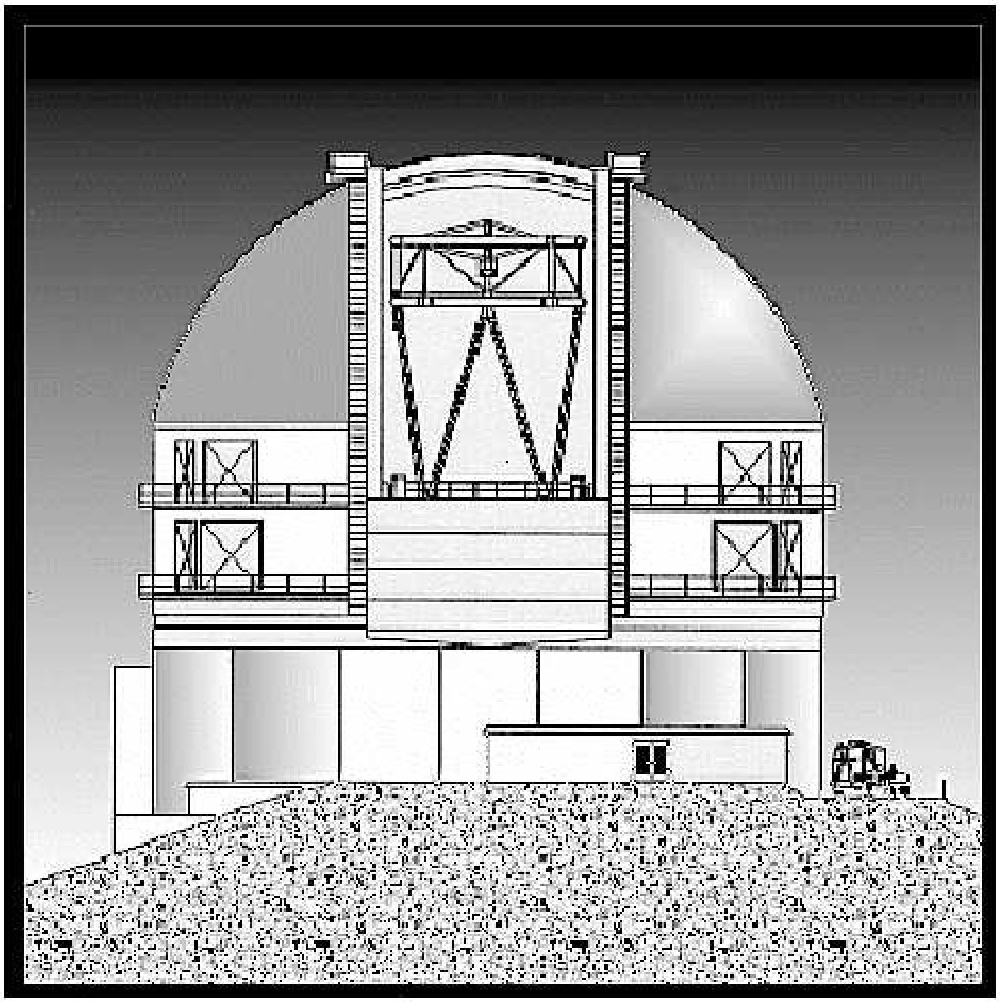
GEMINI
8-M Telescopes Project

PG-I-G0010

Gemini Instrument Safety Policy



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Gemini Instrument Safety Policy
Revision Sheet

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The Gemini Instrument Safety Policy uses as its baseline the following from OSHA Section 5.

Duties:

(a) Each employer -

(1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
(2) shall comply with occupational safety and health standards promulgated under this Act.

(b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

People constructing instruments are highly encouraged to read the items and visit the websites below. Copies of all referenced documents will be maintained at relevant Gemini sites.

- Science Instruments to Facility Handling Equipment, ICD 1.9/2.7.
- Gemini Electronic Design Specification, SPE-ASA-G0008
- Gemini Facility Handling Equipment and Procedures, ICD-G0015
- *www.osha.gov*
  - OSHA Regulations (Standards - 29 CFR)
  - PART 1910 Occupational Safety and Health Standards
  - 1910 Subpart F - Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms (1910.66 to 1910.68)
  - 1910 Subpart G - Occupational Health and Environmental Control (1910.94 to 1910.98) (noise, etc.)
  - 1910 Subpart M - Compressed Gas and Compressed Air Equipment (1910.166 to 1910.169)
  - 1910 Subpart S - Electrical - Definitions (1910.301 to 1910.399)
- *www.ansi.org* (has a way to look for standards, then lets you buy them)
  - Call the Government Printing Office at (202) 512-1800 or fax (202) 512-2250 to order the CD-ROM titled "OSHA Regulations, Documents, & Technical Information on CD-ROM", Stock #729-013-00000-5. Cost: $77/year (four quarterly releases), $27/single copy.
- And *http://www.osha.gov/oshpubs/* has information on ordering dead-tree versions of documents.

1. Safety Considerations

Listed here are some general safety considerations which need to be taken into account by all instrument suppliers for Gemini. We shall ask each supplier how they plan to comply with these items during the Safety Review. Quoted areas are exerpted from the Gemini Electronic Design Specification.

1.1. Handling equipment

The operation of the heavy equipment used to handle instruments is potentially hazardous and is particularly so if the instrument has not made allowances for being handled this way or for the conditions it will experience. The person using a piece of equipment must be checked out for safe operation and handling techniques. Special precautions should be taken in case a person has any impaired functions (due to sleep deprivation, hypothermia, lack of oxygen, etc.) Any special equipment required for handling the instrument must be furnished along with procedures and training by the instrument supplier. This last does not include the facility equipment forklifts, cranes, hoists or an air cart.

1.2. Handling of instruments

Instruments are heavy and delicate. An approved person must be present when moving or operating any instruments. All instruments require a handling cart. Refer to ICD 1.9/2.7 for further handling information. Essentially, we supply cart, the instrument designers supply feet, supports, lifting holes and a method of engaging on the Instrument Support Structure (ISS). Any support equipment (i.e. computers, simulators, test sources) also need a way of being transported safely. Transfer from the handling cart, mounting on the telescope and back off will be a potentially dangerous part of the operation and must be thought out thoroughly. The handling cart needs to allow the orientation of the instrument to be which ever is needed for mounting. Any special equipment must be supplied by the instrument contractor. While on the telescope, Gemini needs to know how the change of components on the telescope, if any, is going to be accomplished safely (for example, GMOS mask cartridge at 50 kg+).

1.3. Unpacking

Unpacking can be potentially dangerous. Wooden boxes and nails are common. Unless unpacking is orderly and there is enough room, or a nearby dumpster, there is a fair chance that someone will stand on an upturned piece of wood with a nail in it discarded during the melee.

1.4. Training

Training of the Mauna Kea and Cerro Pachon personnel in the safe operation of the equipment needs to be done whenever a new instrument comes to the site. A manual of operation is required, and at least one copy needs to be left with the instrument. Any updates must be distributed in a timely manner so that anytime the instrument is used, current documentation is present. Further training of Mauna Kea and Cerro Pachon personnel in the setup and testing of instruments is in your own self interest - the more people who know about the intricacies of the instrument, the fewer night time phone calls you will get.

1.5. Environmental components

The weather is quite variable at both downtown and mountain sites. You need to be prepared for this. Exposed surfaces can experience condensing/running water droplets. Remember that at altitude everyone makes mistakes. Refer to ICD-G0013 Gemini Environmental Requirements for environmental details about mountain sites.

1.6. Cold and hot surfaces

"At an ambient temperature of 25ºC, the operating temperature of control panels and operating controls shall not exceed 49ºC. Other exposed parts subject to [inadvertent] contact by operating personnel shall not exceed 60ºC. The minimum temperature will be determined by the ambient temperature. The exterior temperature should not be less than -25ºC.

1.7. Warning and advisory signing

Hazard areas on the instrument and associated equipment must be signed in both English and Spanish. This includes, but is not limited to, laser, high voltage, liquid electrolyte batteries and moving mechanism warnings.

1.8. Electrical

The potential hazards always present with electrical and electronic instruments are many and include batteries, grounding, isolation, high voltage and high currents, inadvertent or unexpected release of energy. Interlocks may be necessary items in these systems (refer to Gemini Electronic Design Specification, Personnel Safety, section 4.20). Instrument suppliers need to be aware that electrical power can be removed at any time due to failure in the power grid. There are UPSs and generators, but the site may be inaccessible for days at a time due to weather. Instrument suppliers should familiarize themselves with Lockout/Tagout procedures (OSHA 1910-147) to protect themselves while working on power sources.

1.9. Mechanical

One of the easiest items to overlook is that sometimes some parts move when we don't expect them to. Interlocks are necessary items on this also. Gemini needs to be informed of the safety issues with the operation of the instrument. Sliding or rotating mechanisms that create a shearing or scissors action are especially dangerous. Exposed moving element such as gears or levers should have protective covers. Apertures in instruments larger than that big enough to accept the smallest human appendage and that contain potentially dangerous moving elements should be clearly labeled with a ***'Danger mechanisms may move unexpectedly, remove power before access'*** or equivalent. Structural integrity: a safety factor of at least 3, with a factor of 4 recommended, will be used to determine safe levels of stress in components including allowances for wear and corrosion (if applicable). The threaded depth of all structural fasteners will exceed 1.5x bolt diameter and 2x is preferred.

1.10. Software

The instrument needs to have an 'engineering mode' to enable checkout prior to observing (for instance, when not connected to the Gemini system). This needs to integrate with the EPICS software as called out in the Gemini Software Standard. If the engineering software bypasses any safety interlocks in the science software (such as when running independently), this must be clearly stated in the documentation and emphasized during handover training.

1.11. Testing

The instrument needs to be fully checked out each step of the way. This means there should be a safe method of setup and test for the instrument off the telescope. Included in this is how the instrument is cooled - how you deal with cryogens, for example. Also, there will be no interlock system off of the telescope.

1.12. Restricted materials

See Gemini Electronic Design Specification, section 4.5.

2. At the site

2.1. Safety at the mountain top - Environmental components

Remember that at altitude everyone makes mistakes. Short term memory loss is very common. Special precautions should be taken in case a person has any impaired functions (due to sleep deprivation, hypothermia, lack of oxygen, etc.) We will be getting a reference for this.

2.2. Vacuum station

There will be a pumping station in the prep area. Safety is always an issue when working with vacuum systems, more an instrument problem than a site problem. Gemini needs to know what requirements the instrument has and how you intend to safely use the system. The instrument should have protection from over pressure explosion hazard by internal leak of cryogens or enthusiastic backfilling.

2.3. Traversing the maze to the telescope

We now are ready to go to the telescope. Instrument designers need to be aware that cryosystems and all services must be disconnected during this handling process. Gemini recommends that designers think about protection of detectors and windows from contamination during this part. The path is not easy. First we lift the instrument onto the air palette, go from the prep room down a crooked hallway, through 3 sets of doors, to a platform next to a crane using the air palette. The instrument is lifted off of the air palette, lowered to the lower floor by means of a jib crane onto another air palette and transported across to the platform lift. The instrument is then lifted to the observing floor on the platform lift, some 2.3m below the Cassegrain rotator. The next transfer is onto the final lifting platform and Cassegrain handling rig which will lift the instrument into mounting position. The instrument is then transferred onto the ISS, aligned (if required), and bolted to the telescope.

3. General service related issues

Gemini needs to know if there are any special safety related problems in these areas:

3.1. Procedures in the dome

Hard hats, steel toe boots are required items in the telescope site. Flashlights are recommended.

3.2. Coolant

Gemini is concerned about spillage of coolant. Instrument designers should be concerned about leakage of coolant (possibly ethylene glycol/water mixture) near power sockets. There is also an interlock on the He pressure circuit which will suddenly and without warning shut down the power to the CCC controller electronics module if there is a failure. Refer to ICD 1.9/3.6 section 3.1.2.1.

3.3. Power

Gemini needs to know if there is a chance of inadvertent contact with exposed power. High voltage halogen and fluorescent calibration and arc lamps are examples of equipment that have a potential hazard.

3.4. Handling procedures

Reach, height and mass allowances for component handling procedures. For example, do you have any heavy sub assemblies (5 kg+) that require removal at arms length.

a) complete instrument - both crane and lifting cart use and hand lifting.
b) major sub assemblies - both crane and lifting cart use and hand lifting.

3.5. Alignment - laser use

Do you need to use a laser, for instance in setup, and how much power is necessary. Lasers must be signed appropriately and appropriate protective measures taken.

3.6. Tools and Procedures

Appropriate tools must be used for fasteners. 'Step down' square drives are not to be used to avoid overstressing bolts and threads. Various torque wrenches of different torque ranges will be available and instrument builders must supply recommended torquing procedures and values on crucial/structural fastened joints.

4. Instrument specific design issues

4.1. Lifting points

Instruments need to be designed so that at least a three point lift is possible for stability when partially assembled. Components of intermediate size and mass require safe, accessible handles and surfaces so that they can be placed down on a flat surface. Items that cannot bear the weight of the assembly should be covered or not exposed to stress when the item is sitting on a flat surface. Refer to ICD 1.9/2.7.

4.2. Handling rig certification

If the rig belongs to Gemini, this is Gemini's problem. If not, the supplier must provide documentation on the rig. A label must be attached to the rig stating the capacity.

4.3. Vacuum vessel integrity

Gemini needs to know what precautions need to be taken to ensure that there is no chance of violating vacuum vessel integrity. Some facility to protect personnel from potentially dangerous overpressure of vacuum vessels is a must.

4.4. Personal safety

What is the method of gaining access to the instrument enclosures, and are there any hazards. Refer to Gemini Electronic Design Specification, Personnel Safety, section 4.20. Fans must be protected with a 'finger shield'. There should be no sharp edges on any manufactured item. Sheet metal work, lenses and windows in particular should be de-burred, chamfered or beveled.

4.5. Interlocks

Electrical hazards and moving parts must be disabled by interlocks.

4.6. Cryogenic safety

Reference Compressed Gas Association CGA P-12-1987 Safe Handling of Cryogenic Liquids and CGA Bulletin #SB-2-1983 Oxygen Deficient Atmospheres.

4.7. Compressed gas safety

Reference OSHA regulations (1910 Subpart M).

4.8. Emergency cut outs

There is an interlock on the He pressure circuit which will suddenly and without warning shut down the power to the Closed Cycle Cooler controller electronics module if there is a failure. Refer to ICD 1.9/3.6 section 3.1.2.1.

5. Instrument specific problem areas:

These are areas specific to each instrument that Gemini has identified. This list is by no means complete, but we need to know how each instrument team is planning to address them.

1) GMOS:
   - Mask making
   - Clean room practice
   - Access dangers
   - Laser safety
   - Carbon fibre dust extraction
   - Handling of masks and loading cartridge

2) GNIRS:
   - Handling due to size and weight
   - Entrance window

3) HROS:
   - Handling due to size