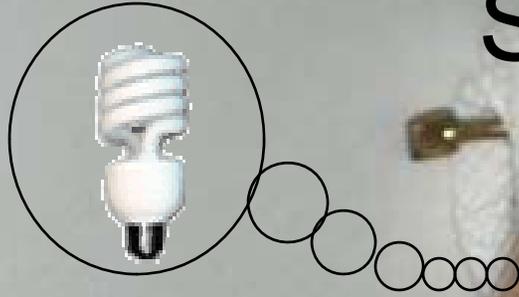


Maine Compact Fluorescent Lamp Study



Deb Stahler, Stacy Ladner, and
Heather Jackson

VERIFY CLEANUP GUIDANCE

- Maine Ambient Air Guidelines [MAAG] of 300 ng/m³
- Venting
- Floor surface
- Vacuuming
- Change Guidance?

Study Room: dimensions 11'4" x 12'1" with 10' ceilings





05.23.2007



JUN 7 2007

Study Design

Floor	Cleanup of Brand A 60 watt equivalent
Wood	No lamp cleanup/ no ventilation
Wood	Ventilate room and clean up glass over $\frac{3}{8}$ " [hardware cloth], clean remainder according to current guidance
Short pile rug	Ventilate room and clean up glass over $\frac{3}{8}$ " [hardware cloth], clean remainder according to current guidance
Long pile "shag" rug	Ventilate room and clean up glass over $\frac{3}{8}$ " [hardware cloth], clean remainder according to current guidance
Short pile rug	Ventilate room and clean up glass over $\frac{3}{8}$ " [hardware cloth], vacuum
Long pile "shag" rug	Ventilate room and clean up glass over $\frac{3}{8}$ " [hardware cloth], vacuum

Additional Scenarios: Pre-Study Guidance

Scenario	CFL Type*	Floor Type	Cleanup
SA	“Brand B” 26w=90watts	Wood	Same as Scenario 2
SB	“Brand C” 13w=60watts	Wood & Short Nap Carpet	Same as Scenario 2
SC	“Brand D” 14w=60watts	Wood	Same as Scenario 2
SD	“Brand A” 14w=60watts	Wood	Same as Scenario 2, except CFL “hot” instead of “cold”
SE	“Brand B” 26w=100watt	Wood	Same as Scenario 2
SF	“Brand B” 26w=100watt	Wood	Same as Scenario 2, except vent for 46 minutes before cleanup
SG	“Brand D” 23w=100watt	Wood	Same as Scenario 2, except vent for 11 minutes before cleanup
SH	“Brand E”, 15w=60watt	Wood	Same as Scenario 2, except vent for 7 minutes before cleanup
SI	“Brand F” R30 15w=50watt	Wood	Same as Scenario 2, except vent for 5 minutes before cleanup
SJ	“Brand A” 14w=60watt	Wood	Same as Scenario 2, except CFL cracked instead of thoroughly broken

Additional Scenarios: Vacuuming

Scenario	CFL Type*	Floor Type	Cleanup
SK	"Brand B" 26w=90watts	Long pile "shag" rug	Same as Scenario 6
S5T3 Re- vacuum	Previously cleaned "Brand A" 14w=60watt	Short pile rug from S5T3	No venting, Re-vacuum once
SB Vac1	Previously cleaned "Brand C" 13w=60watts	Short pile rug from SB	No venting, Vacuum four times
SB Vac2			
SB Vac3			
SB Vac4			
SL Vac1	"Brand B" 26w=100watt	Short pile rug	No venting, Clean up big pieces and put in room trash, Vacuum rest of debris and leave in room. Vacuum four times.
SL Vac2			
SL Vac3			
SL Vac4			



05.29.2007



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Container Study: Phase 1

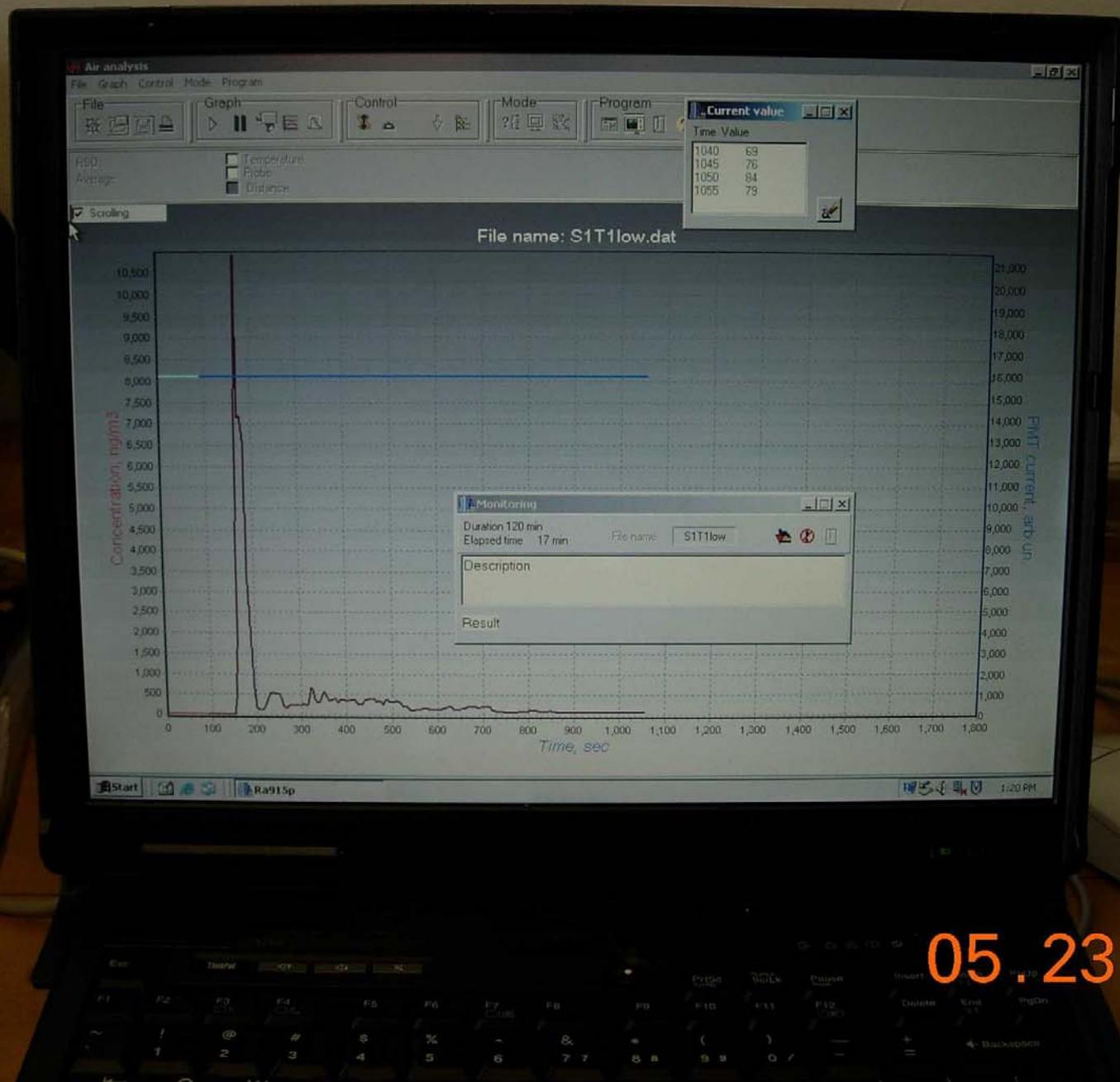
1 gal #2 plastic Joint Compound bucket/ plastic snap on lid
Amber glass jar/ plastic screw on lid
Double re-sealable polyethylene storage bags
Gladware®
Glass peanut butter jar/ metal screw on lid w/ gum seal
Glass pickle jar/ metal screw on lid w/ gum seal
Mason jar/ metal screw on lid w/ gum seal
Metal tea tin/ metal push on lid
Paint can/ metal push on lid
Plastic peanut butter jar/ plastic screw on lid
Plastic yogurt / plastic snap on lid
Tidy Cats Cat Litter #2 plastic/ plastic screw on lid

Container Study: Phase 2

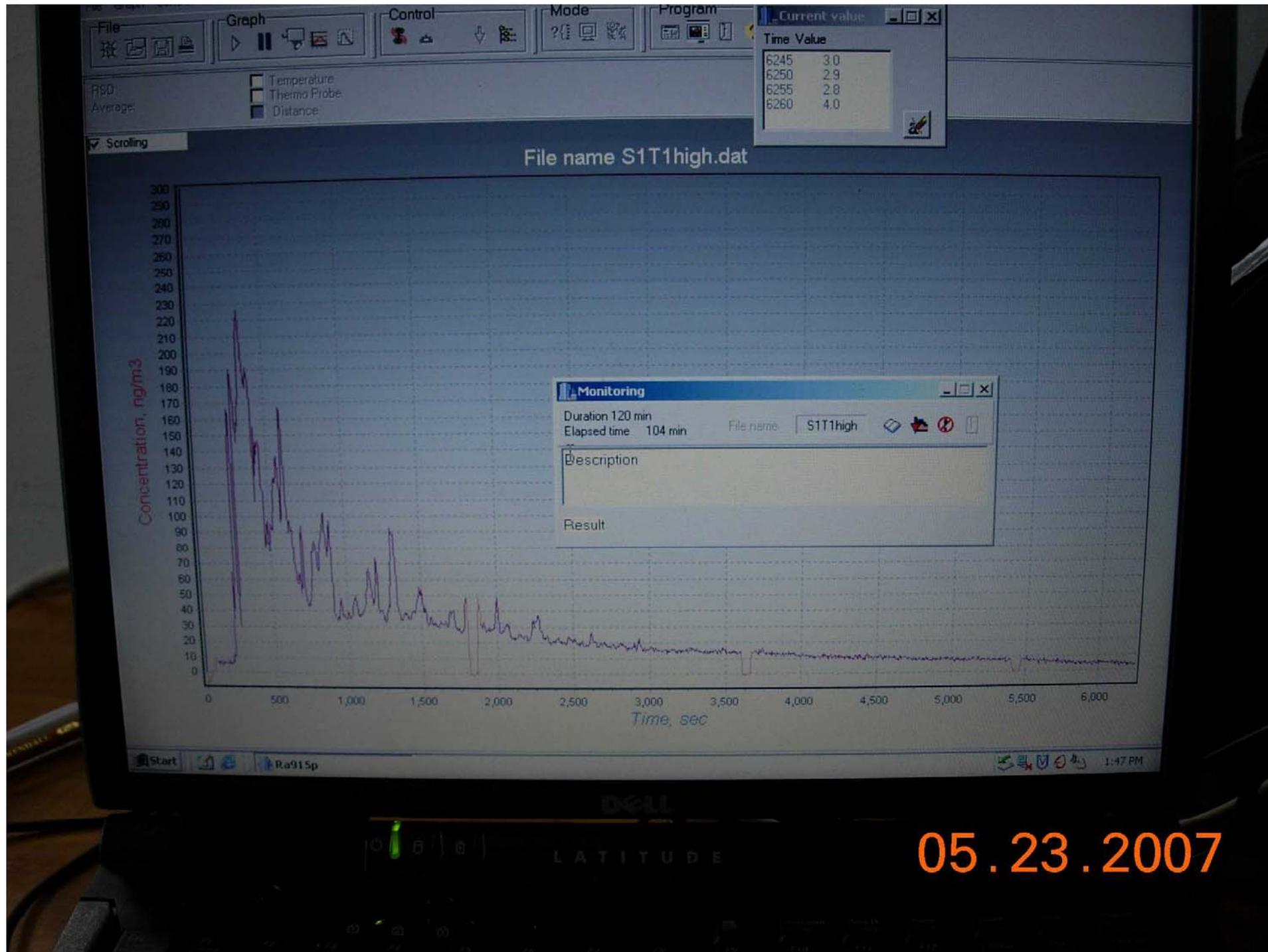
Container	CFL
Double re-sealable polyethylene bags	“Brand B” 26w = 100w
Double re-sealable polyethylene bags	“Brand D” 14w = 60w
Glass peanut butter jar/ metal screw on lid w/ gum seal	“Brand B” 26w = 100w
Glass peanut butter jar/ metal screw on lid w/ gum seal	“Brand D” 14w = 60w

Quality Control for Study

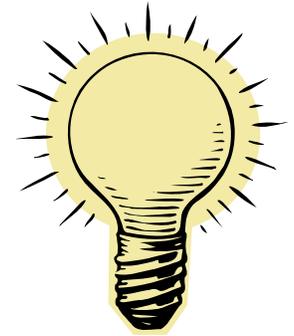
- **Follow standard procedures**
- **Control variables**
- **Monitor temperature**
- **Instrument calibration and background checks**
- **Decontamination procedures**
- **Replicate trials**
- **Data files**



05.23.2007

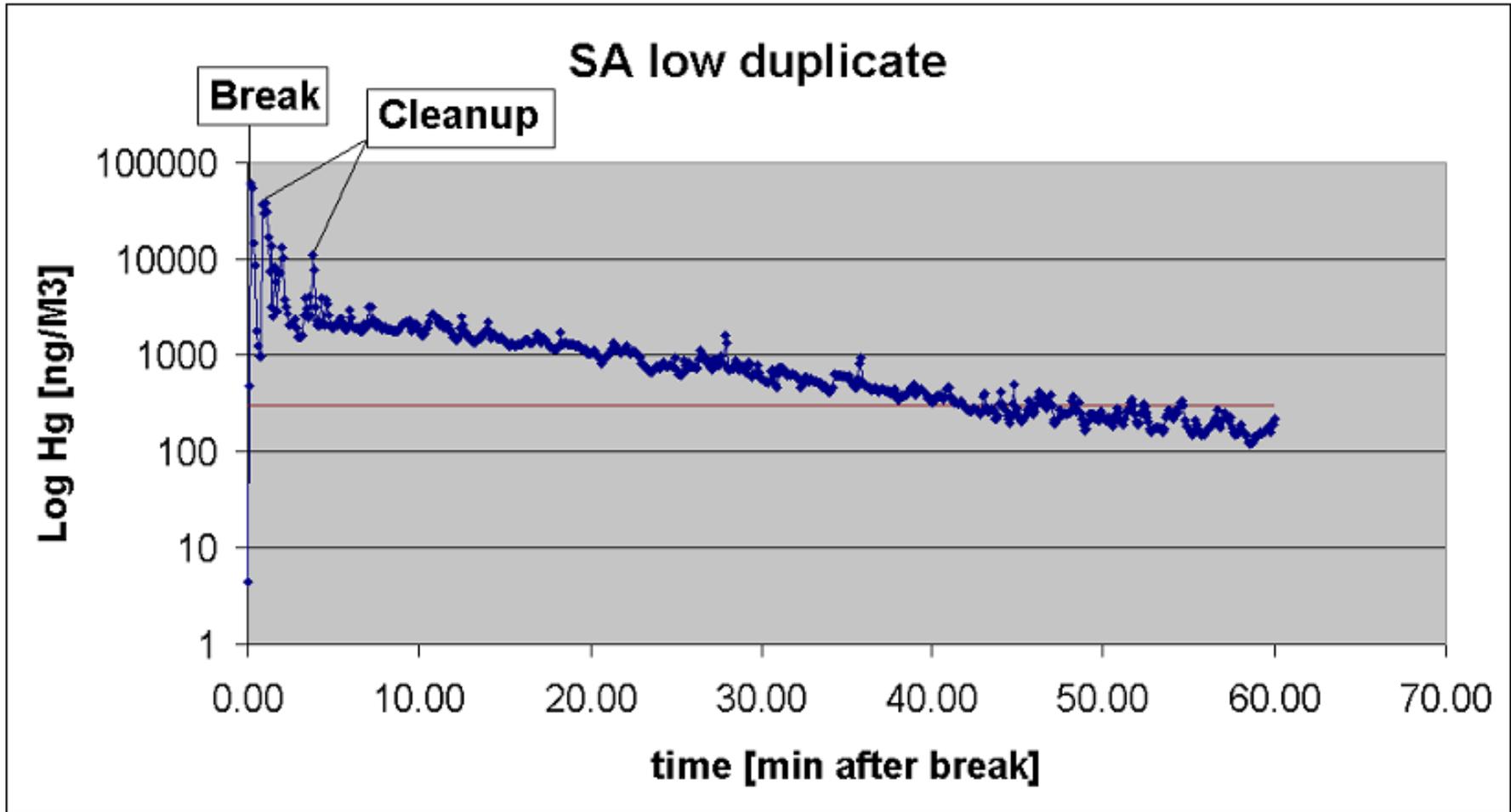


Study Findings



- Venting room after CFL break dramatically reduces concentration of mercury in room
- Results variable depending on amount of ventilation, lamp brand/type, etc.
- A mercury source still can exist in flooring, which when agitated either through use, or vacuuming, can cause mercury to emit in the immediate area of breakage and can result in elevated mercury concentrations in the room weeks and months after the CFL break is cleaned up.
- The study identified better containers for controlling fugitive mercury emissions from cleanup debris.

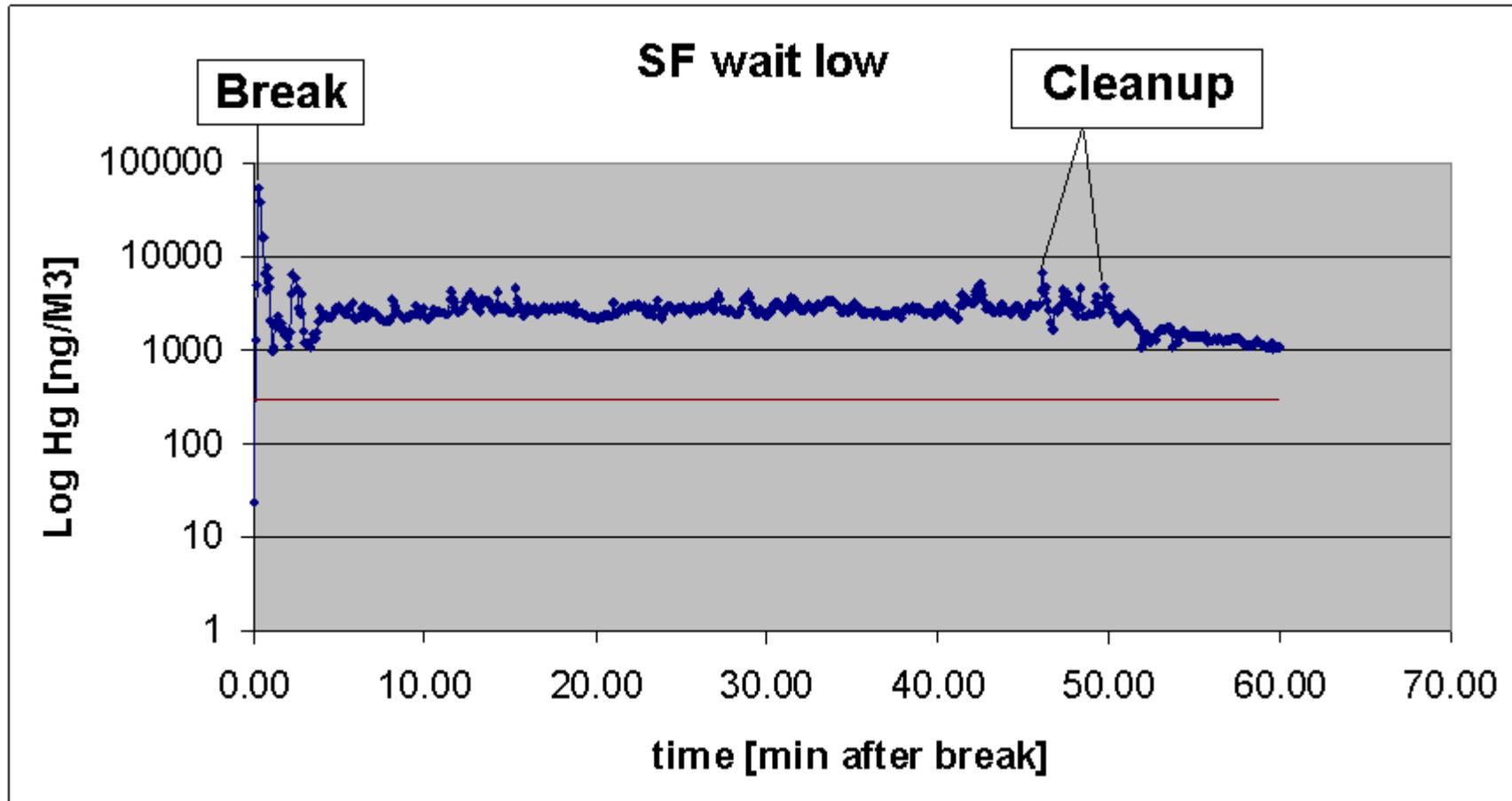
Why wait to clean up?



1 Minute Wait

Based on study results, waiting 15 minutes looks reasonable

Waiting 46 Minutes



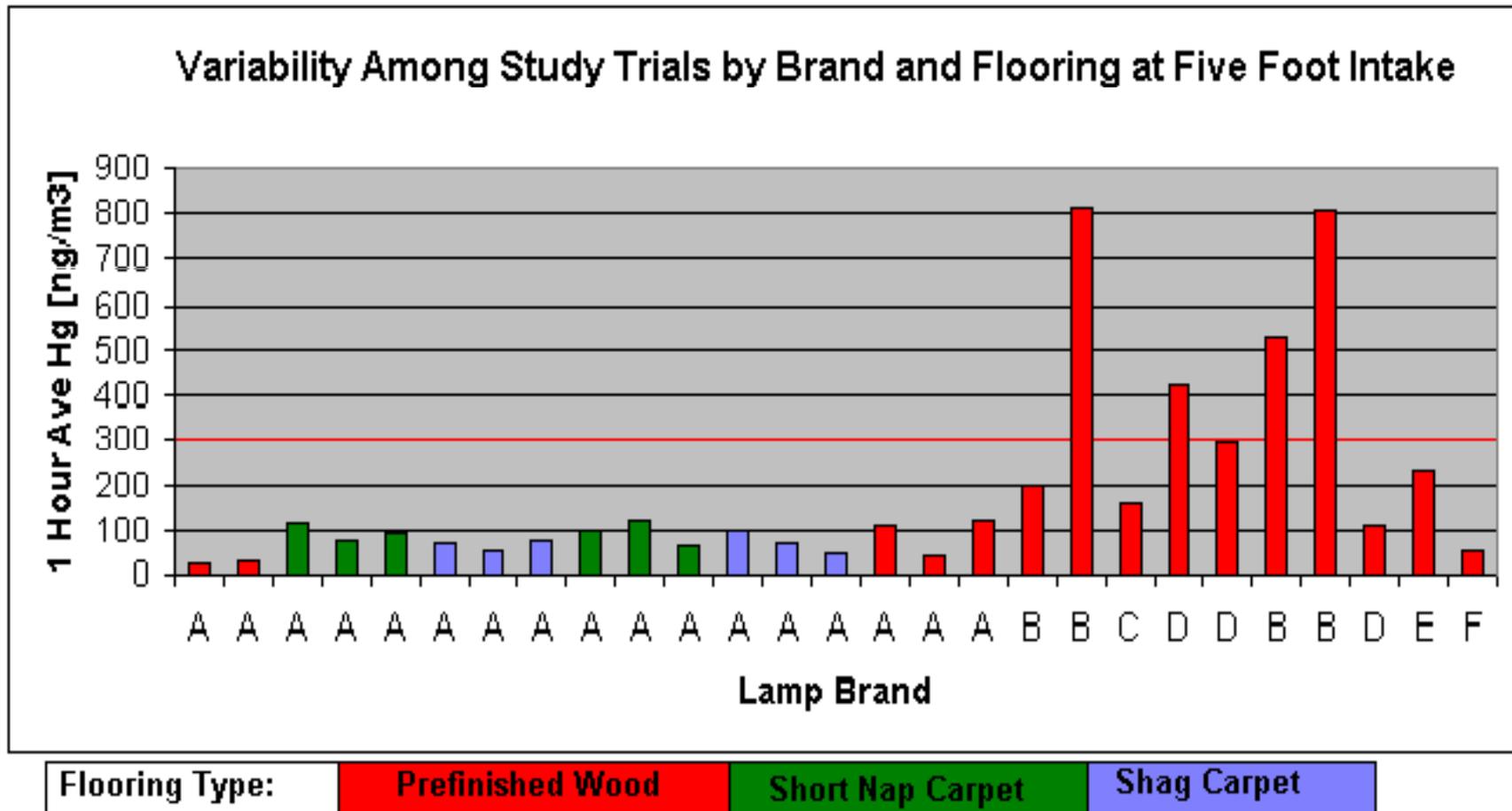
Waiting longer like this, not recommended

Variability in Results

- Air currents
- Adjacent room ventilation
- Lamp brands
- Possibly lamp types, but not enough data
 - Amalgam
 - Non amalgam
 - Different wattages
 - Duds
- Vacuum types
- Flooring surfaces
- Temperature
- Clean up technique
 - Thoroughness
 - Missed particles
- Agitation of area (how will area of break in the home be used?)
 - High traffic area, hallway?
 - Close carpet use such as in front of TV?)
- Combination of factors



Variability



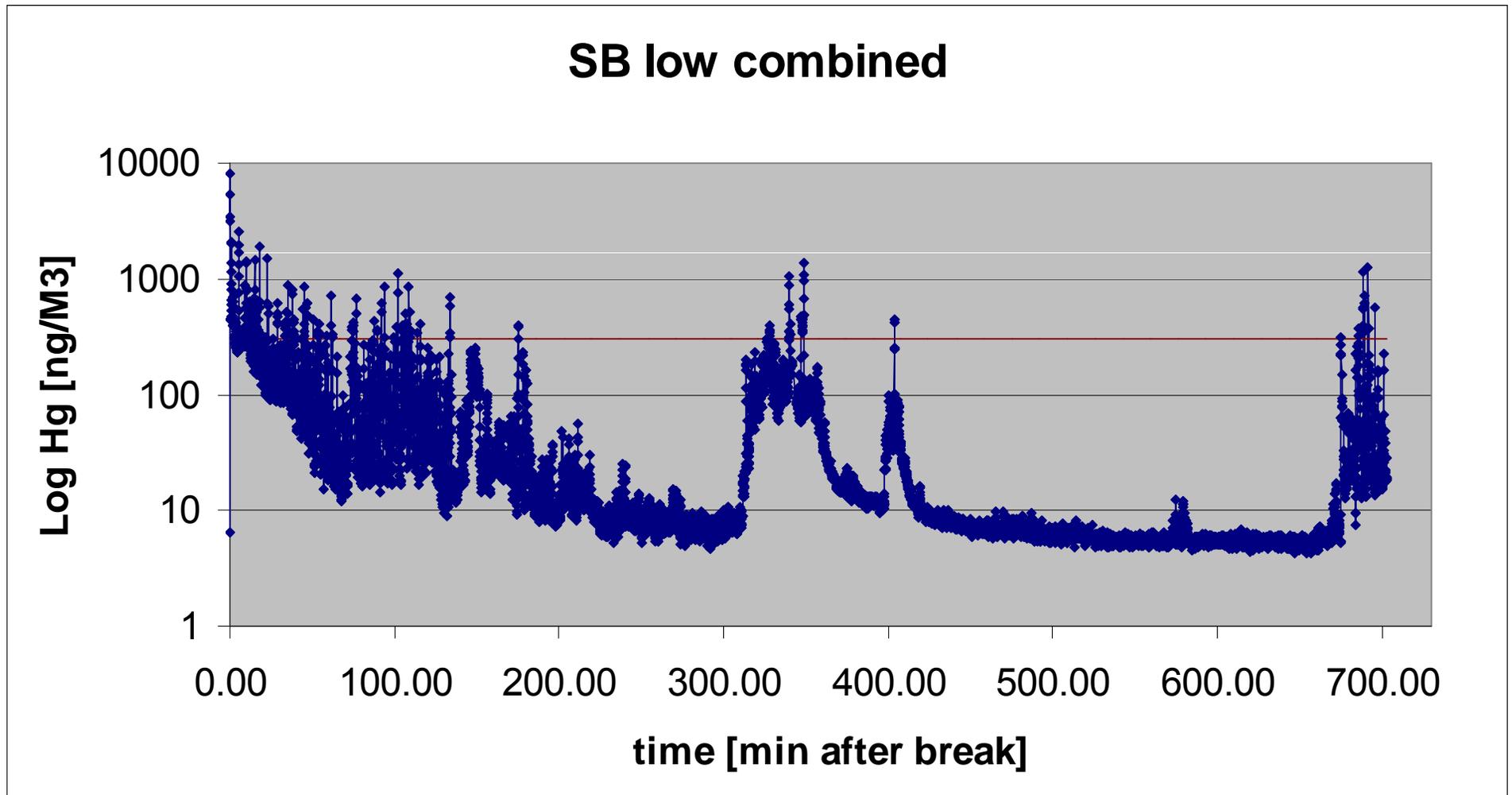
All trials in this slide were vented

Amalgam Technology

- **Pellet dosing:** accurately dosing lamps with a “solid” form of mercury
- **Mercury vapor control**
Special use lamps:
 - Dimmable
 - Enclosed Fixtures
 - Extended temperature range



Example of “Spiking” from Mercury Sources in Carpet

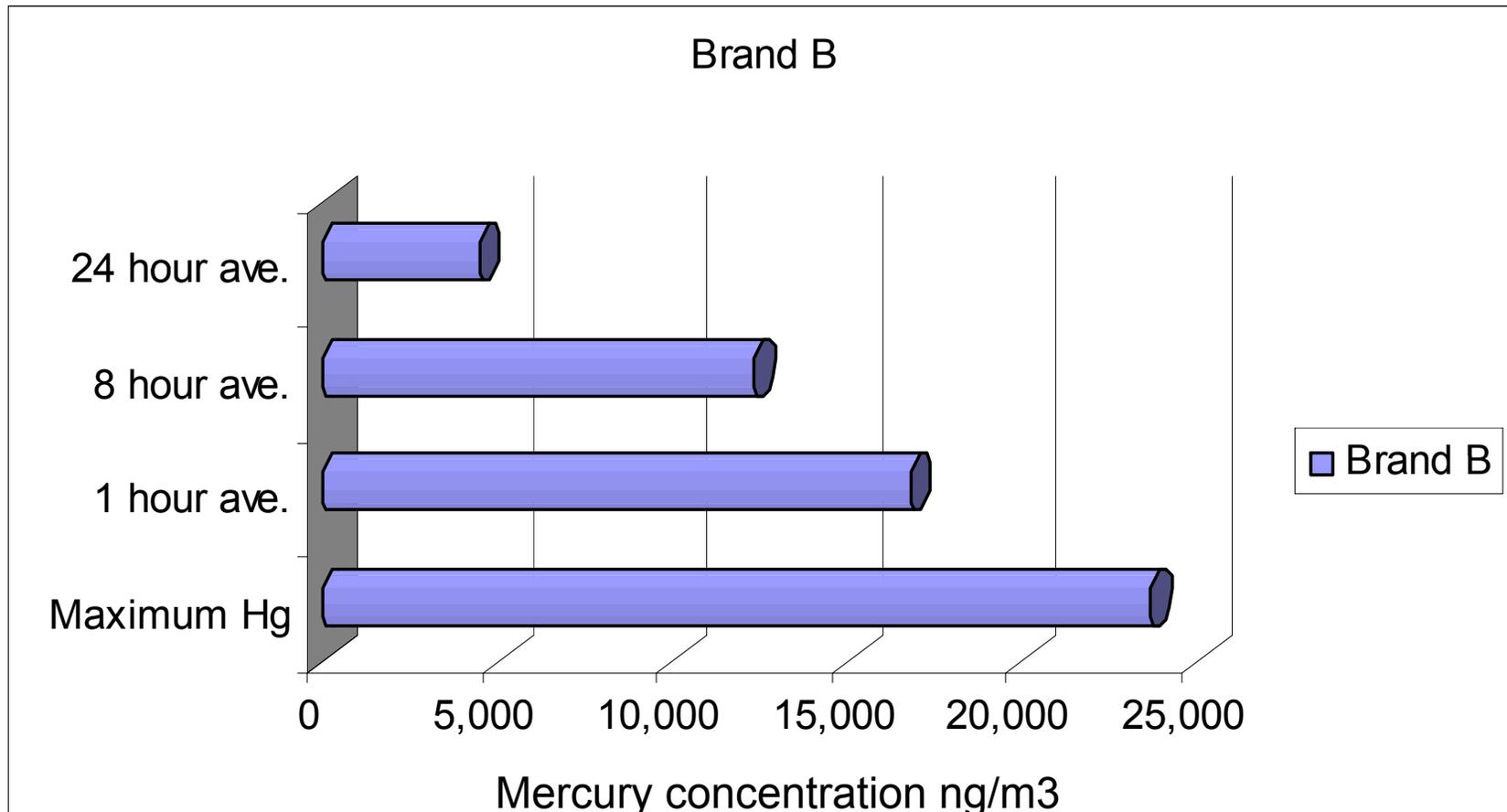




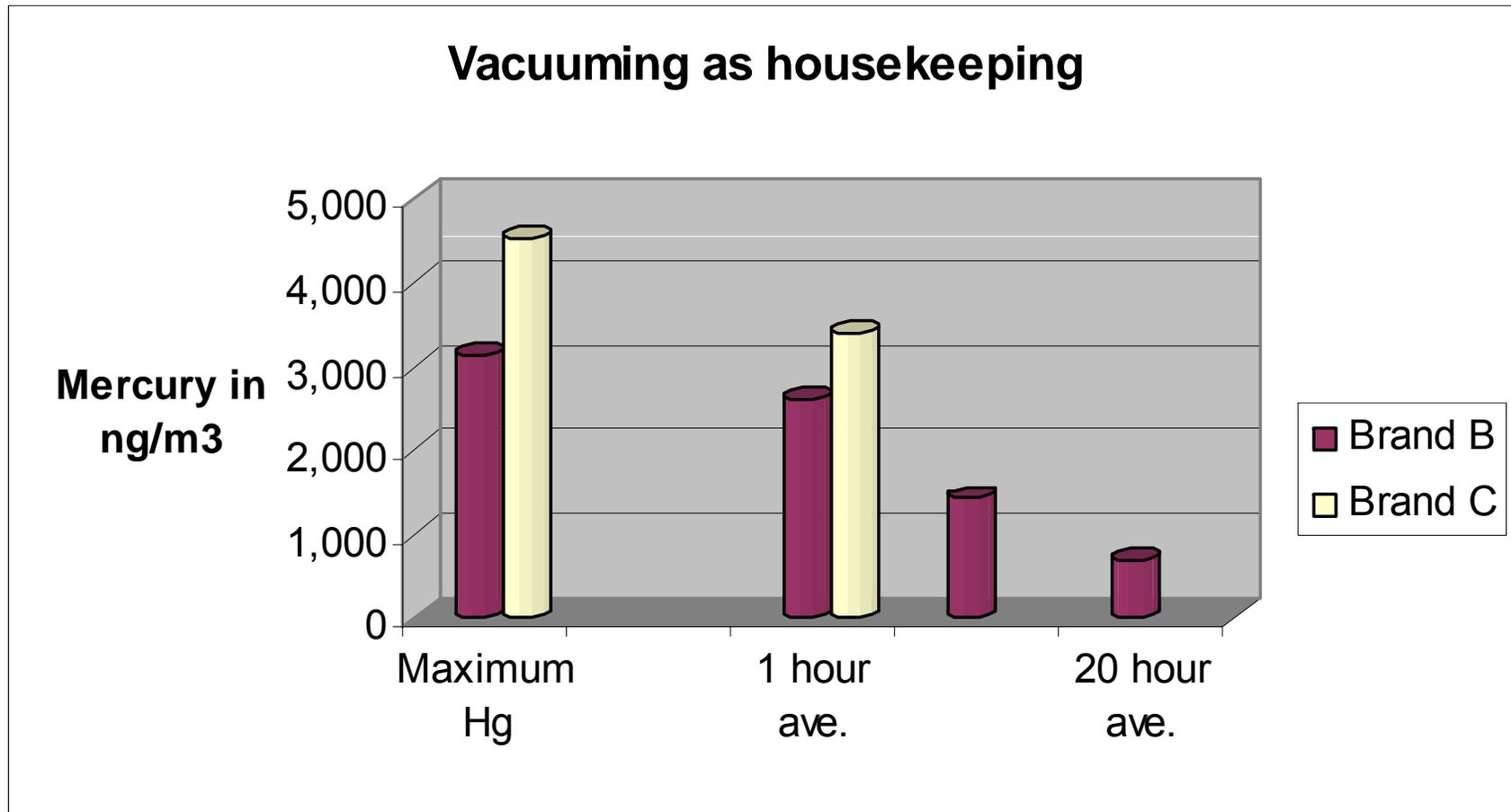
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Vacuuming Story

- Vacuuming as clean up technique, an attempted worse case scenario. Unventilated room on short pile carpet at 5 foot height.



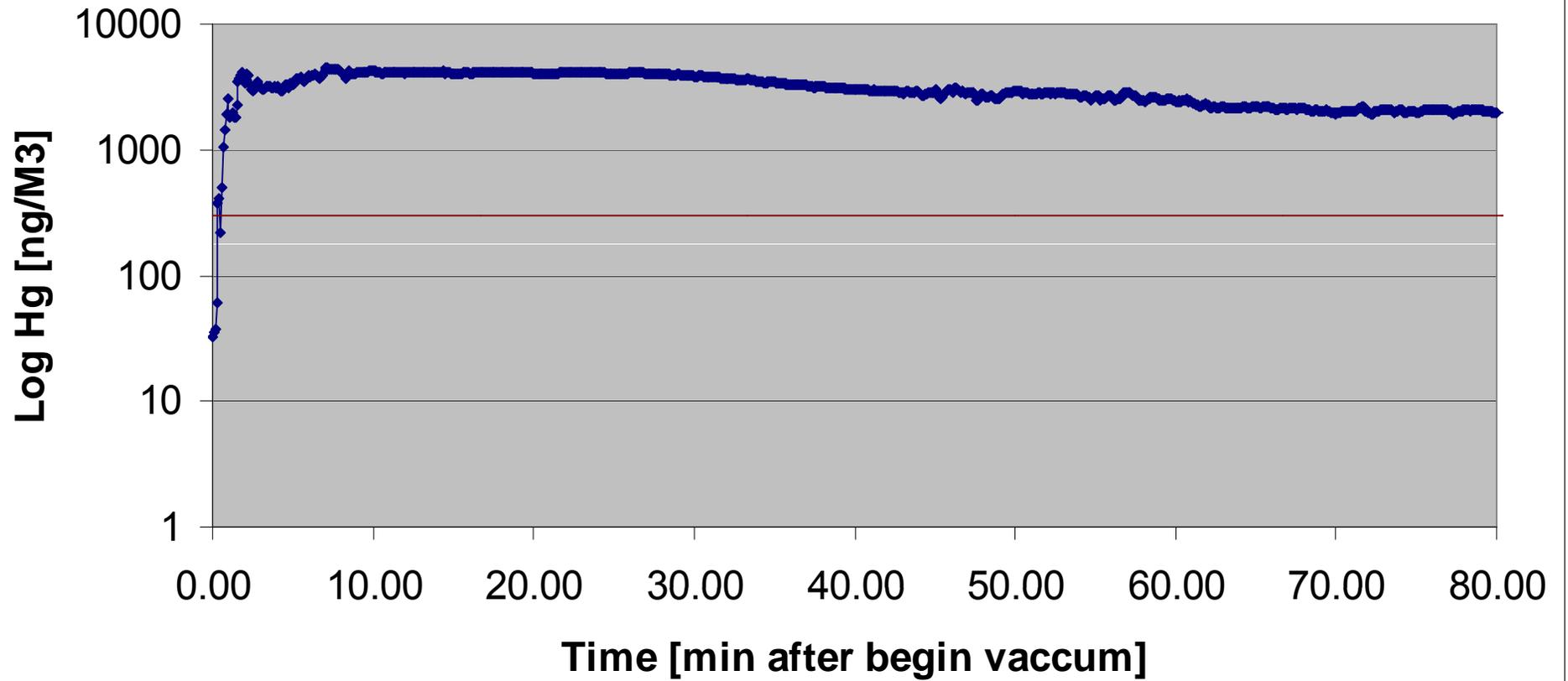
First vacuum after break in unventilated room on short nap carpet at 5 foot height



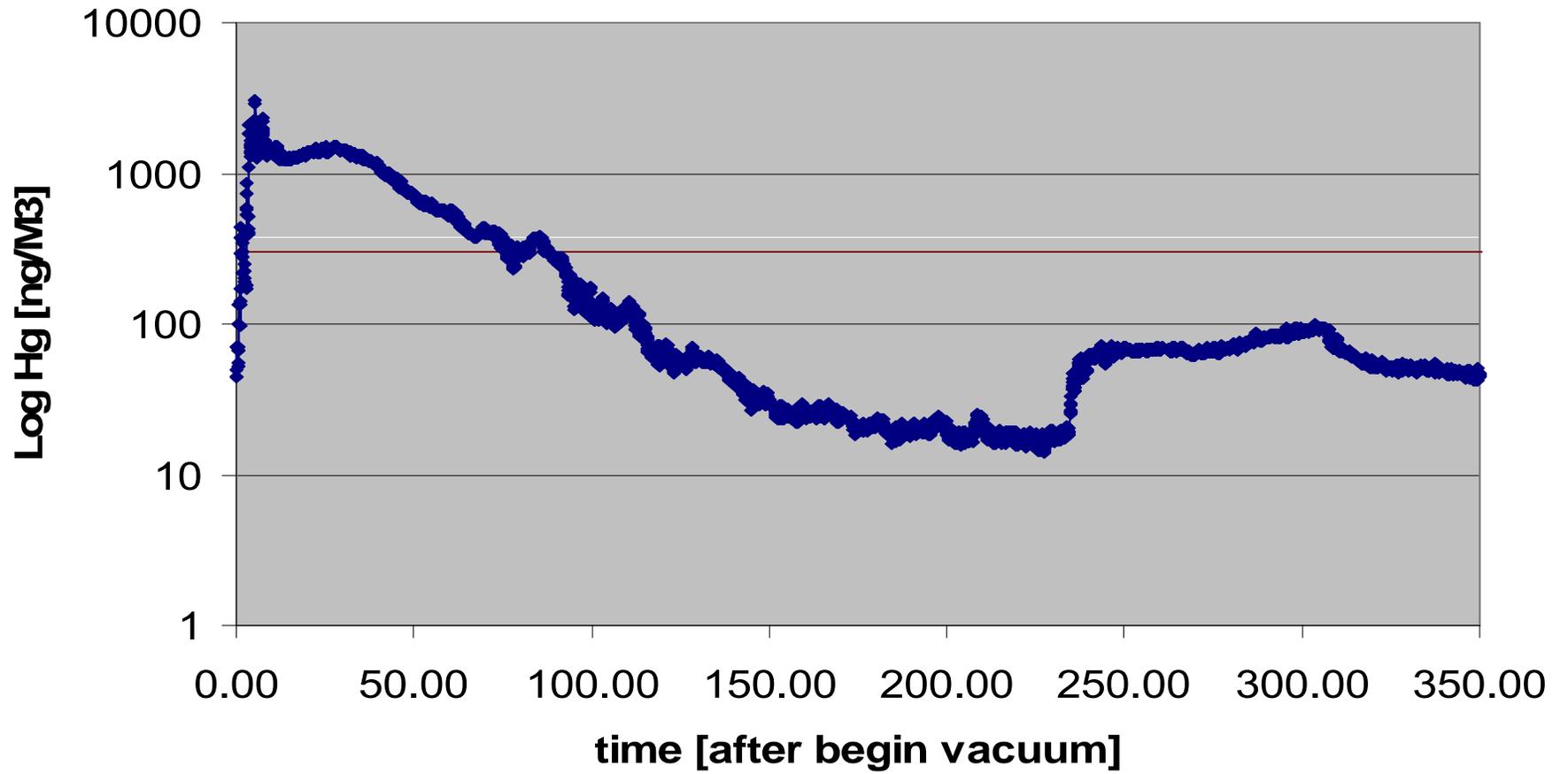
Vacuuming as regular housework, example:

- Short pile carpet cleaned up 3 weeks prior to first vacuum
- Not worst case lamp type
- This first time vacuumed, the vacuum was contaminated with over 50,000 ng/m³ and the mercury in the breathing zone hung in the 4,000 to 2,000 ng/m³ range for over two hours.
- The second time vacuumed, the mercury in the breathing zone hung around 1,500 to 500 ng/m³ for an hour and a half.
- The third time vacuumed, the mercury in the breathing zone hung over 600 ng/m³ for over two hours/ over 300 ng/m³ for over three hours.

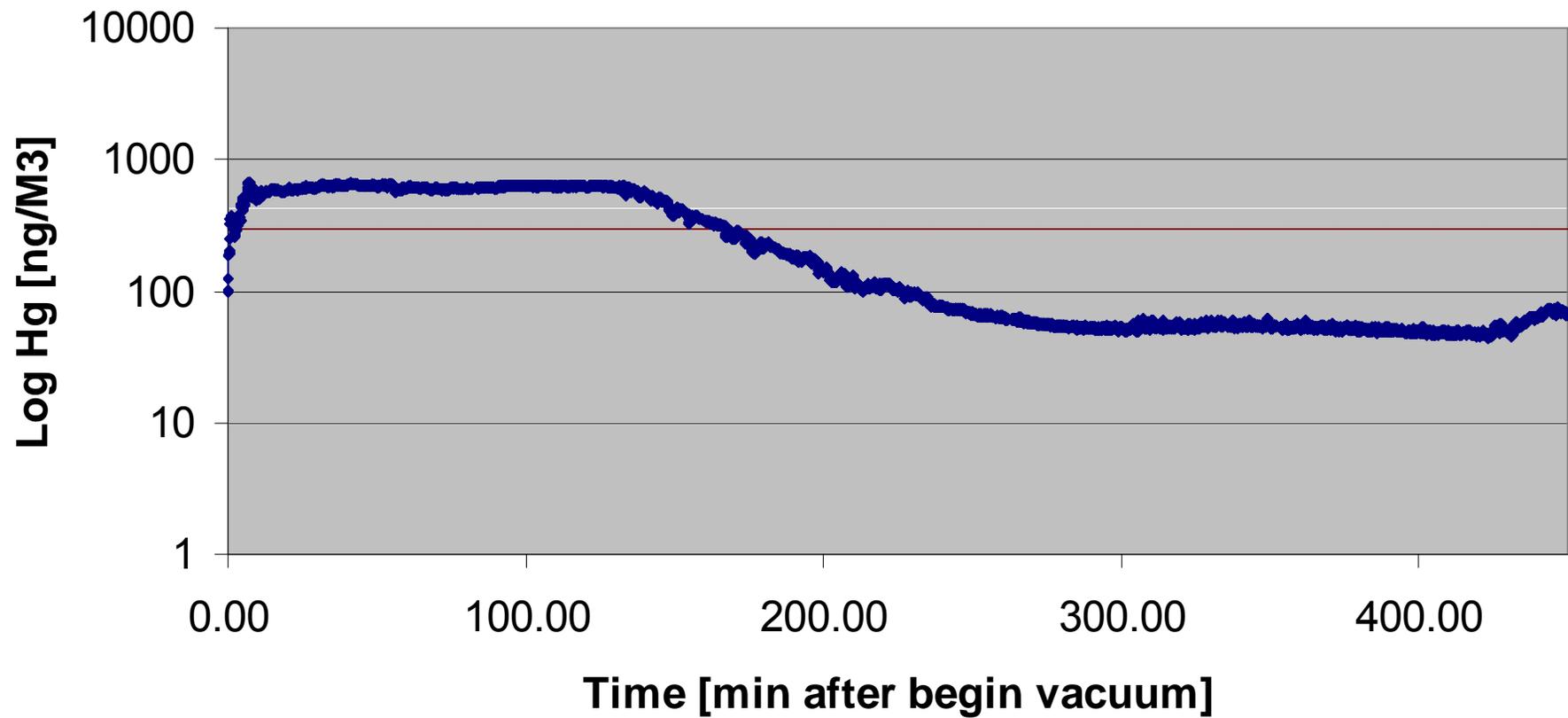
SB high 1st Vacuum



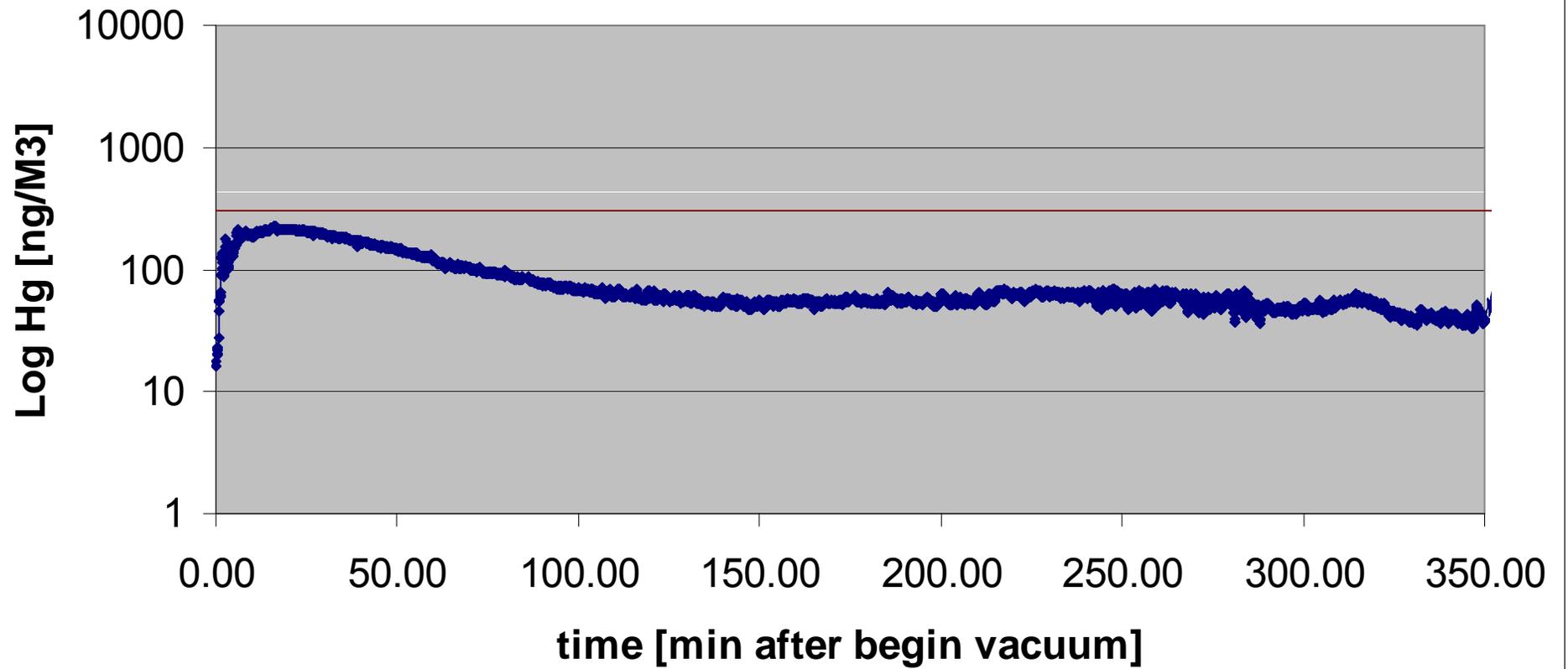
SB high 2nd Vacuum



SB high 3rd Vacuum



SB high 4th vacuum





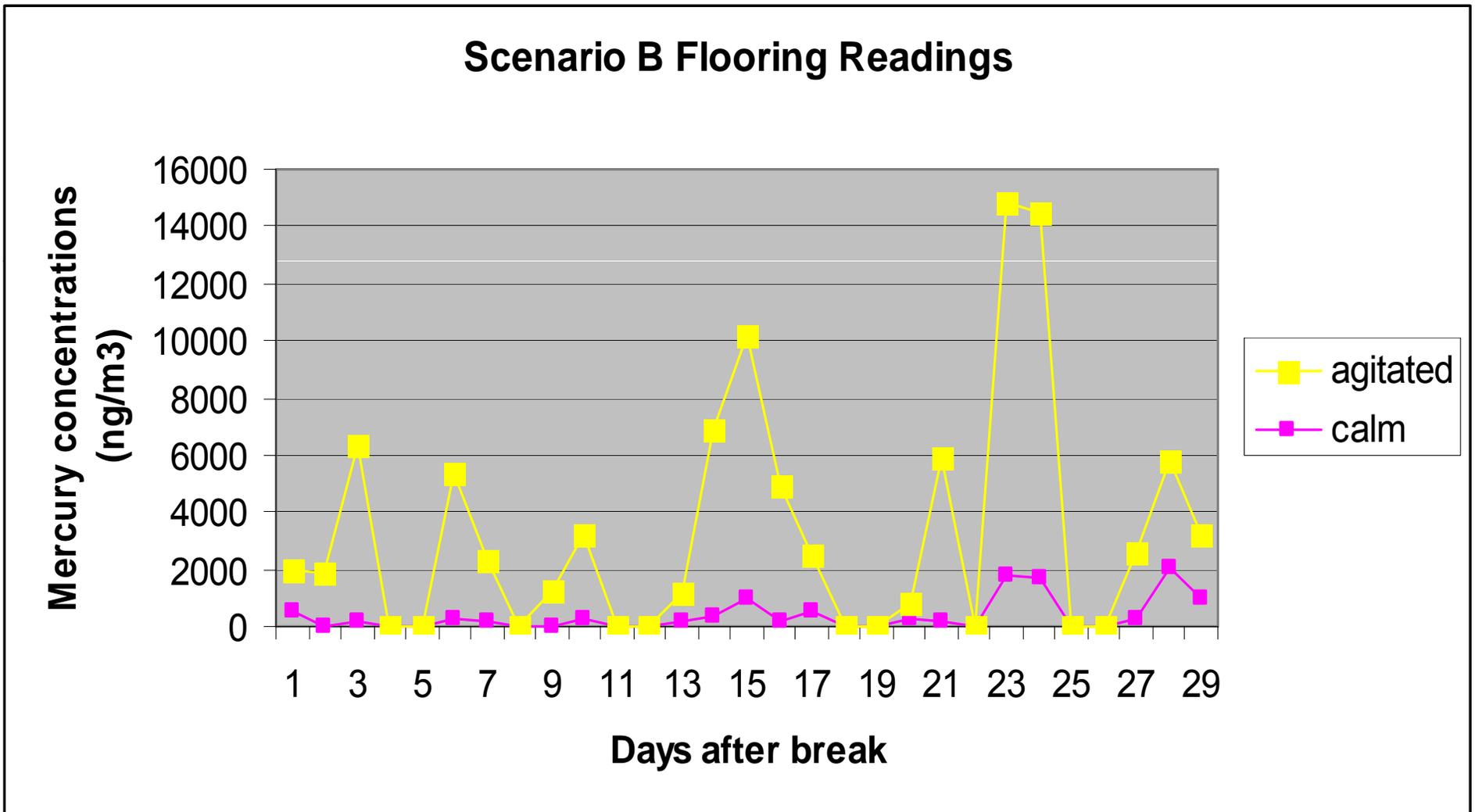
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Flooring Surfaces

- Tested wood, short nap and shag carpets
- All visibly clean
- Some cleared to $<20 \text{ ng/m}^3$ with clean up and venting
- All have higher readings with agitation
- Some were not cleared after a month, with clean up and repeated vacuuming, example:

SB Carpet Date↓	Unagitated carpet Mercury 1" above (ng/m³)	Agitated carpet Mercury 1" above (ng/m³)	Vacuumed?
6/27/07	1,004	9,197	
6/28/07	207	4,697	
6/29/07	544	1,983	
7/2/07	233	570	
7/3/07	195	5,694	vacuumed
7/5/07	1,803	13,010	
7/6/07	1,686	12,750	vacuumed
7/9/07	253	2,317	vacuumed
7/10/07	2,077	3,717	vacuumed
7/11/07	959	2,297	
7/26/07	141	2,275	
7/27/07	265	4,593	
7/30/07	160	2,652	
7/31/07	102	3,301	
8/1/07	75	6,019	
8/2/07	226	1,876	
8/3/07	1,202	1,696	
8/7/07	318	540	
8/9/07	524	13,030 (in sun)	
8/10/07	79	456	

Effect of agitation

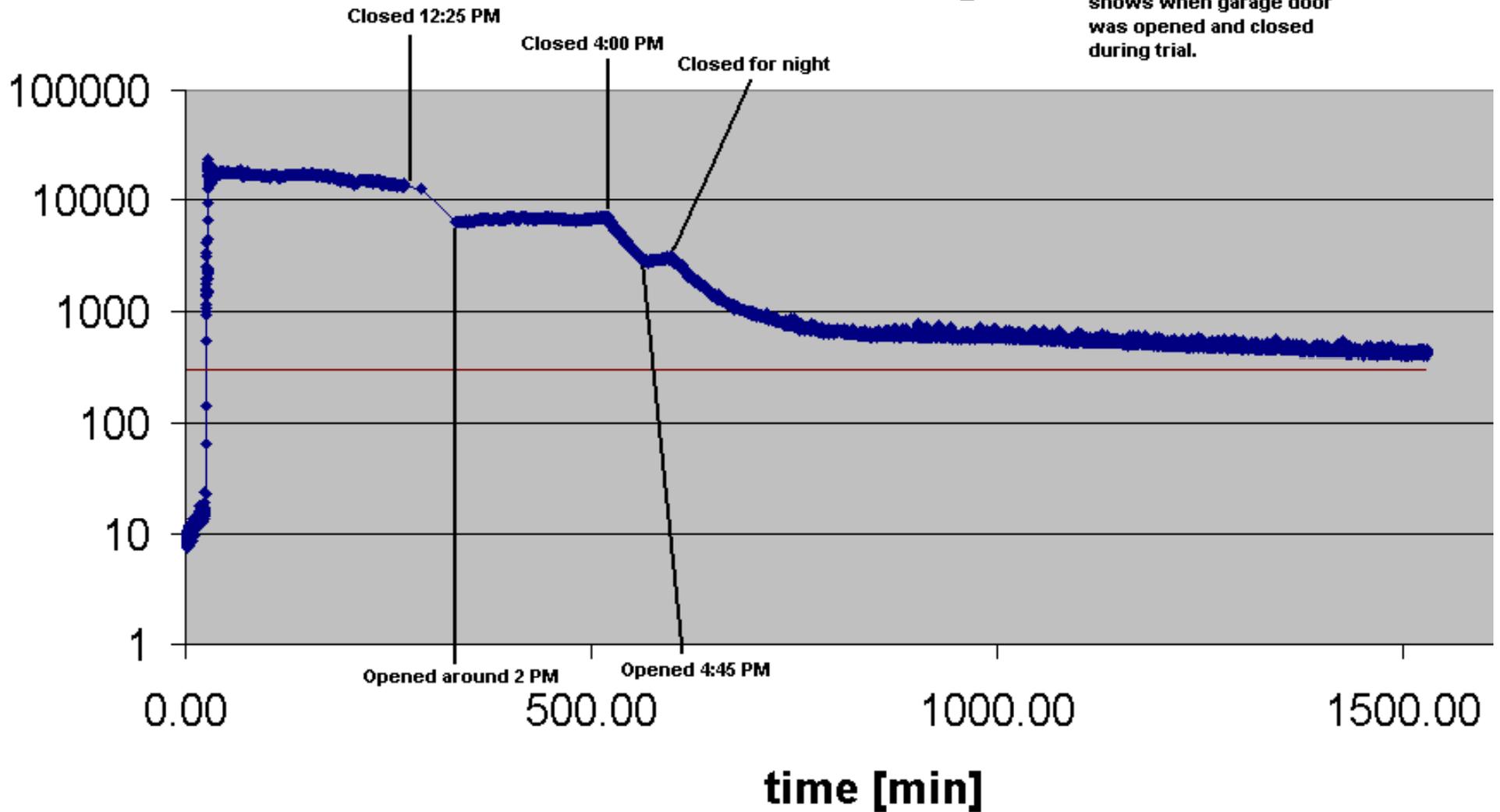


Unintended Venting

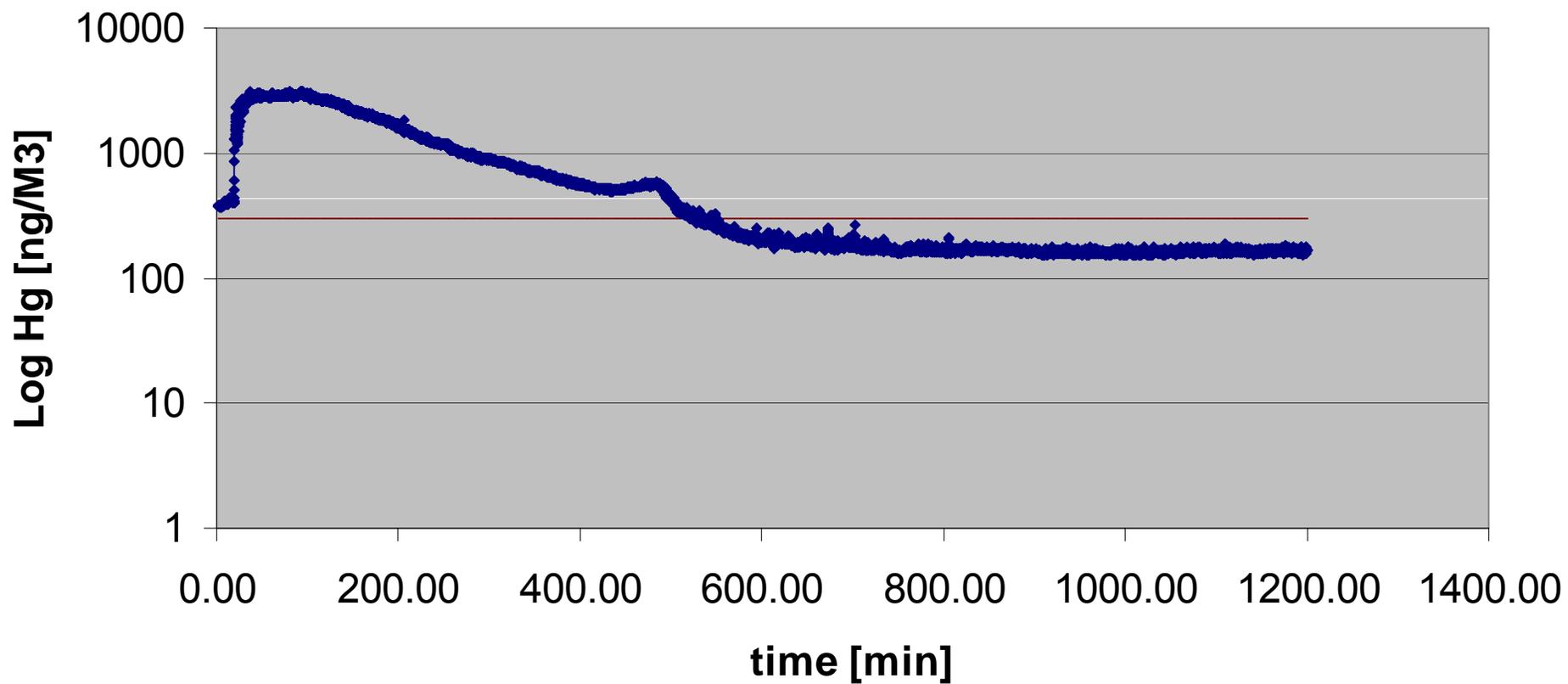


SL 1st vac nv high

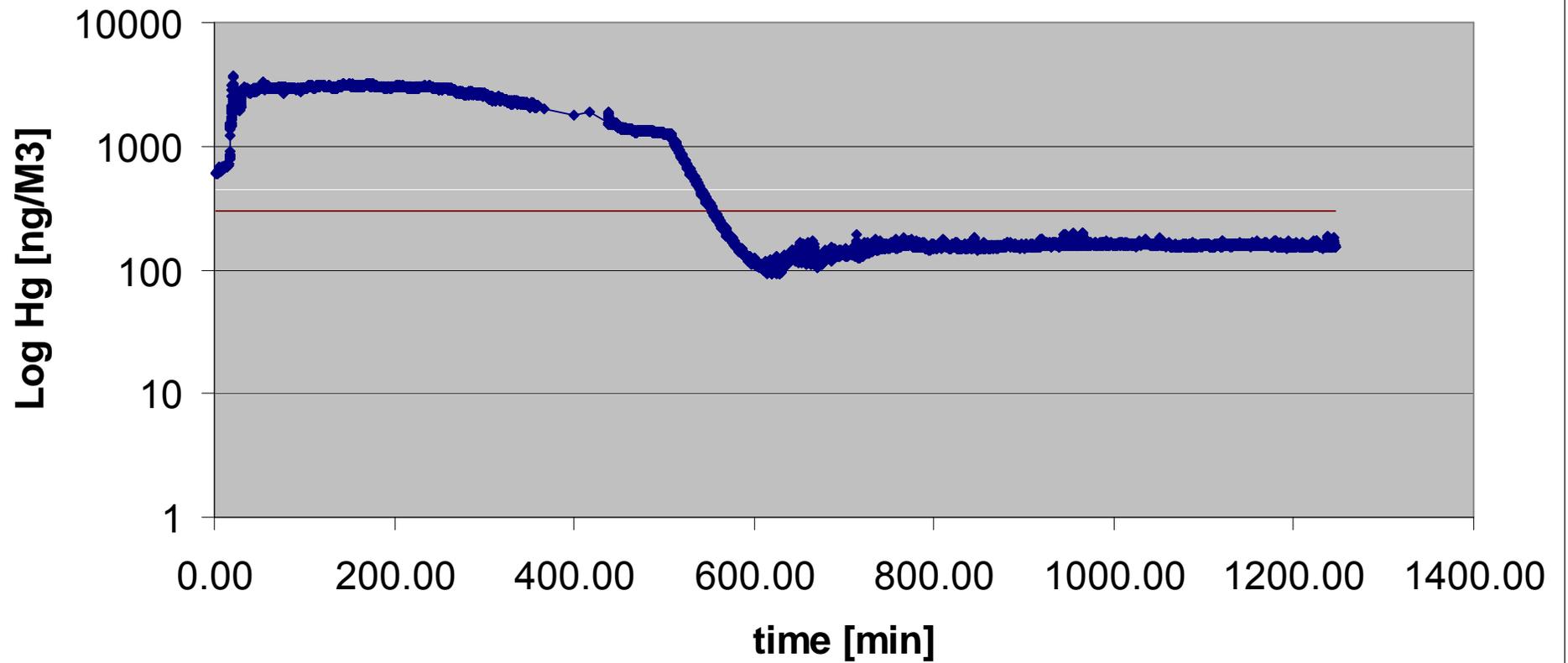
Overhead garage door open at beginning of trial. Graph shows when garage door was opened and closed during trial.



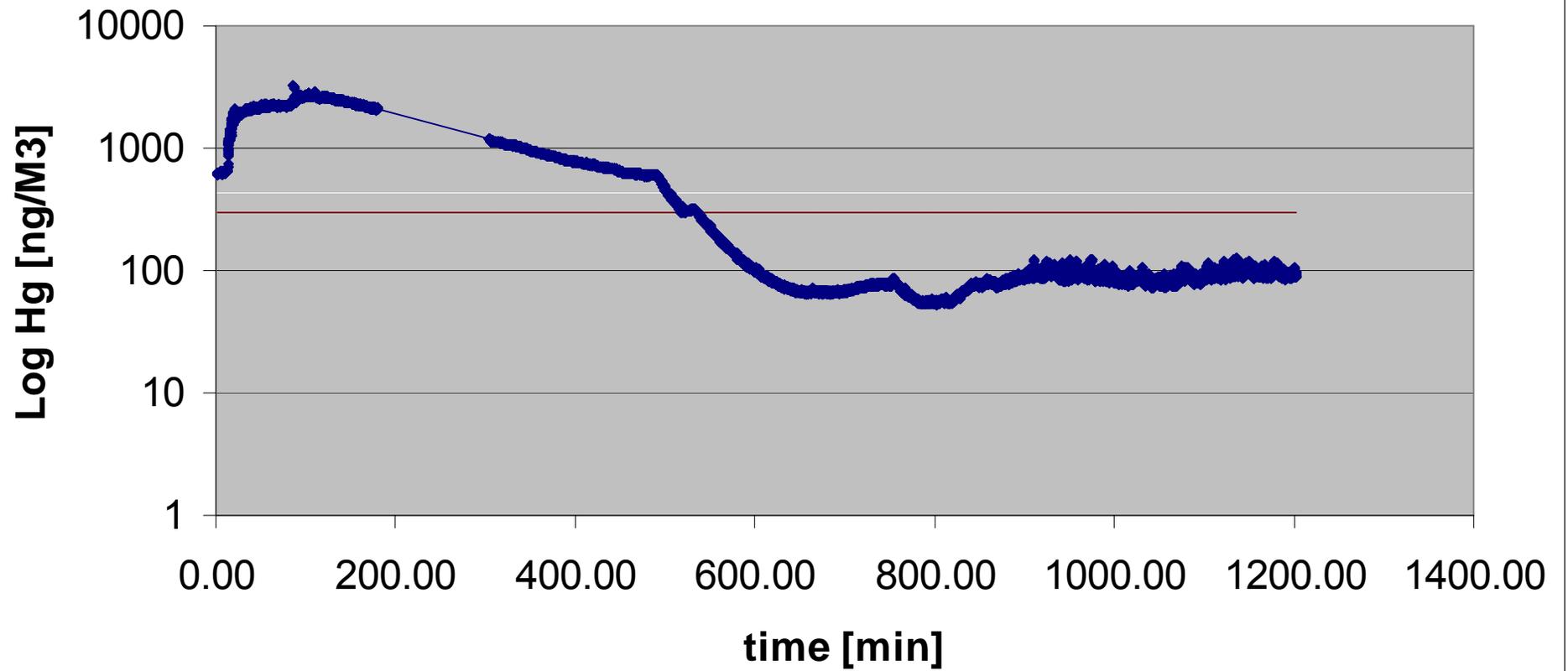
SL-2nd vac nv high



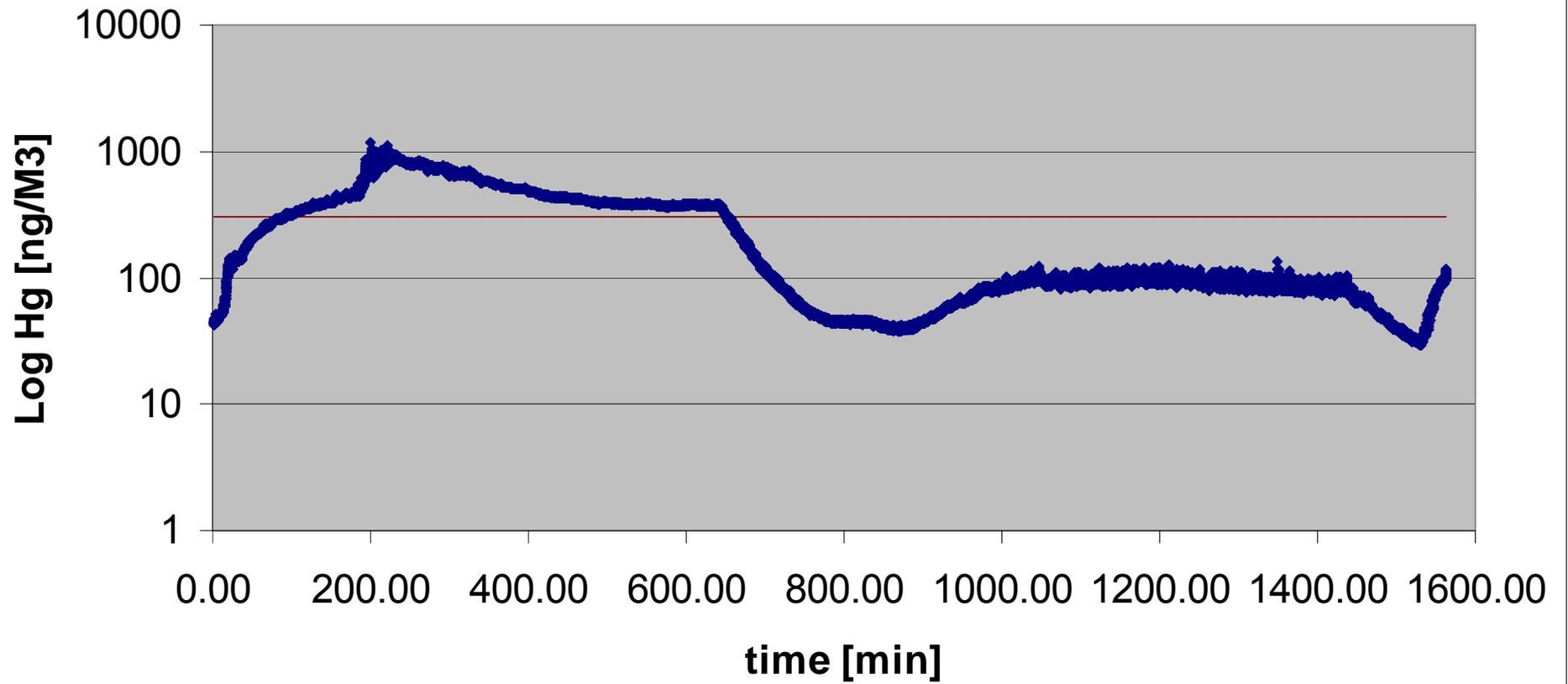
SL-3rd vac nv high



SL-4th vac nv high



SL carpet combined high



SL Brand B 100 No Venting Date↓	Un-agitated carpet Mercury 1" above surface (ng/m ³)	Agitated carpet Mercury 1" above surface (ng/m ³)	Vacuumed?
7/19/07			vacuumed
7/23/07			vacuumed
7/24/07	862	>50,000	vacuumed
7/25/07	690	37,000	vacuumed
7/26/07	990	13,200	
7/27/07	10,505	29,000	
7/30/07	392	7,795	
7/31/07	912	21,070	
8/1/07	310	16,708	
8/2/07	2,116	12,170	
8/3/07	2,691	7,382	
8/7/07	2,033	14,536	
8/9/07	433	4,183 (in shade)	
8/10/07	551	7,456	43



Figure A-112.
Containers



Re-sealable Plastic Bags



Canning Jar





JUN 27 2007

Glass jar with metal screw lid, rubber seal

Date/Time	Hg In 5 gallon pail (ng/m³)	Hg In room (ng/m³)
7/6/07 8:25 am	< 20	
9:35 am	< 20	
11:05 am	32	
1:34 pm	< 20	
2:45 pm	< 20	
7/9/07, 6:30 am	11,700	
7/10/07, 5:30 am	7,639	
3:00 pm	5,593	
7/11/07, 10:05 am	Moved to room, measure at 5'	33
10:15 am		20.3
12:10 pm		< 20
3:05 pm		20.7
5:00 pm		30
7/12/07, 4:00 pm		< 20
7/18/07, 6:30 am	remained below 20 ng/m³	< 20



← Canning Jar

Best Containers



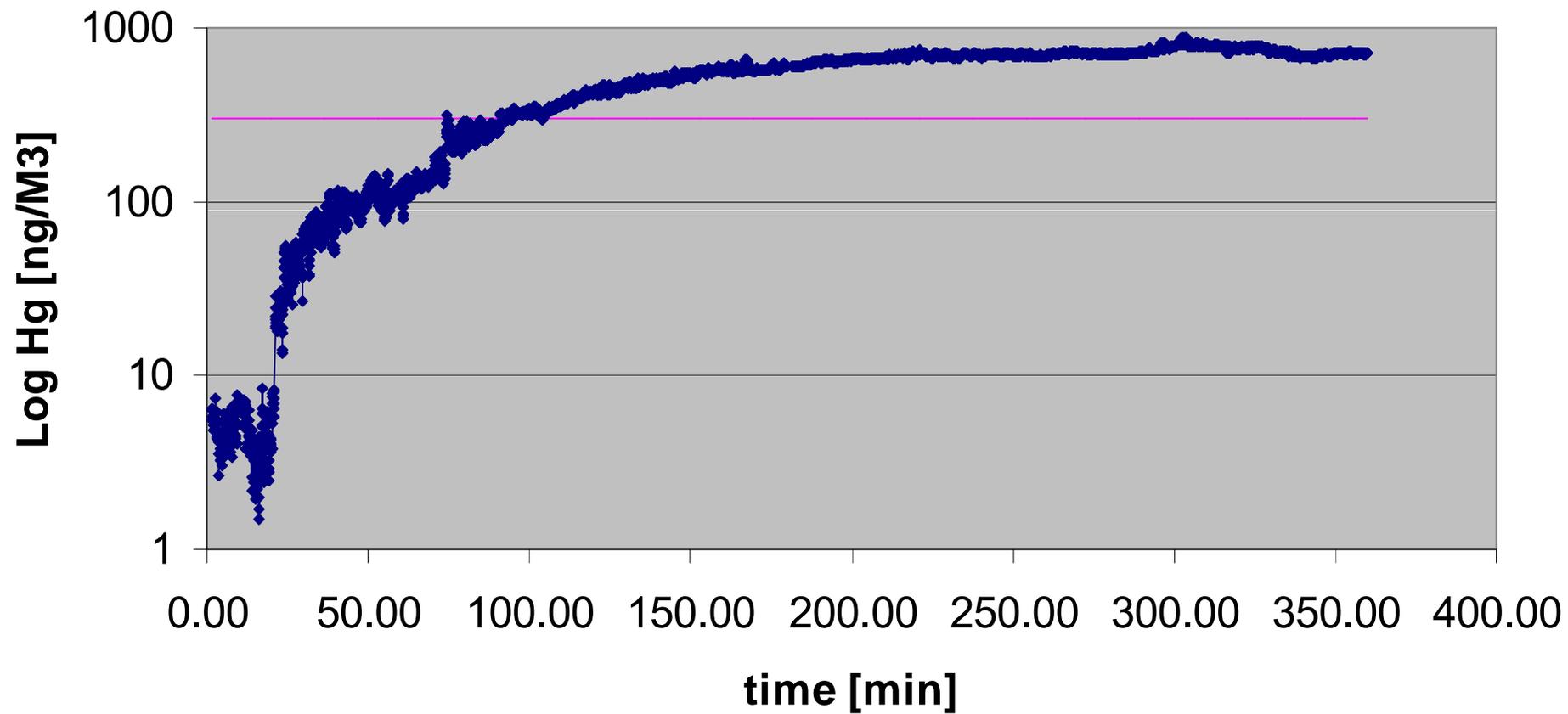
Peanut Butter Jar →



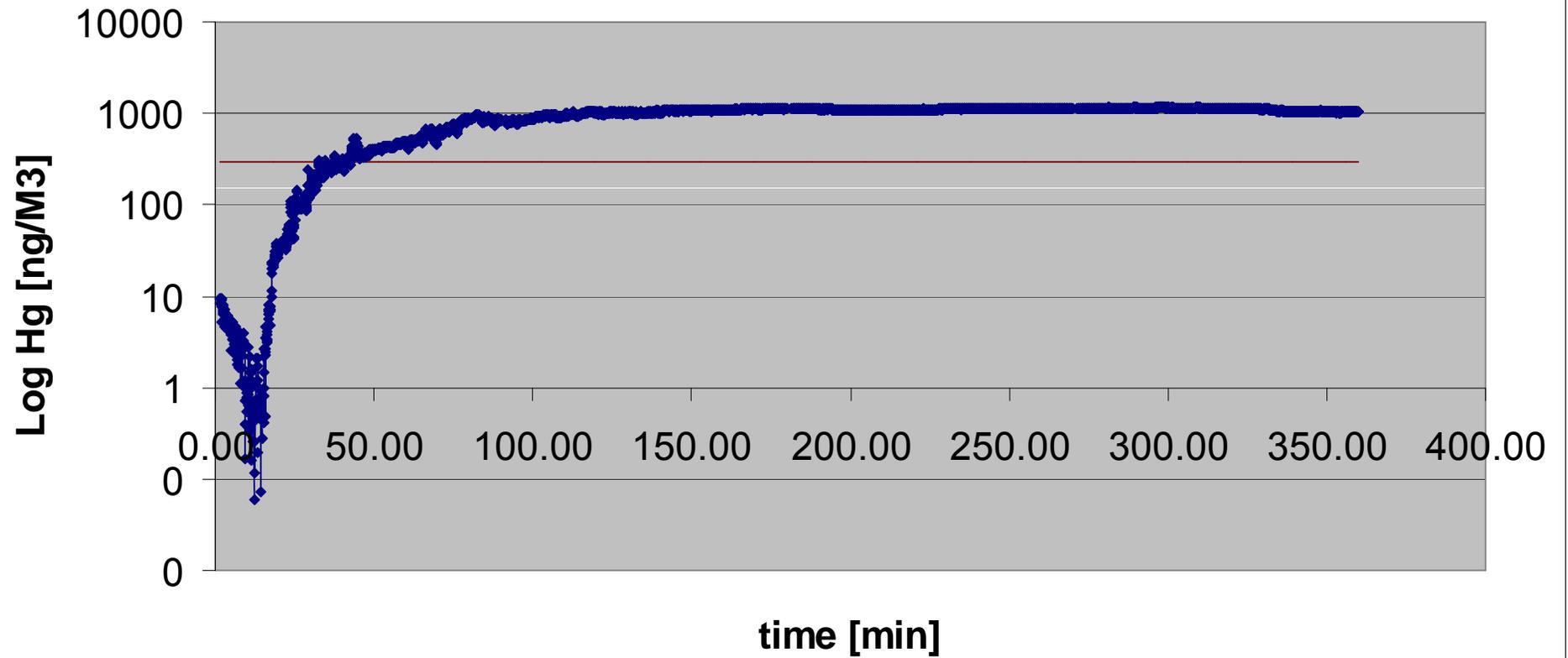
Pickle Jar



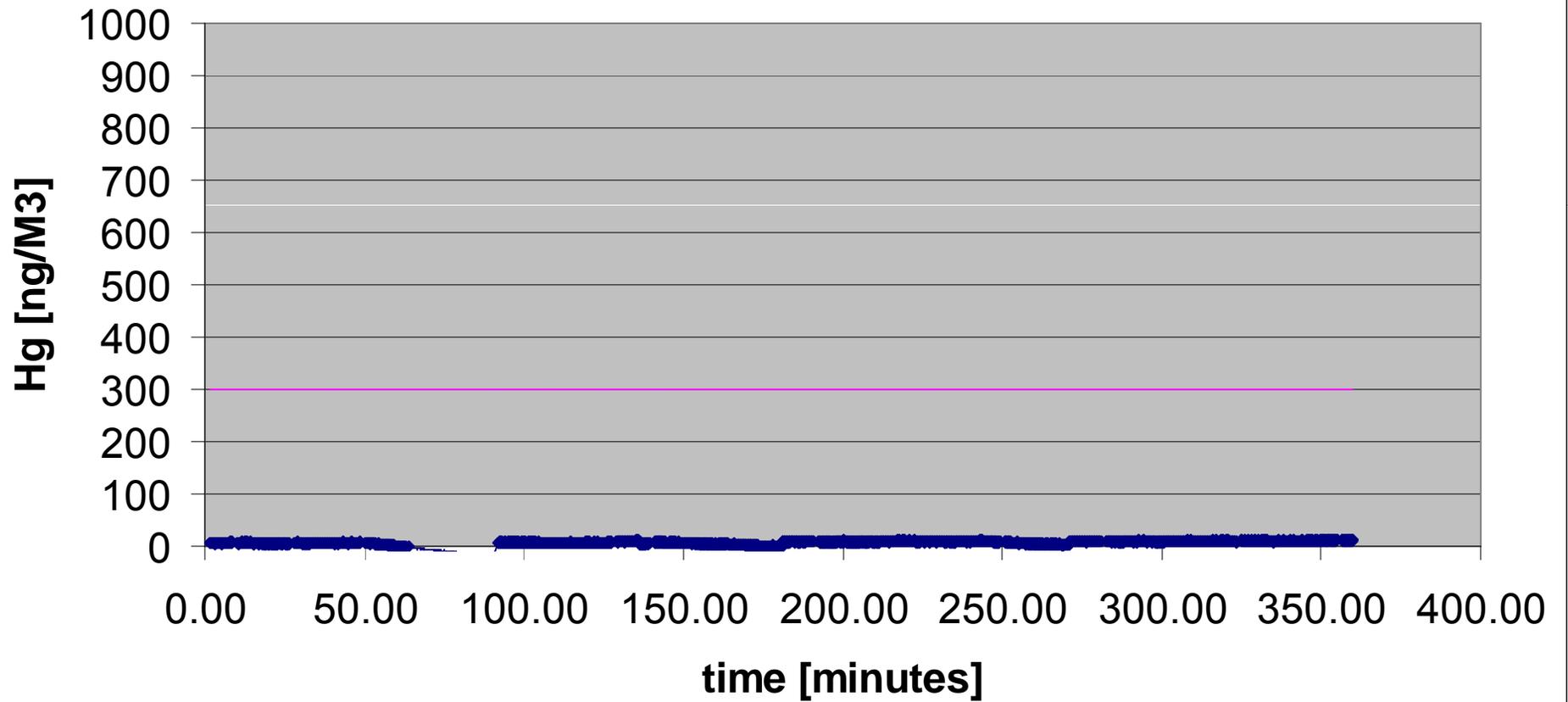
Brand D 14w = 60w in Double Poly Bag 5'



Brand B 26w = 100w in double poly bag 5'



Brand B 26w = 100w in glass container 5'



Revisions to Cleanup Guidance

- For most part pre-study cleanup guidance looks good.
- Changes:
 - Leave area and wait 15 minutes after breakage to begin cleaning up;
 - Use a glass container, metal screw top lid with seal, such as a canning jar to contain the lamp pieces, powder, and cleanup materials;
 - Immediately remove the containerized lamp debris from the living quarters, especially if glass container not used;
 - Continue venting room for several hours;
 - Consider removal of carpeting sections where breakage occurred as a precaution in some situations, particularly in homes with infants, small children or pregnant women; and
 - If carpet is not removed, vent room during next several vacuumings.

Additional Precautionary Guidance

- Consider removal of carpet sections where breakage has occurred, particularly in homes with infants, small children or pregnant women.
- The next time you replace a lamp, consider putting a drop cloth on the floor so that any accidental breakage can be easily cleaned up.
- Consider not utilizing lamps in situations where they could be easily broken, in bedrooms or over carpet in rooms frequented by infants, small children and pregnant women.
- Avoid storing too many spent lamps before recycling.

What if I accidentally break a fluorescent lamp in my home?

- Do not use a vacuum cleaner to clean up the breakage.
- Keep people and pets away from the breakage area until the cleanup is complete.
- Ventilate the area by opening windows, and [leave the area for 15 minutes before returning to begin the cleanup.](#)
- Wear rubber gloves to protect your hands from the sharp glass.
- Carefully remove the larger pieces and place them in a secure closed container, preferably a glass container with a metal screw top lid and seal.^{[1][2]}
- Collect the smaller pieces and dust. You can use two stiff pieces of paper.
- Pat the area with the sticky side of duct tape, packing tape or masking tape to pick up fine particles. Wipe the area with a wet wipe or damp paper towel to pick up even finer particles.
- Put all waste and materials into the glass container, including all material used in the cleanup that may have been contaminated with mercury. Label the container as “Universal Waste - broken lamp.”
- [Remove the container with the breakage and cleanup materials from your home.](#) This is particularly important if you do not have a glass container.
- [Continue ventilating the room for several hours.](#)
- [Wash your hands and face.](#)
- Take the glass container with the waste material to a facility that accepts “universal waste” for recycling. To determine where your municipality has made arrangements for recycling of this type of waste, call your municipal office or go to MaineDEP.com, click on “[Fluorescent Light Bulb Information](#)” and look for the link to [municipal collection sites](#).
- [When a break happens on carpeting, homeowners may consider removing throw rugs or the area of carpet where the breakage occurred as a precaution, particularly if the rug is in an area frequented by infants, small children or pregnant women.](#)
- [Finally, if the carpet is not removed, open the window to the room during the next several times you vacuum the carpet to provide good ventilation.](#)
- The next time you replace a lamp, consider putting a drop cloth on the floor so that any accidental breakage can be easily cleaned up.
- [If consumers remain concerned regarding safety, they may consider not utilizing fluorescent lamps in situations where they could easily be broken.](#)
- [Consumers may also consider avoiding CFL usage in bedrooms or carpeted areas frequented by infants, small children, or pregnant women.](#)
- [Consider not storing too many used/spent lamps before recycling as that may increase your chances of breakage.](#)

^[1] Other jars that can be made of glass and also work are pickle, peanut butter and applesauce jars. Not ideal but also a good choice for containing breakage is a heavy duty #2 plastic container with either a screw lid or push-on lid such as a joint compound bucket or certain kitty litter-type containers.

^[2] If the only suitable jar available has food in it, you may need to empty it into another container before using it.

Questions?

**For now and
the future**