Subject: Re: L1100046-v1, VRB request: no baking for optics?
From: John Worden <worden_j@ligo-wa.caltech.edu>
Date: 3/2/2012 1:06 PM
To: Dennis Coyne <coyne@ligo.caltech.edu>
CC: GariLynn Billingsley <Billingsley_G@ligo.caltech.edu>, Peter Fritschel <pf@ligo.mit.edu>, Calum Torrie <torrie_c@ligo.caltech.edu>, Margot Phelps <mphelps@ligo.caltech.edu>, Mike Zucker <mike@ligo.mit.edu>, Fred Raab <fjr@ligo-wa.caltech.edu>, Michael Meyer <mmeyer@ligo-la.caltech.edu>, Rainer Weiss <weiss@ligo.mit.edu>, John Worden <worden@ligo.caltech.edu>
BCC: worden_j@ligo-wa.caltech.edu

This document - L1200067-v1

Dennis,
The VRB concurs with your proposal to waive the baking and FTIR testing of the referenced optics.

John

On 2/27/2012 10:33 AM, Dennis Coyne wrote:

> VRB members,
> We have FTIR results on the cleanliness of ground optic barrels that have been cleaned but not baked. Please see report E1200010-v2. Barrels were contaminated with fingerprints (FTIR indicated 0.1 to 0.3 micrograms/cm^2), then cleaned per E000007, and re-tested by FTIR and passed (< .02 micrograms/cm^2, sensitivity limit of the FTIR measurement). No RGA measurements were made. (The FTIR is likely more sensitive anyway.)
>
> The proposal is to waive the requirement to bake optics. Further I propose to waive FTIR testing as well in production cleaning of these optics with ground barrels, i.e. just rely upon the repeatability of the cleaning procedure/process and our quality control (optics inspection, careful attention to cleaning, .
>
> Comments?
>
> Dennis Coyne
> Chief Engineer, Advanced LIGO & LIGO Laboratory
> California Institute of Technology
> MC 100-36, 1200 E. California Blvd.
> Pasadena, CA 91125 USA
> Telephone 626.395.2034
>
> On 3/3/2011 6:37 AM, Rai Weiss wrote:
>
> > Dennis,
> > Yes, I did misunderstand. I thought there was no cleaning at all after delivery from the

vendors. Now, did read E000007 and see that there are cleaning steps. Infact, one quite aggressive one using Liquinox which could cause trouble for the optic.

The plan to test some large area of optics once for hydrocarbons seems like a good idea before making new rules. If I understand your latest email, that is what you are planning. Given what goes on in optical shops
it is unlikely that there is a serious hydrocarbon contamination but let's revisit this after your gross test.
RW

Sorry Rai, but I did not make myself clear. For now we continue with our currently defined practice which is:
1) clean commercial-off-the-shelf optics with polished barrels per E000007; no bake, no RGA and no FTIR
2) clean commercial-off-the-shelf optics with unpolished barrels per E000007, and then vacuum bake with an RGA

In the interim we are looking into testing a significant surface area (~2000 cm^2) of unpolished optical substrates. For this test we will clean per E000007 and then perform both an FTIR and an RGA test (with only a very low temperature bake to drive off water). If this test indicates that the cleaning alone is sufficient to meet our FTIR and RGA requirements, then I will once again ask the VRB if we can do without baking optics which do not have polished edges/barrels.

Dennis Coyne
Chief Engineer, Advanced LIGO& LIGO Laboratory
MC 18-34, 1200 E. California Blvd.
Pasadena, CA 91125 USA
Telephone 626.395.2034

On 3/2/2011 4:50 PM, Rai Weiss wrote:

Dennis,
I agree, FTIR for large optical parts and RGA for the smaller ones.
RW

On Wed, 2 Mar 2011, Dennis Coyne wrote:

> OK, as I suspected. We will continue with our planned test of the cleanliness of

unpolished optic substrates after cleaning without a bake. These tests will be FTIR and RGA.

Dennis Coyne
Chief Engineer, Advanced LIGO& LIGO Laboratory
MC 18-34, 1200 E. California Blvd.
Pasadena, CA 91125 USA
Telephone 626.395.2034

On 3/2/2011 1:27 PM, Fred Raab wrote:

> Dennis,
>
> I think the reasoning for the spec was that polished edges are relatively small area, easy to clean and easy to inspect. Ground barrels have much larger area, are harder to clean and also generally get less respect in handling (e.g., people seem unable to resist writing on them in pencil, never mind handling with fingers).
>
> So the question I would ask is do we know either:
> 1. That the planned cleaning is known to remove all traces of contaminants to a level similar to what the current procedure achieves; or 2. that the ground edges have been far better treated than typical optics from commercial suppliers.
>
> I think we had confidence that REO in the past was at least as careful in handling mirrors as we were and, of course, fingerprints, smudges, etc., that might signal bad handling would show up more easily upon bright-light inspection. Perhaps a test of the cleaning is more reasonable than faith in the handlers.
>
> Fred
> ---

On 3/2/2011 1:21 PM, John Worden wrote:

> Dennis,
>
> I'll defer to those with more experience with optics but is there a chance that an optic is taken from a dirty lab, processed without baking, and then installed into the vacuum system with insufficient cleaning?

Not any more so than any other vacuum prepared part. After cleaning the optic, we can add a label stating that it is a UHV class A part.

> Perhaps there are already controls on how optics are selected for service?

Besides selecting suitable optics based on their measurements (ROC, etc.), we mark them ready for UHV service after cleaning just like any other part.

> Is an air bake safer than a vacuum bake for these?

I would think so. I think the air/water acts a buffer to prevent/mitigate contaminants from plating onto the optic.

john

On 3/2/11 12:45 PM, Dennis Coyne wrote:

> L1100046-v1
>
> To the VRB:
> Our current (iLIGO) cleaning procedures for in-vacuum commercial optics (other than Core or IO Optics), is E000007 <https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=22937>-x0. The vacuum preparation document, E960022 <https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=3652>-v10, states:
>
> /12.17.1. Fused silica 1” and 2” mirrors and substrates
> For completely polished mirrors from REO (edges also polished!), no baking required. Clean as per E000007.
> For mirrors with ground edges clean as per E000007, then vacuum bake
> at 120 deg C for 48 hours.
> /
>
> I suspect that baking the optics with un-polished barrels/edges is not necessary and simply increases the risk/likelihood that the optical surfaces will have a thin layer of contaminant coated on them from the vacuum bake. There are ~110 in-vacuum optics with un-polished barrels per interferometer but they are relatively small (2" dia x 3/8" th or 1" dia x 1/4" th). Most of these optics are in the HAM1/6 and HAM 7/12 chambers. While HAM1/7 are intended to always be isolated from the main
> vacuum volume, HAM6/12 will likely be opened to the main volume

eventually.

In addition to these small (1" and 2" dia) optics, there are also the Transmission Monitor telescope elements which do not have polished barrels. The primary optic is 230 mm dia x ~50 mm thick. The fold mirror #1 is 160 mm dia x 25 mm thick. The fold mirror #2 is 84 mm dia x 25 mm thick

I suggest that no optics be baked after cleaning. Is this acceptable?

We are looking into the possibility of quickly testing the outgassing rate for unpolished optic substrates (with significant surface area in the bake load, order of 2000 cm^2) as a check.

--
Dennis Coyne
Chief Engineer, Advanced LIGO& LIGO Laboratory
MC 18-34, 1200 E. California Blvd.
Pasadena, CA 91125 USA
Telephone 626.395.2034

--
John Worden
Observatory Manager
LIGO Hanford Observatory
P.O. Box 159
Richland, WA 99352

Office: (509) 372-8136
Fax: (509) 372-8137
worden_j@ligo-wa.caltech.edu
www.ligo-wa.caltech.edu

Shipping address:

LIGO Hanford Observatory
127124 N Rt 10
Richland, WA 99354