KLOE to SAND Progress Report

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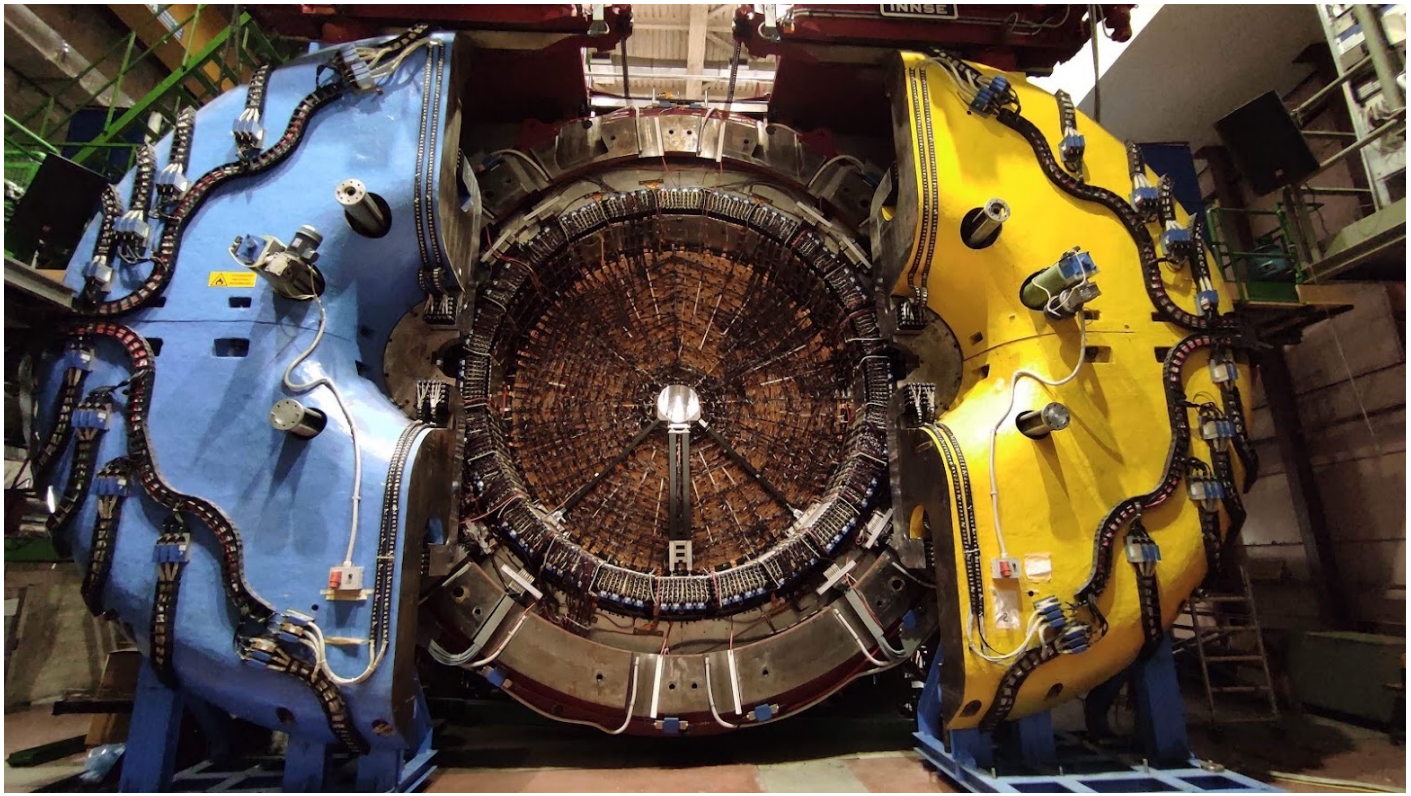
on behalf of the SAND-ECAL and SAND-Magnet WGs



SAND General Meeting – 10 December 2024

KLOE-to-SAND activities at LNF

Plan of operations:

✓ Removal of all cables and the FEE+HV racks

✓ Extraction of the Drift Chamber

Calorimeter

✓ Laser tracker survey before ECAL dismounting

✓ Extraction of Barrel (24 modules)

- insertion/extraction machine refurbished
- movable platform built

• Dismounting of EndCaps
- original insertion/extraction/rotation machine has been refurbished and modified

• Operational test of ECAL modules

• Studies for the ECAL working point & FEE

Magnet and Yoke

• Installation of new Power Supply
- new Power supply unit and revamping of passive components (OCEM)
- Control system and full support for magnet test/ dismount/remount by ANSALDO ASG

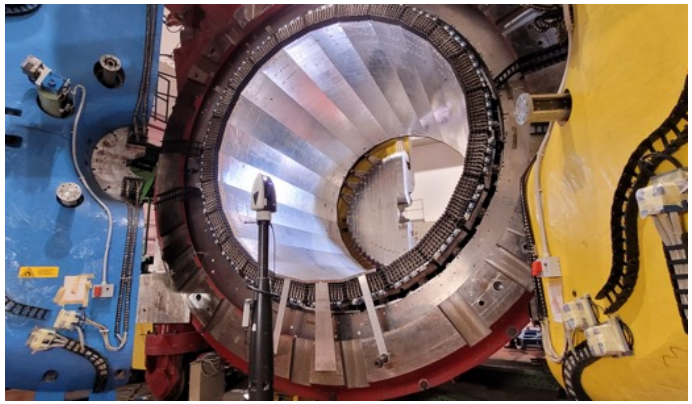
• Cooling of coil

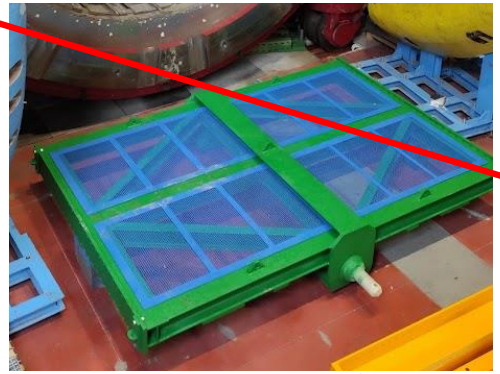
• Operational test of magnet
- in preparation

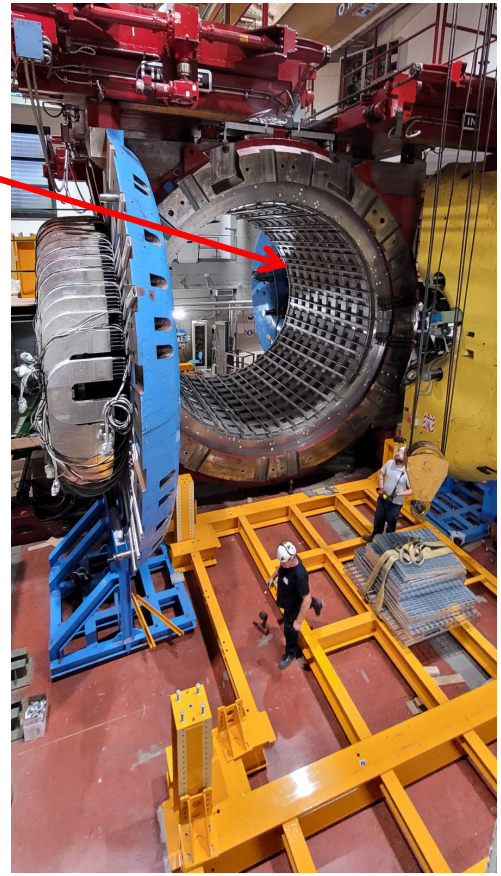
• Extraction of coil

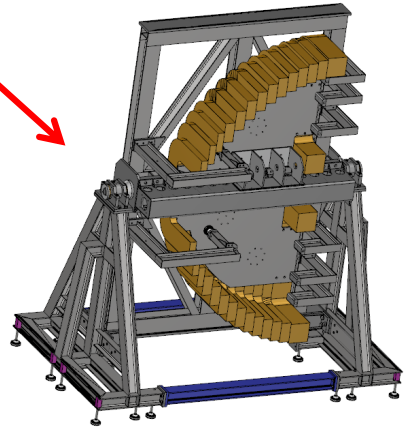
• Dismounting of Iron Yoke

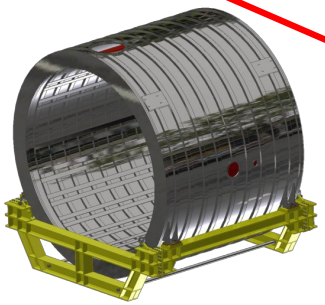
Packaging & Shipping at Fermilab











Flooding of the KLOE assembly hall

In total 16 boxes soaked, 60 PMT+base each,
corresponding to 8 complete barrel modules: in total ~ 1000 PMTs + bases

In addition ~ 150 spare bases stored in the “alte energie” building ground floor.

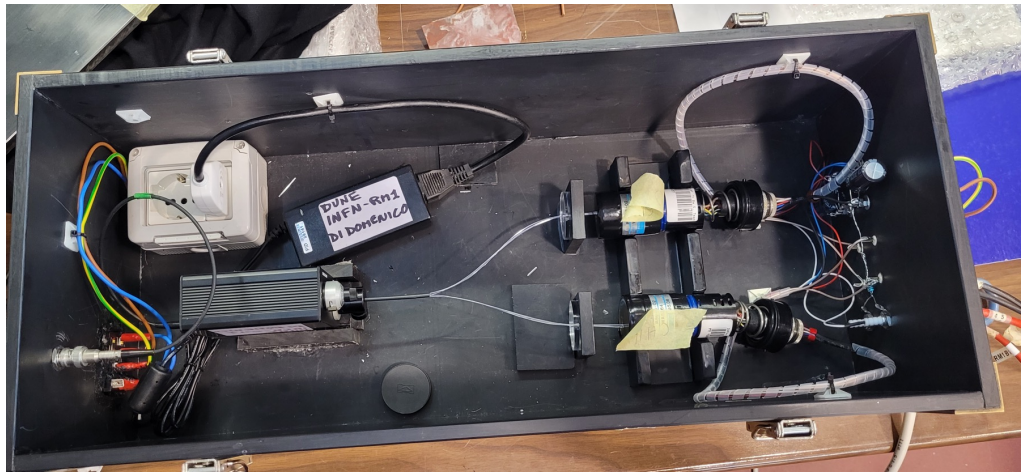
Cleaning, drying and test of wet PMTs and bases

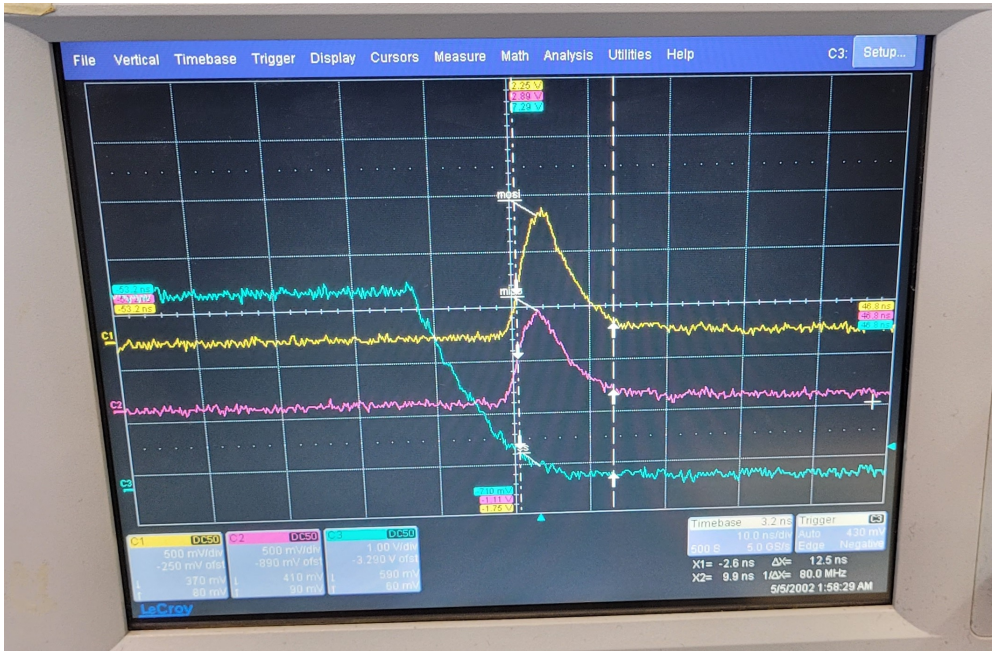
dried in climatic room:

~1000 bases
from barrel modules

~150 spare bases
(no end plug and
connector)

Cleaning, drying and test of wet PMTs and bases





PMT system test at LNF with
- CAEN LED driver SP5605 (UV wavelength ~ 250 nm) with fine tunable LED intensity
- scint. fiber splitter
- two PMTs (e.g. for relative QE meas.)

Cleaning, drying and test of wet PMTs and bases

black box:
connectors
isolation improved

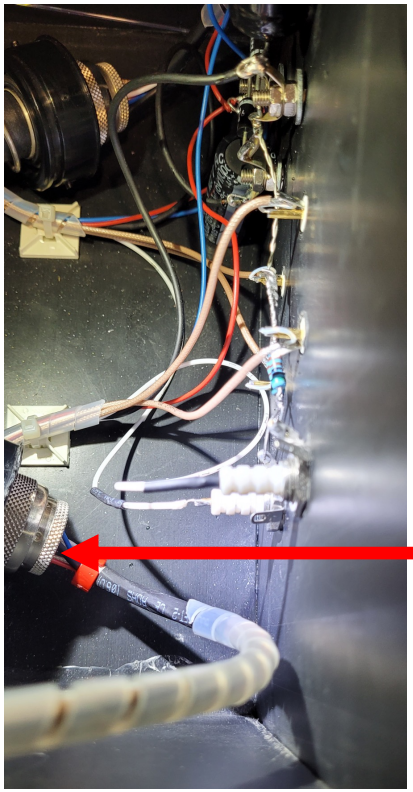
up to now 240 PMT+bases (2 complete barrel modules) tested out of ~1000:

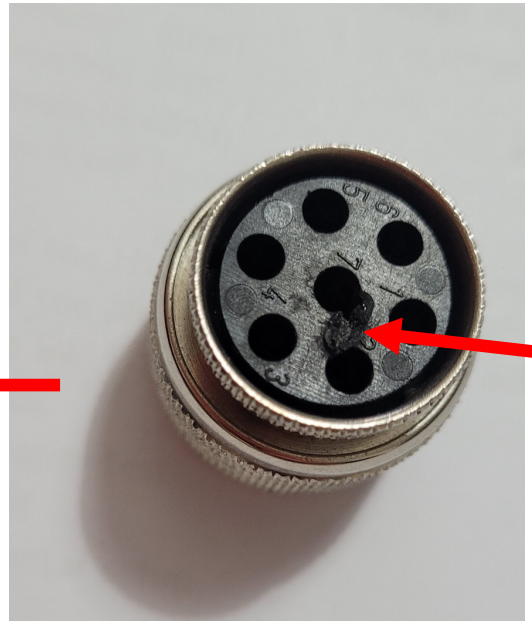
<u>1 PMT not working</u>
3 bases not working (no signal – previous problem before flooding? –> repair)
5 base signal not stable (discharge -> try to wash)
2 bases signal coaxial pins bent (repair or replace pins)

=> ~ 5% of failure

Cleaning, drying and test of wet PMTs and bases

HV alarm





HV discharge on the ground of the coax pulse test pin!

ECAL module consolidation and test

Consolidation
- Gluing of delaminated parts
- Replace light-guides protections
- Wrap with new Aluminum-Fiberglass tape

Operational Test
- test basic performance with cosmics rays
- test of new FEE prototypes (comparison with old KLOE electronics)

24 Modules are stored each on its own support that will be used also for the transportation
An experimental area is being set up for Consolidation and Operational test of the modules

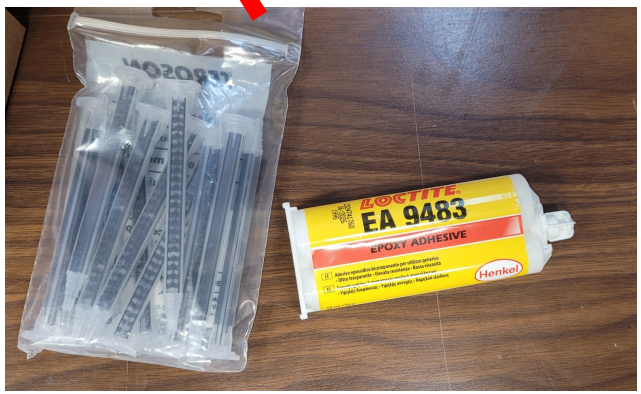
ECAL signal+HV cables
15+15 m long
in 12 storage boxes

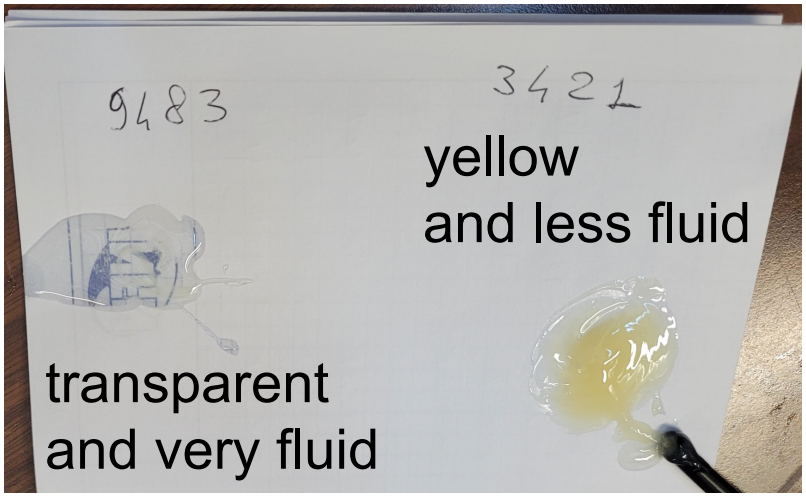
ECAL module consolidation and test

First gluing test: 4 calorimeter prototypes built (with pol.hi.tech. fibers)
=> stiffness of the stack very much increased with loctite (3421 or 9483)

optical glue used for plexiglas (light guides)

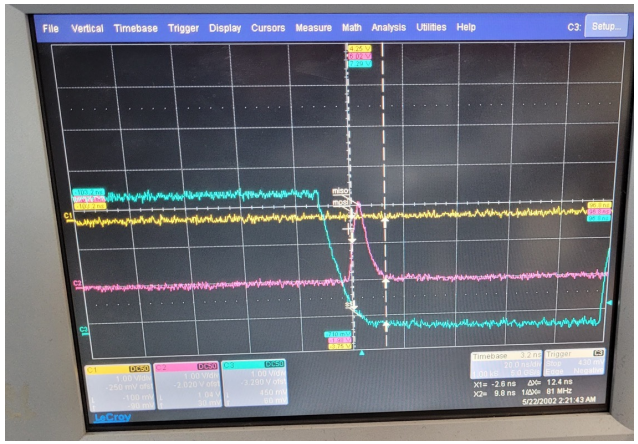
no glue





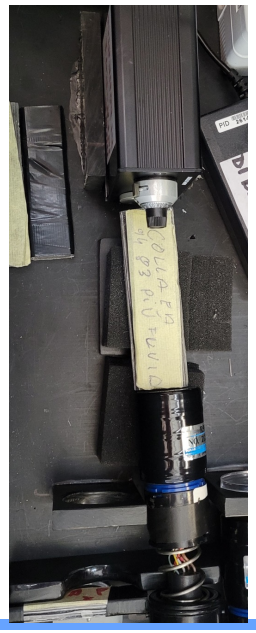
ECAL module consolidation and test

Light yield and transmission test:



3421

9483



no glue

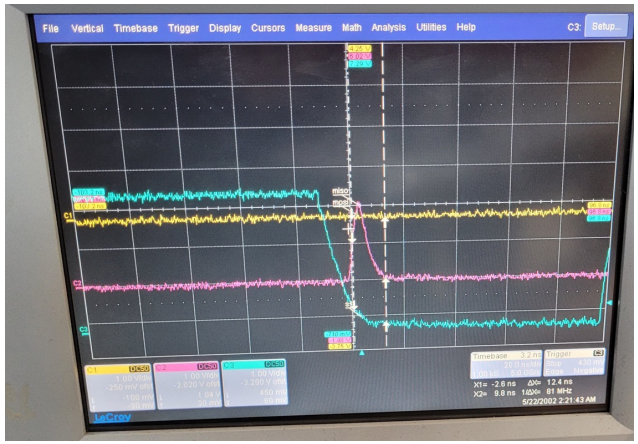
glue for plexiglass

Glue type	signal amplitude (a.u.)
3421	~0.5
9483	~ 1
no glue	~ 1
plexigl. glue	~ 0.1

different areas and position tested:
measurement reproducibility ok

ECAL module consolidation and test

Light yield and transmission test:



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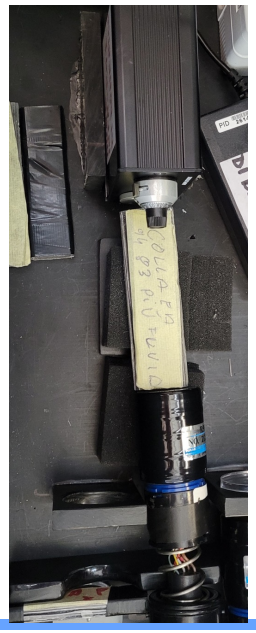

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ECAL module consolidation: first gluing test

first test on
KLOE
ECAL module 0

ECAL module consolidation: first gluing tests

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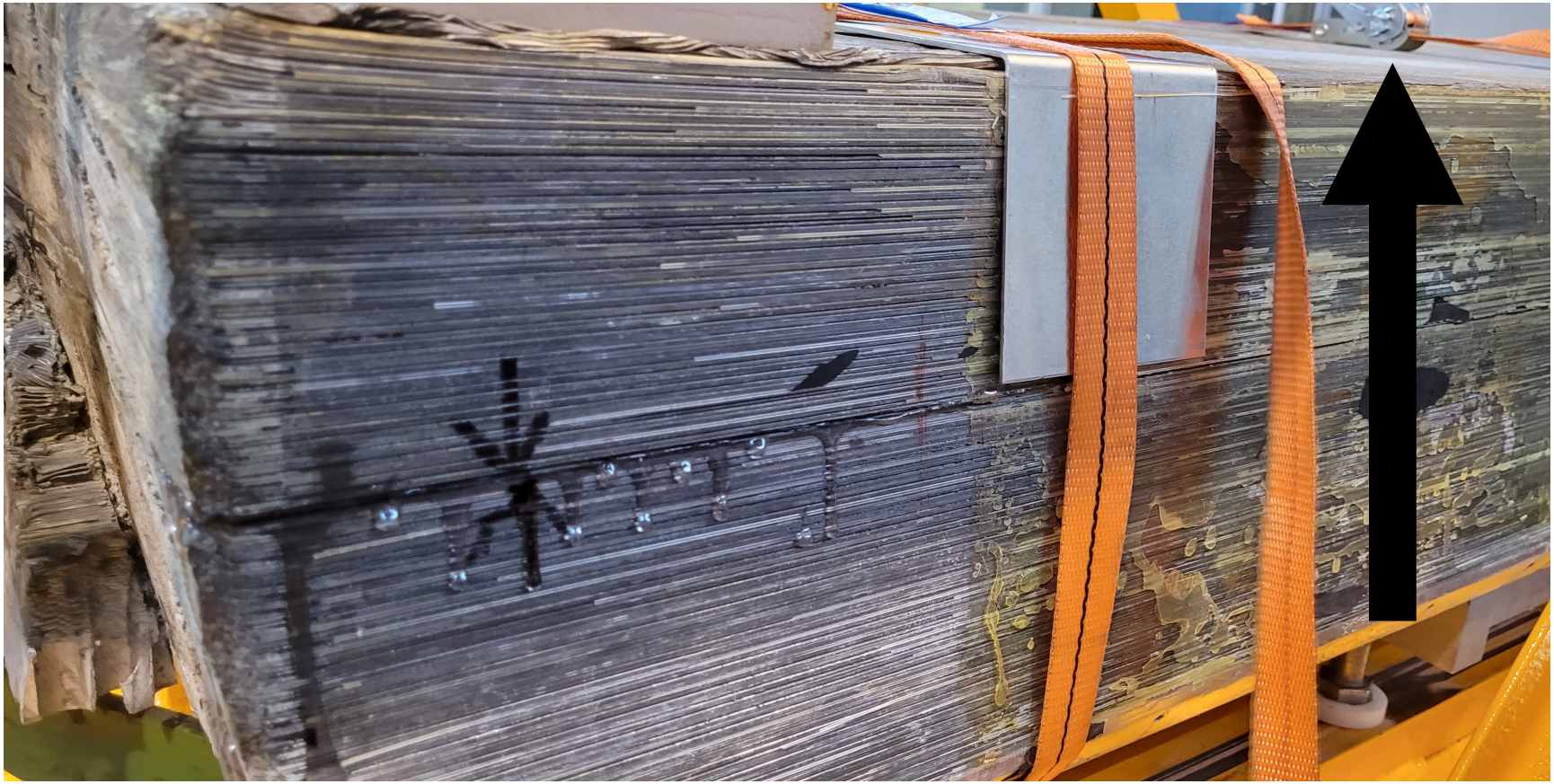
ECAL module consolidation: first gluing tests

glue EA9483

ECAL module consolidation: first gluing tests

ECAL module consolidation: first gluing tests



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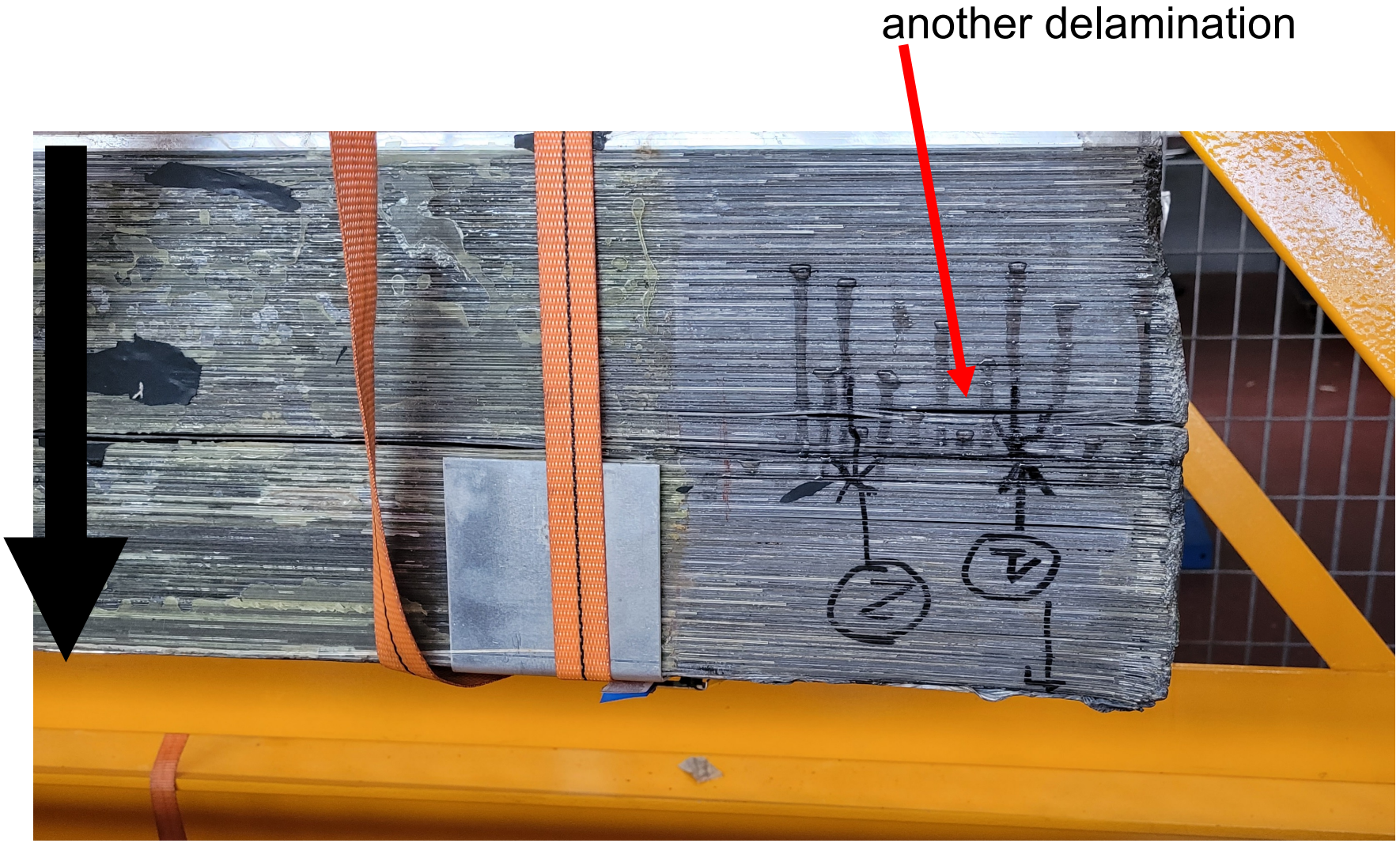
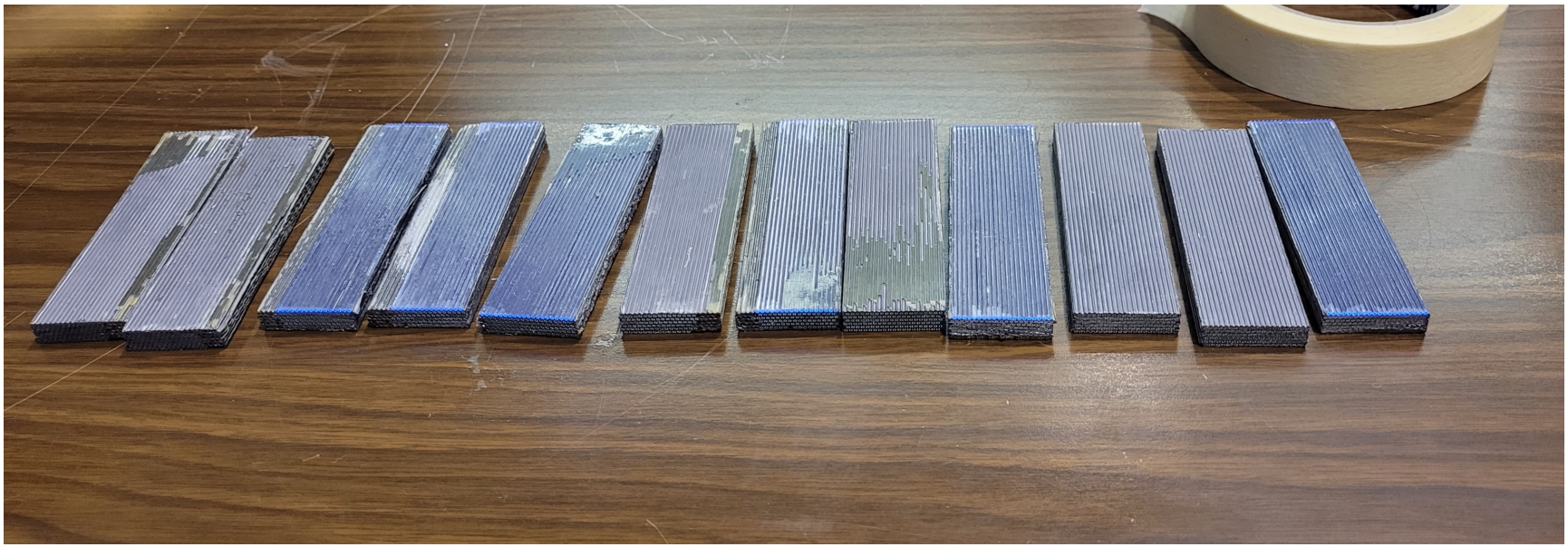


ECAL module consolidation: first gluing tests

ECAL module consolidation: first gluing tests

delaminations 1 and 2: small areas treated with glue EA9483;
repair qualitatively OK
more quantitative tests in progress

ECAL module consolidation: first gluing tests



preparation of specimen for glue tests from old KLOE ECAL prototyes in the form of tiles (30 x 10 x 1 cm^3)

ECAL module consolidation: first gluing tests

preparation of specimen from old KLOE ECAL prototyes
in the form of tiles (20 x 10 x 1 cm^3)
glued with EA9483 to make a ticker specimen (~ 4 cm)

ECAL module consolidation: setting up the procedure

Calorimeter module refurbishing .

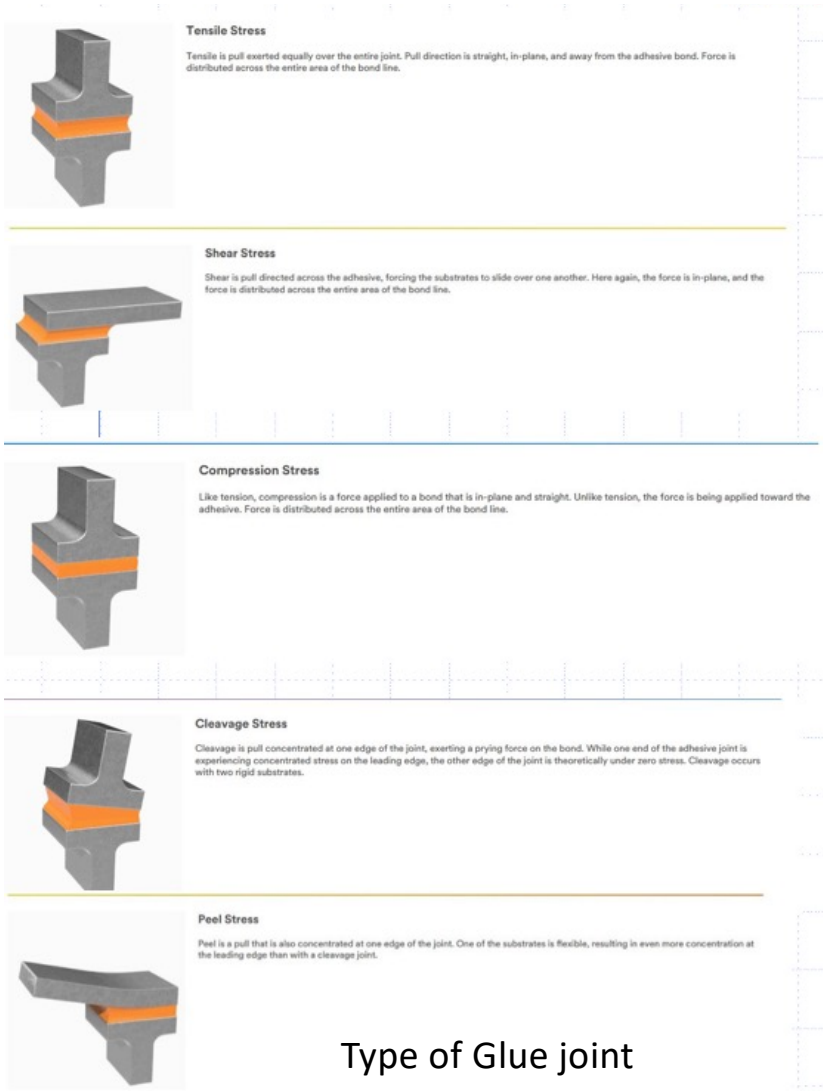
The steps envisaged to consolidate the calorimeter modules:

- Removing the outside tape and cleaning.
- A visual inspection (report).
- Measure the calorimeter modules.(Laser Tracker)
- Preparation of the surface to improve the adhesivity to the tape.
- Mechanical test on test specimens on tape and on glue.
- Module repair procedures – glue infiltration on delaminated modules (tooling necessary).
- Apply tape wrapping
- Define the qualification Test on repaired modules.

- (Increase the calorimeter radii to increase clearance between modules.)

ECAL module consolidation: setting up the procedure

Glue joints have strength that depends of the applied loads and join geometry



Type of Glue joint

Glue joint are weak in traction and on a peel mode.

Test on Glue join.

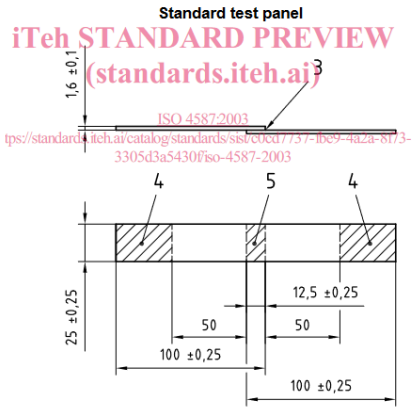
- We have to evaluate of the glue joint strength using a real adherent that is lead.
- The calorimeter structure is made by lead and fiber layers glued together. Some layers in same regions are delaminated. One method to restore the calorimeter is to glue again the layer. The gluing surface have glue residual from the previous glue operation.
- We starts to test two type of glue joints using a lead calorimeter samples:
- a) single lap test;
- b) pulling test

ECAL module consolidation: setting up the procedure - glue

Preparation of the test

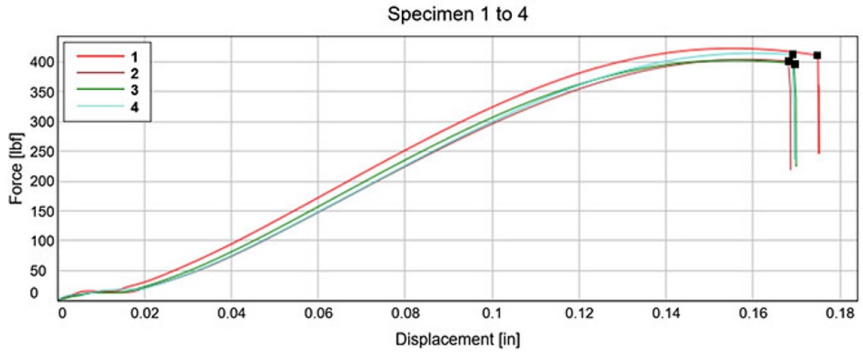
EA 9483 Loctite Henkel

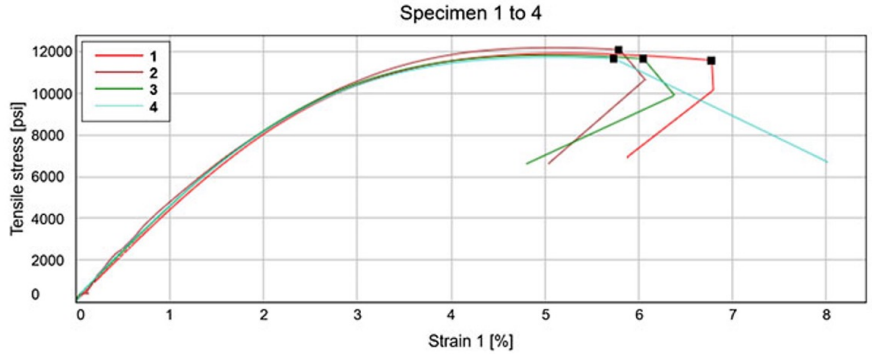
Single lap shear test
ISO 4587-2003



ASTM D638 - 14 Standard

Graph 1: Force vs. Displacement





Example of shear test results

ECAL module consolidation: setting up the procedure - tape

Peel strength test and unwrapping force test of adhesive tape

- The use of tape can help the glue joints. (traction and Peel)
- We choose an aluminum tape reinforced with glass fiber for his unwrapped strength.
- To test the load the tape capacity we are preparing a setup similar to a portion of calorimeter wedge.
- We are using a Brass wedge to have a material that have a density 1.5 grater than the lead fiber sandwich (5500 kg/m3) The brass density is 8470 kg/m3 about 1.5 *5500= 8250 kg/m3.
- We can orient the setup with different angles with respect to the vertical gravity such that the caring load will be different.
- The Tape data on the unwrapped strength is 2364 N/100mm.
- The most used adhesive on tape is acrylic. Our tape is supplied with silicon adhesive, that is weaker than acrylic.

ECAL module consolidation: setting up the procedure - tape

Data on Aluminum glass fiber fabric tape

363

Supporto: tessuto di vetro/alluminio
Adesivo: siliconico

Resistente ad altissime temperature 316° C

Prodotto	SAP ID	Colore	Dimensioni	Spessore totale nastro
	7000001165	argento brillante	25mm x 33m	0.15mm
	7000028867	argento brillante	50mm x 33m	0.15mm
	7100140900	argento brillante	450mm x 33m	0.15mm

Mercati	Aerospaziale, Automobilistico, Edilizia, Elettrodomestici, Industriale generico, Lavorazione dei metalli, Settore elettronico, Settore militare e pubblica amministrazione, Trasporti, Veicolo speciale
Quantità per confezione	36/case,24/case
Resistenza alla trazione (misure metriche)	57 N/100mm, 2364 N/100mm
Specifiche soddisfatte	ASTM D3330, ASTM D3758, D3652, F.A.R. 25.853(a)
Spessore del supporto (misure metriche)	0.06 mm
Spessore lato posteriore adesivo (misure metriche)	0.1 mm
Spessore totale senza liner (misure metriche)	0.19 mm
Temperatura operativa massima (Celsius)	316 °C
Temperatura operativa minima (Celsius)	-54 °C
Tipo di Adesivo	Silicone
Vita utile	36 Mese

Adesivo standard da tape è acrilico.

Buongiorno,
facendo seguito alla conversazione telefonica, le inoltro i codici dei prodotti che potreste testare.

890 MSR Scotch

Supporto: poliestere
Adesivo: gomma resina modificata (Hot Melt)
Adesione N/cm: 8.10
Carico di rottura N/cm: 1380
Allungamento %: 8

Prodotto	SAP ID	Colore	Dimensioni	Spessore totale nastro
	7000095844	trasparente	25mm x 50m	200µm
	7000035410	trasparente	50mm x 50m	200µm
	7000095843	trasparente	100mm x 50m	200µm

363

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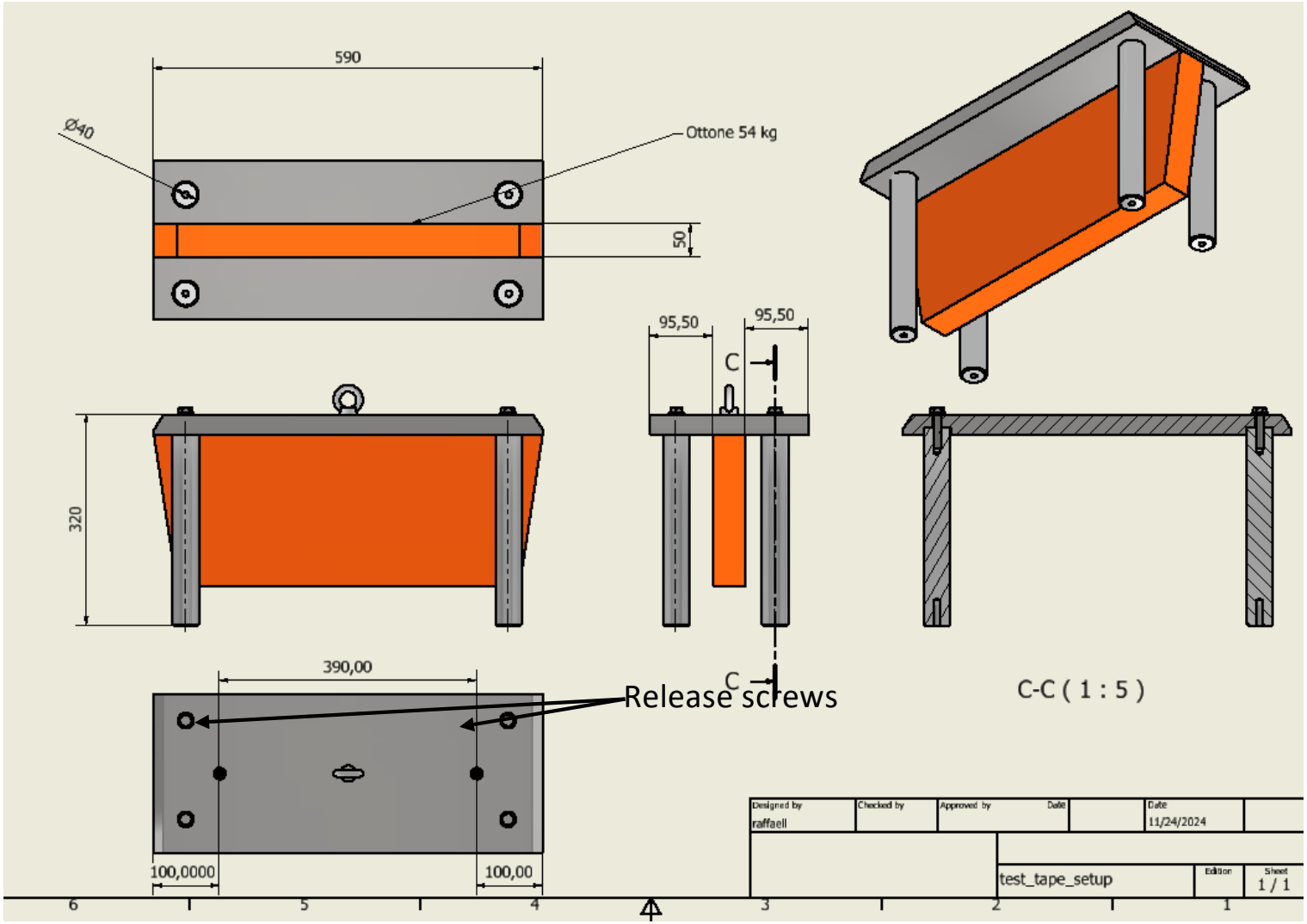
3M Science. Applied to Life.™

ECAL module consolidation: setting up the procedure - tape

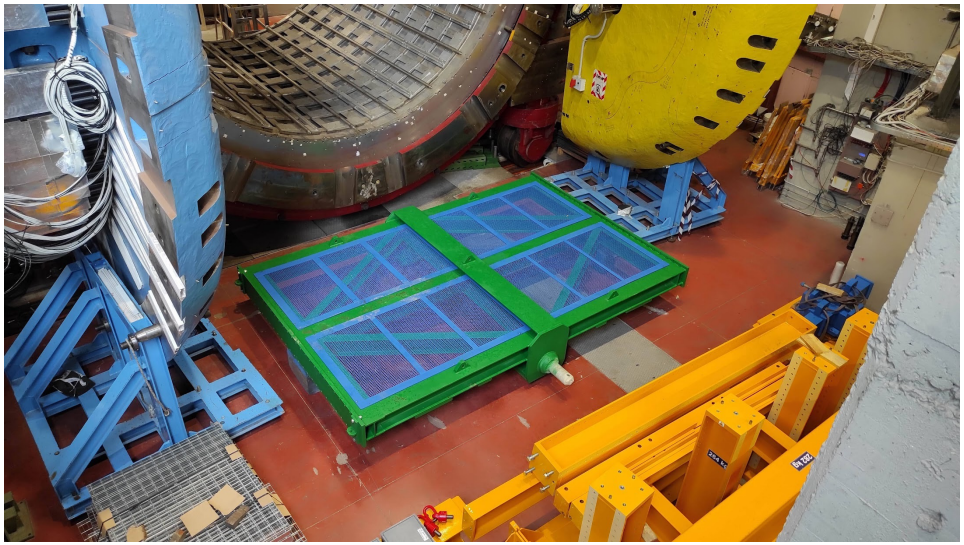
Preparing the tools for test

Wrapped tape test

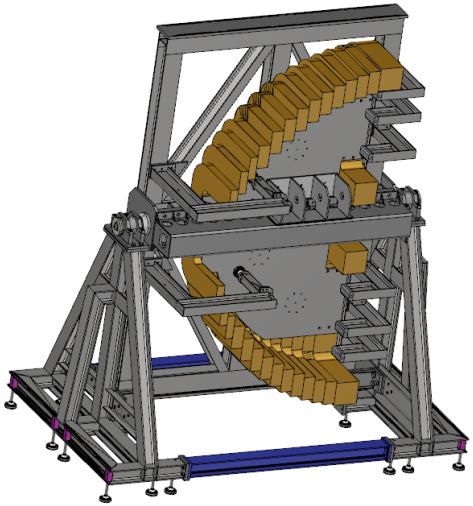


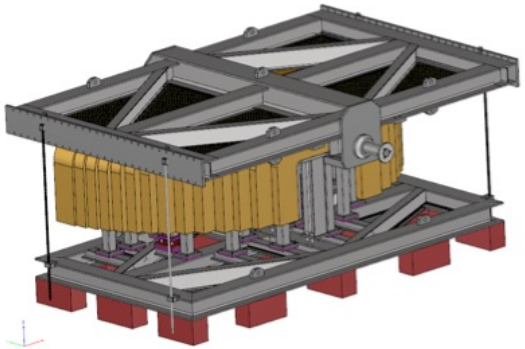
Preparation of dismounting ECAL End-caps

- blue bar ready; all pieces ready!
- waiting for external company report with dimensional calculations and CE certification (solicited!)



Rotation frame
(rotation from vertical to horizontal)





Support frame
(handling and shipping)

Choice of FEE for SAND/ECAL

Solutions investigated with CAEN

DT5203+A5256

PicoTDC + discr. double threshold with ToT

A5204 RADIOROC with picoTDC

PicoTDC + discr. single threshold with ToT (for all signals) + peak sensing ADC with slow shaper – dead time 20μs and good resolution (for rarer signals of large amplitude); feasibility study in progress

- Forthcomig visit on 18-19 December 2024 at CAEN for tests and discussion:

1. Optimization of the thresholds for the best perfomance in the whole expected dynamic range (2.5-2000 mV) and in the preamp saturation regime.
2. Other solutions based on PicoTDC + amplitude meas. (RADIOROC chip) are being investigated in collaboration with CAEN and appear very promising.
3. Integration of the chosen FEE solution in the SAND/DUNE DAQ – timing with a flexible scheme.

Superconductive Magnet Activities

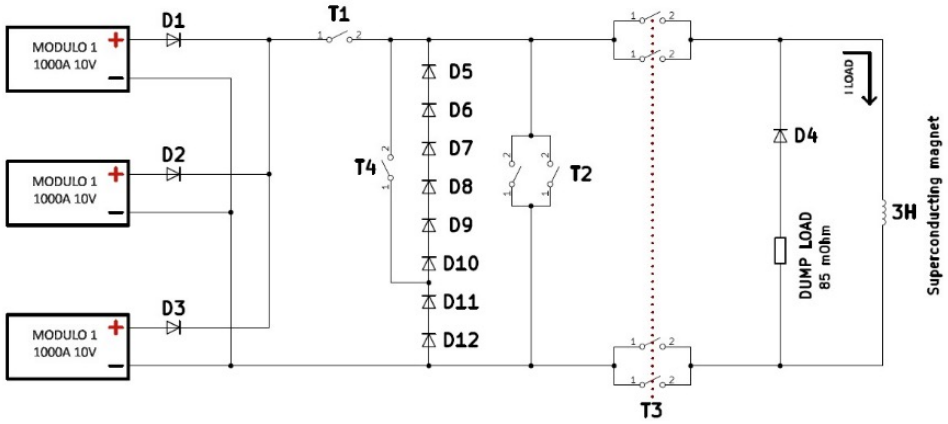
Quench Detector	Dump resistor Filter	Bus bars Contactors	Power Unit Free wheels diodes

Power Supply

contactors, busbars and other passive components can be saved after test

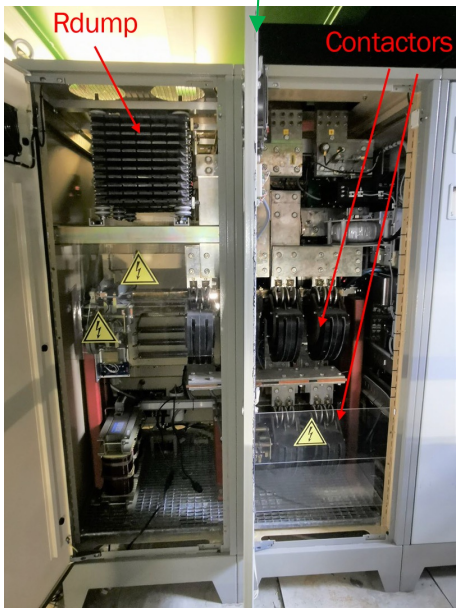
10V/3000A power unit provided new by OCEM

due delivery date in 8-12 months



Control System

to be migrated from LabVIEW to most recent SW release



Superconductive Magnet Activities

Quench Detector

Dump resistor

Filter

Bus bars

Contactors

Power Unit

Free wheels diodes

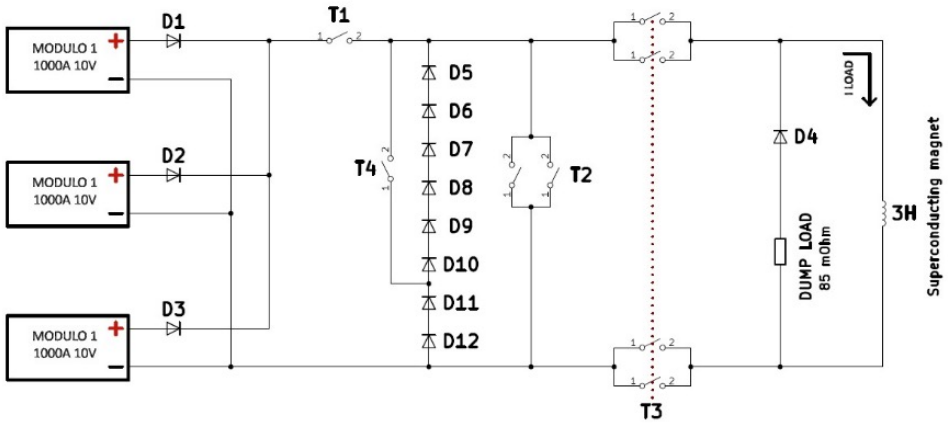
Power Supply

contactors, busbars and other passive components can be saved after test

10V/3000 CEM

du

order ready! will start before the end of the year



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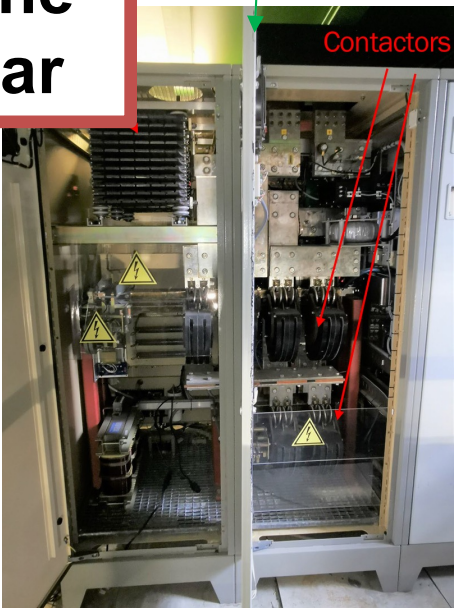

KLOE-to-SAND Project Time Schedule