Super-B EMC

Babar EMC Disassembly,

Transport & Re-integration

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21 March 2012

Introduction

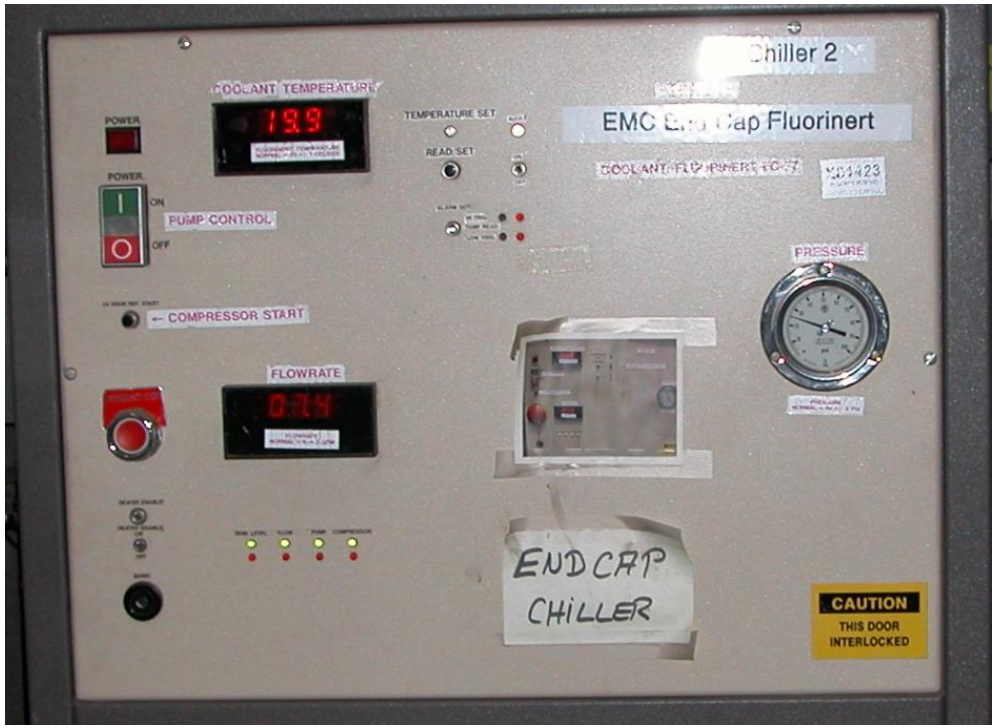
- November visit to SLAC by KF and INFN team (Crisos, Pino, Valerio, Fabio, Corrado) investigated issues relating to transport to Italy of the Babar Barrel EMC as an integrated unit
- However, the INFN mechanical engineer (Corrado) participating in the November visit resigned immediately thereafter, and there is currently no replacement
  - **Design and construction of a suitable Barrel EMC transport frame cannot be done without significant professional engineering support from INFN**
- There is not enough time remaining before the target Super-B detector TDR target publication date to propose transport of the Barrel EMC as a single piece for the baseline scenario
- The necessary alternative baseline is to propose de-integration of the Babar Barrel EMC down to the module level, packaging the individual modules, and separately shipping to Italy all 280 modules, as well as the support cylinder, inner shield, carbon fiber manufactory, etc., along with all necessary tooling

Plan of the Talk

- Barrel and Fwd Endcap current status
- Preparation and procedures for Barrel de-integration
- Module packing, shipping
- Reception of modules, etc. in Italy
- Carbon fiber fab
- Ongoing work, current issues
- Personnel, Schedule and Cost
- Procedure Documentation
- Alternative Barrel Scenario
- Forward Endcap issues
- Solenoid, Flux Return issues
- Discussion

Babar EMC Current Status

- Barrel, FWD endcap are housed at IR-12
- Sealed and connected to chillers (20 ± ~1C)
- Temps monitored and continuously archived through EPICS
- Physical condition of chillers checked/logged daily
- One spare chiller available at IR-12



Prep for Moving From IR-12 to IR-2

- IR-2 will be used for work required under any scenario for Barrel, and likely the FWD Endcap as well
- Necessary prerequisite to go to IR-2 is the moving of the solenoid, flux return steel, cradle and arch, as well as general clean-up of the IR-2 hall
- Clean-up of IR-2 hall **is** SLAC D&D budgeted, shipping of magnet-related items **is not** included
- About one month will be needed for IR-2 preparation, assuming plan exists for disposition of the big magnet pieces
  - SLAC preference is to ship solenoid and flux return items to Italy rather than shuffle the big magnet pieces to other SLAC location(s)
- Under any scenario, it is very desirable to quickly move to IR-2 given the less-than-ideal IR-12 environment
  - IR-12 fire suppression sprinklers active
  - Limited IR-12 work space

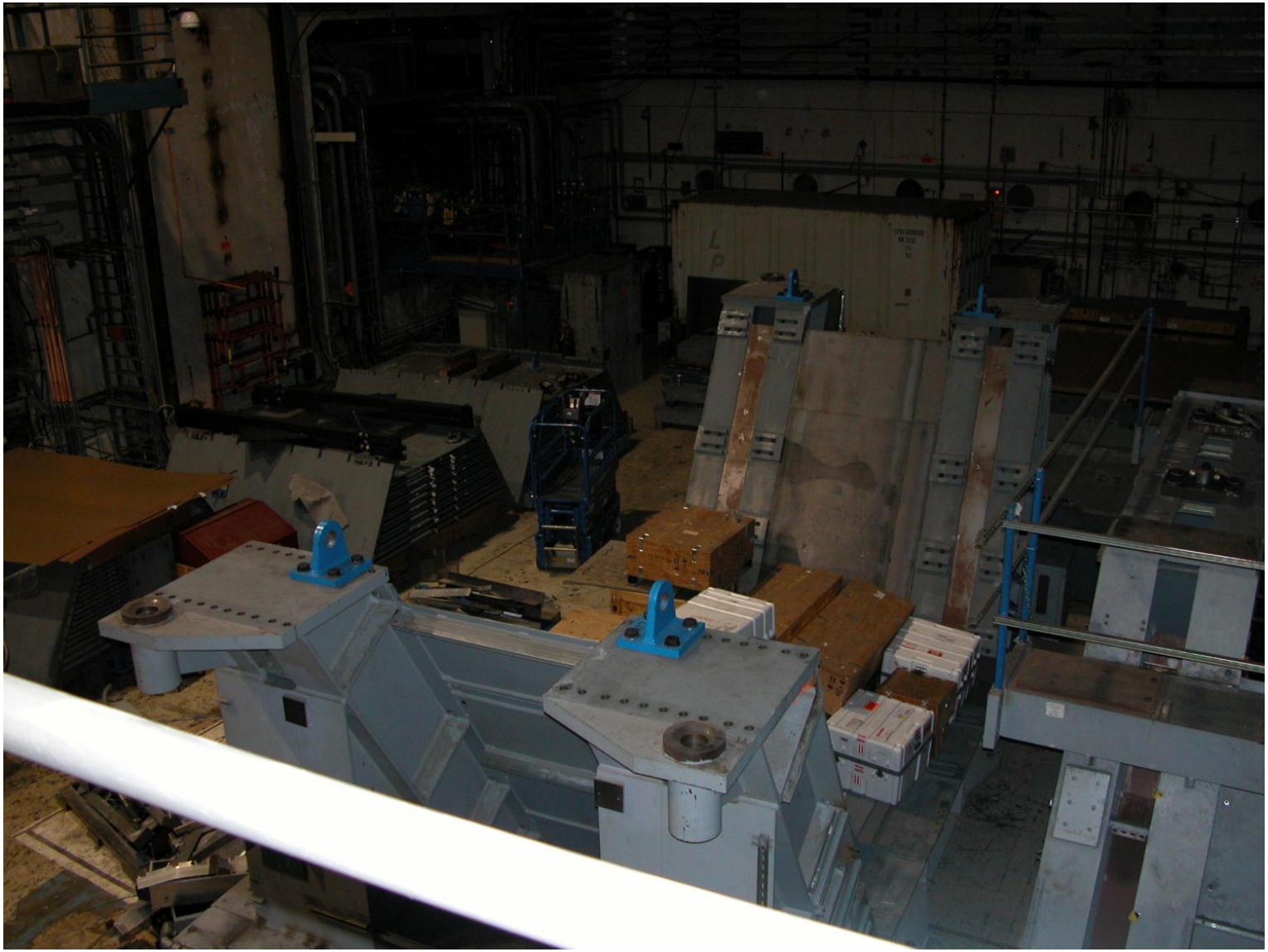
Transport from IR-12 to IR-2

- Need to rent 60-ton trailer/tractor
- $4-5K, not SLAC D&D budgeted
- Reservation lead time can be up to a few months
- Prepare for transport by raising the barrel construction frame on blocks
- Process takes one very long good-weather day to load at IR-12, transport, then unload at IR-2
- Move of FWD endcap can be done using SLAC equipment

Barrel EMC leaving IR-2

Arrival at IR-2

- Barrel needs to be deposited where cradle, flux return steel, etc. are currently stored



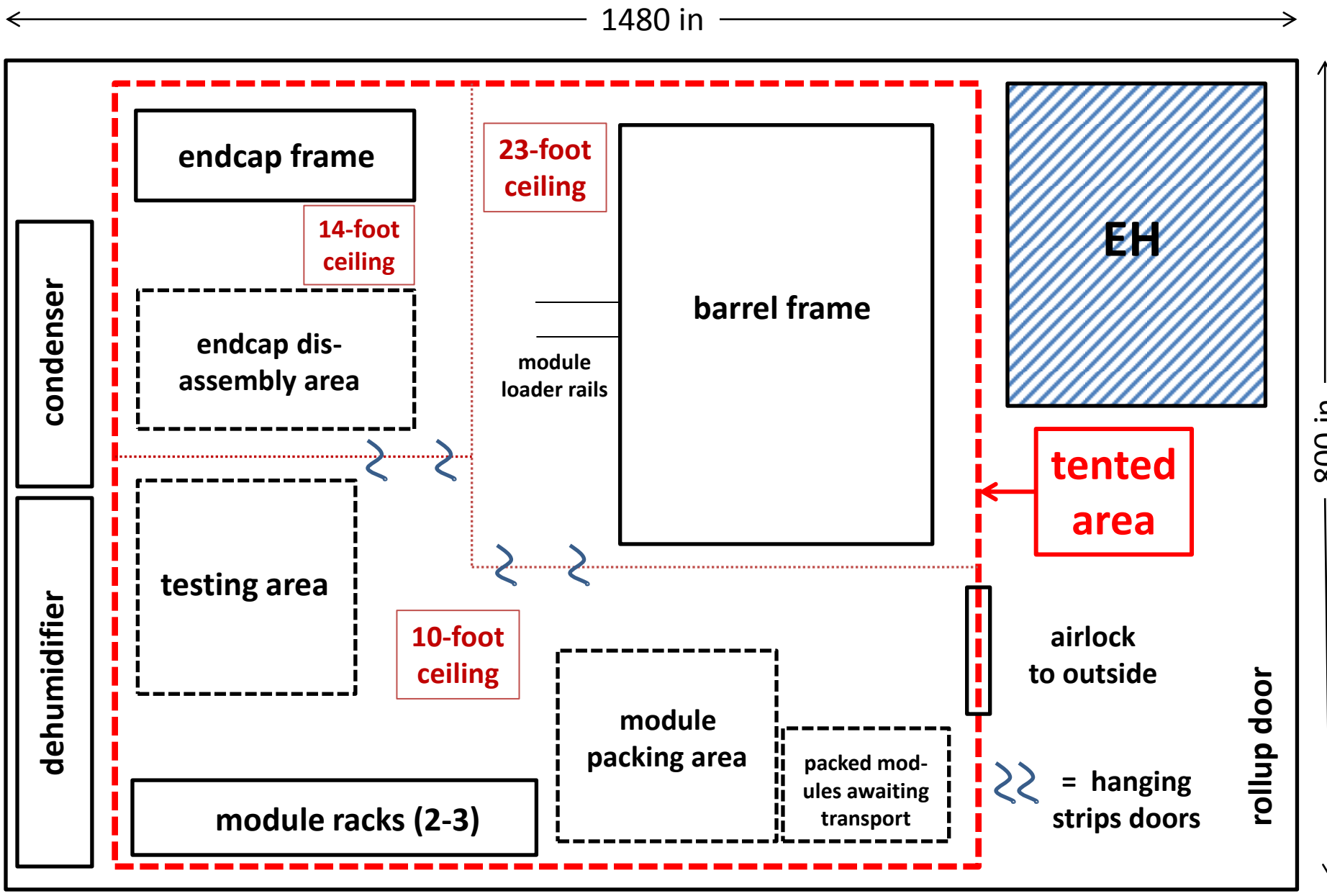
Barrel Disassembly Facility at IR-2

- Requires design and installation of a temperature and humidity controlled environment, similar to the construction-phase tented "barrel assembly room" in SLAC Building 110 in the research yard
- Design, materials, installation about $250K
- 2-3 weeks to install and condition space
- Work space will contain construction frame, module testing station, warehousing of modules awaiting processing, and packaging workspace
- Can also use for disassembly and processing of endcap
- Before tenting: Barrel and endcap can be stored similarly to IR-12 using intercooler in IR-2 and refurbished spare chiller moved over from IR-12

IR-2 Tented Area

- Construction-phase Bldg 110 layout is at SLAC Doc GP-0996-343
- Final Bldg 110 layout was slightly different (IIRC...)
- IR-2 usable space: 63x45 ft / 19x14 m (LW)
- Construction frame work area: 29x25x23 ft (9x8x7 m) (LWH)
- Testing area: 8 x 10 x 10 ft / L x W x H m (LWH)
- Packaging area: 8 x 10 x 10 ft / L x W x H m (LWH)
- Module storage: 16 x 10 x 10 ft / L x W x H m (LWH)
- Endcap storage: 14 x 10 x 14 ft / L x W x 4 m (LWH)
- Total volume: 22000 ft^3 / 620 m^3
- Some additional space is needed, either in IR-2 outside the tented area or completely outside the building, for dehumidification and condenser HVAC systems

Possible Layout in IR-2 (not to scale)



Barrel Module Racks

- Capacity of 21 barrel modules/rack
- Probably need 2-3 at IR-2
- 6-7 module racks have been located
- All are stored outside
- All need refurbishment
- 14 racks total will be needed to store all 280 modules in Italy
- Drawings not located, but simple design

Barrel Disassembly 1

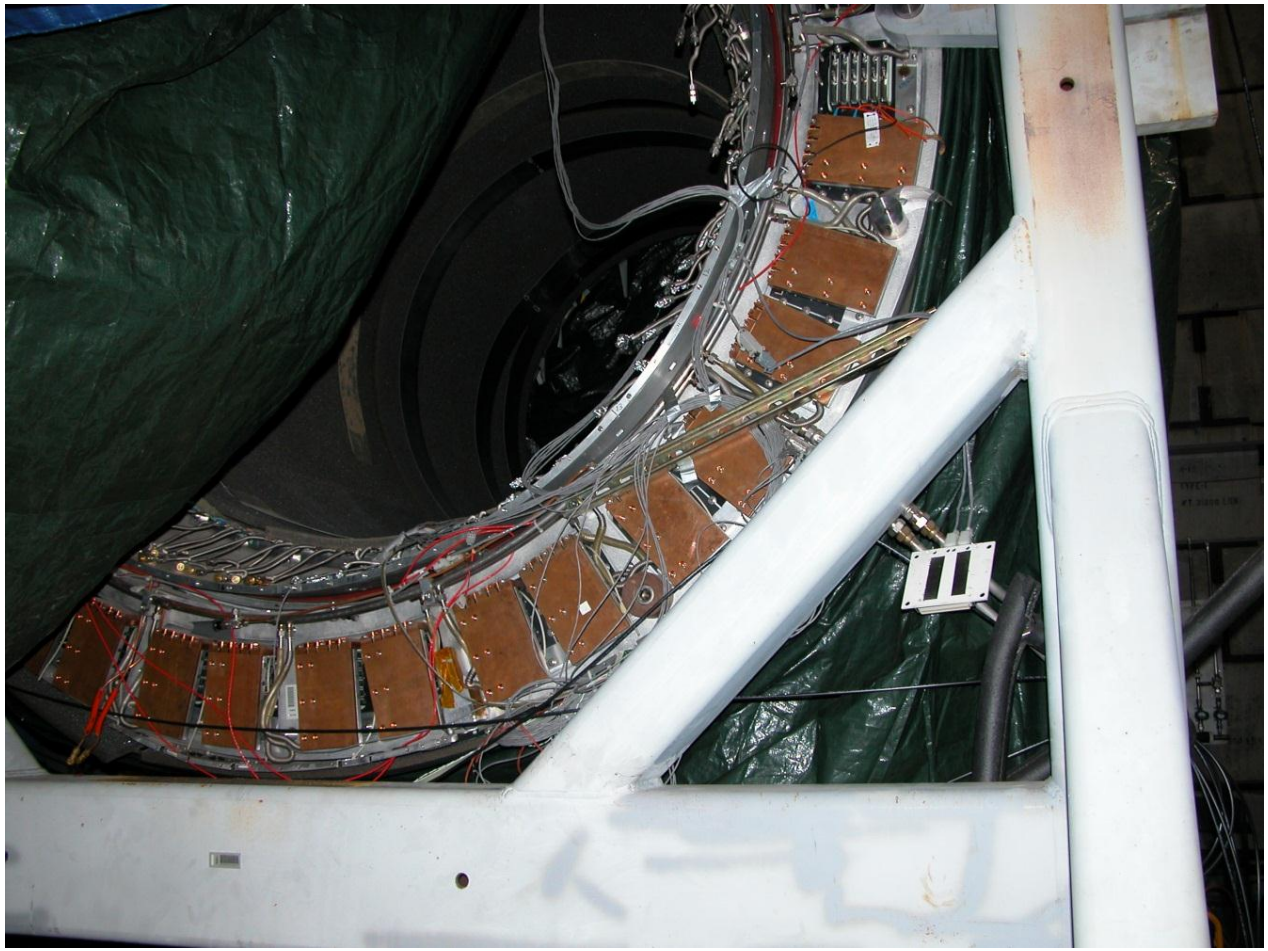
- Remove the source calibration fluorinert lines

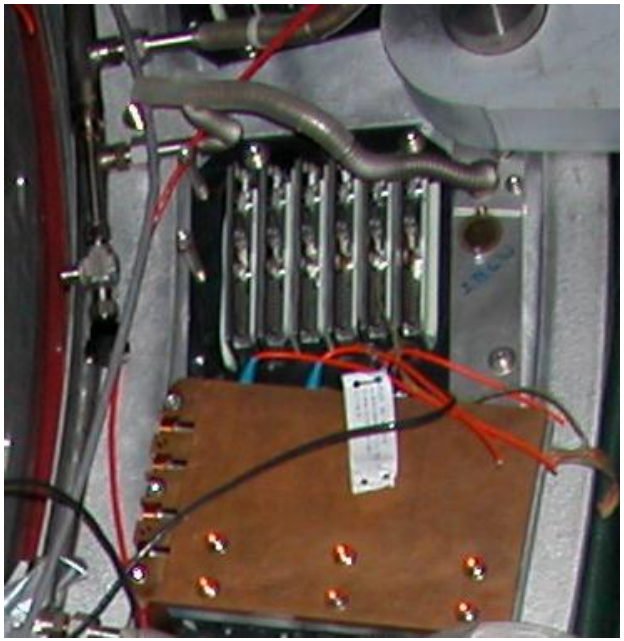
Barrel Disassembly 1

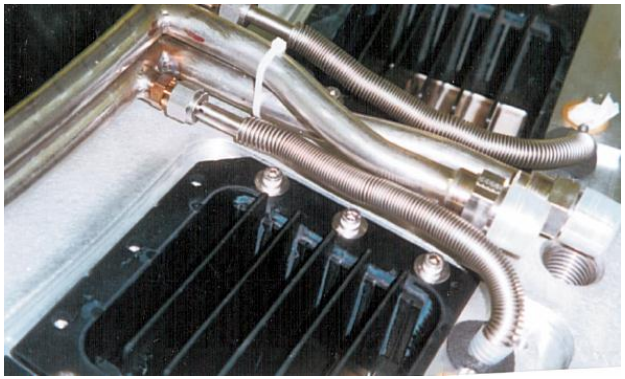
- Drain chiller lines
- Remove the inner shield

Barrel Disassembly 1

- Remove brass heat xfer blocks, etc. covering front-end mini-crates
- Remove mini-crates and inside interface boards

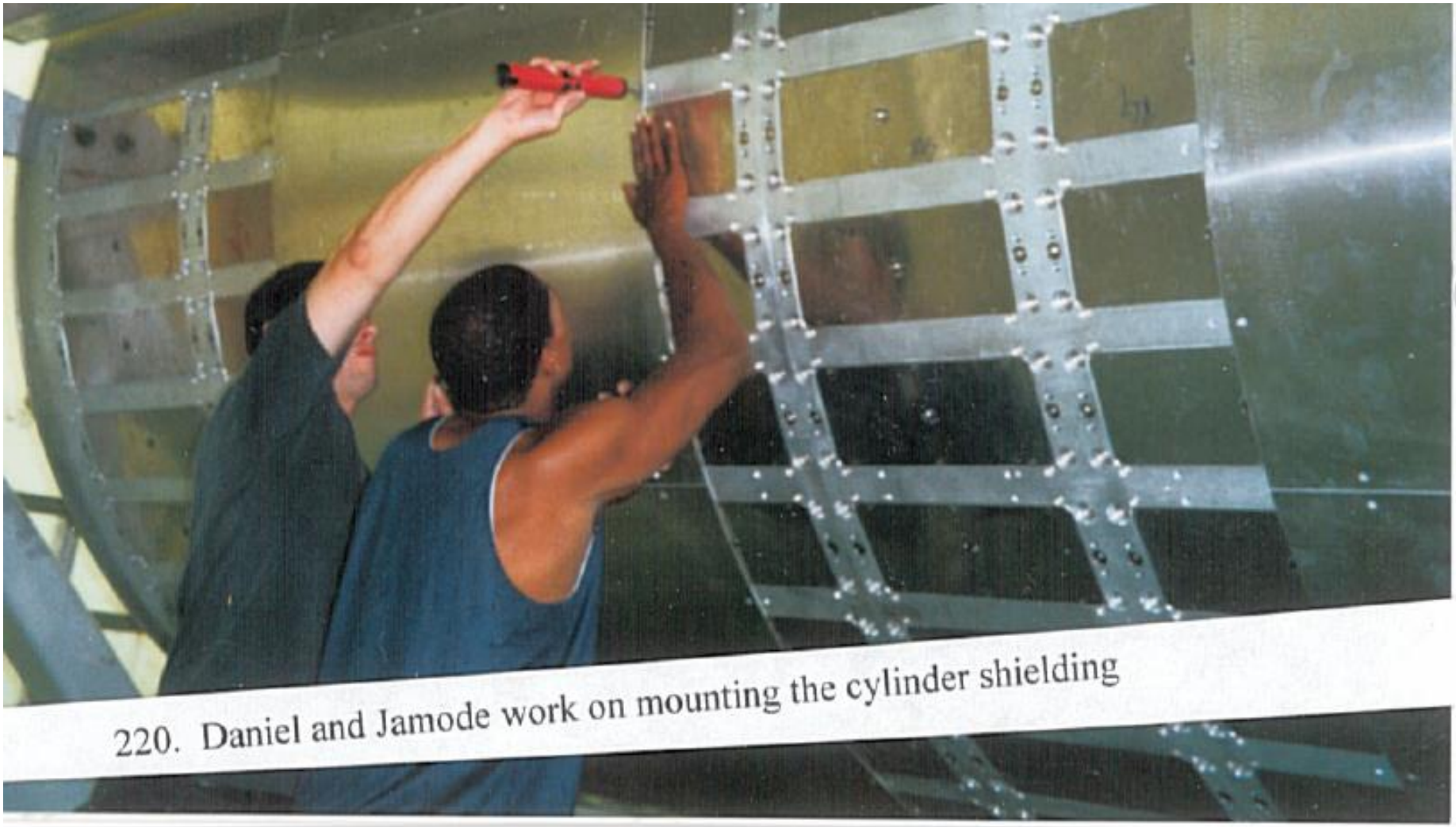






Barrel Disassembly 1

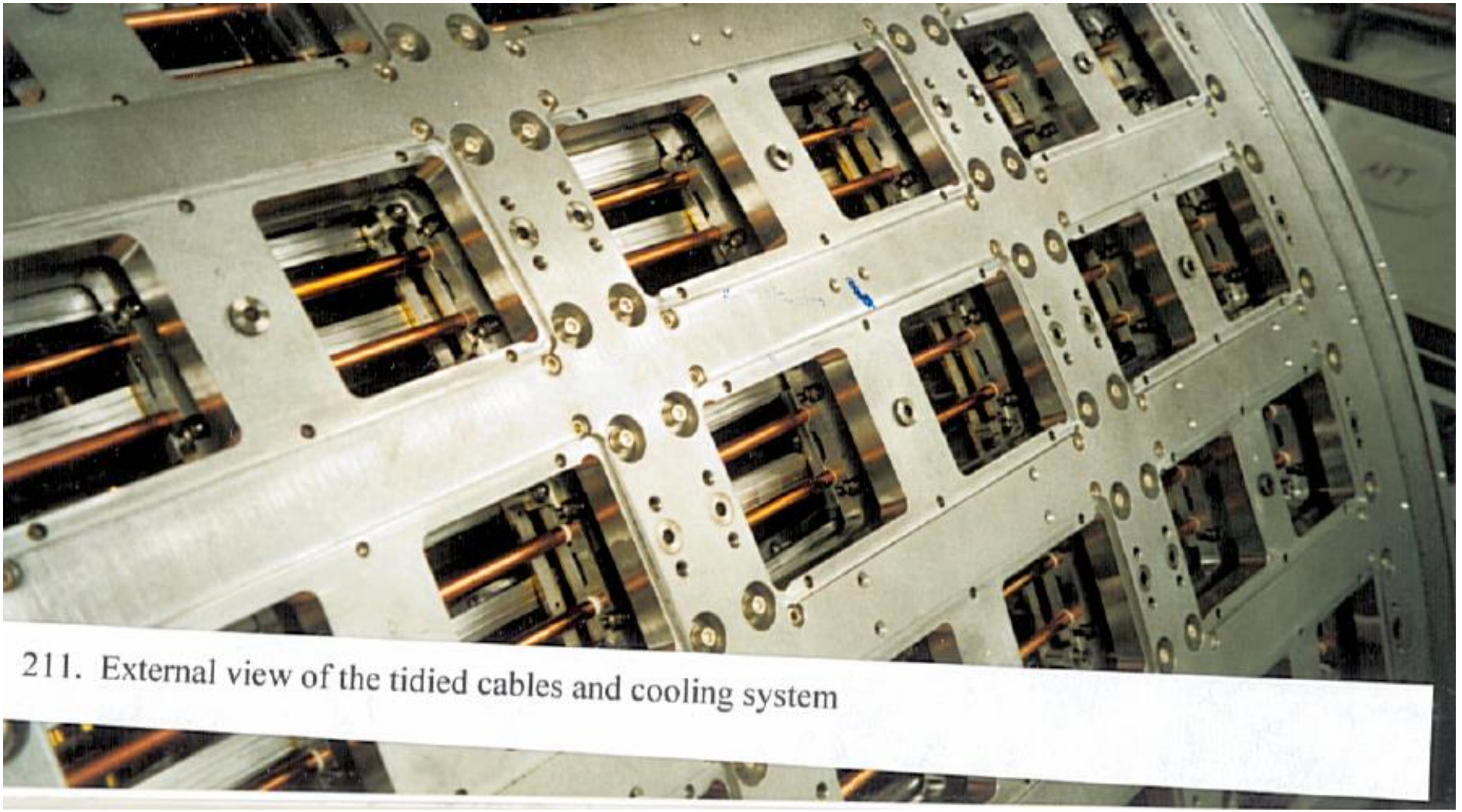
- Remove cylinder outer cover and module cover plates



220. Daniel and Jamode work on mounting the cylinder shielding

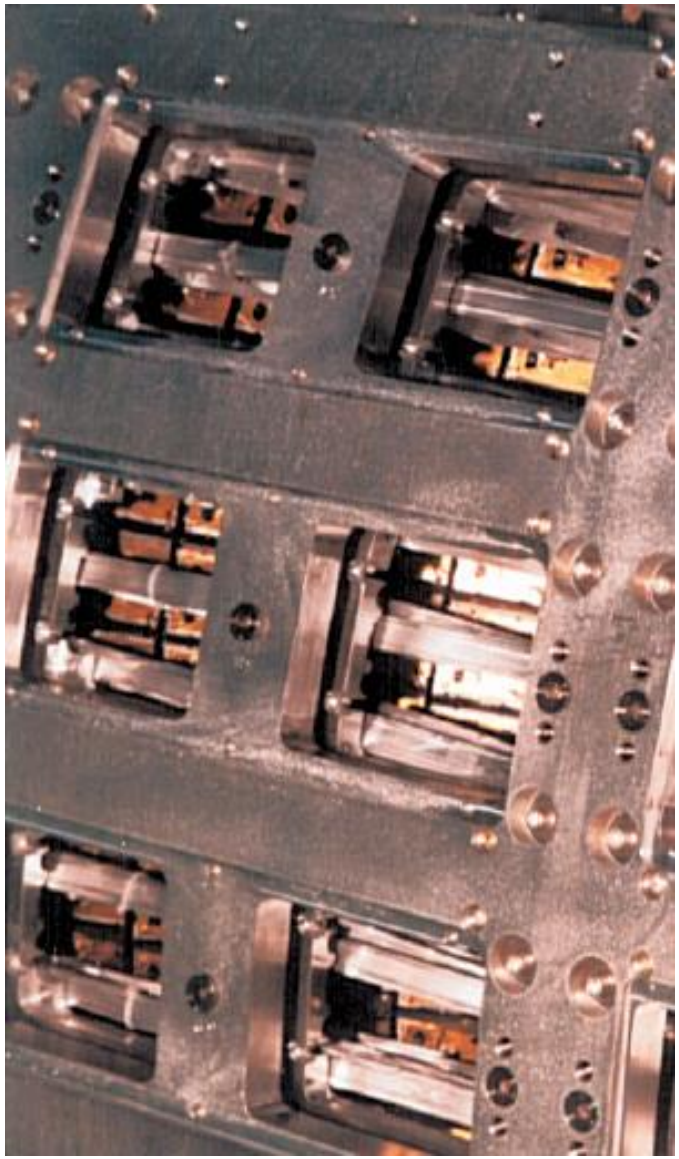
Barrel Disassembly 2

- Remove preamp cooling pipes
- Tooling/drawings for cooling pipe system still to be found (if exists?)



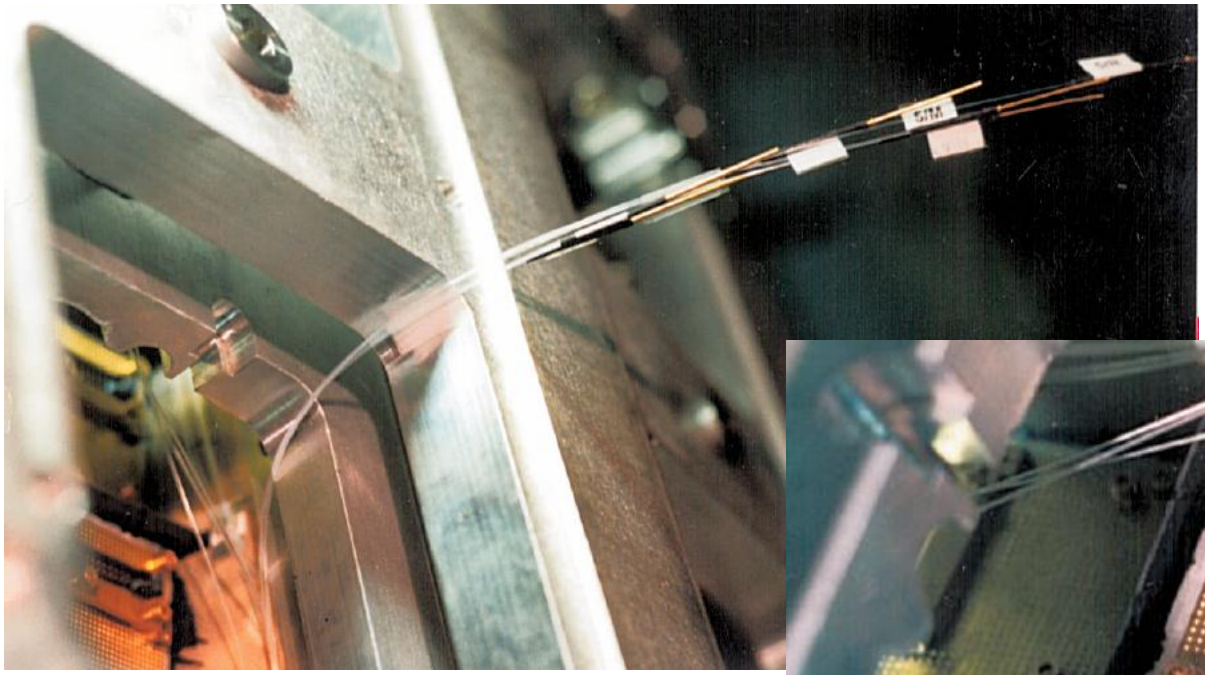
Barrel Disassembly 3

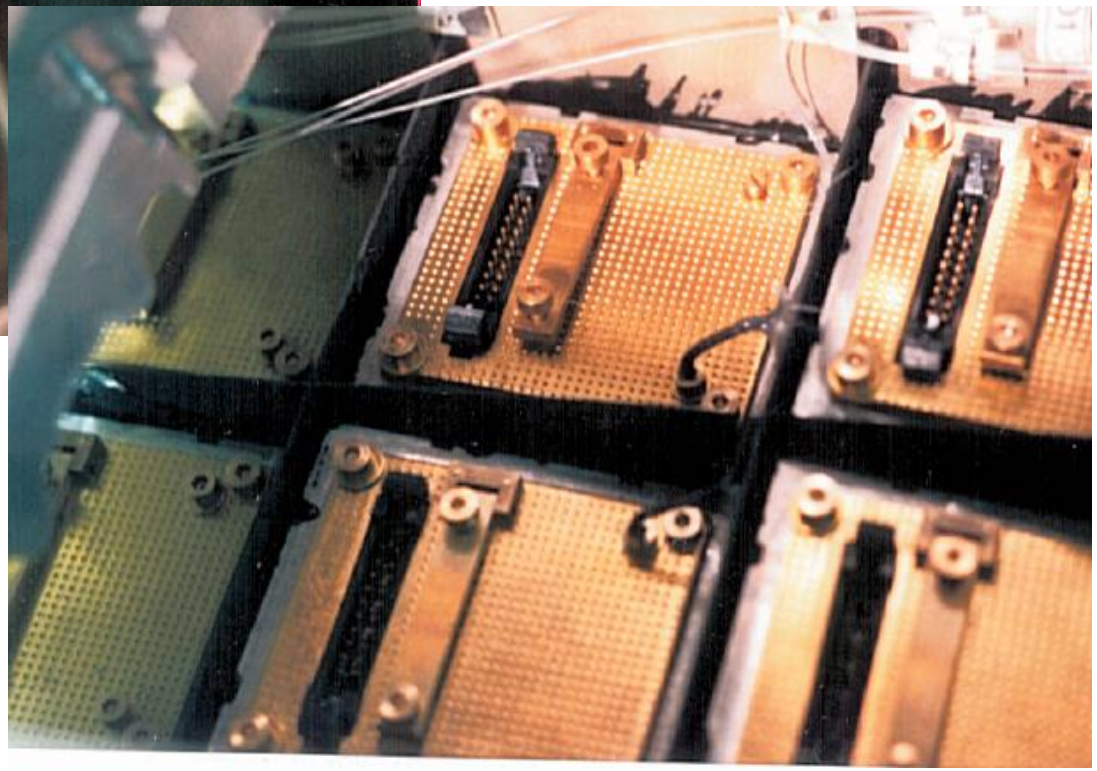
- Remove preamp electronics cables



Barrel Disassembly 4

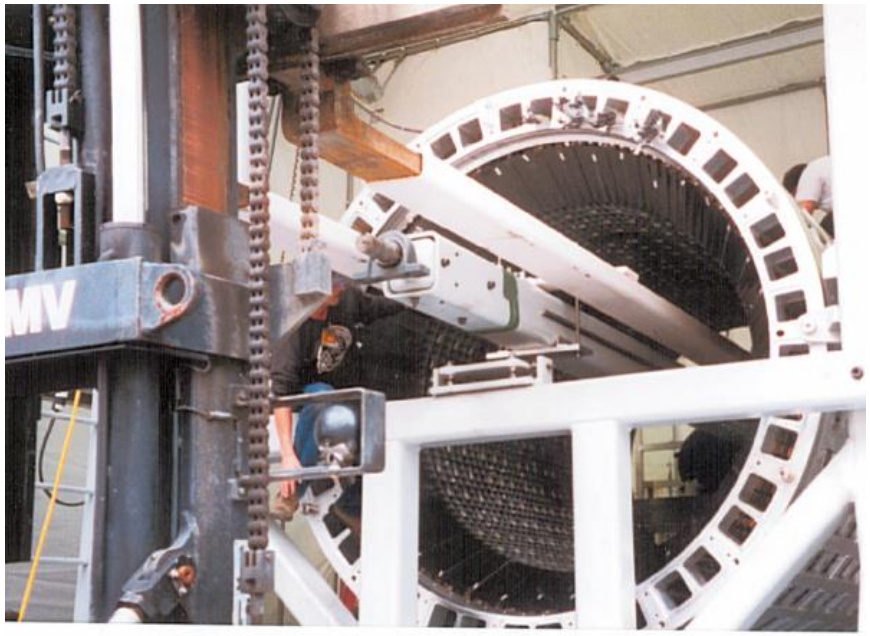
- Unbundle and remove the light fibers

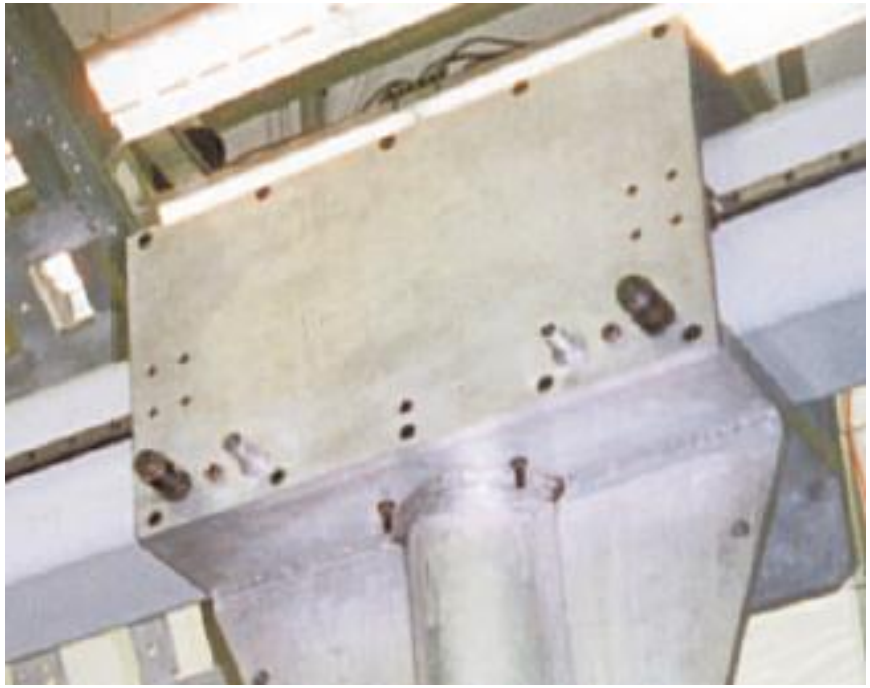




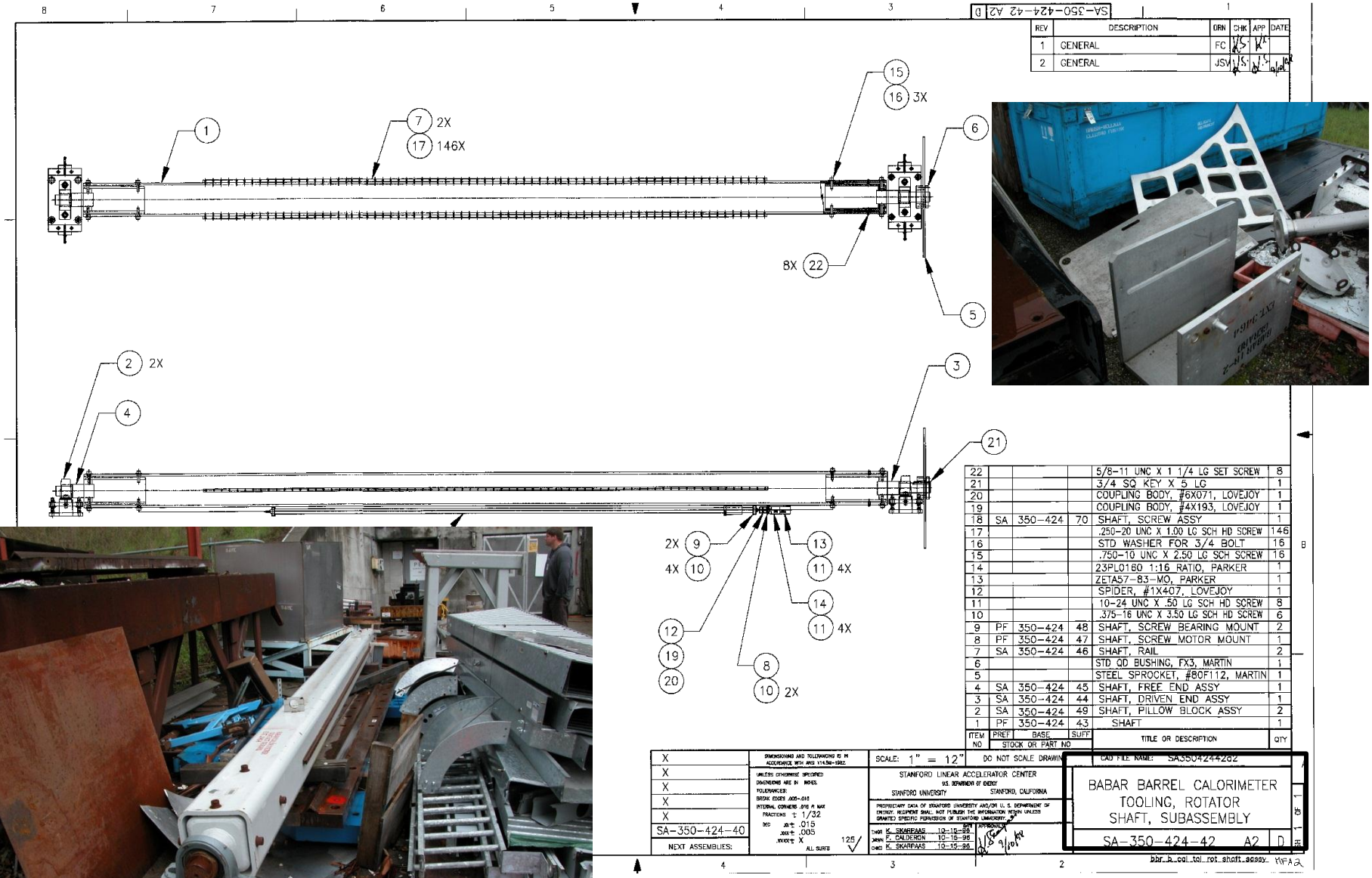
Barrel Disassembly 5

- Insert the rotator shaft
- Attach the mounting plate for the rotator arm subassembly to the rotator shaft
- Rotator shaft is held up by two stands

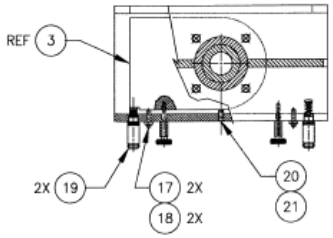




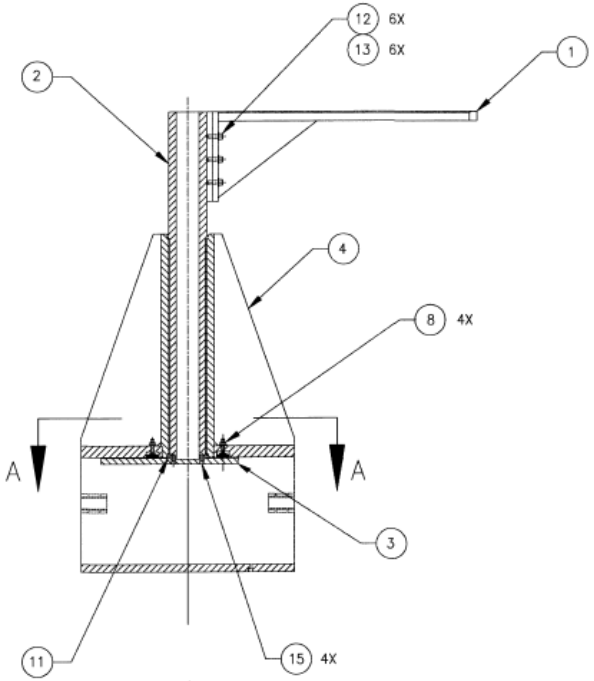
Drawing SA-350-424-42: Rotator Shaft

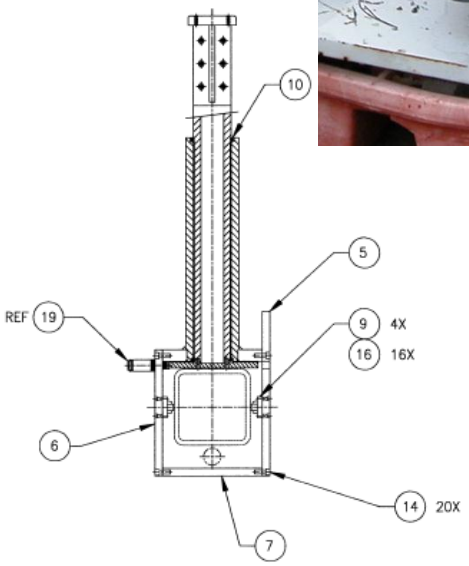


Drawing SA-350-424-75: Rotator Arm Subassembly



SECTION A–A





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19	X	X	X	SHOCK, A 1/2 X 1, ACE CONTROLS INC	2
18	X	X	X	1/2–13 UNC HEX HD NUT	2
17	X	X	X	1/2–13 UNC X 1 1/2 LG SET SCREW	2
16	X	X	X	M8 X 34 MM LG SCH SCREW	16
15	X	X	X	3/8–16 UNC X 3/4 LG SCH SCREW	4
14	X	X	X	1/2–13 UNC X 1 1/4 LG SCH SCREW	20
13	X	X	X	STANDARD WASHER FOR ø1/2 SCREW	6
12	X	X	X	1/2–13 UNC X 1 1/2 LG SCH SCREW	6
11	X	X	X	KD 045CPO BEARING, 4.500 ID, KAYDON	1
10	X	X	X	KD 047CPO BEARING, 4.750 ID, KAYDON	1
9	X	X	X	HSR 25 LA RAIL BEARING, THK AMERICA INC	4
8	SA	350–424	83	FRICTION PAD	4
7	PF	350–424	82	BOTTOM PLATE	1
6	SA	350–424	81	ADJUSTMENT PLATE	1
5	PF	350–424	80	SLOTTED PLATE	1
4	SA	350–424	79	EXTENSION	1
3	SA	350–424	78	INDEX PLATE	1
2	SA	350–424	77	SHAFT ASSEMBLY	1
1	SA	350–424	76	PADDLE ASSEMBLY	1

X
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SA–350–424–40
NEXT ASSEMBLIES:

DIMENSIONING AND TOLERANCING IS IN ACCORDANCE WITH ANSI Y14.5M–1982.
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES:
BREAK EDGES .005–.015
INTERNAL CORNERS .015 R MAX
FRACTIONS ± 1/32
DEC .XX ± .015
.XXX ± .005
.XXXX ± X
ALL SURFS 125

SCALE: 1/8
DO NOT SCALE DRAWING
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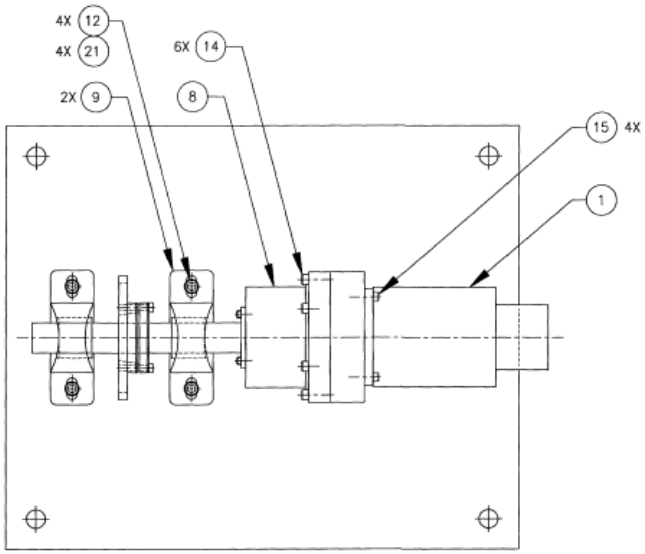
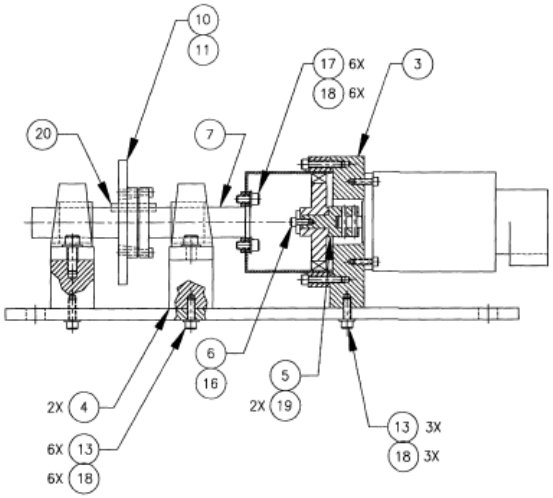
DES K. SKARPAAS 10–15–96
DRWN F. CALDERON 10–15–96
CHKD K. SKARPAAS 10–15–96
APPD

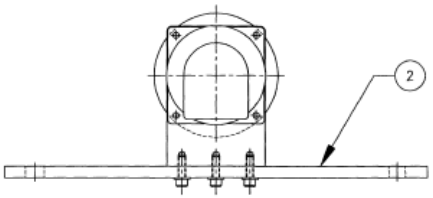
BABAR BARREL CALORIMETER
TOOLING, ROTATOR
ARM SUBASSEMBLY

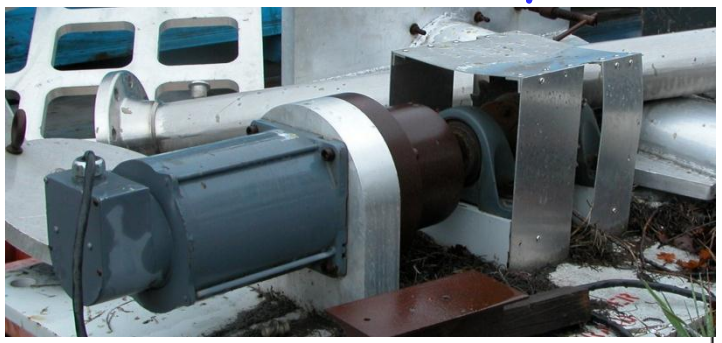
SA–350–424–75 A1 D

Drawing SA-350-424-88: Rotator Motor Assembly









ITEM NO	PREF	BASE	SUFF	TITLE OR DESCRIPTION	QTY
	STOCK OR PART NO				
21				STANDARD WASHER FOR ø5/8 BOLT	4
20				1/2 SQ KEY X 3 LG	1
19				ø5/16 X 2 LG SPRING PIN	2
18				STANDARD WASHER FOR ø1/2 BOLT	15
17				1/2-13 UNC X 1 LG SCH HD SCREW	6
16				3/8-16 UNC X 7/8 LG SCH HD SCREW	1
15				3/8-16 UNC X 1 1/4 LG SCH HD SCREW	4
14				7/16-14 UNC X 2 1/4 LG SCH HD SCREW	6
13				1/2-13 UNC X 1 1/2 LG SCH HD SCREW	9
12				5/8-11 UNC X 1 3/4 LG SCH HD SCREW	4
11				SFX2 BUSHING, MARTIN	1
10				80SF24 SPROCKET, MARTIN	1
9				MB-2 PILLOW BLOCK, BOSTON GEAR	2
8				HARMONIC DRIVE HDC-8M/200, PARKER	1
7	SA	350-424	38	SHAFT, MOTOR	1
6	MP	350-424	39	ITEM 6	1
5	MP	350-424	39	ITEM 4	1
4	MP	350-424	39	ITEM 3	2
3	MP	350-424	39	ITEM 2	1
2	MP	350-424	39	ITEM 1	1
1	PF	350-424	89	MOTOR, STEP, ELECTRIC	1

X
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SA-350-424-86
NEXT ASSEMBLIES:

DIMENSIONING AND TOLERANCING IS IN ACCORDANCE WITH ANSI Y14.5M-1982.
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES:
BREAK EDGES .005-.015
INTERNAL CORNERS .015 R MAX
FRACTIONS ± 1/32
DEC .XX ± .015
.XXX ± .005
.XXXX ± X
ALL SURFS 125

SCALE: 1/4 & NOTED
DO NOT SCALE DRAWING
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		DATE
DWGR	K. SKARPAAS	10-15-96
DRAFT	F. CALDERON	10-15-96
CHKD	K. SKARPAAS	10-15-96

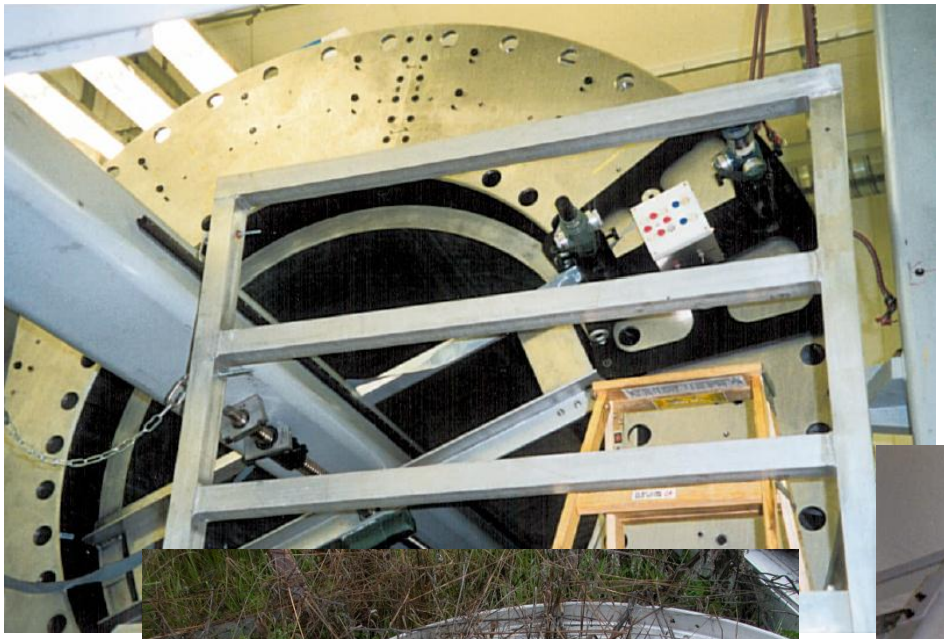
APPROVALS

BABAR BARREL CALORIMETER
TOOLING, ROTATOR
MOTOR ASSY

SA-350-424-88 A0 D

Barrel Re-assembly Step: Alignment

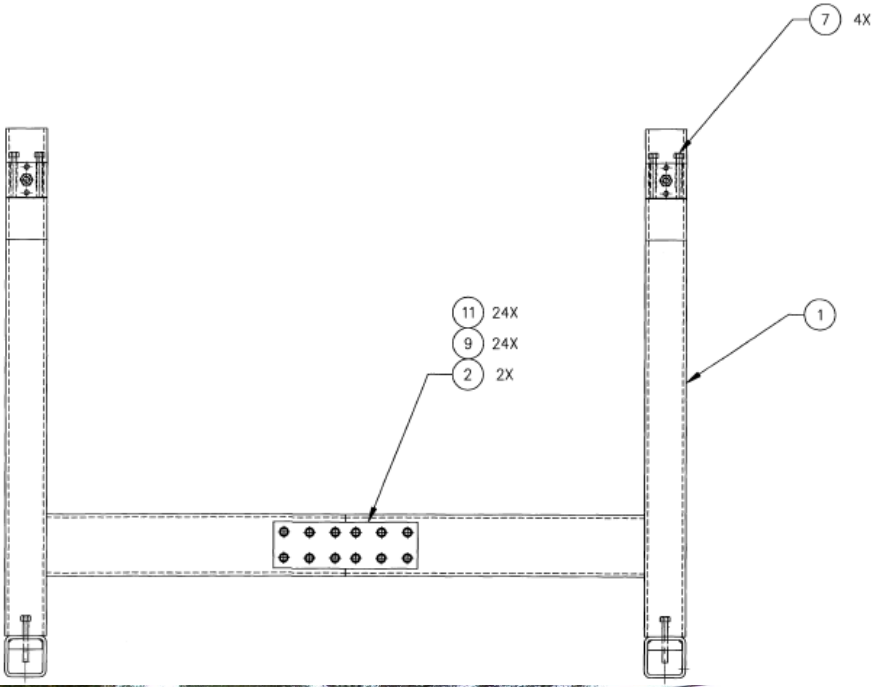
- Module alignment calibration plate would be put in place at this point in the re-assembly phase
- Also would mount the alignment optics arm on the rotator shaft

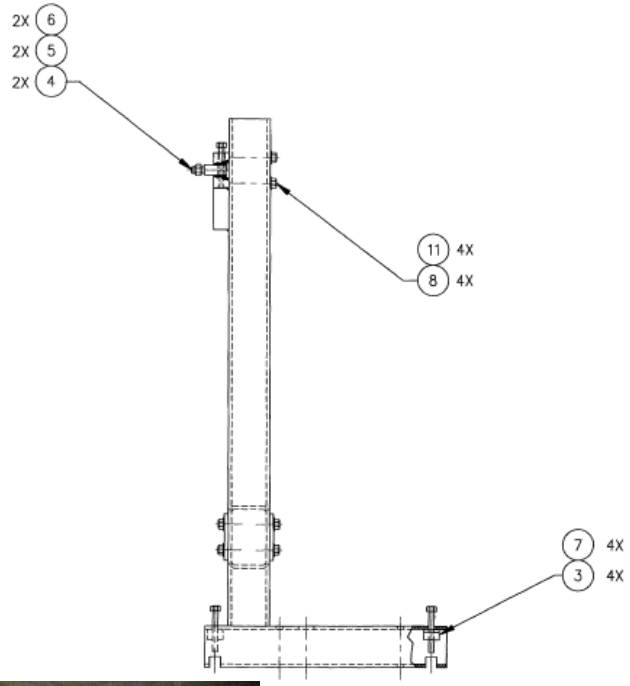


Barrel Disassembly 6

- Next is splitting the barrel
- Will need to look at method for this, acme screw was only designed to close the two sections, not open them
- Flanges, end stands, drawings located

Drawing SA-350-424-53: Removable Assembly Stands





ITEM NO	PREF	BASE STOCK OR PART NO	SUFF	TITLE OR DESCRIPTION	QTY
11	X	X	X	STANDARD WASHER FOR ø1 BOLT	28
10	X	X	X	X	X
9	X	X	X	1–8 UNC X 2 LG SCH BOLT	24
8	X	X	X	1–8 UNC X 9 LG SCH BOLT	4
7	X	X	X	1–8 UNC X 8 LG SCH BOLT	8
6	X	X	X	1 1/4–7 UNC HEX NUT	2
5	MP	350–424	54	ITEM 9	2
4	MP	350–424	54	ITEM 8	2
3	MP	350–424	54	ITEM 5	4
2	MP	350–424	54	ITEM 7	2
1	SA	350–424	62	WELDMENT, REMOVABLE STAND	1

X
X
X
X
X
SA–350–424–50
NEXT ASSEMBLIES:

DIMENSIONING AND TOLERANCING IS IN ACCORDANCE WITH ANSI Y14.5M–1982.
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES:
BREAK EDGES .005–.015
INTERNAL CORNERS .015 R MAX
FRACTIONS ± X
DEC .xx± X
.xxx± X
.xxxx± X
ALL SURFS X

SCALE: 1/12

DO NOT SCALE DRAWING

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ENGR	K. SKARPAAS 10–15–96	
DRWN	J. CORNEJO 10–15–96	
CHKD	K. SKARPAAS 10–15–96	

BABAR BARREL CALORIMETER
TOOLING, ASSEMBLY STAND
REMOVABLE STAND

SA–350–424–53 A0 D

Barrel Disassembly 7

- Add module transport rails for loader
- Rails not found, but places still to look

Barrel Disassembly 8

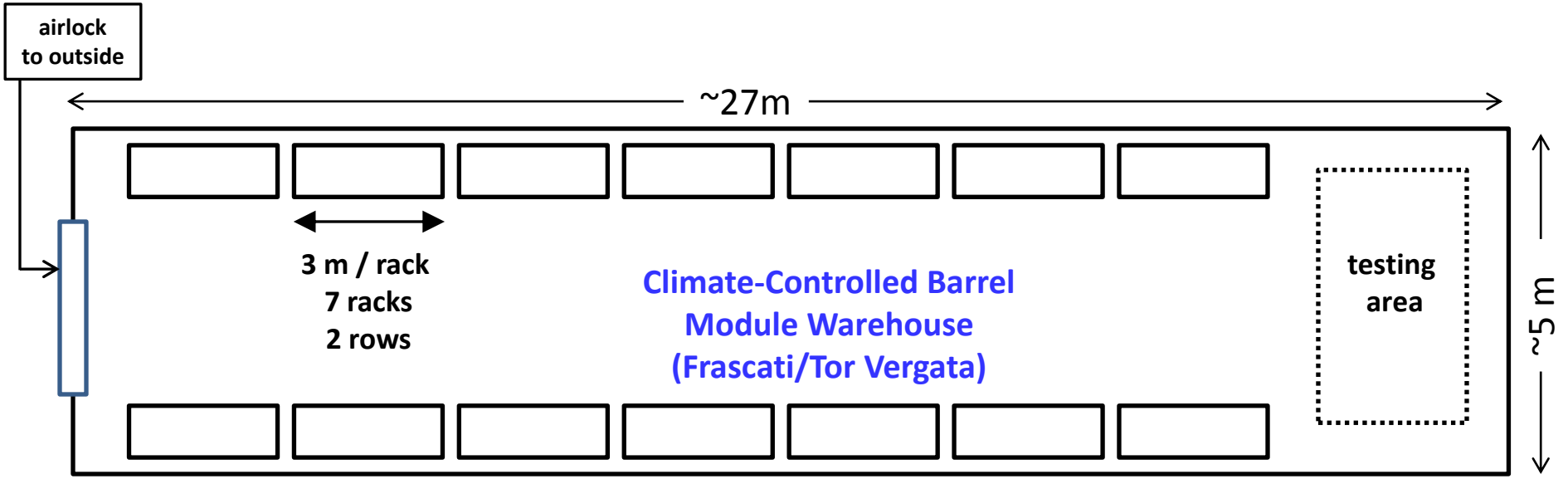
- Slightly loosen all modules before starting module de-integration
- Possibly some modules will be blocked in, ... last in, is first out?

Barrel Disassembly 10

- All previous steps will take about 3 months for a crew of two techs, an engineer, and a safety supervisor
  - 2-3 riggers, HVAC and machinist will also be needed
- Core crew will take ~3 months to unload all modules
  - 280 modules, ~1 module/hour, ~5 modules/8-hour shift
  - 280/5 ~ 56 shifts ~ 12 weeks
- A module test should take < ~1 hour using a single person (should be a SuperB physicist(s))
  - Fetching/Positioning/Cabling module, 15-20 mins
  - Running tests (gain, source/LP), 15-30 mins
  - De-cabling/Storing, 10-15 mins
- Packing for shipping will likely need two techs and take about 1 hour per module, techs are likely to be the same ones who are doing the modules de-integration
- Total time for disassembly, testing, packaging/shipping using a crew as above, plus a physicist for testing, is ~6 months

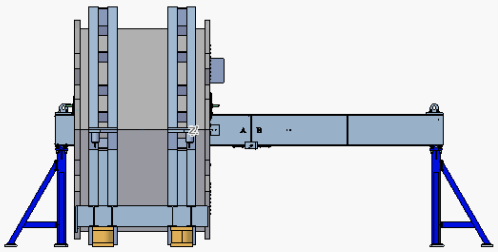
Packing, Shipping and Receiving

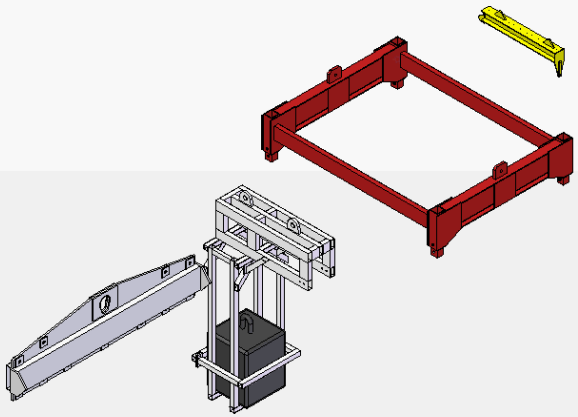
- Need to develop the packaging process, then ship a few spare modules with dummy xtals and accelerometers inside and out
- Endcap modules were originally shipped from Liverpool, so safe shipping is clearly possible for barrel modules
- Shipping means there must be a climate-controlled receiving facility in Italy sufficient to house the 14 module racks needed to hold all 280 barrel modules
- A long low room is probably the most efficient use of space if a suitable building or room is available



SLAC Endgame After Last Module Shipped

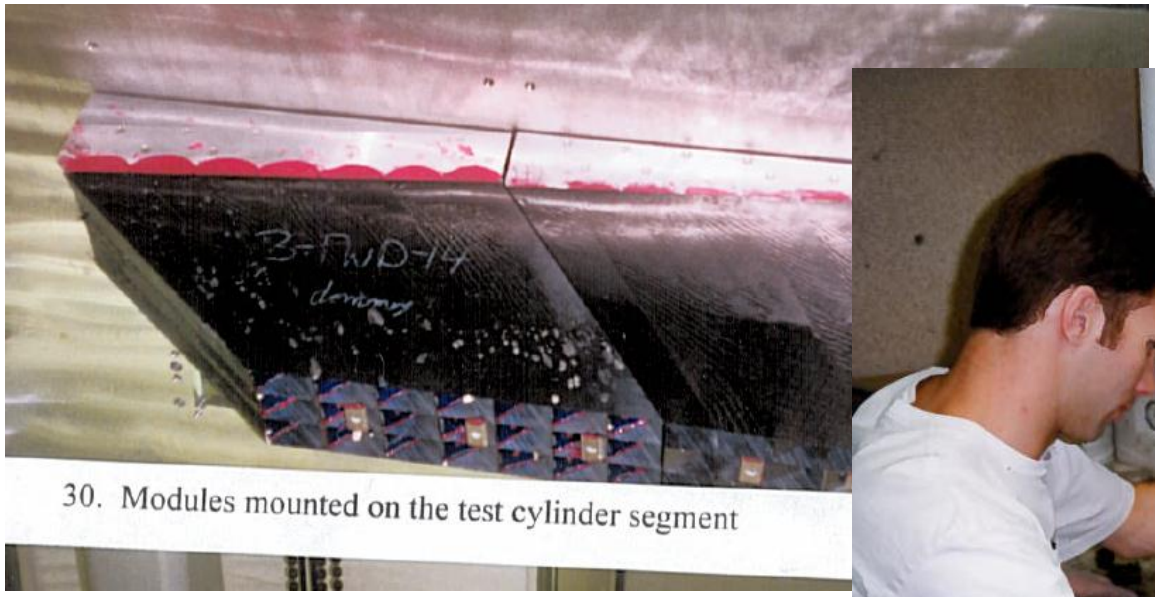
- All the items used at SLAC for local transport, (dis)assembly, and insertion into the complete detector must be broken down and prepared for shipping to Italy, then delivered to the airport for international air freight
  - Tent, dehumidifier, condenser, duct work, etc.
  - Inner shield, support cylinder, cooling loops, etc.
  - Barrel assembly/calibration tooling, construction frame
  - **All tooling for barrel insertion into the overall detector**
  - Carbon fiber module fabrication facility
- Some of this can be shipped at any time, other pieces will become free during the disassembly process, some stuff cannot be shipped until the last module comes off the cylinder
- A few extra module racks will need to be built since Italy will need 14 racks to store all modules, and SLAC will still need 1-2 racks for the conclusion of the module extraction





Further Considerations

- The first module(s) removed from the cylinder should be carefully inspected with respect to the integrity of the strongback/carbon fiber glue joints
- Even in the scenario of shipping the barrel as a whole unit, it would be conservative to remove at least a few modules for inspection to ascertain if the glue joints are still robust



30. Modules mounted on the test cylinder segment

53. Daniel preparing the strongback for installation by applying some pink lady epoxy

Carbon Fiber Module Fabrication

- Much of the tooling for the carbon fiber barrel module fabrication has been located, and there are places to look where more may be found
  - Includes mandrels, troughs, molds, etc.
- Liverpool shipped 10 boxes to SLAC in August 2003 which held the complete carbon fiber kit for the endcap modules
  - Only 2/10 of these endcap boxes have been found
  - Stuart Metcalfe (Endcap System Manager) will try to locate the missing 8 boxes

Status of Ongoing Work

- Need to locate 8 misplaced endcap carbon fiber production crates shipped from Liverpool in August 2003
- Only one large barrel item still not located
  - Some small pieces and carbon fiber tooling also
- **Consolidate all located items to as few locations as possible to protect them from poaching or being disposed of**
- Continue database input of physical info about bar-coded items: drawing numbers, physical locations, radiological status
  - 837 bar-coded items so far ...
- Continue locating and cataloging tooling drawings
  - Lots of endcap stuff from Stuart in last few weeks
  - Many drawings available in pdf form and databased
- Detector/subdetector structural calcs, and civil calculations (slab, building, etc.) all available
- Several terabyes of D&D video awaiting processing by Ray Lo
- **Have ~total set of SolidEdge/ProE 3D CAD barrel drawings**

Test Stand Transfer, Accounting Considerations

- Transfer of barrel test stand (~ $100K item) Italy will require a formal request, either stand-alone or along with the much larger list of PEP-II etc. items
- Many paper and photographic records are waiting on temporary clerical help in order to be scanned and labeled
- SLAC has an expectation of eventual reimbursement for costs like this which are incurred solely for the benefit of SuperB
- An account was set up shortly after the November visit to track efforts made by SLAC or vendors for which the beneficiary is exclusively SuperB and, in the long run, this account will need to be settled
- **Shawn Osier has been ~15-20% FTE, since the end of Babar D&D, researching, locating, developing and archiving paper and computerized records for all Babar detector subsystems**
- **His time thus far is budgeted under SLAC D&D**
- However, near the start of the process described on the previous pages, his time will become 100% billable

Personnel

- SLAC personnel needed
  - **Bill Wisniewski**, SLAC management (~5% FTE)*
  - **Shawn Osier**, D&D Project Engineer (80-100% FTE, depending on the phase of the project)
  - **Two techs** (100% FTE for most of the project)
  - **Sandy Pierson**, SLAC safety (100% FTE during module disassembly, intermittently during other times)
  - **Mike Racine**, SLAC HVAC (100% FTE for tenting, and transfer/hookup of IR-2/12 chillers before tenting, likely ~6-8 weeks total, will increase if some missing tooling is re-made at SLAC)
  - **2-3 SLAC riggers** (100% FTE intermittently during the process, total of 4-6 weeks each)
- **SuperB physicist(s)** ideally should be involved with all phases of the process in order to gain relevant experience which will be invaluable during re-assembly, only useful if person(s) will be involved in SuperB long-term

* If USA becomes a SuperB collaborating nation, Bill's time comes gratis as a collaborator

Schedule and Cost (developed in consultation with Bill W and Shawn)

- 20-26 weeks to refurbish barrel tooling, develop written and visualized procedures (this effort can overlap next few items)
  - **~ $50K (will be re-used in Italy)**
- 1 week to clean up IR-12 enough to proceed
- 4-5 weeks to clear IR-2 of interfering items, prep hall
- 2-3 weeks to set up IR-2 environmental system
  - **~ $250K (will be re-used in Italy)**
- 12-15 weeks to move barrel from IR-12, strip the barrel down to the module level, and put removal tooling in place
- 12 weeks to do the actual de-integration and module testing
- 12 weeks for packaging and shipping (overlaps de-integration and module testing, and likely following by about two weeks)
- **Total for personnel and all other costs not broken out above**
  - **~ $600-700K**
- 4-6 weeks to break down, prepare all barrel tooling for shipment to Italy, where it will be needed for re-assembly/re-insertion
  - Includes alignment items, e.g., optical targets, frame, etc.
- 2-3 weeks to prepare and load support cylinder on travel frame

- **TOTAL TIME: 1.0-1.5 YEARS**

TOTAL COST: ~ $1M

Other Possible Costs (in consultation with Bill W)

- If damaged, inner cylinder replacement $140-200K
- Alignment system, $40-130K
  - Depends on parts missing or not refurbishable
- Missing carbon fiber fabrication tooling, ???

Procedural Documentation

- Detailed written procedures and, as applicable, procedural videos will be developed by Shawn
- D&D procedures can be adapted for transport from IR-12 to IR-2
- New procedures must be developed for the whole de-integration process starting with the removal of the inner cylinder
- Shawn will develop procedural videos/animations based on 3D models
- Procedure will also be needed for tent installation

Alternative Barrel Scenario

- The alternative barrel scenario is to transport the barrel intact in a shipping frame
- However, it is impossible to develop a credible procedure without significant mechanical engineering effort from INFN
- Conservative approach would be to disassemble barrel enough to fully inspect at least few modules and at least partially access many more
- This process would be essentially identical to the initial parts of the disassembly scenario described above
- Would require tent etc. at SLAC, but this will also be needed in Italy even if the preamps etc. are replaced on xtals with all modules in situ

Forward Endcap Notes

- Met with Stuart Metcalfe, Bill W and Shawn for to discuss forward endcap status and other items
- Endcap disassembly can take place sequentially before or after the barrel in the IR-2 tent
  - Done before, will provide crystals to play with ...
- Cost should roughly scale with barrel estimate
- A module loader and module holder frame(s) for working on the modules will be needed, particularly in the crystal unloading scenarios, as well as module warehousing rack(s)
- There should be no problems with replacing any or all rings of crystals, including the innermost ring with the inert material (probably mostly lead), since endcap was made with this in mind
- Also, no problems foreseen loading 4 LYSO xtals in one slot
- Stuart was more uncertain about possible problems which might arise because of shorter xtal lengths, eg. preamp placement, cooling, etc., and this will need to be examined
  - Empty endcap module located in November is maybe available with an informal request to Bill W

Considerations for the Solenoid and Flux Return

Assuming the Italians ship the Solenoid and Flux Return here are a few things to consider:

1. We need additional Lifting Lugs fabricated and load tested so each component of the Flux Return has a complete set. During the D&D phase we had to re-use a number of the Lifting Lugs for each lift. This may not be practical when the items are loaded onto a ship. (Estimated cost $25,000; Carpenter Rigging) This may require a lead time of two months.
2. Each component of the Flux Return was originally secured in a wooden crate during transportation. We may be able to use plastic tarps instead of fabricating wooden crates?
3. In order to transport the majority of the Flux Return a 60-ton tractor/trailer is required along with special road permits (extra wide load). Sandy recommended an outside company (Sheedy or Biggie) should be in charge of transporting the items. Some of these items may not fit through the new Alpine gate.
4. We will need Rigging support while we transport the Barrel & Fwd Calorimeter.

Status of the EMC Barrel TDR

9.2. Barrel Calorimeter (20 pp)

9.2.1 Requirements relevant to new environment (1.5 pp)
- i. Crystal Aging at Babar – Draft text done (KF)
- ii. Backgrounds – Draft text committed (CC), figure(s)?

9.2.2 Description of BaBar barrel (5 pp)
- i. Mechanical design – Draft text done (KF)
- ii. Readout (KF) – To do, adapt PD text from Babar NIM paper: sec 9.3.1
- iii. Calibration (DH) – Draft text done, needs partitioning between FWD and barrel (KF)

9.2.3 Performance of BaBar barrel (Notre Dame, Mainz) - NOTHING YET

9.2.4 Electronics changes (Valerio) – NOTHING YET

9.2.5 Disassembly etc. (KF) – adapted from today's presentation and discussion

9.2.6 Electronics refurbishment (Valerio) – NOTHING YET

9.2.7 Calibration systems (DH) – Draft text done, needs partitioning between FWD and barrel (KF)

9.2.8 Reinstall at Tor Vergata (responsible ?)