SNO+ Source Committee

Minutes for November 13, 2024

Present: José Maneira (LIP), Valentina Lozza (LIP), Alex Wright (Queen's)

Umbilical report and cleaning procedure

The committee discussed the document [1], that reports on two main sets of tests done to investigate the cleanliness of the umbilical surface and possible leaching into LAB.

Umbilical UV-Vis tests

Fig. 3.2 of [1] shows the UV-Vis spectra of LAB samples taken over time from a vessel where the umbilical is left soaking in the LAB. There is a continuous increase in absorbance over time, between 350 and 390 nm, with a shape without any peaks, compatible with scattering. This increase appears to be higher than what one expects from LAB ageing, so it presumably is related to the umbilical.

Question: Is the vertical scale really in AU? Or can it be interpreted as an actual absorbance? Also, what was the LAB volume in the pot?

Taking the values as a real absorbance, and extrapolating over time, one would expect an increase of about 0.2 per year at 370 nm, and nothing above 390 nm. Even if the actual deployment times are shorter, we should expect some LAB to remain in contact with the umbilical still during storage.

Umbilical FTIR tests

The report shows a series of FTIR tests on the umbilical, on samples of tygothane, SilGel and LAB. While the results seem to indicate no presence of SilGel on the surface of the umbilical, it is not clear what is the sensitivity of the method is. Also, it appears that the tests were made only in a limited zone of the umbilical, and so may not be representative of the whole object.

Also, it appears that the LAB in the soak pot was not tested for FTIR. It could have been interesting to do that to check for SilGel traces, to see if the soak helps in removing any SilGel surface contamination.

Conclusion

The FTIR tests do not indicate any obvious problems, but its sensitivity might not be enough to take more conclusions beyond that.

The UV-Vis results from the soak tests show an increase in absorbance, but in a region well below where the scintillation light is (above 420 nm). Moreover, the concentration of any impurities in the LAB in the AV should be scaled by the mass ratio (w/r to the LAB in the test pot), i.e., roughly 5 orders of magnitude.

So it appears that the contact of the umbilical with the LAB should not cause a measurable optical impact.

Still, these tests do not show in clear terms if there are any advantages of soaking the umbilical for extended periods, in terms of its capability of cleaning its surface. Testing the LAB in the pot after soaking would have helped.

Umbilical cleaning procedure

Specific questions/comments

- **p3, line 2** What is this high density PTFE tape? Sourced where? If this is used in contact with the cleaned umbilical surface, how do you guarantee its cleanliness?
- **p3, sec 4.1, point 2** Is mylar clean and LAB compatible? Is it aluminized? If so, maybe we don't want it touching the umbilical?
- **p3, sec 4.1, point 3** What is this low static plastic sheeting for? Is this material clean and LAB compatible?
- **p4, sec 4.3, point 2** Probably gloves should be worn after this, and changed to fresh ones after every bag removed. To make the glove changing safer, the operator should use two pairs of gloves and only change the outer ones.
- **p4, sec 4.3, point 3** Where is the umbilical in the bag stating in the DCR? On top of the nearest table? Or on top of some prepared, cleaner surface?
- **p4, sec 4.3, point 5** Do we really want to use dish soap?
- **p5, sec 4.3, point 8** See question above about the plastic sheeting.
- **p5, sec 4.3, point 9** What is this foam for? Is it LAB compatible?
- **p5, sec 4.3, point 14** Where do the ends of the umbilical go while soaking in LAB? How do we protect them from any contact with LAB? It seems one should detail more what are those steps that should be taken to keep the ends out of the LAB, and not just "if possible", but "in no case". Those steps may include and additional container for those ends, and some means of securing the ends to it.
- **p5, sec 4.3, point 15** Do ratchet straps actually give a good seal? The foam stuff is exposed to the LAB?
- **p5, sec 4.3, point 16** It's not clear what a week of soaking does. Danica's report[1] seems to suggest: nothing.
- **p6, sec 4.4, point 7** See question above about aluminized mylar bags.
- **p6, sec 4.5, point 4** Maybe you should use washed nitrile gloves?

Overall comments/suggestions

The main issues that we question/suggest in the cleaning procedure are the following:

- **History of umbilical and URM** Where/when was this umbilical fabricated? Where and how was it stored since then? What were the past cleaning steps, if any? The history of URM should also be documented: What cleaning steps were taken since its arrival at SNOLAB? (at the LIP workshop, the cleaning was minimal, just to remove most grease and dust). There is likely some documentation already, it would be good to have a list and any relevant updates.
- **Checklist** It would be good to make the list of steps in the procedure into an actual checklist, with tick boxes, so that the operators can print it and use it during the work.

- **Basic cleaning with kim wipes** Since it's not clear how much the soaking does, the initial steps should be with LAB-soaked kim-wipes.

- **Tape lifts** It's important to check the effectiveness of cleaning along the way so we suggest that the procedure should include a few tape lifts at key moments.

It is accepted that tape lifts cannot be conducted on LAB wetted umbilical. More thought will be required.

- **URM installation** Installation of the umbilical in the URM is a critical step. We are worried that this is a moment where contamination can be accumulated, so for sure it should not be the last step, after all the cleaning is done. It will probably be impossible (or very messy) to install the umbilical after both the source connector and the feedthrough plate are attached to both ends. It's necessary to think through and write the full procedure in advance.

An example procedure has now been written for the installation end to end as part of the URM commissioning procedures

- **Final cleaning** This should be done after the umbilical installation in the URM, to make sure any dust accumulated in that process is caught. We reccomend that the umbilical is unwinded from the URM, using LAB-soaked kim-wipes, into the final soak. From that point on, no more wipes. Those also carry a risk and may not be fully lint-free, so the final soak may serve to catch residual dust/lint from the wipes.

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Scintillator AmBe

A few questions from the previous meeting were not answered in this new document. We recall them here for convenience:

1. The document says vacuum grease for the lubricant but is it ok if in contact with LAB? How dirty is it?

Replaced references to vacuum grease with LAB when there is a possibility that it will come in contact with LAB

2. In SNO it was found that Super Lube was quite good and low in radioactivity. However, there might still be a risk of compatibility when in contact with LAB. Probably best is to use LAB as lubricant and if the source needs to be disassembled soak/spray it in LAB before. The most critical part might be the the quick connector threads as it is steel. Might want to test if using LAB is enough.

Replaced references to vacuum grease with superlube in the cases where there is no contact with LAB (only affects StSt encapsulation

3. Are all o-rings compatible with LAB+PPO?

All o-rings used are FFKM which are known to be compatible with LAB

4. How do we make sure the o-ring for stainless encapsulation layer is compressed properly? How we do know it doesn?t loose compression? Can we make a mark on the edge of the container to know that it remains in the same position?

Intend to use a feeler gauge to check the tolerance of the enclosure.

It might be reasonable to do so… but is there a possibility of changing the compatibility charactoristics by doing so

5. We should also make sure that the screws that pass the dowels have the proper length and do not push into the acrylic.

With the lid fully assembled and the stem in place it is impossible to do this with the existing screws. Prior assembly tests did not do this.

And here is the list of new questions/comments:

1. Add a checklist along the procedure, including tick boxes, to make sure nothing is missed.

Done

2. The acrylic stress situation seems to have improved significantly with the new dowel design. Need to make sure that the screws fixing to them are the right length, to avoid putting pressure on the acrylic below. Also, in the case of the screws that tighten on an acrylic thread, care must be taken to neve overtighten.

There was no change in the dowel design. Did not overtighten though.

3. **Page 15, point 2, page 16, point 5** Ultrasonic cleaning of the steel pieces: for how long? With or w/o heat? Do we leave the pieces free in the UC or are they inside some glassware? Is this using the std SNOLAB procedure?

Will use the written instructions for the ultrasonic cleaner as a suggested procedure for this. Will omit acrylic as per the material suggestions in the SNOLAB procedures

4. **Page 16, point 6, 7** Ultrasonic cleaning of the steel pieces: There is some history of acrylic crazing being induced by the USC. If this is needed, should use low power and no heat. Why wipe with Alconox? If u/s cleaning with Alconox should u/s clean with UPW.... In general there is a lot of Alconox, might be better to limit its use

That is correct. I was going off of discussions with individuals, but the written U/S cleaner instructions state that this is a problem. Now changed

Alconox is not used so much any more. Adopting Nuclean as the current standard.

5. **Page 16, sec. 4.3 point 1** Do we want nitrile gloves or clean room gloves? Should wash gloves...

We only have one stock of gloves in the cleanlab/underground lab… disposable nitrile gloves. A UPW rinse would not go amiss

6. **Page 17, sec. 4.5.1, point 2** Where do we open the bags?

Moved the "working area" point from section 4.5.2 to address this

7. **Page 18, point 4** For best cleanliness, the operator should put the mask first, then the gloves. Is a mask really needed for clean lead?

The mask is the suggested PPE… what is the threshold for this?

8. **Page 18, point 5a** If you really want it to dry use alcohol...

This is on the deck… It could be used assuming that we are past the prohibition of no alcohol on deck.

9. **Page 18, point 6b** Superlube rather than vacuum grease?

Yes

10. **Page 18, point 6e** How do you remove it? Won't it come apart if you hold it by the top? To avoid touching the outside of the stainless after touching lead, maybe put the lead bottom and ring in, then insert the source, then put on the Pb top. Then you can see that everything nests properly.... Then change gloves and put on stainless top.

Fair point. At this point it is assumed that the lead encapsulation will be held from the side of the cup. The insertion of the cup requires dropping it into the

11. **Page 18, point 6h** How tight to make it? This seals the o-ring, right? Is there anything to prevent it backing out? It could make sense to have a pin or a screw fixing the lid in place at the right tightenss, and to prevent it from twisting off. This could be machined in the already existing cup and lid.

There is no force on this lid except for the pressure of the oring. It should be enough to compress the o-ring such that there is steel on steel contact

12. **Page 18, point 7a** Change gloves. Person who touches stainless should not touch acrylic.

Text altered to reflect this

13. **Page 19, point 7d** "Without touching the acrylic. Change gloves."

Added to the text

14. **Page 19, point 7j** Check that the screws are not so long that the ends of the screws are pushing into the acrylic on the other side of the rods.

Should not be possible with the full assembly; the point was made in the draft

15. **Page 20, point 8b** What about the ones "pinning" the lid to the can? Also, what's the history of the stem, how was it cleaned? With the ultrasonic cleaner?

These will also be wired. The stem has been kept in the DCR and has been UPW wiped multiple times. Not sure if US cleaning has been done

16. **Page 20, sec. 4.5.3, point 1** Not sure more wiping is helping once the wires are on? Why is the nitrogen from the bottle preferable?

Meant to address the vertical surfaces with no wires as a final check

17. **Page 20, sec. 4.5.4, point 4** What glove bag?

Typo; left over from a previous draft

18. **Page 20, sec. 4.5.4, point 7** Is there anything that locks the source connector collar in place?

Not sure. It looks like it is intended to be a friction lock. There may be a tool to aid with this, but more information is needed.

19. **Page 21, sec. 4.5.5, point 11** Do you mean 12 times multiple periods? Why that many?

This is based on discussions with Matt. Further testing with the source cleaning vessel needs to be done to evaluate if this is excessive.

20. **Page 22, point 12** What do we use to pump with? Should be slow enough that there is no risk of putting vacuum on the AV?

We have a pump purge board with a 5 L/min diaphragm pump. It is intended to be used with the gate valves shut, and includes a gauge to monitor pressure in the system. The idea is to evacuate gas from the nipple assembly and re-introduce pure nitrogen multiple times before opening the gate valve. The procedure written here is not meant to be exhaustive. The full procedure will have these detailes

References

[1] D. Levesque, "Umbilical Cleaning Report", Oct. 29, 2024, Version 2 of https://www.snolab.ca/snoplus/private/DocDB/cgi/ShowDocument?docid=8459

[2] R. Bayes, M. Depatie, "Umbilical Cleaning Procedure", Nov. 8, 2024, version 2 of https://www.snolab.ca/snoplus/private/DocDB/cgi/ShowDocument?docid=8459

[3] R. Bayes, C. Lin, M. Depatie, "Scintillator AmBe encapsulation", v9 (v5 of the pdf), Oct. 25, 2024, https://www.snolab.ca/snoplus/private/DocDB/cgi/ShowDocument?docid=8245