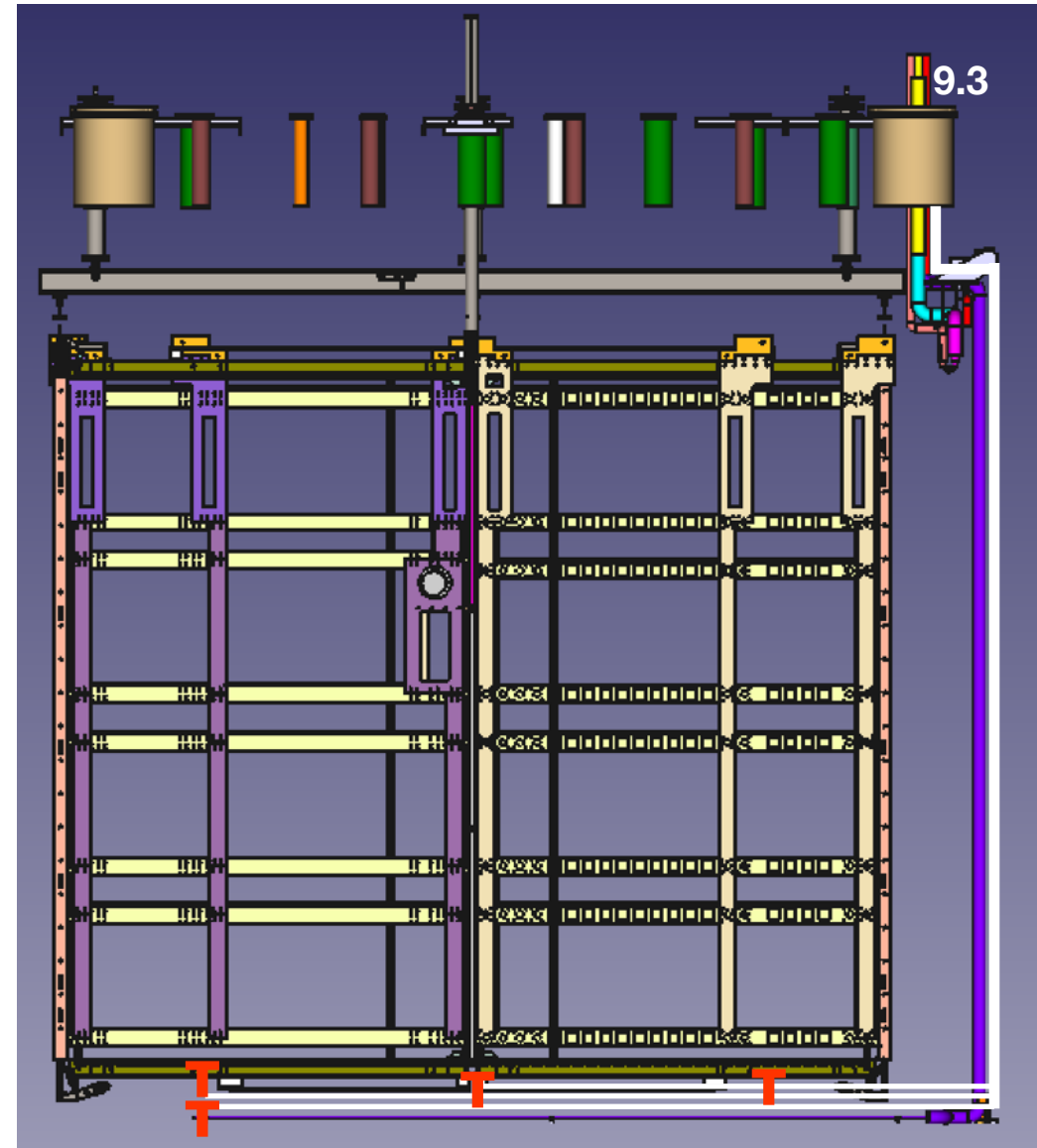
# Sensor map and cabling

- Cables can run attached to the pipes all the way to port 9.3
- Pipes in purple, cables in white

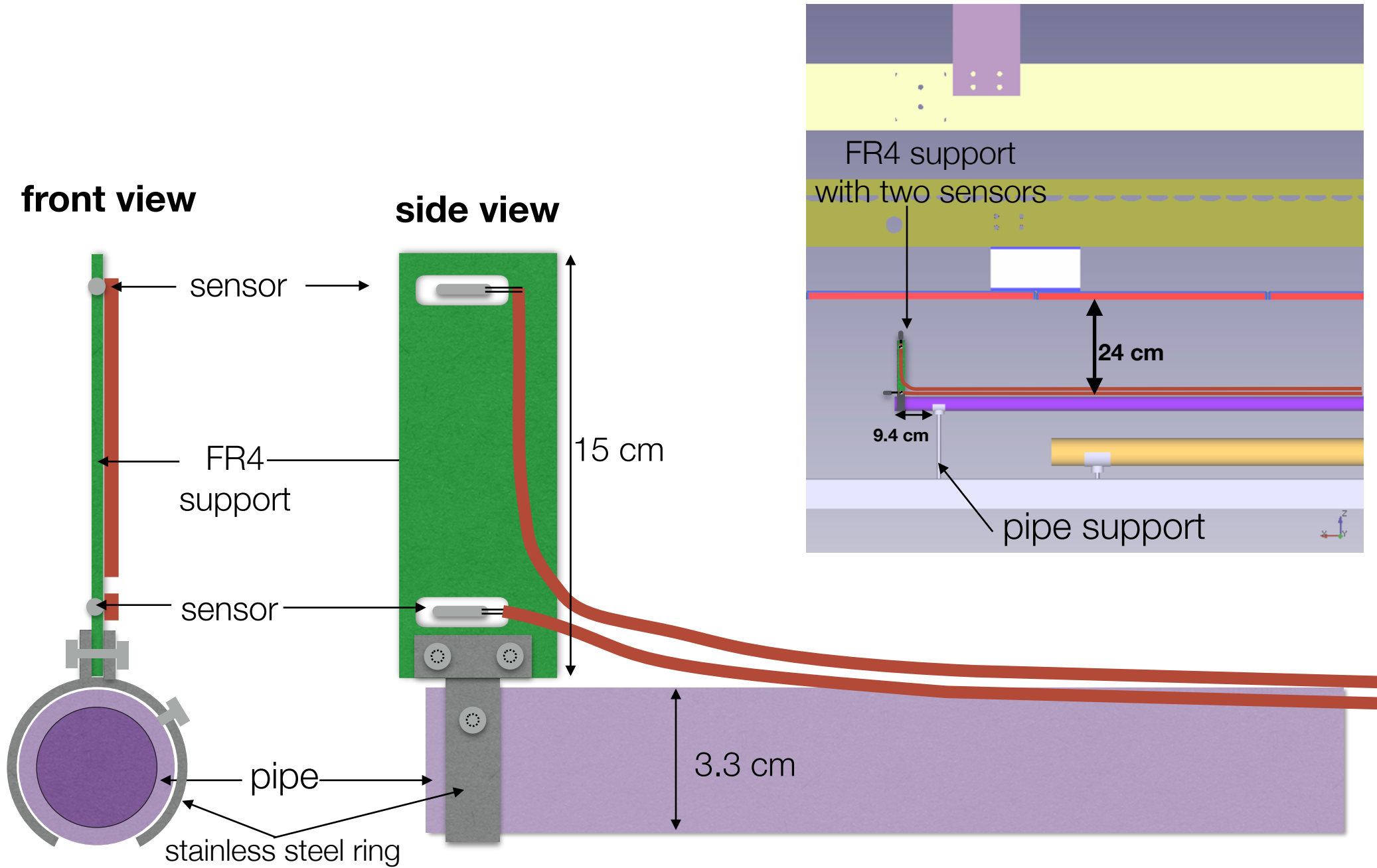
**TOP view**



**SIDE view**

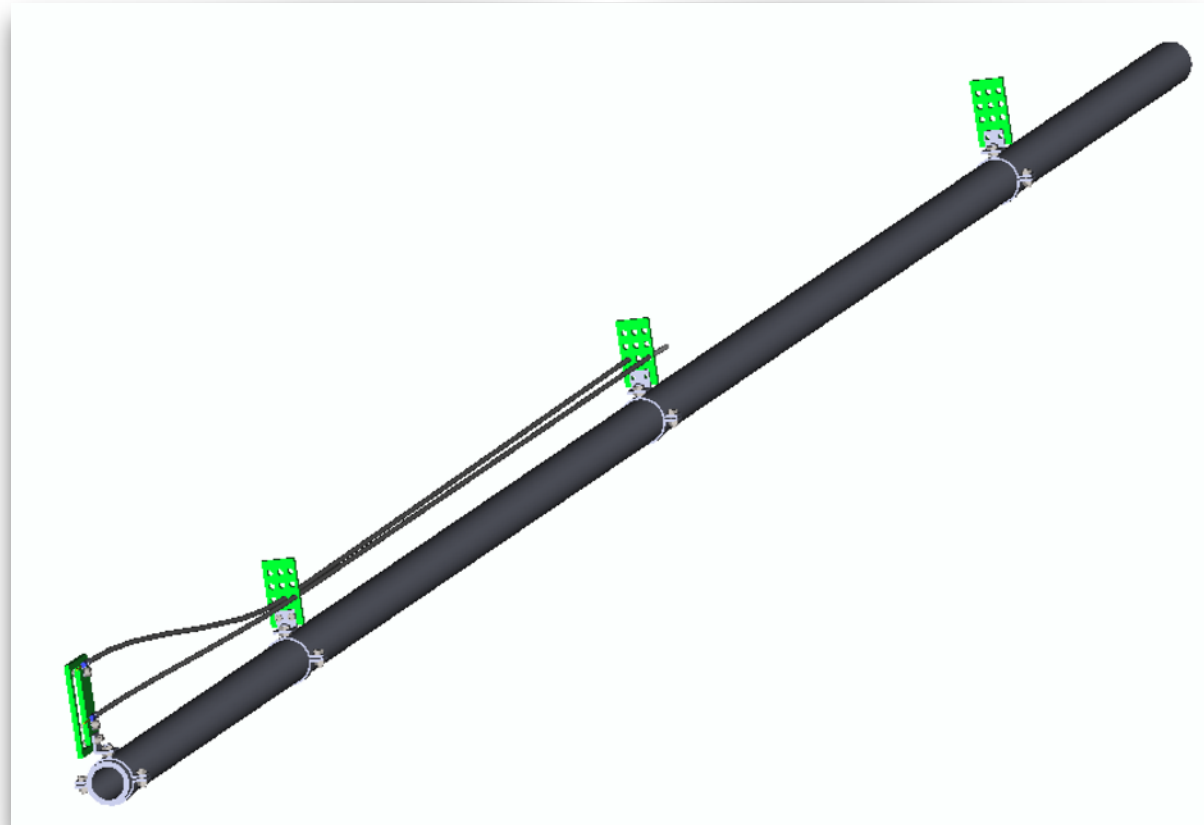
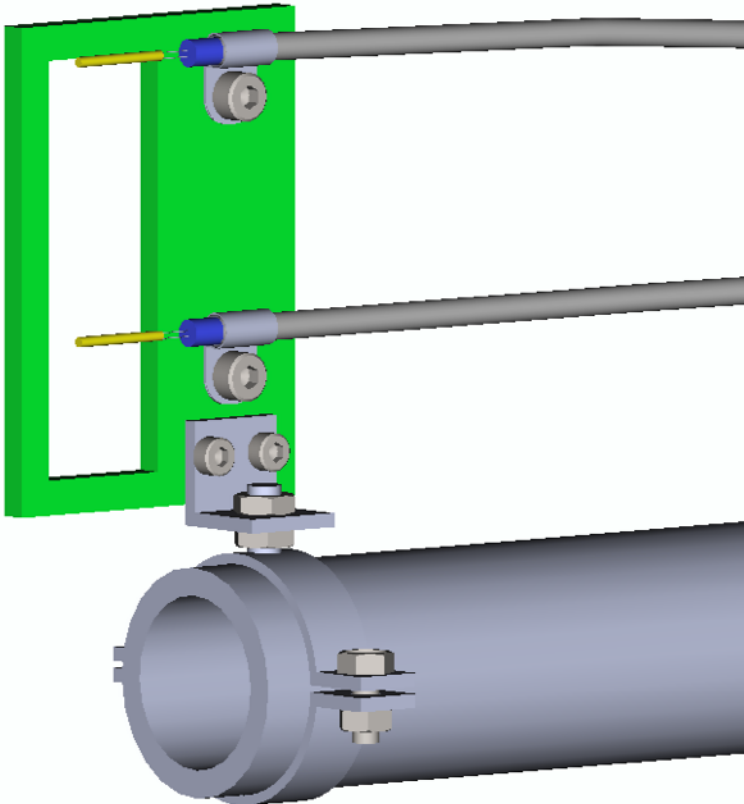
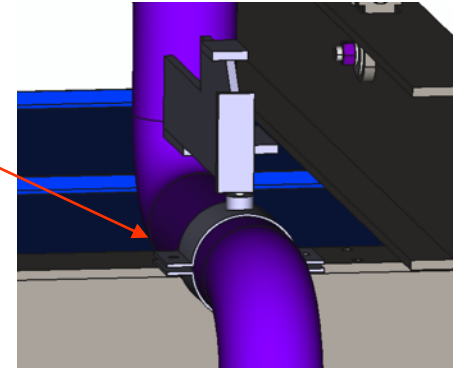


# Conceptual design



# Preliminary 3D model

- We could use a similar system to the one used to hold the pipes
- All those elements must be ready by August
- Installation will happen in september



**calibration**

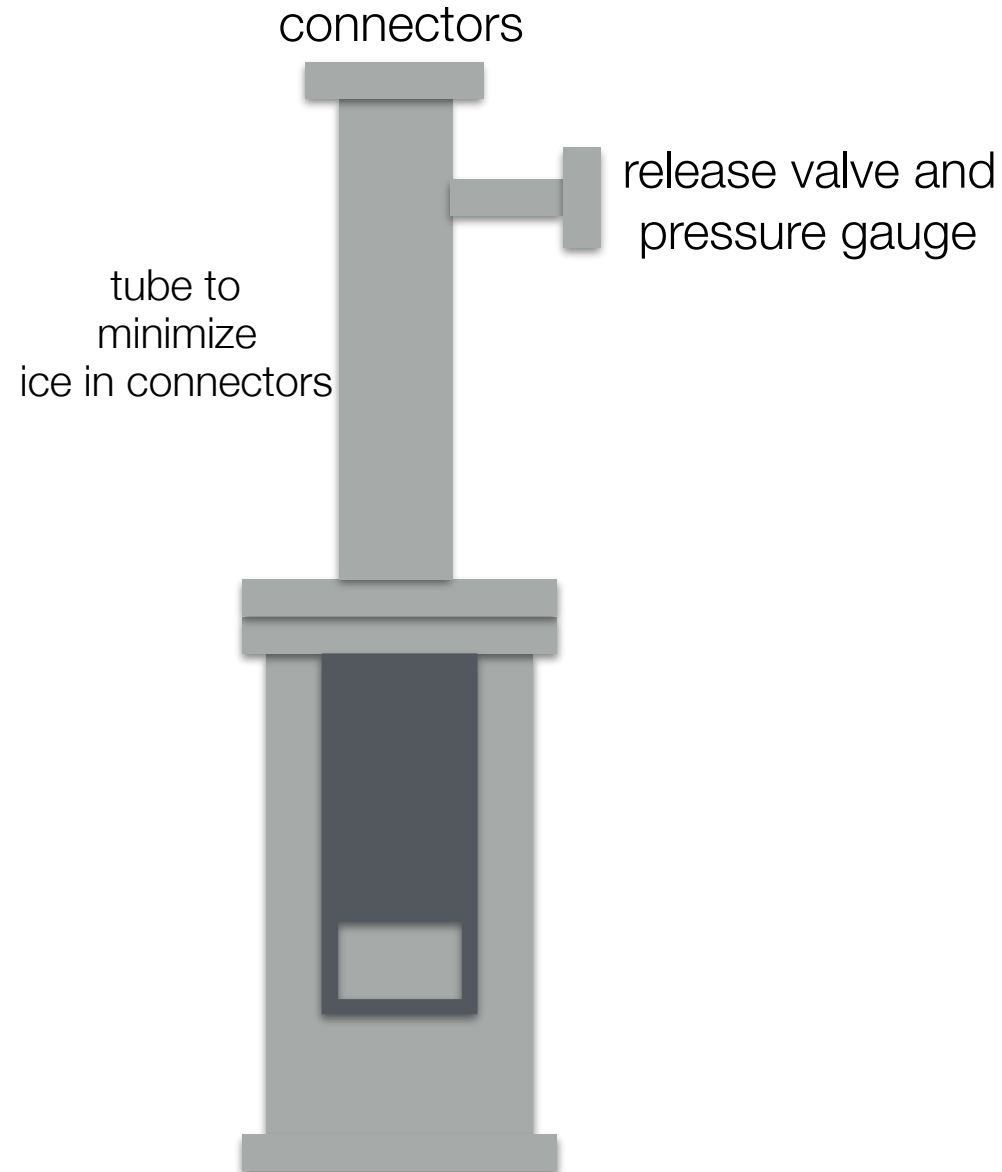
# Next steps

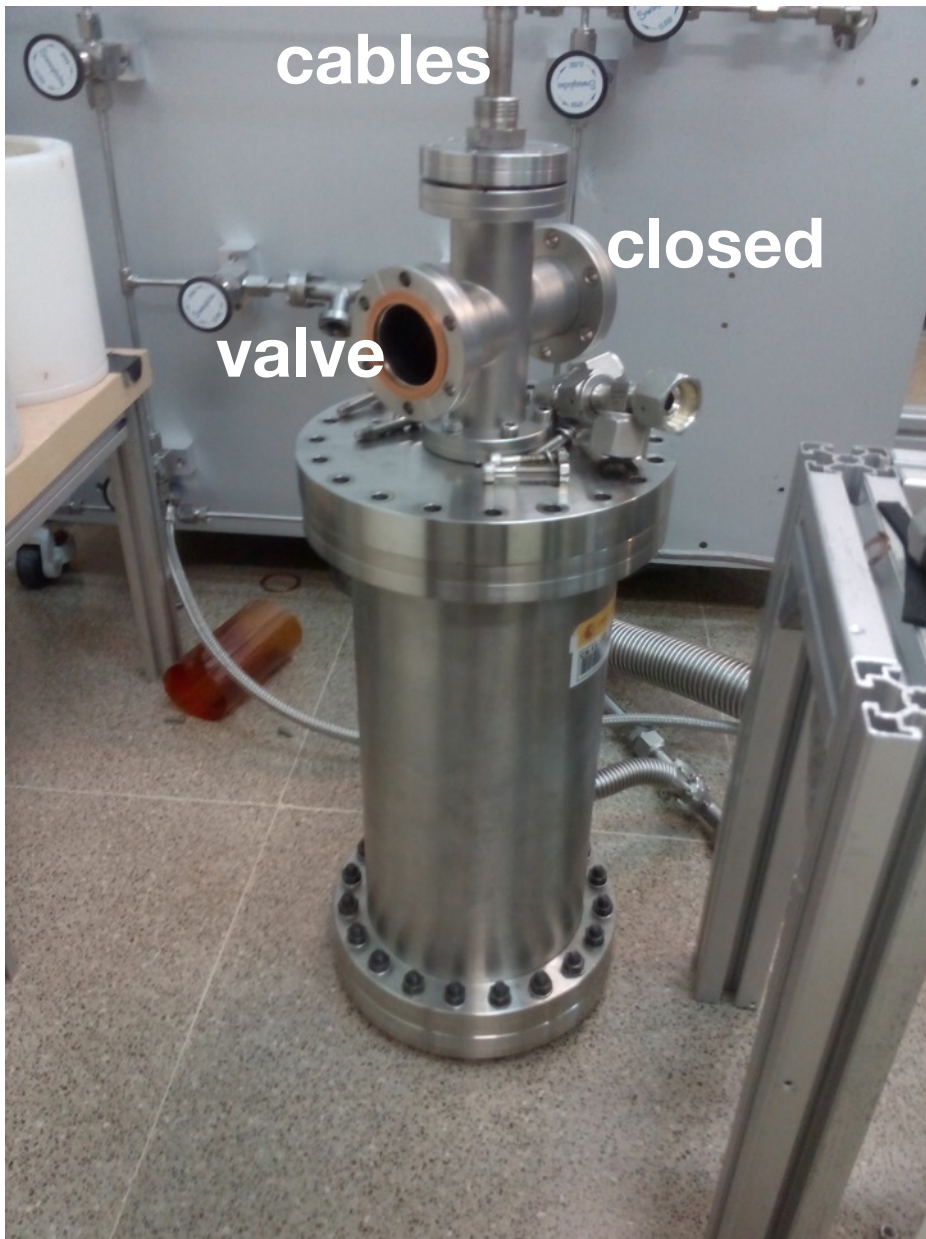
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- We need to start calibrating with closed vessel in July
- Critical point is the flange
- Options:
  - Order the whole thing to a company (Linde, Air Liquide ?)
  - Fabricate it at IFIC

# Conceptual design

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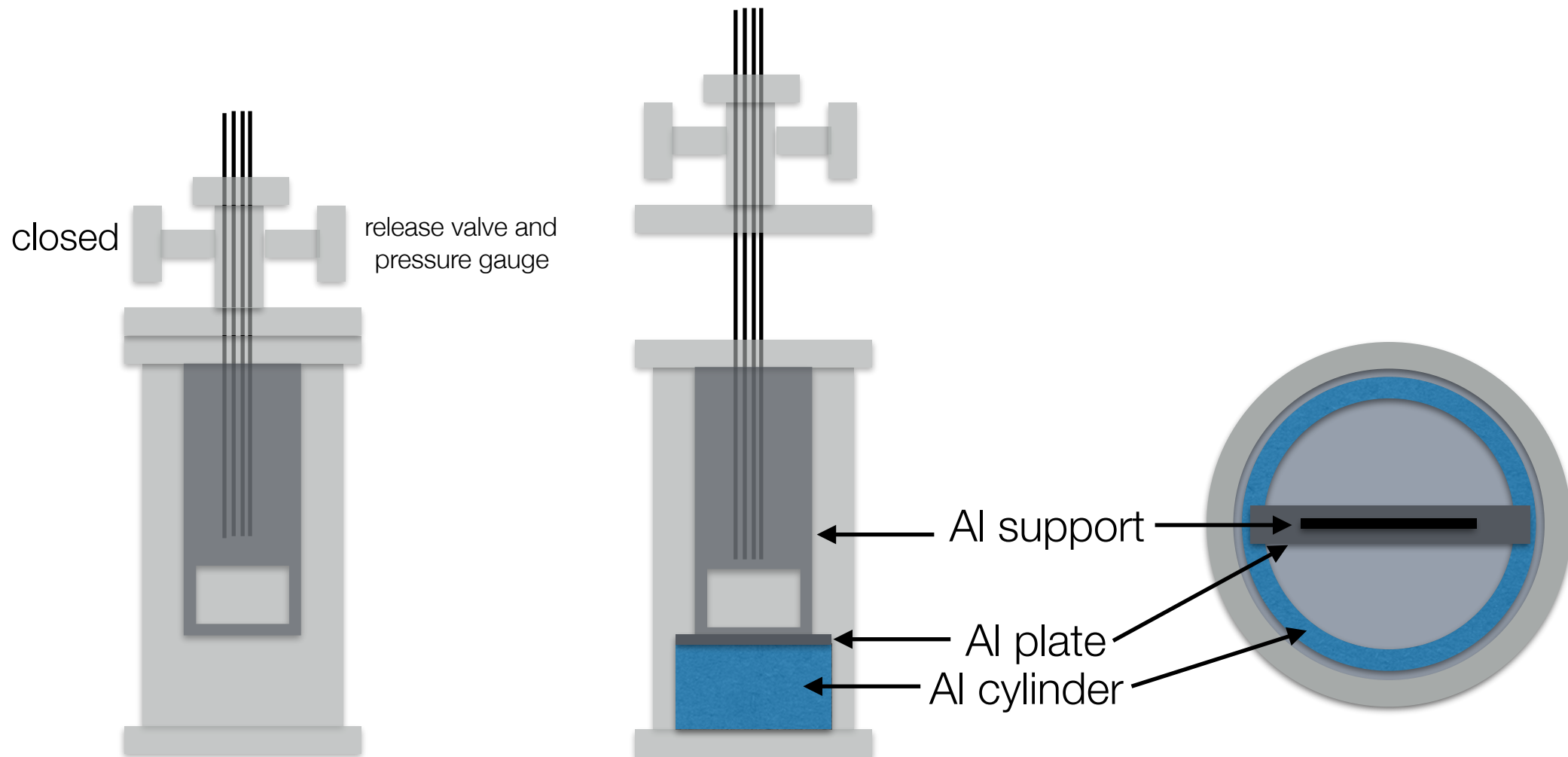




- Put a valve with manometer in one of the side ports
- Close the other side port
- Use the top port for the cables

# Conceptual design

- We should be able to open the chamber without moving the sensors
  - Sensor's support should rest at the bottom ?
  - We need some extra cable inside the chamber

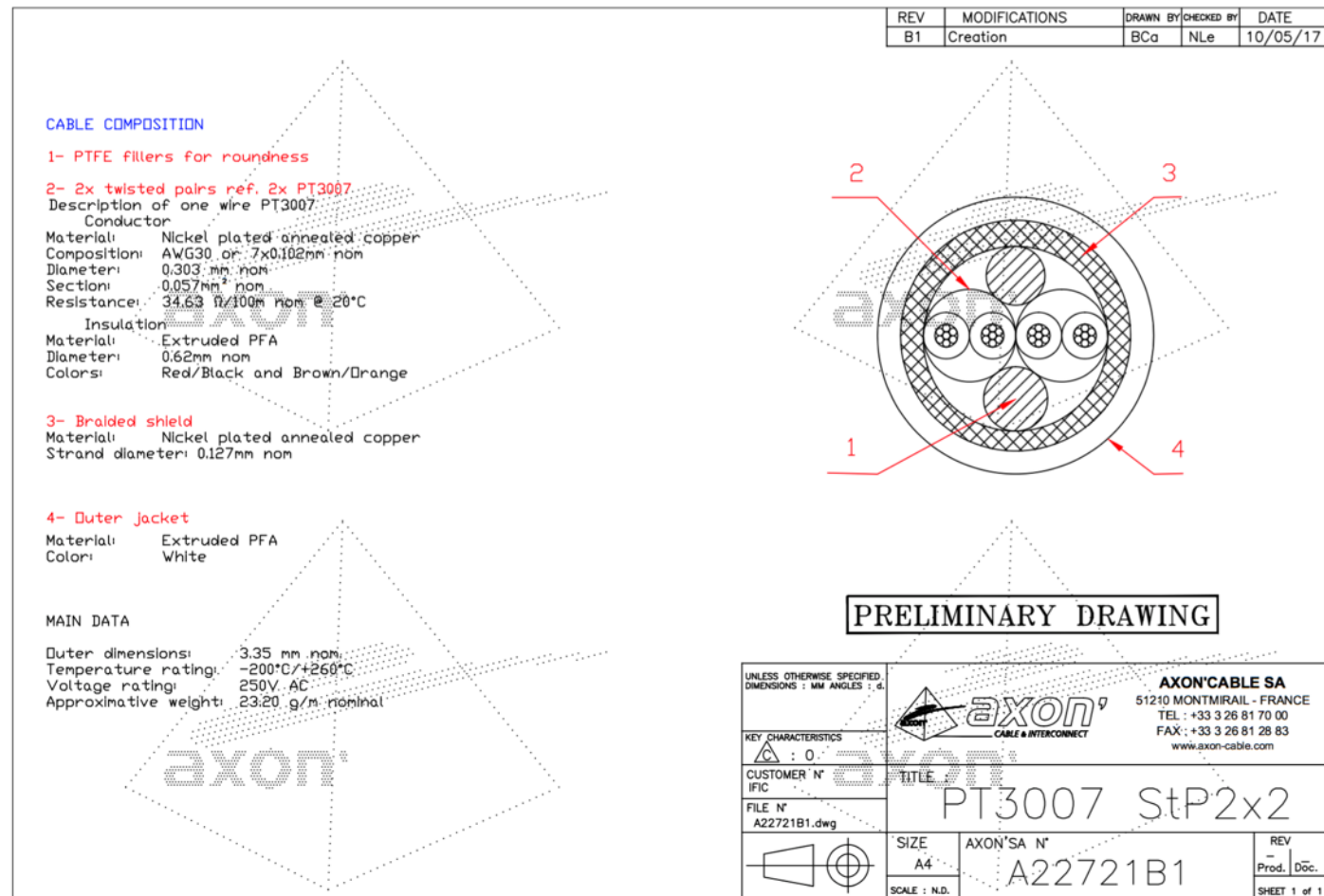


**cable**

# Teflon cable

- Customized cable by Axon
- 10 weeks to deliver. Will arrive at the end of July
- A sample of a similar cable sent to Fermilab for testing

- 4 wires per sensor
- Teflon jacketed (PFA) cables
- 2 twisted pair wires
- EMC shielding



# offer and leadtime



Cust No: 000841 INSTITUTE OF CORPUSCULAR PHYSICS

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E-Mail : a.blasson@axon-cable.fr

Tel : +34 963 544 758  
E-Mail : acervera@cern.ch  
Your ref : RFQ dated May 16th 2017

Montmirail, May 18th 2017

## QUOTATION 17179/ESP/ABI

Dear Sirs,

Further to your request, we are pleased to quote as follows:

No	Reference	Designation	Qty	Leadtime	Unit price	Line total	Comments
1	A22721B1	PT3007 STP2X2	1 KM		9 770.68 € / KM	9 770.68 €	3 options for T-gradient monitor
2	A22721B3	Flat cable ( 6x (PT3007 S2x2) ) P	0.05 KM		126 617.74 € / KM	6 330.89 €	3 options for T-gradient monitor
3	PRESTATION30-03	SET-UP FOR AXP TOOLING COSTS	1 P		350.00 € / P	350.00 €	special tooling is requested for punching in A22721B3

### SALES CONDITIONS

GLOBAL QUOTATION VALUE: 16 451.57 €

This offer is subject to enclosed sales conditions.

Firm prices, except increase of raw materials or labour cost of more than / equal to 2%.

For a standard packaging. Tolerance on quantity +/- 10%.

Standard manufacturing lengths of mini 10 meters. If you need minimum or continuous lengths, please mention it on the order and we will come back to you if additional costs are involved.

Leadtimes are given for information and are subjected to confirmation in case of an order.

#### MINIMUM OF INVOICING OF 200€ per item / shipment

INSURANCE 0.23% OF NET AMOUNT

PACKAGING EXCLUDED

FREIGHT: FCA MONTMIRAIL ACCORDING TO INCOTERMS® 2010

PAYMENT: CASH IN ADVANCE

**VALIDITY OF THE OFFER 30 Days**

We stay at your disposal for any further information you may need.

Alice BLASSON  
Sales Coordinator

A propósito del plazo, te paso los detalles de la mejor opción que tenemos al día de hoy :

Es posible hacer un envío parcial de 500m del estudio A22721B1 a mediados de Julio, si tenemos el pedido antes el final de la semana qui viene (semana 21), y los 500m restantes después.

y enviar los 50m del estudio A22721B3 mediados de Julio, si tenemos el pedido antes el final de la semana qui viene (semana 21).

# Questions to Axon

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Let's focus on the single cable with two twisted pairs.

The shrinkage of cables elements from room to Liquid argon temperature (88 K) would be:

- 28.9 mm/m for PFA
- 3.4 mm/m for the conductor

But what will happen when the cable assembly is put at 88 K during months ? Most likely it will be OK for short cables.

However I have doubts for a 18 m cable, which would be our longest cable.

I can see several possibilities:

1. there are tensions between the different elements in the cable assembly. As a result the PFA is finally broken at several points, even the internal PFA covering each of the conductors such that there are short-circuits
2. the PFA is elastic such that it will shrink less than when isolated, but does not break and finally it stays together with the conductor
3. the PFA in the 18 m cable shrinks 52 cm while the conductors and probably the shield shrinks by 6.1 cm. As a result there are 46 cm (52-6.1) of conductor (the last 46 cm of the 18 m cable) uncovered by PFA.

For short cables, probably 3 is the right answer, but I don't think this will happen for long cables.

I hope 2 is the right answer in that case. But I would need the opinion of experts.

On the other hand it is written in the cable specifications that the temperature rating is from -200° to 260°. What does this means ?

# Answer from Axon

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## **1-Shrinkage**

Unfortunately, the right answer is “46 cm will be uncovered ”

I spoke with R&D department and the colleagues of the cell harness.

The idea is to use a sleeve is not possible because the sleeve will swell under negative temperature and it will not stick the materials ( insulation and conductor )

The best solution to limit the shrinkage is to change the raw material of insulation

We suggest the following modifications

- Insulation of core : extruded PFA -> wrapped and sintered polyimide tape ( coefficient of linear thermal 4.1mm /m instead of 28.9mm/m )
- Jacket : no change
- Addition of tape under the jacket to facilitate the sliding between the shielding and the jacket

## **2-Temperature rating -200°C to 260°C**

The cable can be used until these 2 limits of temperature

### ***Other point***

Technical department have a doubt concerning the conductor for the twisted pair

It seems that the customer's application is similar at a thermocouple cable

In this case, we usually use to 2 raw material different for the conductor

For example: A thermocouple type E, will be constituted with one Chromel° conductor and one Constantan° conductor

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- The scrap rate will be adjusted after two productions of 100m
  - The cable can not be used in dynamic ( risk of break under negative temperature )
  - The designs proposals at index A and B were made of extruded PFA insulations that will lead the undercover of the shielding due to the shrinkage ( conform at your original request )
  - This insulation has a linear thermal coefficient upper than the conductor .Therefore, it is not possible to use a sleeve for protect the conductor after the shrinkage because it will no stick and it will swell at 88K . So ,Axon proposes to change the raw material of insulation selecting an insulation with a linear thermal coefficient close to the conductor. (Just to remember linear thermal coefficient of raw materials that will be used in this index extruded PFA = -28.9mm/m wrapped and sintered polyimide tape = -4.1mm/m NPC conductor = -3.4mm/m )
  - Wherever possible I replaced the extruded PFA by wrapped and sintered polyimide tape except for the jacket of the flat cable. In this case , the polyimide tape has two functions:
    - 1 facilitate the sliding between the shielding and the PFA jacket
    - 2 protection of the shielding after the shrinkage.

# Kapton cable

3

REV	MODIFICATIONS	DRAWN BY	CHECKED BY	DATE
B4	Creation	BCa	NLe	11/05/17
C4	The insulations extruded PFA are replaced by Wrapped and sintered polyimide tape	BCa	NLe	29/05/17

**CABLE COMPOSITION**

**1- Twisted quads of wire ref. FHT3007**

**Conductor**  
 Material: Nickel plated annealed copper  
 Composition: AWG30 or 7x0.102mm nom  
 Diameter: 0.303 mm nom  
 Section: 0.057mm<sup>2</sup> nom  
 Resistance: 34.63 Ω/100m nom @ 20°C

**Insulation**  
 Material: Wrapped polyimide tape and polyimide coating  
 Diameter: 0.55mm nom  
 Colors: Red/Black/Brown/Orange

**2- Braided shield**

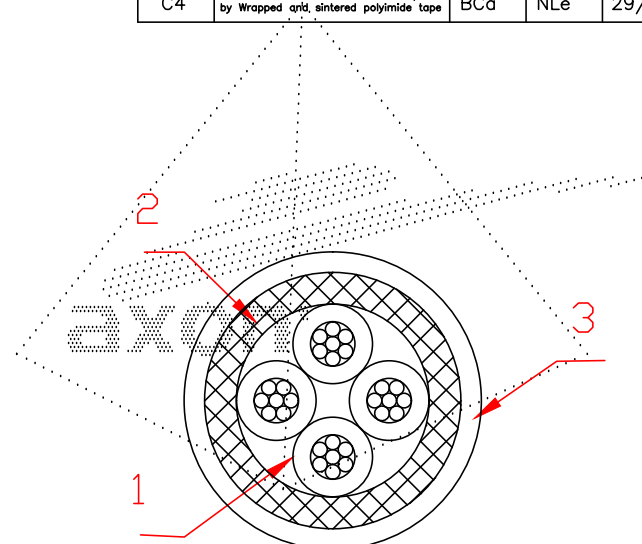
Material: Nickel plated annealed copper  
 Strand diameter: 0.102mm nom

**3- Outer jacket**



Material: Wrapped and sintered polyimide tape  
 Color: Amber

**MAIN DATA**

Outer diameter: 2.05 mm nom  
 Temperature rating: -200°C/+200°C  
 Voltage rating: 250V AC  
 Approximative weight: 9.70 g/m nominal



**PRELIMINARY DRAWING**

UNLESS OTHERWISE SPECIFIED, DIMENSIONS : MM ANGLES : d.		 <b>AXON'CABLE SA</b> 51210 MONTMIRAIL - FRANCE TEL : +33 3 26 81 70 00 FAX : +33 3 26 81 28 83 www.axon-cable.com	
KEY CHARACTERISTICS	△ : 0	TITLE	
CUSTOMER N°	IFIC	FHT3007 StH4	
FILE N°	A22721C4.dwg	SIZE	AXON'SA N°
		A4	A22721C4
SCALE : N.D.		REV	Prod. Doc.
		SHEET 1 of 1	

No	Reference	Designation	Qty	Leadtime	Unit price	Line total	Comments
1	A22721C2	(FHT3007 StH2x2) H6	0.05 KM	TBD	308 401.56 € / KM	15 420.08 €	SOLUTION FOR T-GRADIANT MONITOR ROHS COMPLIANT
2	A22721C3	Flat Cable [6X ( FHT3007 StH2x2)]	0.05 KM	TBD	242 360.02 € / KM	12 118.00 €	SOLUTION FOR T-GRADIANT MONITOR ROHS COMPLIANT
3	A22721C4	FHT3007 StH4	0.05 KM	TBD	41 654.67 € / KM	2 082.73 €	SOLUTION FOR OTHER SENSORS ROHS COMPLIANT
4	PRESTATION30-03	SET-UP FOR TOOLING COSTS	1 P		350.00 € / P	350.00 €	AXP TOOLING COST SPECIAL TOOLING IS REQUESTED FOR PUNCHING IN A22721C3
5	A22721C1	FHT3007 STH2X2	0.05 KM 1 KM	TBD TBD	54 507.36 € / KM 20 107.88 € / KM	2 725.37 € 20 107.88 €	SOLUTION FOR T-GRADIANT MONITOR ROHS COMPLIANT

**backup**