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CHESS
Cornell High Energy Synchrotron Source

July 2, 2002

LNS Safety Committee

Dear Sir or Madam:

CHESS has recently completed a number of white beam tests on the newly constructed G-line. The results of those tests have been very encouraging, ensuring that the beam at the G-line is what was expected and that it can be constrained to accommodate the operations of G-line as foreseen by the designers. We are currently finalizing the design of the various components to G-line as originally conceived. However, there will be more time required to finish the design, machining and assembly of the components prior to installation. The CHESS staff along with G-line staff have considerable experience constructing beam lines, however the demands for G-line are much more stringent than what is normally found at third generation sources. The CHESS staff, along with the G-line consortium, thus propose to operate the G-line in an interim mode to a) gain experience with the beamline and stabilization of the beam related to the other synchrotron beam lines, b) test concepts and equipment that will eventually be used on the G-line, and c) conduct experiments that will further the goals of the G-line consortium participants while d) provide these participants with very needed beam time that is required for their educational goals and continued funding.

CHESS therefore requests that the LNS Safety Committee approve the attached document “G-line Intermediate Operation” and permit the operation of G-line under the auspices of the CHESS Safety Committee and CHESS Operations personnel in a mode consistent with CHESS and LNS standard laboratory practices as described in the attached document. A safety document describing the G-line in its entirety and in its completed form has been in the works for some time with the anticipated completion prior to the July 2002 accelerator shutdown.

Sincerely,

Jeffrey White
CHESS Safety Committee Chair

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Cornell High Energy Synchrotron Source

**Safety Committee 4/5/02: CHESS Approved revised version 4/3/02 J. White**

Prepared by J. White with assistance from D. Richter and D. Smilgies

As you are probably already aware, the completion of the G-line and corresponding stations as originally conceived is behind schedule. Recently CHESS has operated the G-line in a mode that permitted white beam into the G-cave in order to conduct beam diagnostics. This has been very important to future funding and future operations of the beam-line. This document contains details regarding operation of the G-line in a single station user mode that will permit the different station users access to wide band-pass monochromatic beam ($\Delta E/E=1\%$) during HEP operations. The document begins with details of safety considerations regarding bringing white beam into the G-cave in a mode previously approved for conducting the above mentioned beam diagnostics (Sect. A). This is immediately followed by section B that lists the safety implications and details that are associated with the passing of the monochromatic beam into the experimental stations. Operational details involving bringing beam into the cave and each of the stations is then listed out in Table 1. A checklist of safety procedures to be performed is also included as Checklist 1.

The motivation for proceeding with an interim operational mode is to obtain specific experience, prior to CESR shutting down for an extended access in 2003 to install super-conducting wigglers for CESRc operations, and to guide the final design of the G-line experimental area. Thus the principal investigators of G-line would like an interim mode of operation that would provide beam similar to what will eventually be implemented. This will provide much needed experience on the beam-lines along with experimental results that may be crucial to station funding. This mode would be used only before the shutdown just mentioned and not afterward unless it is re-approved.

The concept is that there will be one set of optics available. This will provide beam for whichever station is scheduled at a given time (see fig.1). The aperture at the upstream of the cave (fig. 1 item A) that was installed to provide an effective aperture for the safety brick (fig. 1 item D) will remain. The white beam will be limited immediately upstream of the monochromator to ~2mm in the horizontal dimension with a combination of water-cooled tapered apertures (fig. 1 items C). This is done to reduce the heat-loading on the optics (fig. 1 item E) and not for radiation safety reasons (~300 Watts out of ~10kWatts with 250mA at 5.7GeV). The normal G-line safety brick will remain in place to stop any beam that is not absorbed by the apertures and/or diffracted off of the first stage of the wide bandpass monochromator. The monochromator will be a standard vertical double bounce design to permit the passing of the diffracted beam over the G-line safety brick. Thus only the monochromatic beam will leave the cave.

Two shutters for each station will be affixed to the wall located along the same line and placed on the upstream side of that particular station's upstream shielding wall (see fig. 2). The shutters for G1 will thus be located in the G-cave (see fig. 3a and fig. 3b) with the G2 and G3 shutter assemblies being of similar design. However, since there will only be one beam-path, all station shutters upstream of the station in use will also have to be opened after the corresponding stations are secured (see chart 1). These shutters and housings will be connected together with removable flight tubes. Each pair of shutters is designed with lead apertures to contain the scattered beam within the housing (see fig. 4 and chart 2). All of the shutters that will be used were previously used and approved for other locations. The apertures have been modified for this use and will have a minimum of ¼" overlap with the shutters in all directions. The pipes that go through the shielding walls are designed to ensure that there is no line of site among the seams of shielding in the wall, apertures and shutters. The active flight tubes will be interlocked with sensors so as to close the G-line main beamstops in the event of a leak. This will ensure that the beam attenuation is kept to a minimum and to minimize any ozone production from the monochromatic beam. Whenever a station is scheduled for beam, the flight tube inside that station will be removed and the Be window (covered to avoid contact) will be placed on the pipe at the upstream shielding wall of that station. The experimental equipment will then be placed in the station and the remaining flight tube either evacuated or flushed with Helium. The user can then access the beam via securing the station and opening the station shutters that are for that station and the upstream stations. Though operationally this will limit access to the upstream stations during operation of downstream stations it will ensure without any safety logic changes, the safe operation of the beamline in this intermediate mode. ***A more detailed description of the procedure for accessing beam is described in Table 1.***

**Proposals for all experiments on G-line will have to be approved by the CHESS Safety Committee prior to scheduling.**

Since one monochromator will be used throughout this intermediate period, need for access to the cave will be reduced considerably from what has been the case during the past G-line white beam experimental period. Thus I would recommend that the survey badges that are located in the stations and the cave be removed prior to placing beam in these areas and remain in storage until the end of the running period. However, due to the possibility of Bremsstrahlung radiation in the G-cave, due to the fact that the white beam mirror will still not be used in the vault, surveys will be conducted prior to each experimental running period.

## Safety Considerations

### A. Monochromator box, horizontal aperture, safety brick, the upstream beam pipe and cave radiation survey:

1. The monochromator box (fig 1 item I) is equipped with the full-scale safety brick (fig.1 item D) designed to take the full heat load from the A/G Wiggler up to 500 mA CESR current.
2. A water-cooled copper aperture (fig. 1 item A) positioned at the upstream of the cave will limit the beam size horizontally such that the safety brick will safely stop any white beam.
3. For alignment, the safety brick will be surveyed into place. Burns at the upstream and downstream walls of the G cave will indicate the exact beam path inside the cave.
4. The coffin is supported by a blue table (fig.1 item J), which will be positioned at the end of the cutout on the back wall. The table will be fixed to the ground.
5. The precise beam height will be adjusted with the crank of the blue table. When the safety brick has reached its proper height the crank will be removed and the shaft will be red-tagged.
6. The monochromator (fig. 1 items E,F) will be installed inside the coffin in a helium atmosphere.
7. The safety brick has a tungsten block of 5" length attached which will stop the hard radiation from the wiggler.
8. Safety interlocks (fig. 1 item H), which disable the beamline by closing the main G-line beamstops, will be installed and tested to ensure proper cooling water flow (thermocouple, thermal switch, flow switch).
9. Final burns will ensure that the safety brick and the monochromator are positioned correctly.
10. A helium control panel controls the flow to the monochromator box and the upstream beam pipe. The helium atmosphere will be monitored with an interlocked flow sensor, which disables the beamline by closing the main G-line beamstops if He flow is lost.
11. The mono box and the beam pipe will be evacuated with a roughing pump for more efficient removal of air and for quick backfilling of the system with Helium.
12. **NOTE: The Cave South and West shielding walls are made of 8” and 6” heavy concrete respectively, not the standard Steel/Pb/Steel laminate. The white beam mirror will not be in place during these tests. Thus there is an increased possibility of Bremsstrahlung radiation being created in the cave area. The station shielding walls are designed for operation under these monochromatic conditions.**
13. Survey badges that are normally in the G-cave and G stations will be removed but the badges that could still be used to survey the perimeter remain (See chart 3).
14. The electronic survey meters will remain in place.
15. When the monochromator is put in place, a thorough radiation survey of the perimeter of G cave will be preformed.
16. Due to the increased possibility of Bremsstrahlung radiation, surveys will be conducted prior to each experimental period prior to release of the beamline operator disable key.

B. **Station shutters, flight tubes and station radiation surveys**

1. All of the station shutters and connecting flight tubes will be surveyed into place.
2. Wiring of the station shutter limit switches will be done through connectors in the existing tested interlock wiring.
3. These connections will not be made until there is a shutdown (probably a normal Tuesday shutdown) when we will also be able to conduct an interlock checkout of the stations. No Cross-connect wiring is involved and thus no CESR interlock checkout will be required.
4. An initial machine studies period will be utilized to set up the monochromator. An additional low current machine studies period will be used to conduct burns through the entire flight tube length and all the station shutters to ensure that the alignment is correct.
5. These flight tubes will be interlocked to shut the beamline beamstops if there is either a loss of He flow or vacuum (depending on the procedure implemented) to minimize any ozone production.
6. After ensuring the correct alignment of all the equipment, a radiation survey at nominal beam currents will be conducted.
7. **Proposals for all experiments on G-line will have to be approved by the CHESS Safety Committee prior to scheduling.**
8. Prior to the beginning of any experiment, the station in use will be thoroughly surveyed (including upstream stations) prior to release of the station operator disable key.
9. At the end of each experimental running period the line and station operator disable keys will be red-tagged and locked up.

**Chart 1: Requirements to Get Beam to the Monochromator and Each of the Experimental Stations:**

**G-line** (beam to the monochromator controlled by CHESS Staff):
To open the line shutter and the line stops:

All station Oks
Cave closed and secured
Helium flow interlock on mono box and upstream beam-pipe satisfied
Helium flow or vacuum OK on station flight tubes
Thermal Status OK etc. on Aux. Equip.
Survey of the G-cave perimeter prior to releasing the G-Line Op. Disable Key

**G1:** **(**User controls access to G1 (G2 and G3 can be open))
All of the above
Station secured
"G1" Shutters open (Shutter 1 is the old F2 beamstop #3 and Shutter 2 is the old A-line shutter)
Survey of the G1 station perimeter prior to releasing the G1 Operator Disable Key

**G2:** **(**User controls access to G1 and G2 (G3 can be open))
All of the above
Station secured
"G2" Shutters open (old F2 station beamstop 1 and 2)
Survey of the G2 station perimeter prior to releasing the G2 Operator Disable Key

**G3:** **(**User controls access to G1, G2 and G3)
All of the above
Station secured
"G3" Shutters open (old F-3 shutters)
Survey of the G3 station perimeter prior to releasing the G3 Operator Disable Key

## G-line Intermediate Operation Check sheet

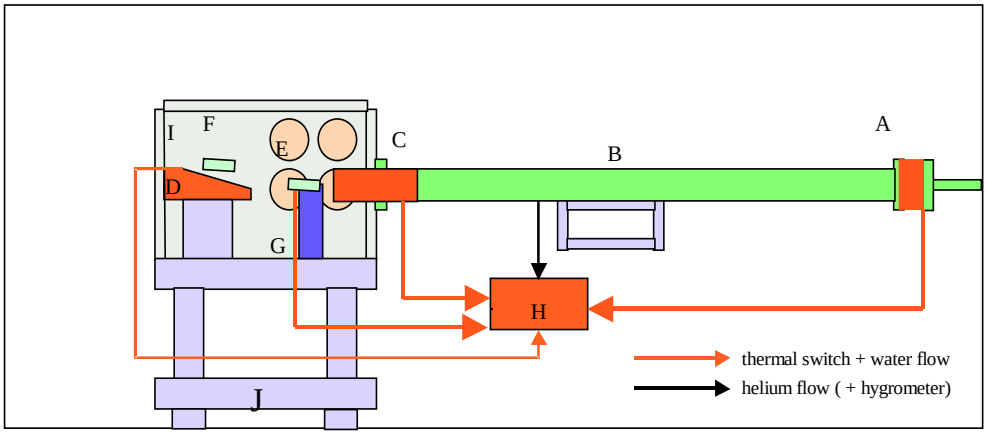
# Monday AM:
# Date ___/___/___ Initials ____,____

- Red-tag the G-line Operator Disable Key
- Red-tag the Station Operator Disable Keys
- Lock-up all of the G-line and Station Operator Disable Keys
- Turn on Low Energy Gamma monitor to x10 scale providing an audible alarm at 2mR/hr
- Post a web-board note regarding above items
- Ensure that the next experiment is approved by the Safety Committee and G-line

# Thursday AM or prior to beam:
# Date ___/___/___ Initials ____,____

- Turn off Low Energy Gamma monitor
- Retrieve the G-line and Station Operator Disable Keys
- Conduct a radiation survey of G-cave perimeter
- Release the G-line Operator Disable Key
- Tune up the monochromator
- Conduct a radiation survey of G1 perimeter
- Release the G1 Operator Disable Key
- If operating G2 also conduct a radiation survey of G2 perimeter, if not go to the last item
- Release the G2 Operator Disable Key
- If operating G3 also conduct a radiation survey of G3 perimeter, if not go to the last item
- Release the G3 Operator Disable Key
- Post a web-board note regarding the above items

**Fig. 1 The G-line Monochromator Beam Project in a Nutshell**




A aperture: is in place.
needs cooling water, flow meter, thermal switch, thermocouple
B transfer pipe: to be modified. Unistrut stand to be built.
C apertures that limit beam to 2mm horizontally
D white beam safety brick: is in place.
needs cooling water, flow meter, thermal switch, thermocouple

E 1st multilayer, water-cooled holder made and Ni Plated for In/Ga.
needs water cooling, flow meter, thermal switch, thermocouple.

F 2nd multilayer
G xz stage:
H auxiliary equipment box:
water flow and thermal switches for A,D,E, He flow for B and C
I mono box on J blue table

**Fig. 2 Location of Station Shutters**

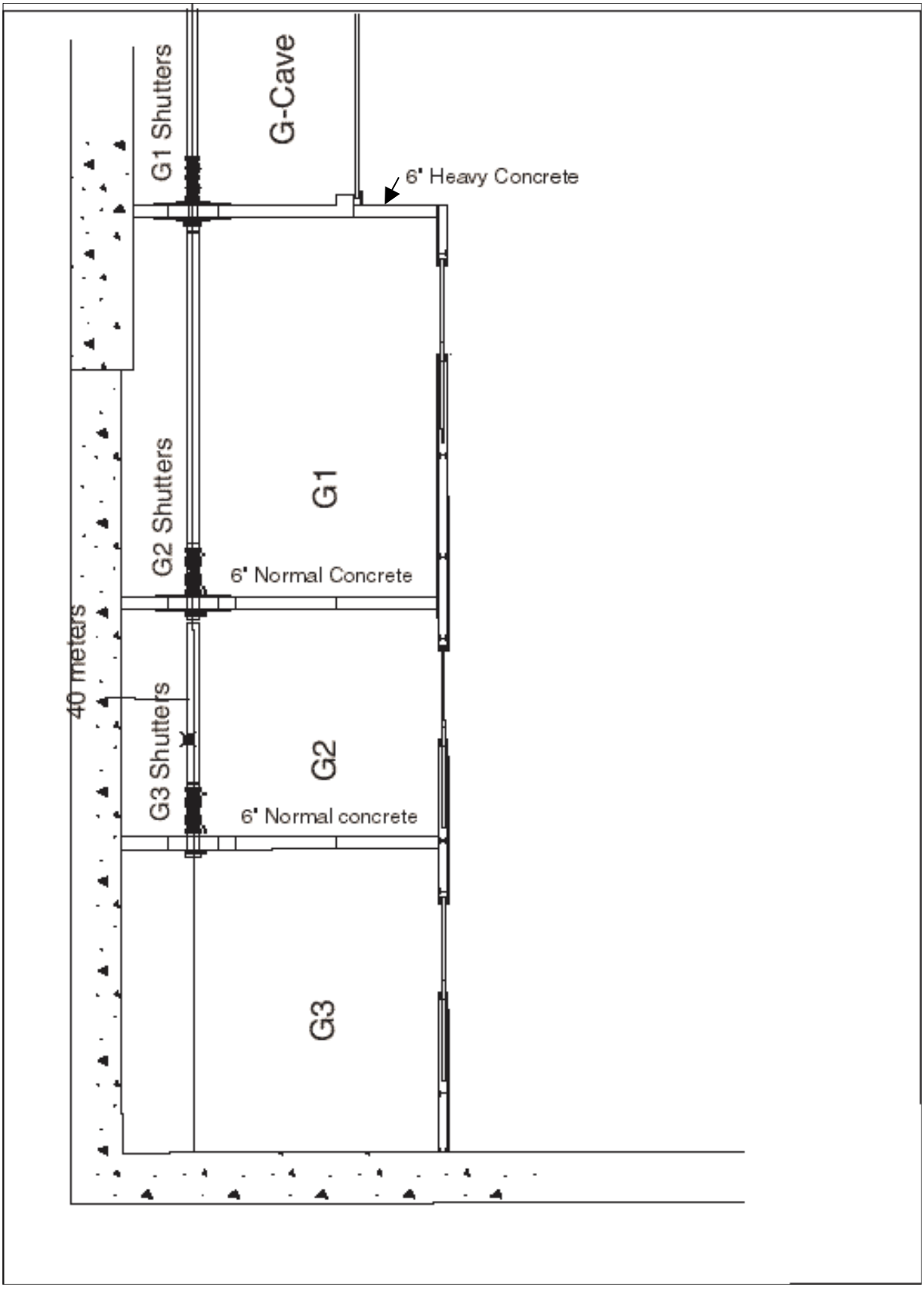


**Fig. 3a  Top View of G1 Shutters and Apertures**

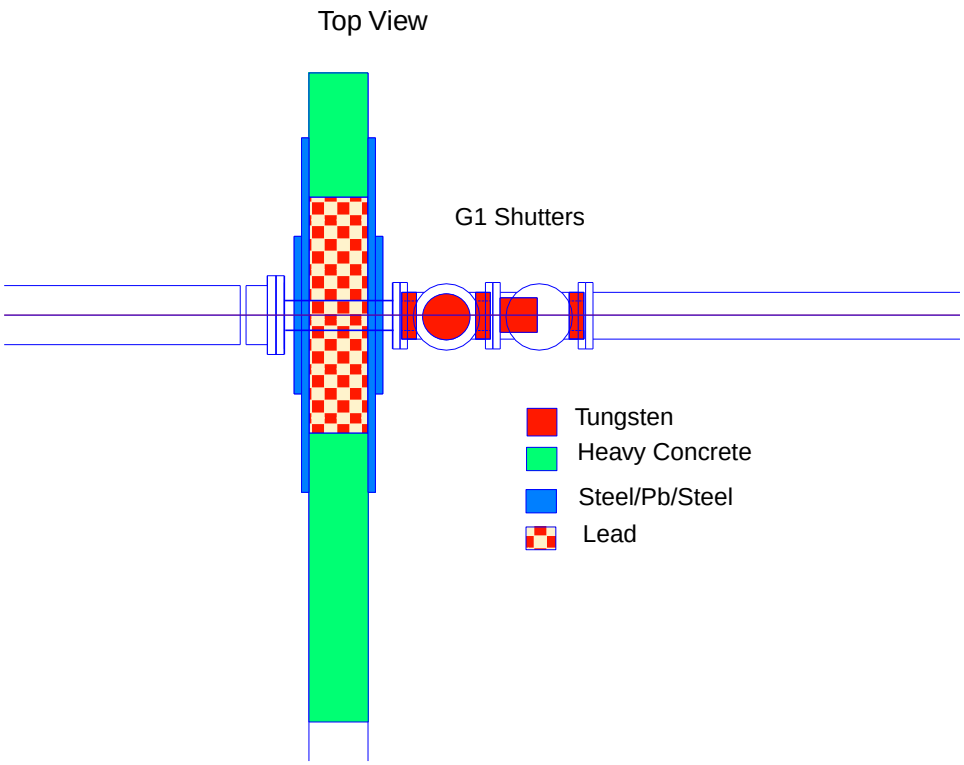



**Fig. 3b  Side View of G1 Shutters and Apertures**

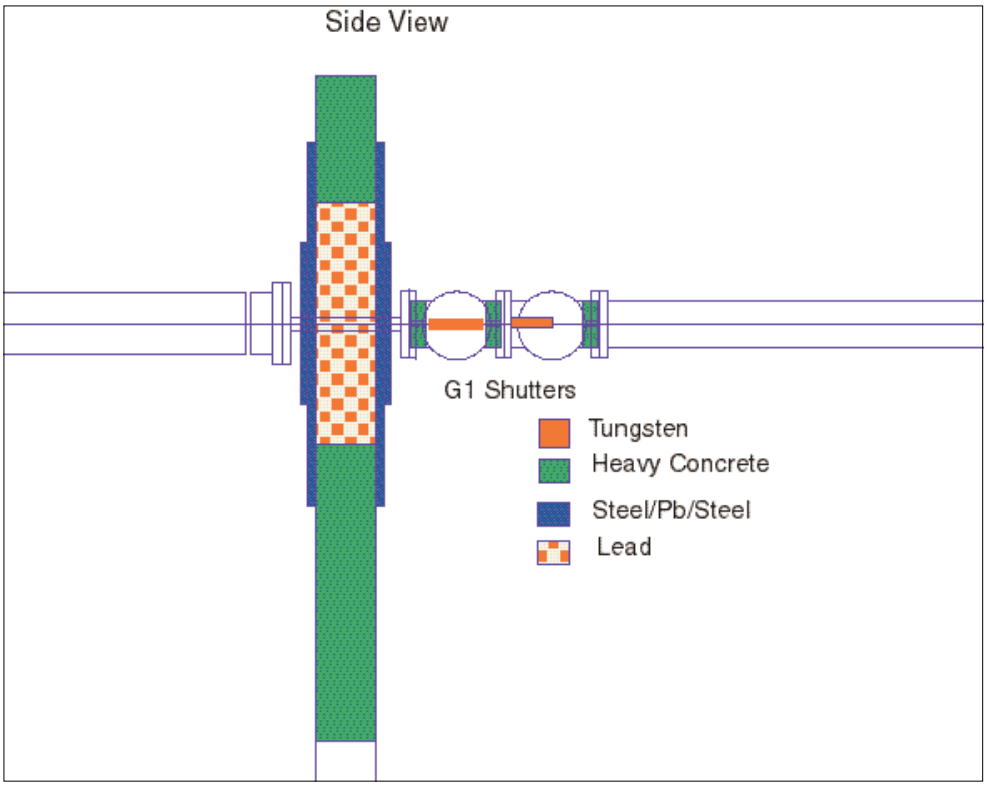


**Fig. 4 End Views of Shutters and Apertures**

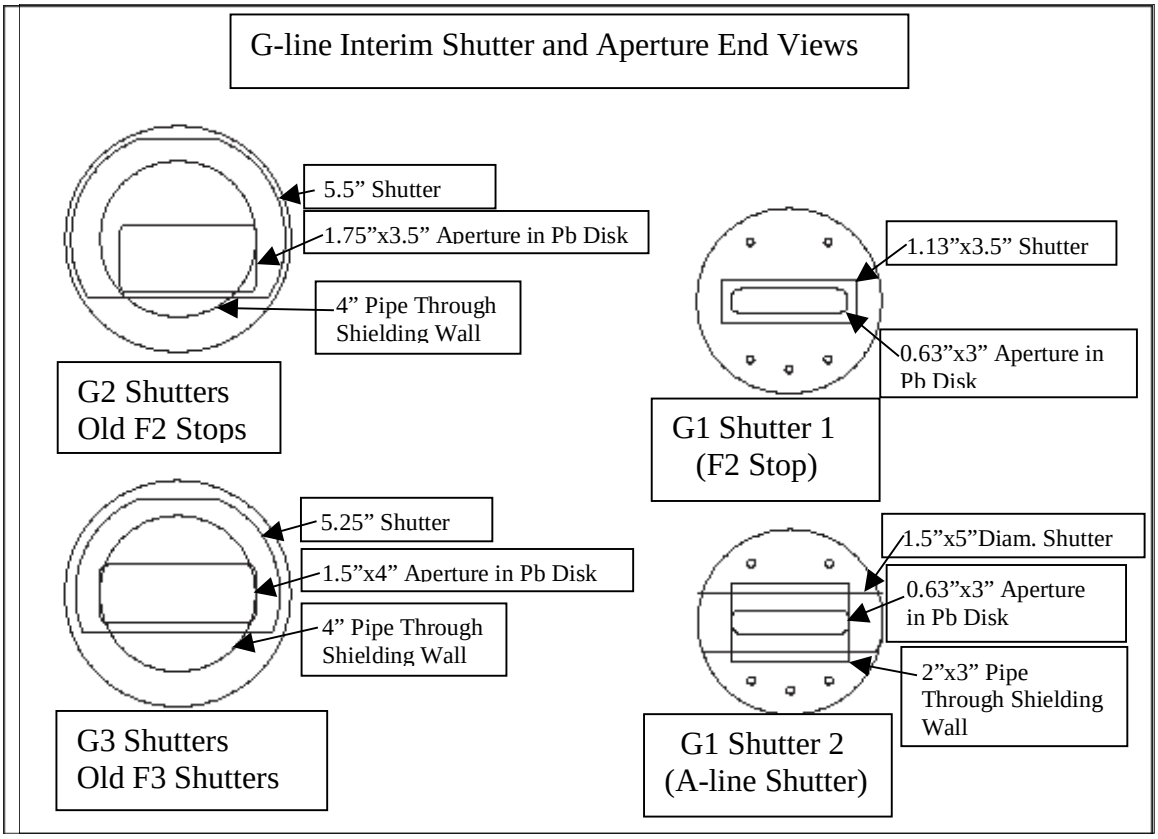


**Chart 2. Shutter and Aperture Sizes**

| Item | Horizontal Size (inches) | Vertical Size (inches) |
|---|---|---|
| G1 Aperture Size | 3 | 0.625 |
| G1 Shutter Size | 3.5 | 1.125 |
| G1 Beam pipe Size | 3 | 2 |
| G2 Aperture Size | 3.5 | 1.75 |
| G2 Shutter Size | 5.25 | >2.25 |
| G3 Aperture Size | 4 | 1.5 |
| G3 Shutter Size | 5.25 | >2 |

**Chart 3. Survey Badge Locations**

| Name | Location | Stay or Remove |
|---|---|---|
| Control | Cross tunnel | Stay to Monitor Background |
| Lab North Center | G-line Chem. Room | Stay to Monitor Perimeter |
| Lab North East | G-line Chem. Room | Stay to Monitor Perimeter |
| G Cave Monitor | South Wall of G Cave | Remove |
| G Cave Cutout | North Wall of G Cave | Remove |
| G1 Hutch | North Wall of G1 Station | Remove |
| G2b Hutch | G3 Station | Remove |
| Kitchen | Kitchen Area | Stay to Monitor Perimeter |
| Office Entrance | G Office Entrance Area | Stay to Monitor Perimeter |