LHCb
UT Integration meeting
26 October 2017

UT CO_2 COOLING DISTRIBUTION SYSTEM
Work in progress

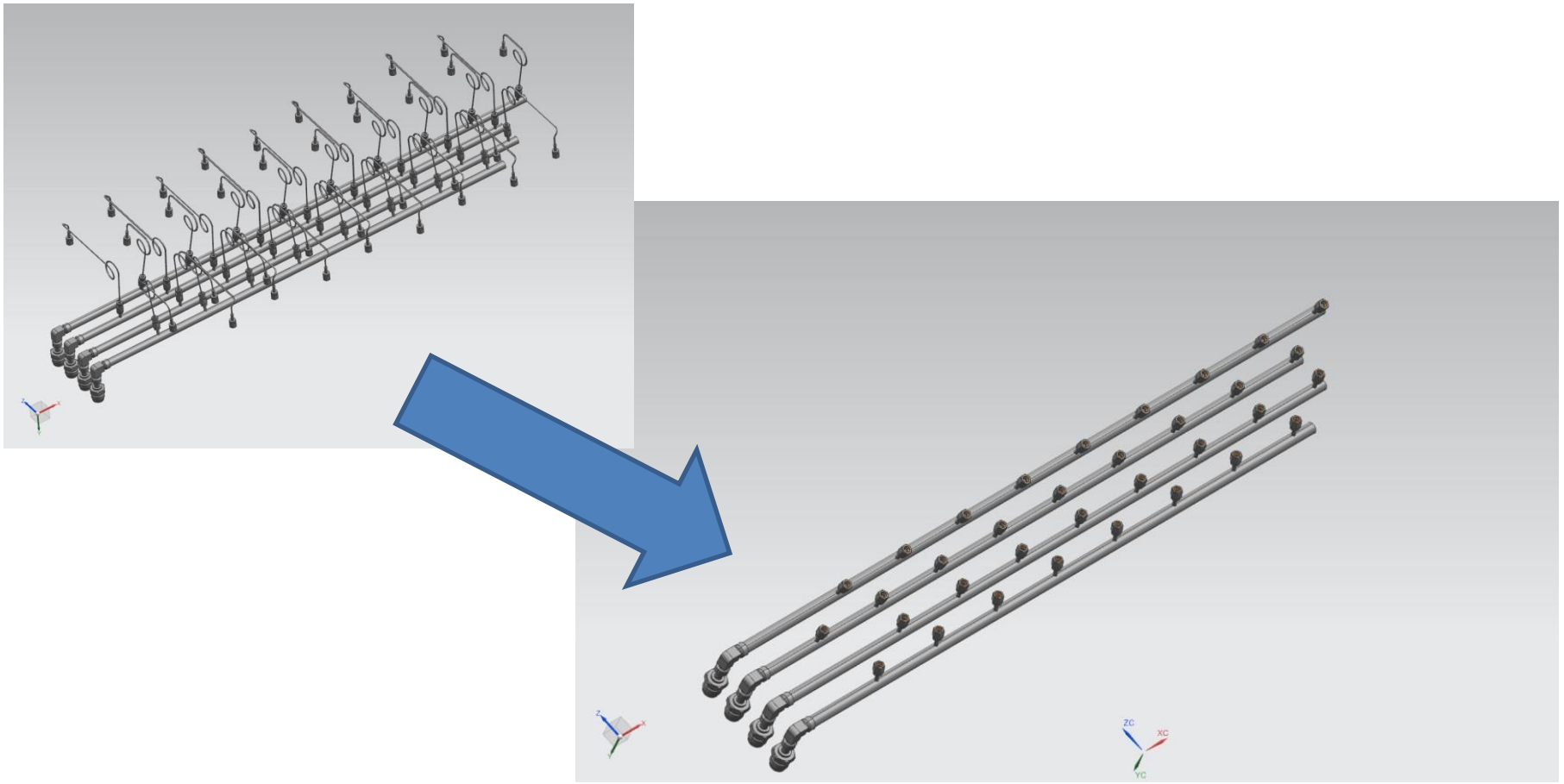
Simone Coelli
INFN Milano

For the Milano UT Group

SUMMARY:

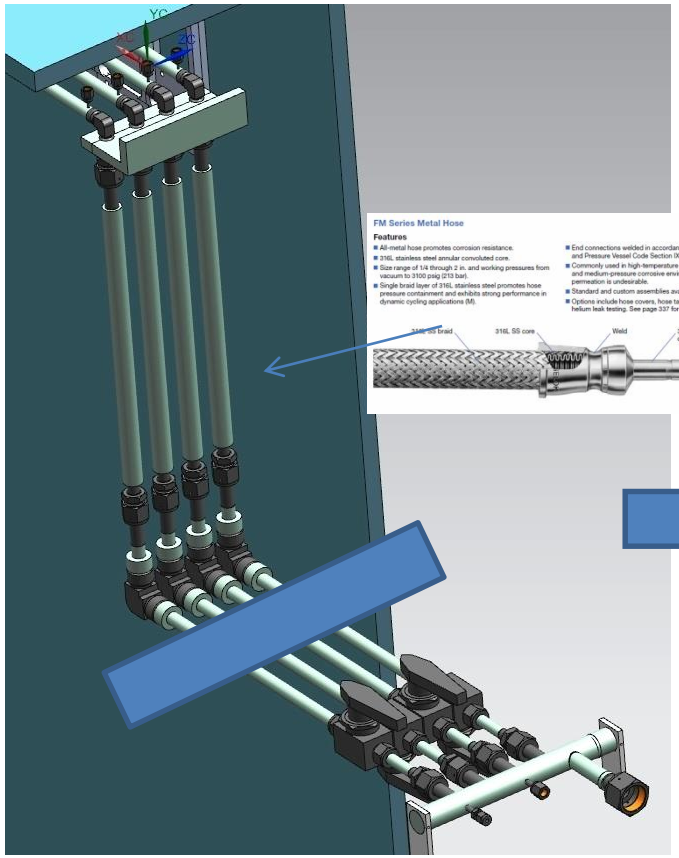
- CO_2 COOLING DISTRIBUTION SYSTEM
  - MANIFOLD DESIGN UPDATE
  - COMMISSIONING/TEST REQUIREMENTS
  - MANIFOLD PROTOTYPE PRODUCTION

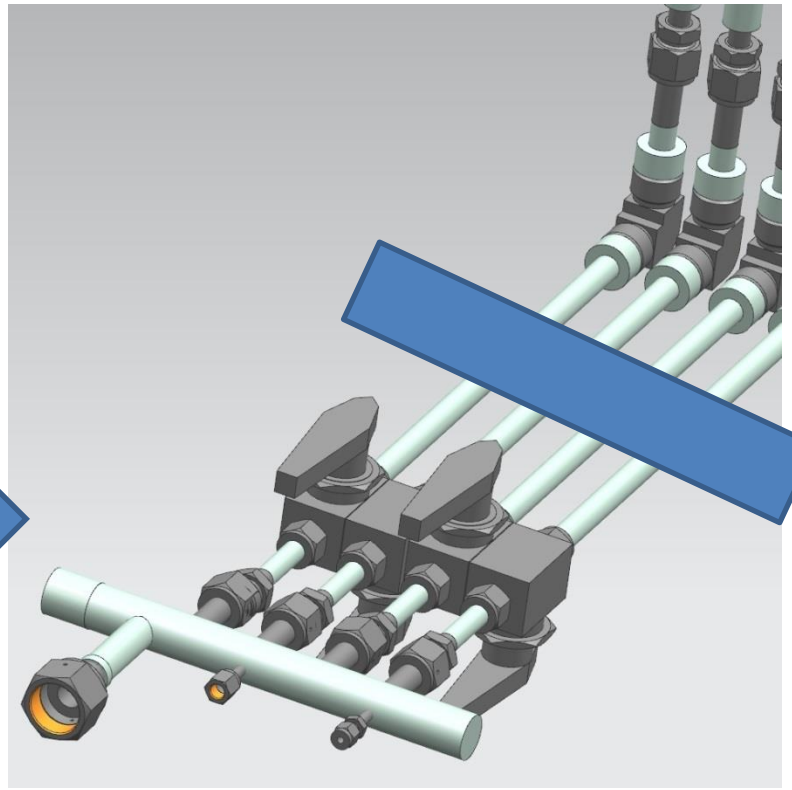
CO_2 COOLING DISTRIBUTION SYSTEM MANIFOLD DESIGN UPDATE



CARLO MANIFOLD MODEL UPDATED ACCORDING TO THE LATEST 3D UT BOX MODEL FROM MICHAL GALKA

CO_2 COOLING DISTRIBUTION SYSTEM COMMISSIONING/TEST REQUIREMENTS





TEST REQUIREMENT:
HAVE THE POSSIBILITY TO OPERATE COOL ONLY ONE OR TWO «HALF-PANEL» (8 OR PARALLEL STAVES) OF THE DETECTOR

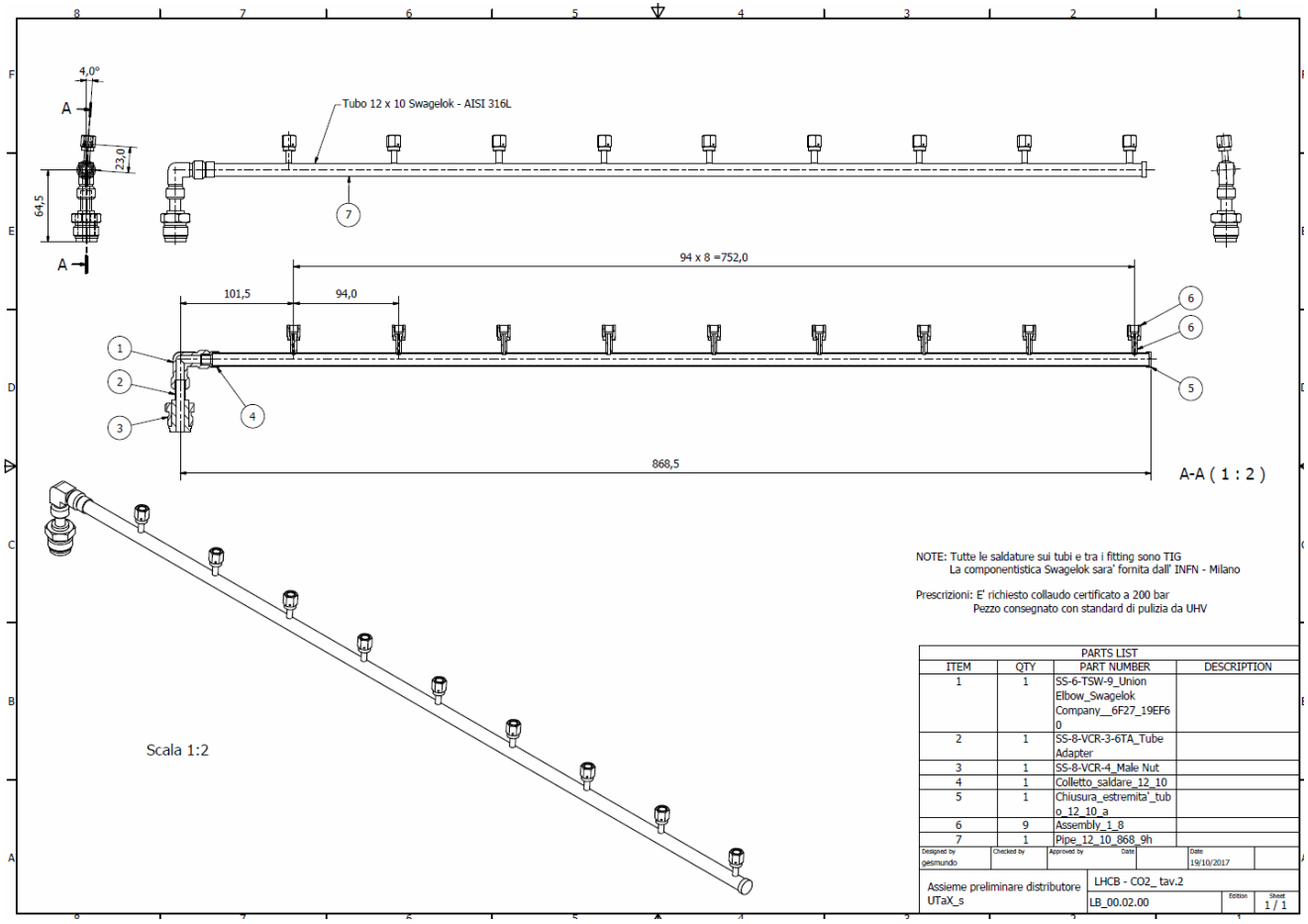
A POSSIBILITY:
INSTALL ON/OFF VALVES ON THE COOLING DISTRIBUTION
NOTES: OUTSIDE OF THE BOX,
COLD (NEED A DEICATED COLD BOX)

CO_2 COOLING DISTRIBUTION SYSTEM ONE MANIFOLD PROTOTYPE PRODUCTION

AISI 316L

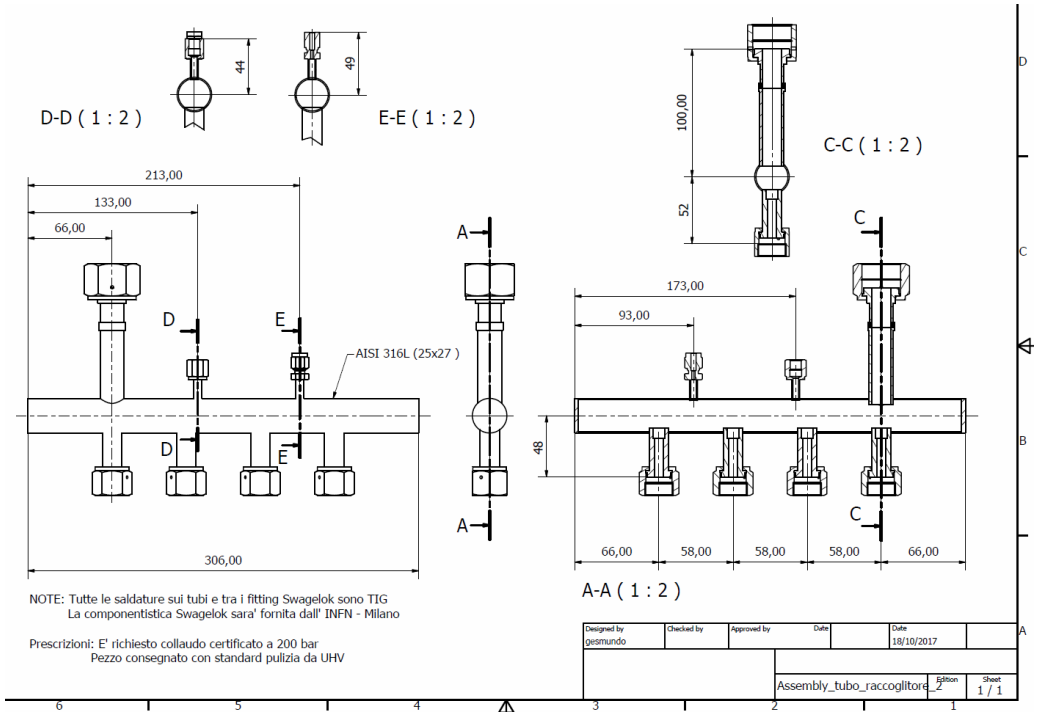
LASER OR MICROTIG WELDED FITTINGS

200 bar PRESSURIZATION AND LEAK CHECK TEST



REQUESTED PRICE QUOTING AND MANUFACTURER COMMENTS on the details

CO_2 COOLING DISTRIBUTION SYSTEM MANIFOLD PROTOTYPE PRODUCTION



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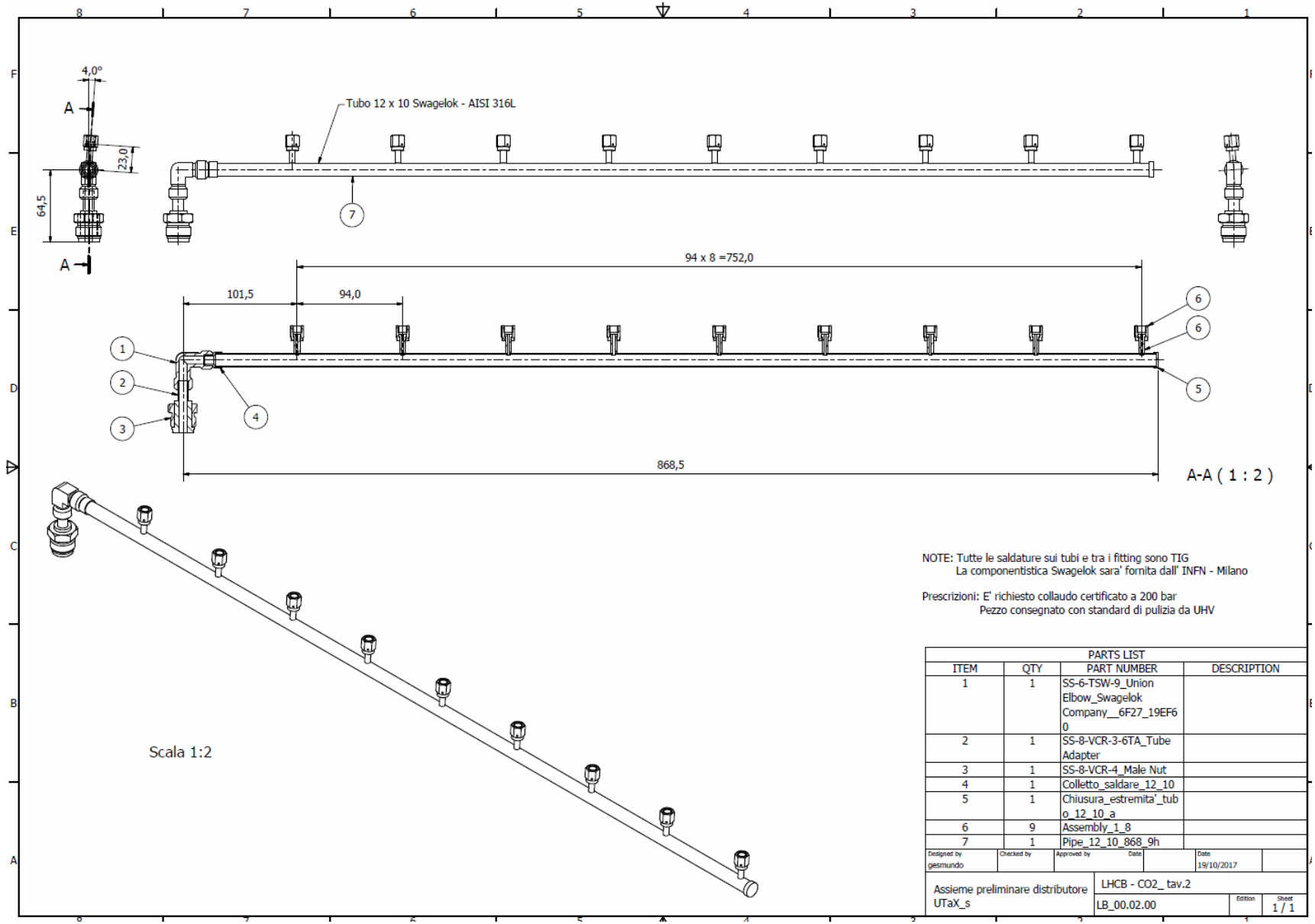


NOTE: Tutte le saldature sui tubi e tra i fitting sono TIG
La componentistica Swagelok sara' fornita dall' INFN - Milano

Prescrizioni: E' richiesto collaudo certificato a 200 bar
Pezzo consegnato con standard di pulizia da UHV

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	SS-6-TSW-9_Union Elbow_Swagelok Company__6F27_19EF60	
2	1	SS-8-VCR-3-6TA_Tube Adapter	
3	1	SS-8-VCR-4_Male Nut	
4	1	Colletto_saldare_12_10	
5	1	Chiusura_estremita'_tubo_12_10_a	
6	9	Assembly_1_8	
7	1	Pipe_12_10_868_9h	

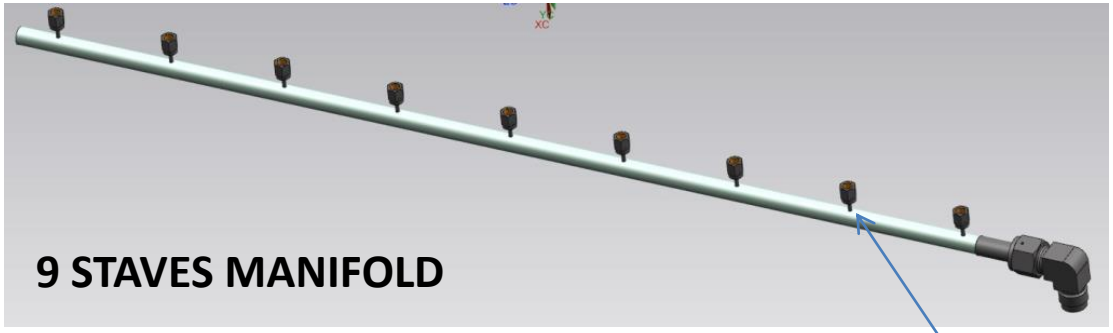
Designed by	Checked by	Approved by	Date	Date
gesmundo				19/10/2017

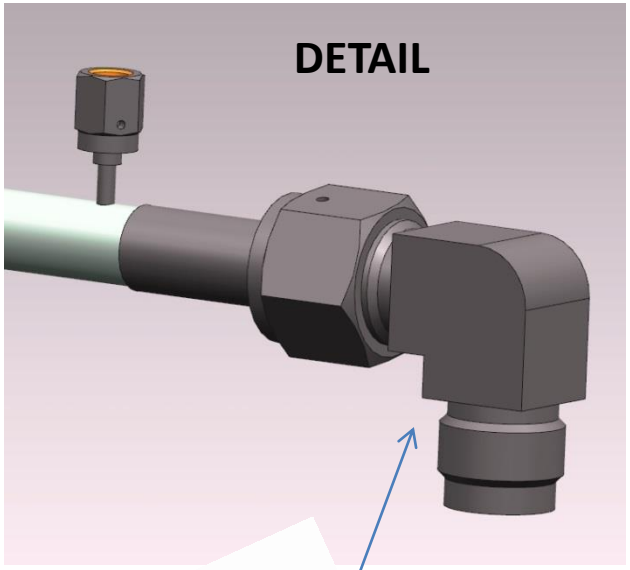
Assieme preliminare distributore UTaX_s	LHCB - CO2_ tav.2		
	LB_00.02.00	Edition	Sheet 1 / 1

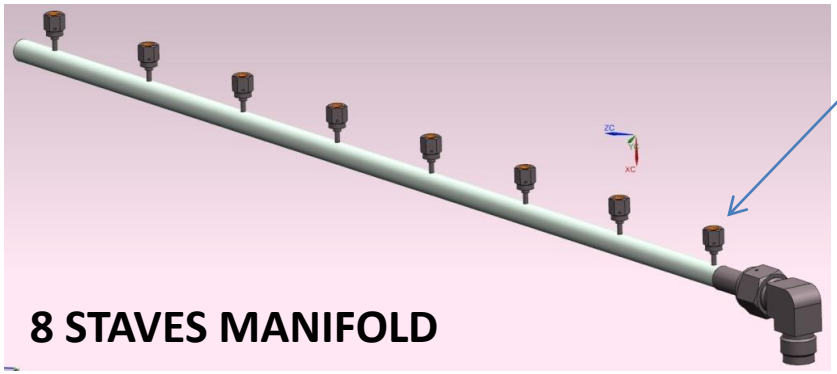
THANKS FOR THE ATTENTION

BACK-UP SLIDES

CO_2 DISTRIBUTION COMPONENTS







316 Stainless Steel VCR Face Seal Fitting, 1/8 in. Female Nut
https://www.swagelok.com/en/search?Ntt=SS-2-VCR-1&language=en

316 Stainless Steel VCR Face Seal Fitting, 1/2 in. Union Elbow Body
https://www.swagelok.com/en/catalog/Product/Detail?part=SS-8-VCR-9

DISCUSSED AND APPROVED BY CO_2 EXPERTS

CAD Carlo Gesmundo

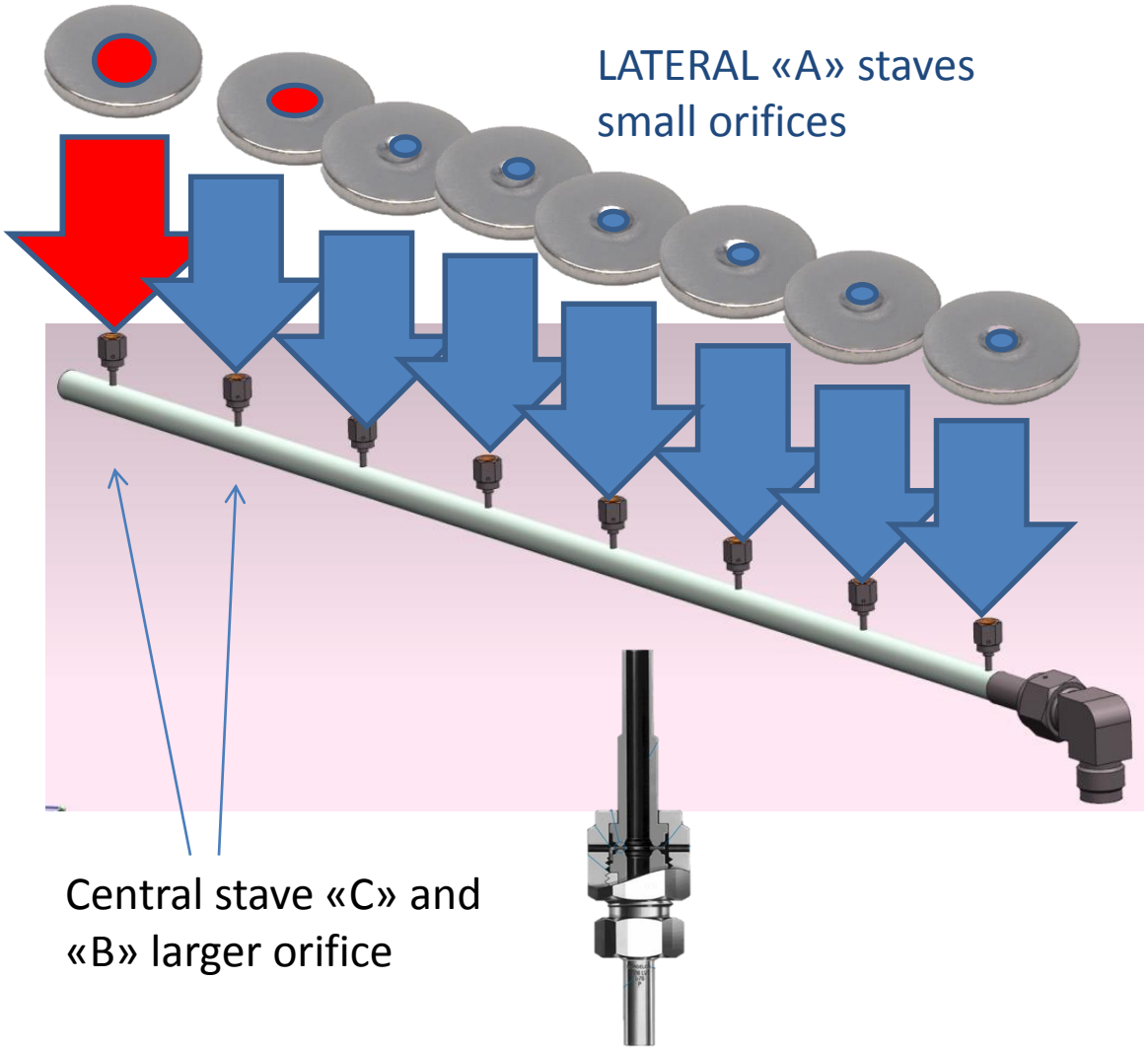
DISTRIBUTION OF COOLANT TO THE STAVES

ANY STAVE INLET

LIQUID CO_2

⇒ **1/8 INCH VCR GASKET WITH ORIFICE FLOW RESTRICTOR**

68 STAVES
=> 34 INLET VCR with ORIFICE for each each of the 2 half box

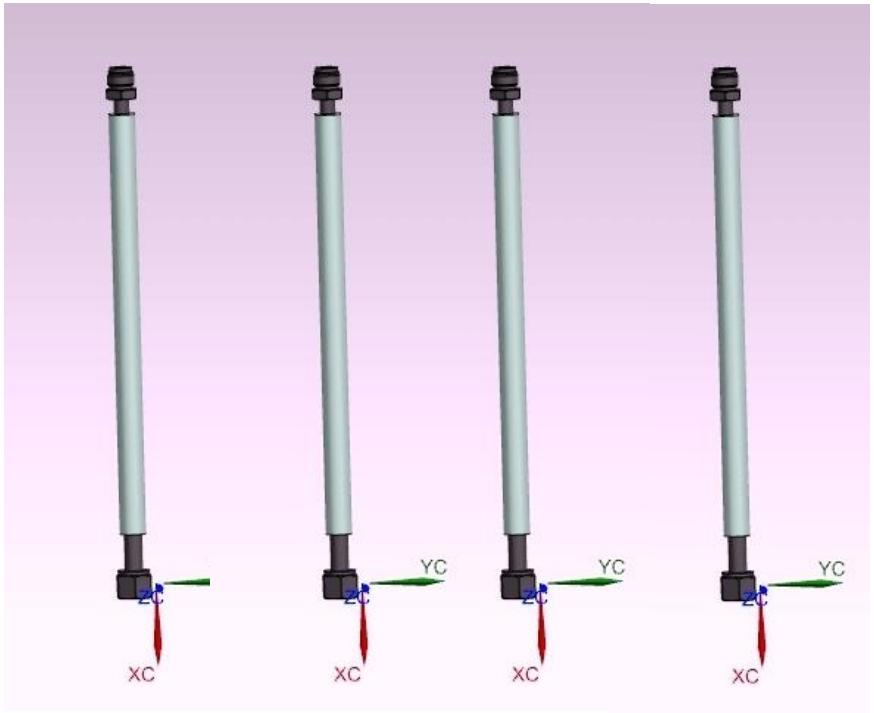


WE PLAN TO TEST
THE ORIFICES
(FROM LENOX LASER)
IN MILANO
WITH THE NEW TRACI (V.3)
TO MAKE A CHARACTERIZATION
OF THE PRESSURE DROP VS
MASS FLOW-RATE IN REAL CO_2
OPERATIVE CONDITIONS

FLEXIBLE HOSES

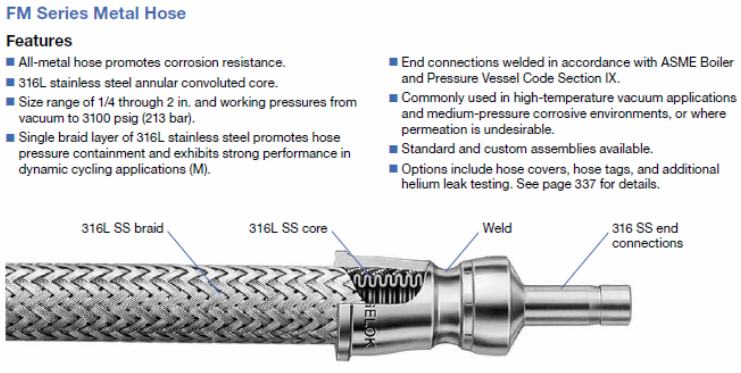
OUTLET EXHAUST AND INLET LIQUID LINES
TO COPE WITH MOUNTING TOLERANCES AND THERMAL CONTRACTIONS

FROM SWAGELOK CATALOGUE
SUCCESFULLY TESTED IN CO2 TRACI TEST



½ INCH
VCR CONNECTION BOTH SIDES

=> THE SYSTEM IS DE-MOUNTABLE IF NEEDED



FLEXIBLE HOSES

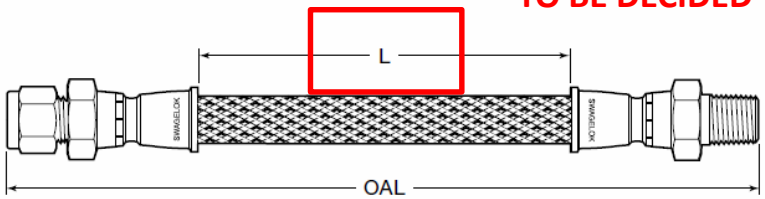
Swagelok Hose and Flexible Tubing

ORDER SPECYFING APPROPRIATE LENGHT
TO BE DECIDED

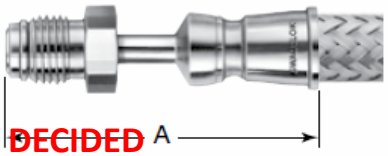
Ordering Information and Dimensions

Standard Length Hose Assemblies

Select an ordering number.



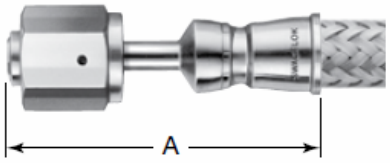
Rotatable Male VCR® Metal Gasket Face Seal Fittings



~~TO BE DECIDED~~

VCR Size in.	Nominal Hose Size Designator	End Connection Designator	Dimensions, in. (mm)		
			A	Minimum Inside Diameter	Maximum Outside Dimension
1/4	4	RM4	2.60 (66.0)	0.18 (4.6)	0.73 (18.4)
1/2	8	RM8	2.83 (71.9)	0.40 (10.2)	1.09 (27.7)
3/4	12	RM12	4.19 (106)	0.65 (16.5)	1.52 (38.7)
1	16	RM16	4.80 (122)	0.87 (22.1)	1.89 (47.9)

Rotatable Female VCR Metal Gasket Face Seal Fittings



VCR Size in.	Nominal Hose Size Designator	End Connection Designator	Dimensions, in. (mm)		
			A	Minimum Inside Diameter	Maximum Outside Dimension
1/4	4	RF4	2.00 (50.8)	0.18 (4.6)	0.87 (22.1)
1/2	8	RF8	2.16 (54.9)	0.40 (10.2)	1.23 (31.2)
3/4	12	RF12	4.15 (105)	0.65 (16.5)	1.74 (44.2)
1	16	RF16	4.76 (121)	0.87 (22.1)	2.03 (51.6)

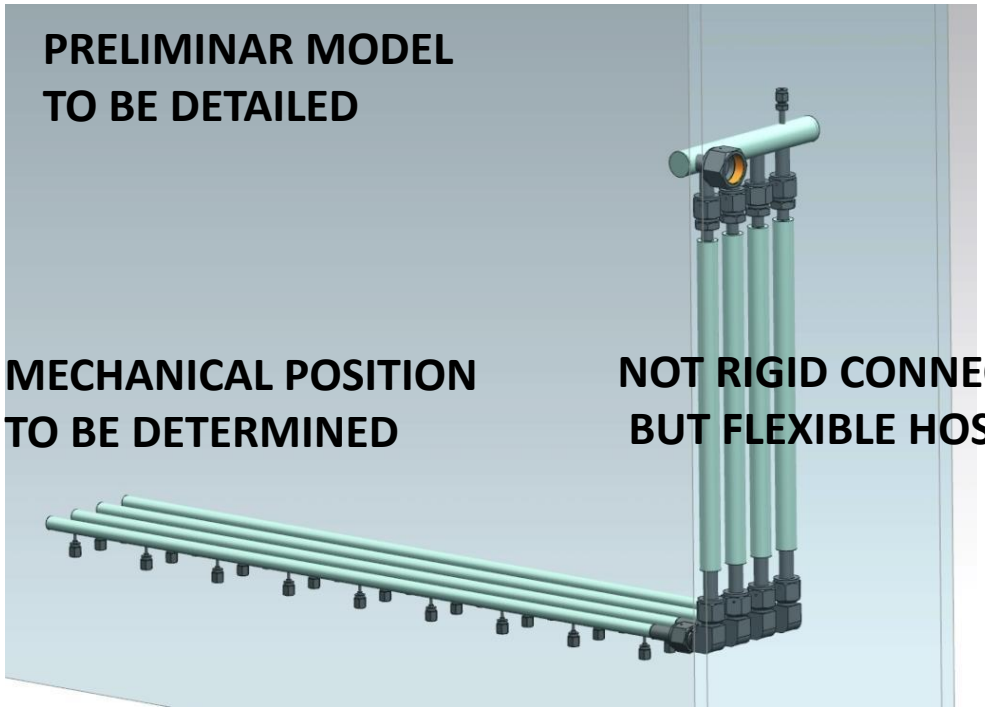
Swagelok Hose and Flexible Tubing CATALOGUE =>

https://www.swagelok.com/tools/Product-Catalog-Download-Redirect.aspx?DownloadURL=/downloads/webcatalogs/en/MS-01-180.PDF&partName=Hose%20and%20Flexible%20Tubing&language=en

PREVIOUS MODEL

PRELIMINAR STUDY
FOR THE DISCUSSION ON THE FLUID-DYNAMIC CONCEPT
WITH CO_2 CERN EXPERT TEAM

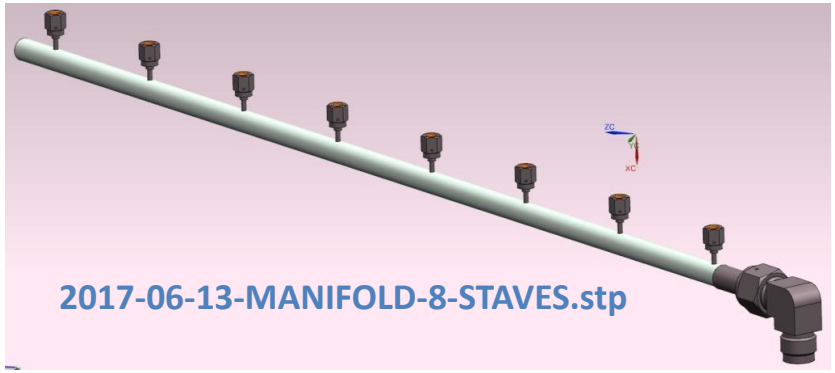
LHCb CO2 cooling meeting https://indico.cern.ch/event/642184/



https://indico.cern.ch/event/642184/contributions/2605760/attachments/1471988/2278509/2017-06-07-LHCb-COOLING-MEETING-MANIFOLD-CONCEPT.pdf

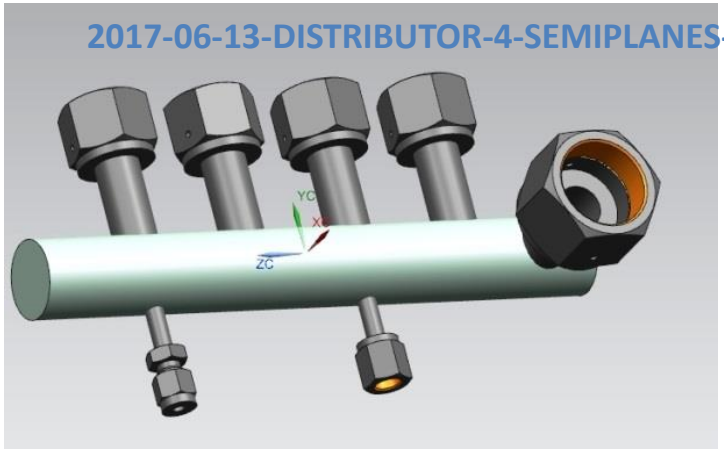
PROPOSAL TO CONVERGE ON AN ACCEPTABLE DESIGN

2017-06-13-MANIFOLD-9-STAVES.stp



2017-06-13-MANIFOLD-8-STAVES.stp

2017-06-13-DISTRIBUTOR-4-SEMIPLANES-TT-PT.stp



THE STEP FILES OF THESE COMPONENTS ARE ATTACHED INTHE INDICO PAGE

THEY CAN BE PLACED AND SUPPORTED INTO THE UT BOX CAD MODEL (MICHAL) IN THE APPROPRIATE POSITIONS

CHOOSING A FEASIBLE FLEXIBLE HOSE LENGHT FROM THE SWAGELOK CATALOGUE

THEN WE CAN DO THE DISTRIBUTION SYSTEM WORKING DRAWINGS FOR CONSTRUCTION

COOLING SYSTEM COMPONENTS TEST

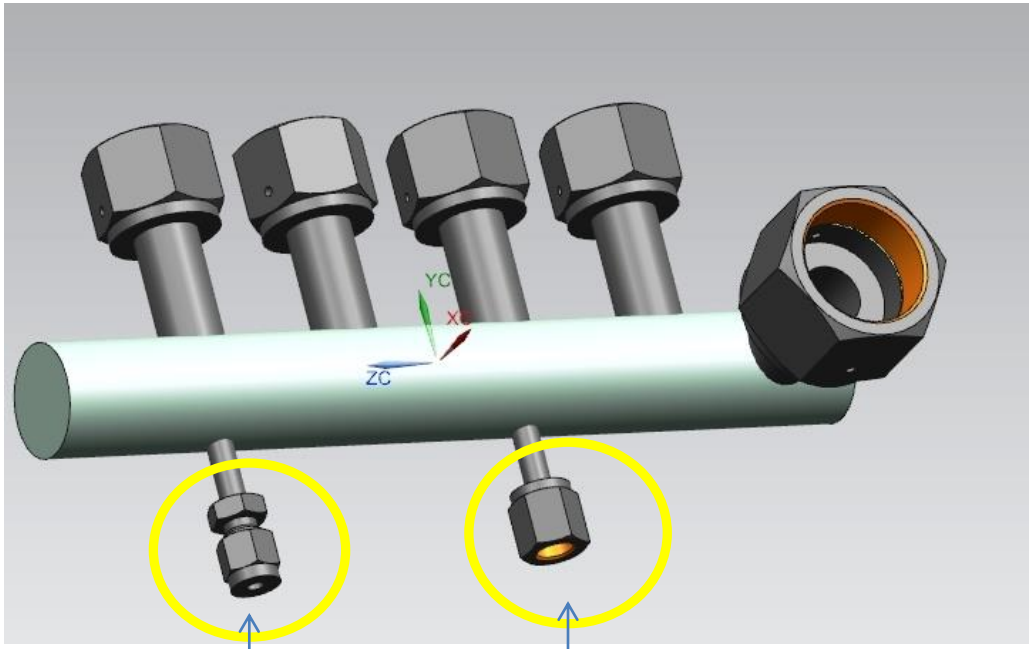
CO_2 DISTRIBUTION SYSTEM
ALL THE OBJECTS ARE «PRESSURE COMPONENTS»

MAX DESIGN PRESSURE = 130 BAR (T.B.C. DEPENDING ON SAFETY VALVE OR RUPTURE DISK OPENING)

THE REQUIREMENTS FOR THE MANUFACTURING FORESEE:

- **PRESSURE TEST (NITROGEN GAS)**
- **HELIUM TEST AFTER PRESSURE TEST: WHAT IS THE ACCEPTANCE LEAK-RATE?**

CO_2 MEASUREMENT POINT



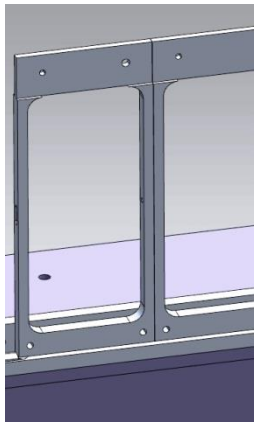
PROPOSED OPTION

IN THE INLET AND OUTLET DISTRIBUTORS

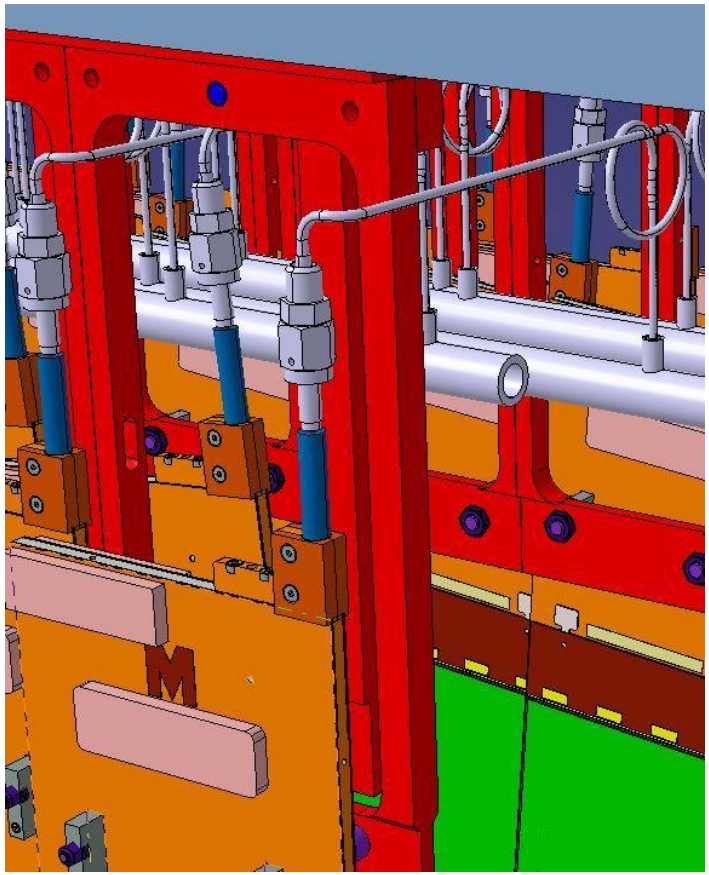
CONNECTION FOR
CO_2 TEMPERATURE TRANSMITTER
PT100 RODAX (TRACI LIKE)

CONNECTION FOR
CO_2 PRESSURE TRANSMITTER
PIEZO-RESISTIVE KELLER (TRACI LIKE)

ACTUAL DESIGN

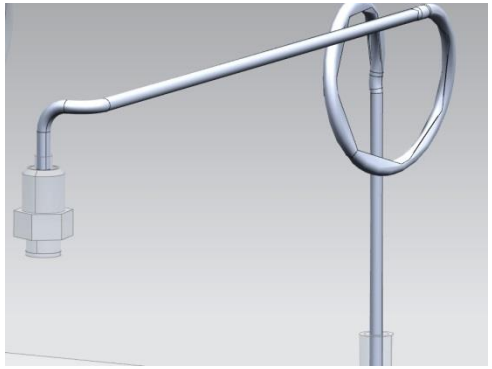


UT BOX STAVE SUPPORTS

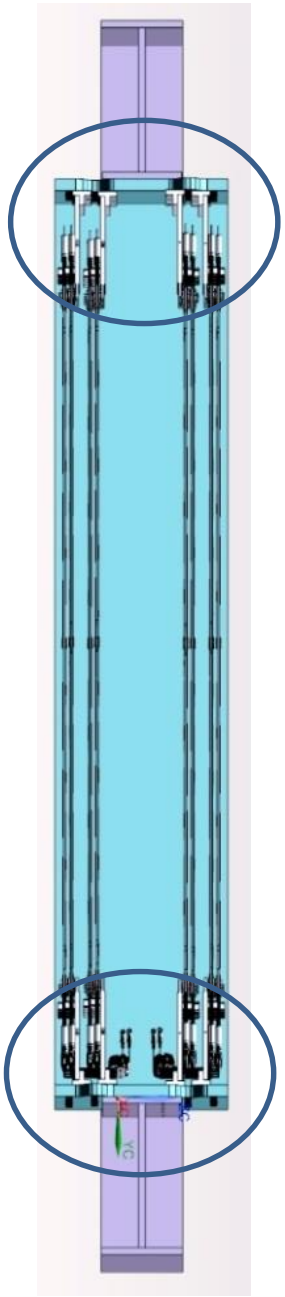


MECHANICAL CLASHES WITH THE COOLING DISTRIBUTION SYSTEM AVOIDED ADDING PIPING COMPLEXITY

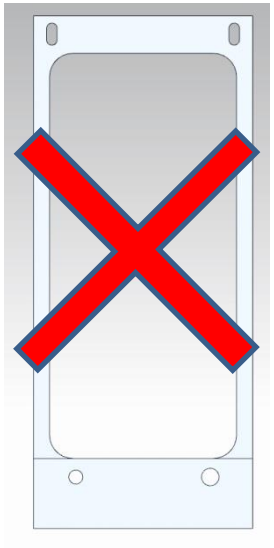
BAD FLUID-DYNAMIC

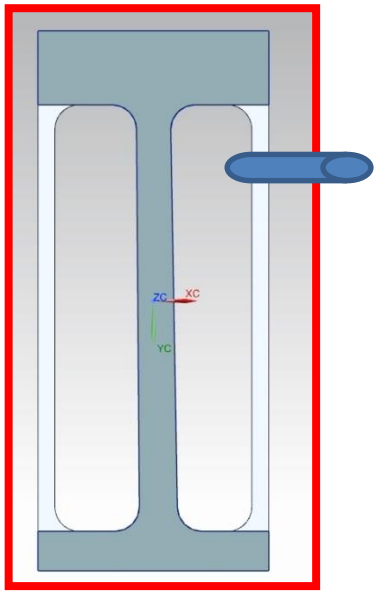


PROBLEMATIC MANUFACTURING

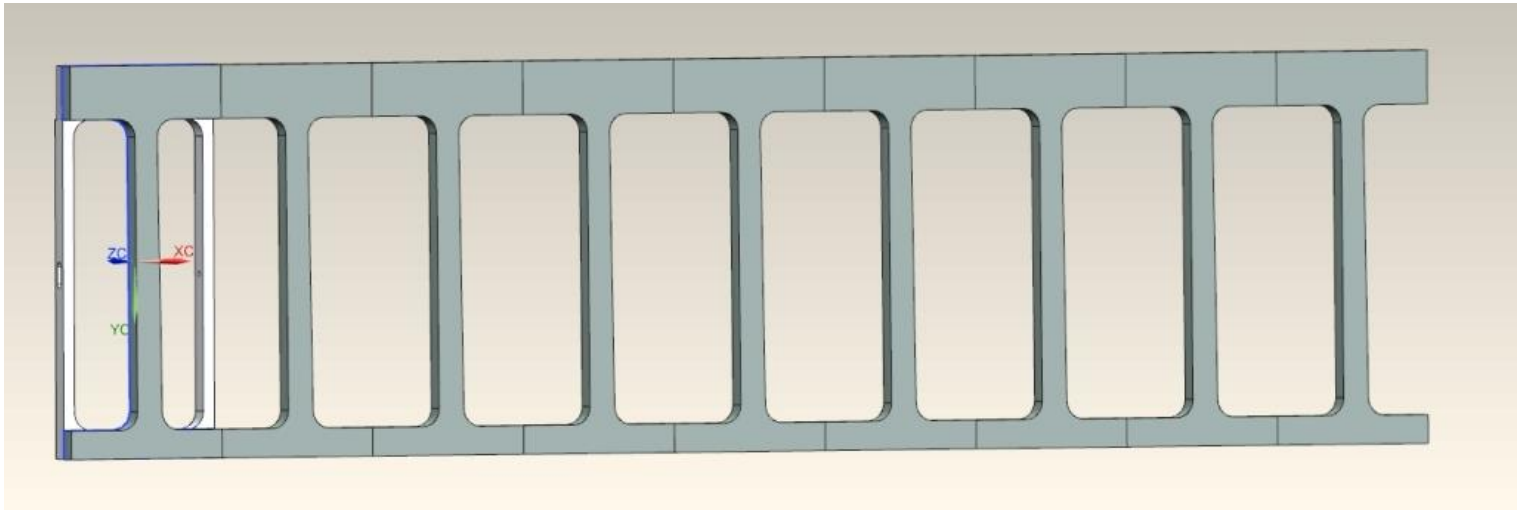


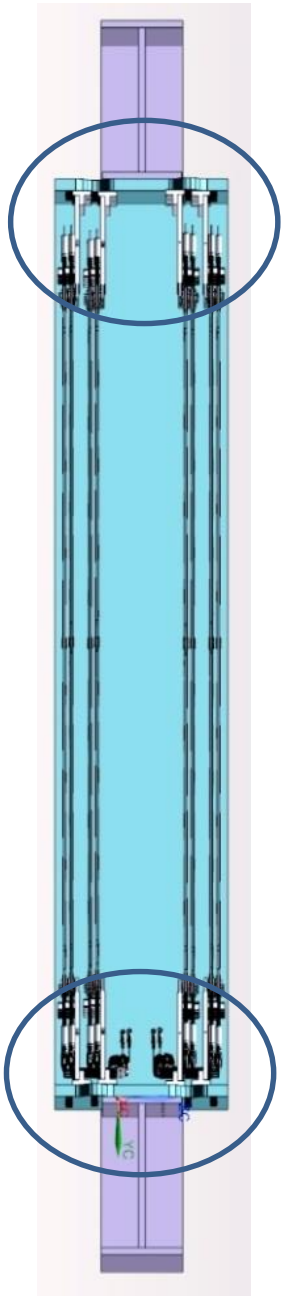
PROPOSED «I» DESIGN



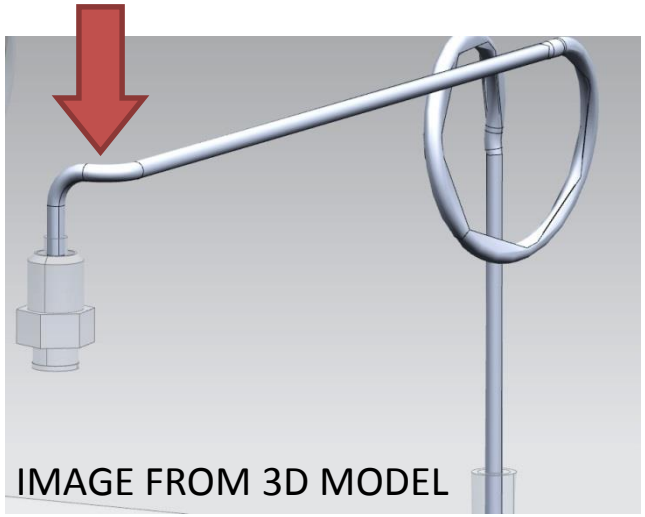


TRYING TO AVOID MECHANICAL SUPPORTS IN THE PIPING STRAIGHT WAY FROM MANIFOLD TO STAVES





UT BOX STAVE NEW CONCEPT TO BE CHECKED



MANIFOLD-TO-STAVE “PIGTAIL” PIPES

TOTAL 68 INLET + 68 OUTLET
VCR 1/8 INCH WELDED ON BOTH SIDES

<u>MANAGEABLE IN PLANE</u> PIPE PROTOTYPE TESTED IN MILANO
– MEASURED PRESSURE DROP IN TRACI COOLING TEST
– FLEXIBILITY OK WITH 1 COIL
– 2 mm INTERNAL/2,5 mm OD STAINLESS STEEL PIPE, TO BE ANNEALED
– MADE ALSO WITH LASER WELDED FITTINGS