

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
-LIGO-
CALIFORNIA INSTITUTE OF TECHNOLOGY
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LIGO-E1200659-v2	5/28/13
AOS SLC BS Elliptical Baffle Install Hazard Analysis	
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CHANGE LOG

Date, version	Summary of Changes
5/28/13 V2	<ul style="list-style-type: none">• Corrected signature page• Added sharp edge cutting hazard• Corrected documentation Sec. 4• Added damage to BS optic and suspension• Added reference to E1200660 AOS SLC BS Ellip Baf Installation Doc

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1. Scope

This document covers safety concerns related to the installation and alignment of the BS Elliptical Baffle on the cartridge or in the BSC chamber of Advanced LIGO. It must be read before beginning the installation, and used in conjunction with [E1200660 AOS SLC BS Ellip Baf Installation Doc](#).

2. Summary of Hazards

2.1. BS Elliptical Baffle

The major hazards to be aware of during installation and alignment of the BS Elliptical Baffles include:

- 1) Injury to body parts as a result of working in a cramped and confined space (4E)
- 2) Eye damage from exposure to infrared autocollimator beam (4E)
- 3) Eye damage from exposure to infrared autocollimator beam (4E)
- 4) Sharp edges present a cutting hazard (4D)
- 5) Damage to BS mirror and suspension (4D)

These hazards are described in detail later in the document.

3. Overview

3.1. BS Elliptical Baffle

A model of the BS Elliptical Baffle is shown in **Error! Reference source not found.**

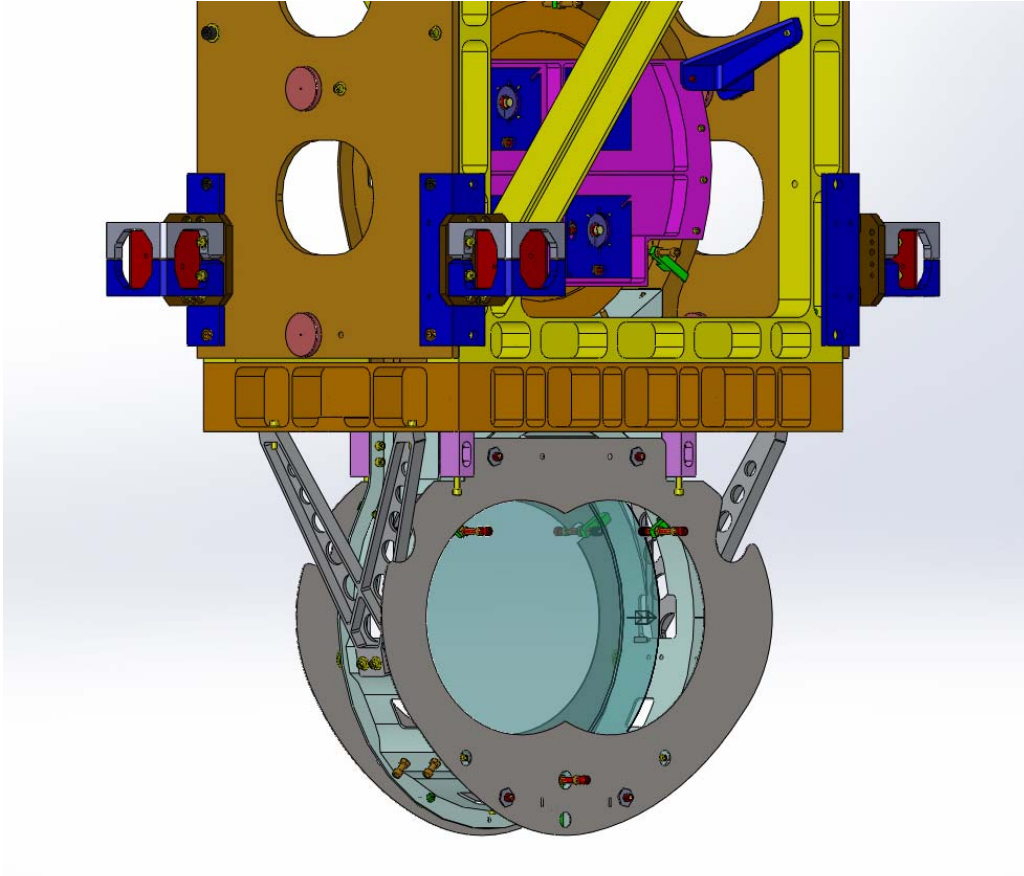


Figure 1: Model of BS Elliptical Baffles Installed on the BS SUS

The 5 lb BS Elliptical Baffle (both baffles plus hardware) is attached to the BS SUS lower frame, as shown in Figure 1. Installation and alignment may occur either on the cartridge or within the BSC.

- 1 The Baffles will be attached, using special mounting hardware, after the BS mirror and suspension structure have been installed and aligned on the BSC ISI optical platform.
- 2 A target will be mounted temporarily to the center of the Baffle, and the Baffle will be moved horizontally and vertically within the mounting clearance holes until the target aligns with an alignment theodolite.
- 3 After alignment, the Baffle will be secured with its mounting bolts, and the target will be removed.

- 4 In the event that access is needed for maintenance of the BS mirror, the Baffles will be removed together with the mounting studs. After repair of the BS mirror, the Baffle will be re-installed without the need for subsequent alignment by simply re-inserting and fastening the mounting studs.

During installation of the BS Elliptical Baffle, a task leader will be assigned to supervise all activities.

4. Related Documentation

[E1200660 AOS SLC BS Ellip Baf Installation Doc](#)

Advanced LIGO Safety: Processes and Guidelines (LIGO-M070360)

LIGO Project System Safety Plan (LIGO-M950046)

LIGO Contamination Control Plan (LIGO-E0900047)

aLIGO Chamber Entry/Cleaning/Exit Checklist (LIGO-E1201035)

LLO Safety Procedure documents (<http://www.ligo-la.caltech.edu/contents/internalmain.htm>)

5. Hazard Analysis

5.1. Injury to Body Parts

The BS Elliptical Baffle will be installed and aligned *in situ* on the cartridge or within the BSC chamber. Injury to a person's head or other body parts may occur as a result of working in a cramped and confined space, encumbered with clumsy clean-room garb.

5.2. Eye Damage from Exposure to Infrared Radiation

A visible theodolite or a high power infrared autocollimator beam may be projected onto the surface of the BS Elliptical Baffle during the alignment of the baffle. Directly viewing the light beam could cause permanent damage to the retina.

This hazard can be eliminated by using proper laser eye protection glasses or goggles during the autocollimator alignment procedure.

5.3. Sharp Edges Present a Cutting Hazard

The baffle is fabricated from a thin piece of metal; beam passage holes are intentionally sharp-edged. A potential hazard exists for receiving cuts if parts are handled improperly. Each team member should inspect to their satisfaction the prospective part to be handled to determine if that part has a potentially hazardous sharp edge. In general, avoid grasping the sharp edge of baffle holes; use Teflon a shield if necessary when grasping the sharp baffle edges by hand. Hands may also be pinched when assembling parts to one another, but this can be mitigated with proper attention to handling the parts.

5.4. Damage to BS Suspension

The BS Elliptical Baffle will be attached directly to the BS triple suspension structure. Dropping a tool or object onto the BS suspension structure or touching the BS optical surfaces may cause serious damage to the structure or to the mirror.

Extreme care must be taken to avoid touching the mirror or the delicate suspension parts.

6. BS Elliptical Baffle Hazard Analysis Severity Table

Item #	Hazard	Cause	Effect	Unmitigated Severity	Unmitigated Probability Level	Unmitigated Risk Index	Comment	Mitigation	Mitigation Severity	Mitigated Probability Level	Mitigated Risk Index
1	Bodily injury	Bumping into rigid structures	Injury to personnel	marginal	occasional	3C	Head injury is possible	Be observant of hazardous structures	minor	improbable	4E
2	Eye Damage	Direct viewing of infrared beam	Injury to personnel	Critical	occasional	2C	Permanent retinal damage	Use Laser protective eye wear	minor	improbable	4E
3	Cutting hazard	Sharp edges present a cutting hazard	Injury to personnel	critical	remote	2D	Beam passage holes in scraper baffles are intentionally sharp edged	In general, avoid grasping the sharp edge of baffle holes. Use Teflon shield if necessary when grasping the sharp baffle edges by hand.	minor	remote	4D
4	Damage to BS and Suspension	Bumping of BS SUS, or impact to BS optic	Misalignment or damage to BS SUS and mirror	critical	occasional	2C	Use barrier between ITM Ellip Baf and BS SUS; Place BS optic on EQ stops; Cover BS optic with protective cover	marginal	marginal	remote	3D

Hazard Severity	Category	Definition	Probability	Level	Individual Item
Catastrophic	1	Death or permanent total disability, system loss, major property damage or severe environmental damage.	Frequent	A	Likely to occur frequently or continuously experienced.
Critical	2	Severe injury, severe occupational illness, major system or environmental damage.	Probable	B	Will occur several times in the life of an item.
Marginal	3	Minor injury, lost workday accident, minor occupational illness, or minor system or environmental damage.	Occasional	C	Likely to occur some time in the life of an item.
Minor or Negligible	4	Less than minor injury, first aid or minor supportive medical treatment type of occupational illness, or less than minor system or environmental damage.	Remote	D	Unlikely but possible to occur in the life of an item.
			Improbable	E	So unlikely, it can be assumed occurrence may not be experienced.

SEVERITY OF CONSEQUENCE	PROBABILITY				
	E Improbable	D Remote	C Occasional	B Probable	A Frequent
1 Catastrophic					
2 Critical					
3 Marginal					
4 Negligible					

Hazard Risk Index
1A, 1B, 1C, 2A, 2B, 3A
1D, 2C, 2D, 3B, 3C
1E, 2E, 3D, 3E, 4A, 4B
4C, 4D, 4E

Risk Code Criteria
Unacceptable
Undesirable (Directorate decision required)
Acceptable with review by Directorate
Acceptable without review