



Atacama Large Millimeter Array

ALMA Safety Manual ALMA-10.08.00.00-011-D-MAN Version: D – Revision 1

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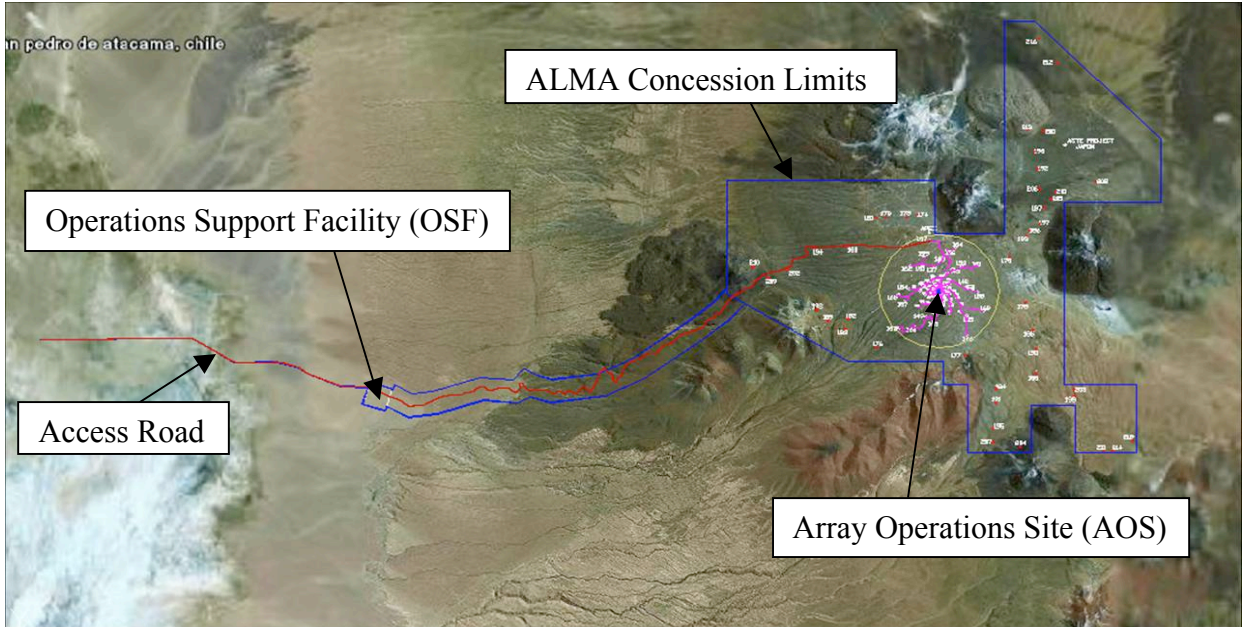
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Figure 1: ALMA Site Map





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I. ALMA DIRECTOR'S STATEMENT ON SAFETY

The Atacama Large Millimeter/sub-millimeter Array (ALMA) is the largest and most ambitious ground-based astronomy project in the world. As such, it will have a momentous impact on all areas of science in astronomy. ALMA is a multinational endeavor with contributions from Asia, Europe, North and South America. The project is located in the Atacama Desert near San Pedro de Atacama in Chile, with facilities at 2,900 and 5,000 meters above sea level. ALMA and contractor staffs come from five different continents endowing the project with a truly multi-cultural character.

Zero-harm to all personnel is the goal of ALMA's Safety Program

To this end, ALMA continuously improves sustainable safety procedures and ensures that safety is integrated into the observatory's culture. It also strengthens awareness of the personal and collective responsibility in the safety effort. For instance, in case of an apparent threat to safety, each worker can and should call for the work to halt. The Managers of ALMA constantly renew their commitment to security and safety and make these criteria an integral part of their performance goals.

Thijs de Graauw



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II. SCOPE

This document describes "Industrial Safety" and "Occupational Safety" for the ALMA site facilities, work area, Members of Personnel under contract with Executives, contractors and visitors.

"Product Safety" of subsystem components (antenna, correlator, and others) shall be controlled according to Risk Analysis Procedures (ALMA-10.08.00.00-004-A-GEN).

III. REFERENCE DOCUMENTS (RD) / APPLICABLE DOCUMENTS (AD)

NO	DOCUMENT TITLE	DATE	DOCUMENT REFERENCE
RD 1	ESO Garching Vitacura Safety Manual	2012-01-15	Doc. No. : SAF-GAR-MAN-0002
RD 2	NAOJ Safety and Health Manual	2005-08-08	
RD 3	National Radio Astronomy Observatory Environment, Health, and Safety Manual	2005-May	Version 4
RD 4	General Safety Design Specification	2003-09-03	ALMA-10.08.00.00-003-A-SPE
RD 5	Resolución Exenta No. 0049/2003, Gobierno de Chile, Comisión Regional del Medio Ambiente, Segunda Región de Antofagasta, Official Resolution from the Environmental Impact Study	2003-03-20	
RD 6	ALMA System Electrical Design Requirements	2003-08-21	ALMA-80.05.00.00-005-A-SPE
RD 7	Earthing, Bonding, and Protection against Lightning and LEMP of ALMA Buildings and Structures	2006-01-20	SITE-20.00.00.00-024-A-SPE
AD 1	Conditions, Rules and Regulations applicable to Contractors working at the Atacama Large Millimeter Array (ALMA) Site	2004-04-28	ALMA-10.00.00.00-004-C-PRO
AD 2	Implementation of minimum safety and health requirements at temporary or mobile ALMA construction sites	2004-09-23	ALMA-10.08.00.00-009-A-GEN



IV. ALMA ABBREVIATIONS, ACRONYMS, DEFINITIONS:

ACHS	Asociación Chilena de Seguridad
AOS	Array Operations Site
AUI/NRAO	Associated Universities Inc./National Radio Astronomy Observatory
PC	Peer Committee
CWG	Chajnantor Working Group
DOT	Department of Transportation
ESO	European Organization for Astronomical Research in the Southern Hemisphere
EXECUTIVES	This term means the entities designated under Article 13 of the Bilateral Agreement to carry out the specific tasks required to construct and operate ALMA.
F/B	Flash Bang
GFCI	Ground Fault Circuit Interrupter
HACE	High Altitude Cerebral Edema
HAME	High Altitude Medical Evaluation
HAPE	High Altitude Pulmonary Edema
IDLH	Immediately Dangerous to Life and Health
IPAF	International Powered Access Federation
IPT	Integrated Project Team
JAO	Joint ALMA Office/ Observatory means the entity established and described in Article 14 of the Bilateral agreement, to be responsible for the overall management of ALMA Construction, Commissioning and Operations.
JHA	Job Hazard Analysis
JSA	Job Safety Analysis
LO/TO	Lock-out/Tag-out
LSO	Laser Safety Officer
MOD	Manager on Duty
MSDS	Material Safety Data Sheet
MPE	Maximum Permissible Exposure
NA	North American
NAOJ	National Astronomical Observatory of Japan
NFPA	National Fire Protection Association
NLSI	National Lightning Safety Institute
OFCS	Optical Fiber Communication Systems
OSF	Operations Support Facility
PAI/PAS	Preliminary Acceptance In-house/ Provisional Acceptance on-Site
PPE	Personal Protective Equipment
SEF	Sites Erection Facilities
SOP	Standard Operating Procedure
SHE	Safety, Health, and Environment
TB	Technical Building
UL	Underwriters Laboratory
UST	Underground Storage Tank



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V. MISSION

The mission of the ALMA Safety Office is to support ALMA's long-term commitment to its safety, health and security responsibilities to Members of Personnel under contract with Executives, contractors and visitors. The mission of the Safety Office also includes support of ALMA's commitment to environmental protection of the project site.

VI. VISION

ALMA is recognized as a global leader in radio astronomy, maximizing value for the scientific community by integrating environmental, security, safety, and health considerations into decision-making. Our vision is to establish and maintain a healthy and safe environment at all ALMA facilities. Our approach in achieving this vision will be to integrate Safety within the supervisory duties of ALMA Management, and train employees to substantiate their Safety awareness and knowledge. The ALMA Safety Program is designed to:

- Protect staff and visitors through a continuous, cost effective, and sustainable state of readiness that is resistant to threats and prepared for natural disasters.
- Develop safety policy which involves management, employees, and other major stakeholders.
- Establish challenging targets at every level to reduce work related injuries.
- Ensure an effective safety management system, led by senior and line Managers, supported by safety representatives.
- Emphasize safe design and learn from accidents and incidents.
- Deliver health and safety services, including training, capable of meeting needs at work.
- Ensure that the actions of contractors, suppliers, customers, and partners are consistent with our standards.
- Develop international cooperation to share safety knowledge and expertise among our partners.
- Meet or exceed regulatory requirements and apply industry standards, codes and best practices in the absence of regulations.

Proactively and constructively participate in the formulation of safety policy.

VII. VALUES

The ALMA Safety Office will:

- Not compromise our safety standards to achieve other goals.
- Support and implement a team-oriented work environment, ensuring cooperation and professionalism.



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- Maintain high standards of environmental, security, safety and health performance, and conduct work with discretion, integrity, to provide objective, unbiased information and analysis.
- Therefore participate in prompt, open and complete communication with all ALMA stakeholders on environmental, security, and safety issues.

Waiver / Exception to the Safety rules

Sometime exceptions to the rules can be requested provided that there is a major reason. Then a hazard analysis is necessary and specific precautions must be taken. If the risk assessment shows that the residual risk is acceptable then the exception must be approved and documented by the ALMA Director or his representative. If the risk requires violation of LOTO or Energy Source Controls, the Director ***shall not*** delegate responsibility for authorization to waive.

VIII. SAFETY OFFICE ORGANIZATION

The ALMA Safety Manual, with all its elements, is administered by the Safety Office. All safety plans, procedures, equipment requirements, training, and audits are subject to approval by the ALMA Director.

Implementation of the Safety Manual is providing instruction, and thereby a line responsibility. The Safety Office serves as an advisor to assist the line management and employees in fulfilling their responsibilities.

Executives

The ALMA Executives have the ultimate responsibility for SSHE matters, and release the Safety policy and manual. The authority to propose these, to fully implement them, and to establish, implement and execute an ALMA Safety program has been delegated to the ALMA Director.

In this context ALMA undertakes to promptly and fully report to the Executives on any incidents and accidents affecting their staff, their property or their contractual relations.



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ALMA Director

The Director establishes the ALMA Safety, Health and Environmental protection (SHE) manuals in line with the Executive's policies on that matter, provides strategic direction and sets organization-wide goals. The Director is responsible to provide leadership for all SHE matters, the ultimate responsibility for safe operations resides nonetheless with the Executives.

Managers and Supervisors

Safety within the various divisions and departments within ALMA is a primary and direct responsibility of the Managers and Supervisors.

At ALMA, each Manager or Supervisor is responsible for:

1. The implementation of ALMA safety requirements within the group
2. The conduction of a Safety Program suitable for his or her area of responsibility
3. Providing the Safety Manager an assessment of the level of risk associated with their operations
4. Ensuring that all necessary training has been provided prior to work assignment
5. Providing all necessary safety equipment
6. Selecting and employing work practices to reduce potential for accident or injuries
7. Appointing a Team Safety Representative to all hazardous operations
8. Supervising staff performance to ensure that required work practices are employed
9. Arranging appropriate medical attention for employees in the event of occupational accident or disease
10. Promptly reporting any accidents or injuries to the Safety Manager or Safety Officer. Immediately upon providing first aid to injured or stabilizing the situation for non-injury incident.
11. **Stopping work immediately when an accident occurs or when there is an imminent risk of accident**

Members of Personnel under contract with Executives

Each individual is responsible for performing assignments in a manner that will not endanger themselves or their co-workers. Each employee is responsible for:

1. Following all the ALMA safety policies and procedures
2. Utilizing all safety equipment in the proper manner
3. Performing assignments in a manner that will not endanger themselves, their co-workers or any ALMA's property or equipment



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4. Stopping any activity if, in his/her judgment, the activity constitutes an imminent threat to personnel, site equipment, or property.
5. Promptly reporting all unsafe conditions to their Supervisor and correcting those that they can.
6. Promptly reporting all work related injuries, illnesses, and near misses to their Supervisor
7. Promptly seeking appropriate medical attention when injured on the job
8. Securing the site whenever someone is injured, alert the paramedic/policlinic, and provide first aid
9. Being well acquainted with all the specific safety procedures and requirements regarding to their task and work area
10. **Stopping work and informing Supervisors immediately when there is an imminent risk of accident**

Safety Organization

Safety Manager

The ALMA Safety Manager is responsible for the following:

1. Review, implement, and administer all aspects of the ALMA Safety manual.
2. Evaluate ALMA compliance, develop, present and implement all policies and procedures which ensure that the site is in full compliance with all applicable safety, security, health and environmental regulations.
3. Develop and maintain the ALMA Safety Manual, including reviews to ensure that it is current.
4. Direct communication with and motivation of all levels of ALMA management and staff to assure efficient program implementation.
5. Conduct or oversee all safety training, and security concepts.
6. Review construction specifications to assure contractor compliance with fire, health, safety and environment applicable codes.
7. Coordinate with architects, engineers and ALMA management to review safety requirements.
8. Conduct site safety inspections.
9. Develop health and safety educational programs together with all the safety executives.
10. Ensure that safety training and accident recordkeeping is maintained.
11. Participate in environmental team meeting to assure site monitoring.
12. Develop, recommend, and implement policy on environmental protection.
13. Maintain/ conduct ALMA environmental compliance inspections and audits.
14. Develop, recommend, and implement policy on environmental protection.
15. Maintain/ conduct ALMA environmental compliance inspections and audits.
16. Develop emergency procedures including evacuation, earthquake, fire and other emergencies.
17. Advise, coordinate with and provide technical guidance to the IPT`s.



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18. Review system safety of any technical equipment
19. PAI/PAS participation of IPT deliverables.
20. Participates in reviews and acceptance processes of any technical equipment.
21. In general, provide consistent and timely review of IPT prepared Hazard Analysis, CREs, specs, etc.
22. Ensure consistent approach to vendor and IPT design safety solutions
23. Research EU, NA, Asian and Chilean safety - health and environmental requirements and their applicability to the site
24. Serve as a resource for IPT safety queries
25. Participate in IPT meetings, AIV meetings, and PAC meetings, if required
26. Attend ALMA system reviews and closure of safety related Action Items, as appropriate
27. Assist AIV in acceptance process and transition safety rollover into OPs , as appropriate

The Safety Manager has the authority to stop any activity if, in his or her judgment, the activity constitutes an imminent threat to personnel, site equipment, or property, or to the operation of the Observatory.

Safety Officer(s)

ALMA has a designated Safety Officer(s). These individuals assist the Safety Manager with the development and implementation of the ALMA Safety Program. Specifically, the Safety Officer(s):

1. Will be present at the site continuously
2. Coordinate the efforts of the Polyclinic (Paramedic).
3. Assist the Site Managers with Security related efforts.
4. Regularly visit the site installations and report all deficiencies.
5. Record all visits and site control reports.
6. Administer the safety policies and new employee orientation training,
7. Attend site safety meetings.
8. Assist in the preparation and review of safety plans,
9. Control maintenance of the site specific safety requirements,
10. Coordinate environmental, security, and safety for visitor access and new employees.
11. Represent the site in visits or investigations by outside government agencies and insurance agencies.
12. Participate in all safety training.
13. Report to the Safety Manager all specific or critical safety issues.
14. Assist with accident investigation and recordkeeping



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Also Safety Officers have the authority to stop any activity if, in his or her judgment, the activity constitutes an imminent threat to personnel, site equipment, or property, or to the operation of the Observatory.

ALMA Safety Advisory Committee

The ALMA Safety Advisory Committee is an independent body which examines and evaluates safety, security, health and environmental policy matters affecting the Executives. The ALMA Safety Advisory Committee also provides safety advice to the ALMA Director and the ALMA Safety Manager.

The ALMA Safety Advisory Committee consists of the ALMA Safety Manager and the Safety Engineers representing the three Executives in matters of Safety. Other persons may be invited on request of the Committee members.

The Committee shall meet at least once a year and on an ad-hoc basis upon request of the ALMA Director.

Contractors

Contractors at ALMA are expected to take all relevant measures in the performance of the work under his/her contract to protect the health and safety of employees and the public and to minimize danger from hazards to life and property. They shall comply with all SSHE requirements (including reporting requirements) required by contract and/or site policy/manuals.

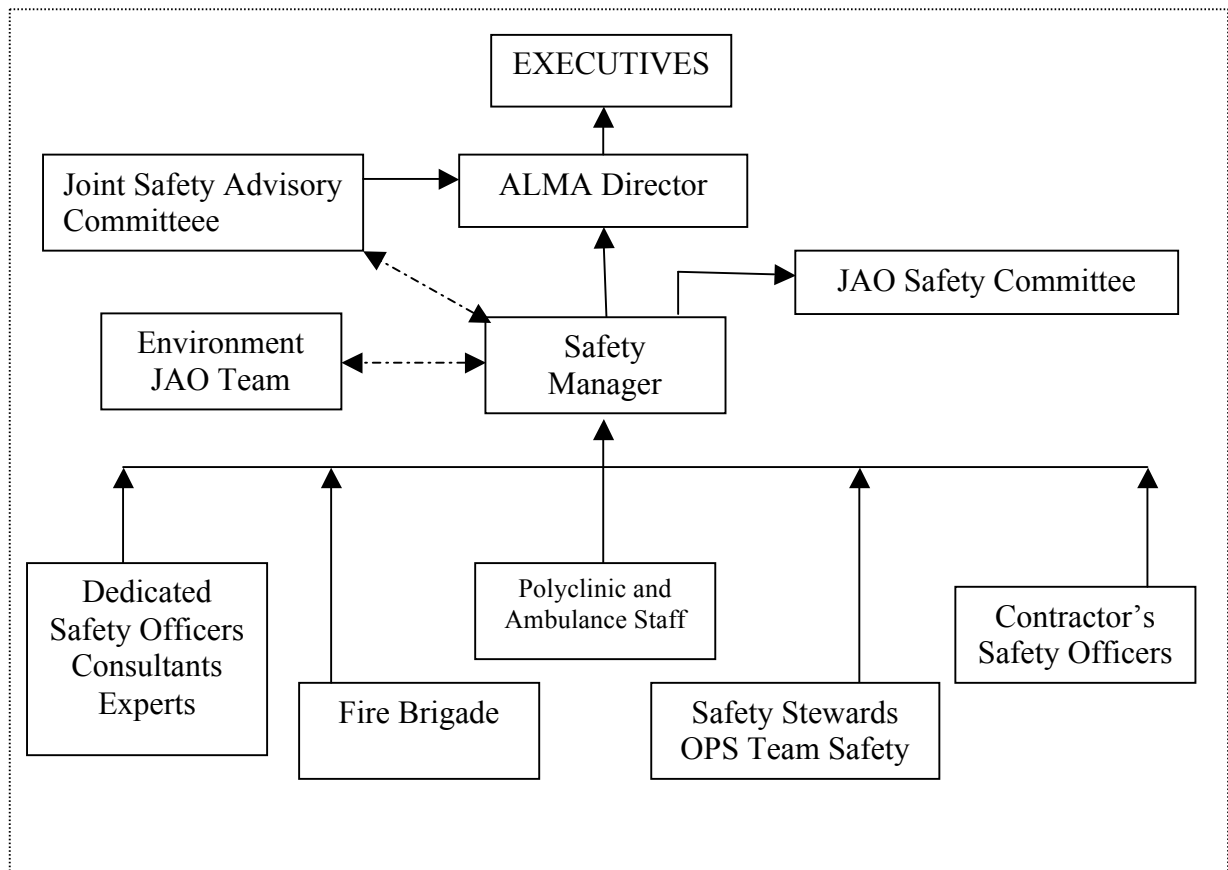
ANY CONTRACTOR EMPLOYEE MUST STOP ANY ACTIVITY IF, IN HIS OR HER JUDGMENT, THE ACTIVITY CONSTITUTES AN IMMINENT THREAT TO PERSONNEL, SITE EQUIPMENT, OR PROPERTY, OR TO THE OPERATION OF THE OBSERVATORY.



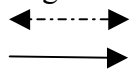
SAFETY ORGANIZATION CHART

The following Organization Chart outlines the reporting structure of the ALMA Safety Office.

Figure 2: ALMA Safety Organization Chart



Legend



Indicates close cooperation between the respective groups

Indicates



1 - Emergency Preparedness Policy

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1. EMERGENCY PREPAREDNESS

1-1 Accident Investigation Procedures

- 1) **Purpose** - This procedure provides direction for investigation of accidents.
- 2) **Scope** - Cooperation is required for all individuals involved in incidents and accidents at the ALMA site. This includes personal injury, property loss or damage, and near miss incidents. References include
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
- 3) **Rules / Requirements**

The effort needed to investigate an accident depends upon the severity of the injury, the number of persons involved, property loss, and whether the hazardous condition had been previously reported. The following steps are to be used by Supervisors and the Safety Office to investigate accidents.

INITIAL INVESTIGATION

- Immediately after ensuring emergency medical care, the responsible Supervisor will secure the accident site to preserve evidence and ensure that no additional injuries occur.
- It is the responsibility of the Supervisor to report the injury or incident as soon as it is made known to them excepting only a delay to stabilize the situation. Rapid reporting is a requirement.
- The responsible Supervisor and the Safety Office will conduct the initial investigation as soon as possible after the incident.
- The Safety Office will examine the area and take appropriate pictures and notes.
- The Safety Office will interview all witnesses. Interviews should take place individually. with the support of Supervision

ANALYZE FACTS

- The Safety Office will compile all information and, if needed, review findings with individuals qualified in technical aspects of the equipment involved.
- The investigation will review contributing factors.
- The findings will be summarized in a report.
- This report shall be immediately transmitted to the affected (personnel, property, insurance) Executive(s)
- The investigation will determine the direct and indirect causes of the accident.

PREPARE INVESTIGATION REPORT

- The report shall include relevant details of the incident.



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- The investigation will result in a listing of causes and factors determined to have a direct or indirect bearing on the accident.
- Recommendations for any actions to prevent recurrence will also be included.

MANAGEMENT REVIEW

- The Safety Manager, or designee, will review the report with the responsible Supervisor and the corresponding PC (Peer Committee).
- A copy of the report will be provided to the Site Manager, the ALMA Director, and the Safety Executives.
- Any action plans to remedy the hazard(s) will be reviewed with the Supervisor(s) to prevent recurrence, as necessary.

4) Responsibilities

MANAGEMENT

Line Management and Supervisors are responsible for the following:

- Immediately report any accident, near miss, incident which might have led to an accident.
- Immediately report any injury requiring medical treatment, or accident with property loss or a near miss to the Safety Manager.
- Immediately report any fatalities to the Safety Manager, the Site Manager on Duty and the ALMA Director.
- Initiate the Accident/Incident Report and provide a copy to the Safety Manager for every accident.
- Secure the accident site to preserve evidence and to ensure that no additional injuries occur.

SAFETY OFFICE

The Safety Manager is responsible to:

- Conduct the investigation as soon as the immediate medical and production needs have been met.
- Obtain copies of all official reports including paramedics, police, contractors, and others.
- Develop recommendations, trainings and action plans to prevent future recurrences.
- Review the accident with appropriate Supervisors.
- Review and forward copies of accident reports to the Site Manager on Duty (MOD).
- Prepare periodic safety reports to issue to the ALMA Director and the Executives.
- Inform the corresponding PC (Peer Committee)

INDIVIDUALS

All individuals are required to cooperate with the Safety Office and designated officials during an accident investigation.



1 - Emergency Preparedness Procedure

1-2 Accident Reporting Requirements

- 1) **Purpose** - This document details procedures to report accidents when someone is involved in a workplace incident.
- 2) **Scope** - Cooperation is required for all incidents (Near Miss) and accidents that occur at ALMA. This includes personal injury, property loss or damage, and near miss incidents. References include:
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
- 3) **Rules / Requirements**

CATEGORIES OF ACCIDENTS

- Personal Injury - Any injury or illness due to an accident associated with the operation of ALMA.
- Near Miss - Any incident that had the potential for personal injury or illness involving persons at or near the scene of the accident.
- Property Loss - Any accident, not in one of the above categories, which involves a property loss and is deemed worthy of documentation by the Safety Manager.

REPORTING

- Employees must notify their immediate Supervisor of all workplace injuries or illnesses as soon as possible (within the same working day).
- An Accident/Incident Report form must be filed by the responsible Supervisor with the Safety Office for every accident.
- The Safety Office must inform the JAO Management team and the Executives Safety Reps as soon as possible.
- A fatality or hospitalization accident or near-miss must be reported immediately to the Safety Manager, the Site Manager (or the MOD), the Executive(s) and the ALMA Director.
- Persons responsible for visitors shall report injuries or illnesses promptly.
- An Accident/Incident Report should be filed with the Safety Office by the end of the next working day after the accident.
- Accident/Incident Report must also be completed for near miss accidents.
- If a motor vehicle accident involves an employee, the Safety Office must be notified to coordinate drug and/or alcohol testing.
- Occupational motor vehicle accidents occurring outside the ALMA site involving property damage or personal injury are also reported to the Safety Office.

INVESTIGATION



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- The Safety Manager may appoint an Investigating Committee which may include members of the Peer Safety Committee and/or representatives of the Executives. See the attached flowchart for additional information.
- The Safety Officer and the Manager(s) involved shall investigate all other accidents and property damage and any near miss accidents deemed appropriate (See Section 1-1 Accident Investigation Procedures).

REQUIRED FORMS

- ALMA requires the completion of the following form, 'ALMA Accident/Incident Report', to report all accidents and incidents.
- There may be forms necessary to ensure that workers compensation and liability insurers are properly notified. Consult the Safety Office for information on any additional requirements.

5) Responsibilities

MANAGEMENT

Line management and Supervisors are responsible for the following:

- Initiate the Accident/Incident Report and provide a copy to the Safety Office for every accident.
- Immediately report any fatality or hospitalization accident, including near-misses of this gravity, to the Safety Manager, the Site Manager (or the MOD), the Executive(s), and the ALMA Director.
- The ALMA Director shall report any fatality or hospitalization accident to the Executives Director Generals and shall provide an investigation report in case of major accidents to the Executives.

SAFETY OFFICE

The Safety Manager is responsible to:

- Determine if there is a need for an Accident/Incident Report for near miss accidents.
- Coordinate drug and alcohol testing for vehicle accidents involving employees.
- Liaise with local regulatory officials when necessary.
- Inform Executives Safety Representative.
- Inform and collaborate with ALMA Peer Committee

INDIVIDUALS

Every employee at ALMA must:


- Employees must notify their immediate Supervisor of all injuries or illnesses as soon as possible.
- Persons responsible for visitors shall report injuries or illnesses promptly.



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Figure 3: ALMA Accident / Incident Report

	<p>ALMA ACCIDENT/INCIDENT REPORT Figure 2.4.3.1</p>	<p>Case Number (Safety Officer use only) Date & Time of Incident Incident Category (see reverse side)</p>
<p>Name of person injured or ill (if any). A separate form is required for each injured person. _____ _____</p> <p>Nature of injury and part of body _____</p>	<p>Employment Status:</p> <p> <input type="checkbox"/> Full Time <input type="checkbox"/> Temporary <input type="checkbox"/> Part Time <input type="checkbox"/> Non-employee <input type="checkbox"/> Contractor <input type="checkbox"/> Visitor </p>	<p>Department & Supervisor's Name: _____ _____</p>
<p>Severity of Injury</p> <p> <input type="checkbox"/> Non-disabling <input type="checkbox"/> Disabling <input type="checkbox"/> Medical Treatment <input type="checkbox"/> First Aid <input type="checkbox"/> Fatality <input type="checkbox"/> None Other (specify) _____ </p>	<p>Location of Incident _____ _____ _____</p>	<p>Property Damage or Loss <input type="checkbox"/> Yes <input type="checkbox"/> No What was Damaged or lost? _____ _____ _____</p>
<p>Describe how incident occurred (provide details, witnesses, photos, etc.). _____ _____ _____</p> <p style="text-align: right;">(Use reverse side or attach pages if more room is needed)</p>		
<p>Describe injury or damage (see item "D" below, include supervisor comments) _____ _____ _____</p> <p style="text-align: right;">(Use reverse side if more room is needed)</p>		
<p>Person Completing Form</p> <p>Name _____ Date _____</p>	<p>Signature of Supervisor</p> <p>Name _____ Date _____</p>	
<p>INSTRUCTIONS FOR COMPLETION OF THIS REPORT:</p> <p>A. Completion of this report is REQUIRED for any incident in Categories shown on the back of this form.</p> <p>B. It is the Supervisor's responsibility to ensure that this report is fully completed and turned in.</p> <p>C. Medical personnel may initiate this report but the supervisor must sign it and turn it in.</p> <p>D. Promptly complete this report and send original to the SAFETY OFFICER with a copy to the appropriate SUPERVISOR. Retain one copy for your records.</p>		



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Continue from front:

(Use extra sheet, if needed and attach to this document)

SAFETY OFFICE USE ONLY

Disposition:

 Signature / Date

Medical Authorization

Was medical report filled out? _____ Yes _____ No
 Degree of disability, if any? _____
 (Temporary, Permanent, Partial)

Number of days away from work _____

Date returned to work _____

Medical Authorization to Return to Work _____
 Signature / Date

1. **Personal Injury** – any personal injury or occupational illness of industrial origin involving an ALMA employee, visitor, or member of the public due to an incident associated with the operation of ALMA.
2. **Near Miss** – any incident, which had the potential for or may have caused personal injury or occupation illness involving persons at or near the scene of the incident.
3. **Property Loss** – any incident, not in one of the above categories, which involves property loss and deemed worthy of documentation by the Safety Officer.
4. **Unsafe Act or Condition** – any hazard created or existing that has the potential for injury or occupational illness to persons at or near the hazard.



1 - Emergency Preparedness Procedure

1-3 Emergency Procedures / Contacts

- 1) **Purpose** – This document provides guidance to ensure emergency medical care and presents a listing of emergency numbers for quick reference.
- 2) **Scope** - This guidance is available for all persons at the ALMA site. Proper use of emergency services and the polyclinic must be communicated to all staff and information shall be provided to visitors and contractors to ensure access to prompt emergency care. References include:
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
- 3) **Rules / Requirements**

IMMEDIATE MEDICAL ATTENTION

If immediate medical attention is required, secure the site, and inform the nearest emergency health care facility. This should be accomplished by calling site paramedic who will initiate the emergency care and transport. The following emergency numbers must be used in case of any injury, illnesses, accidents or near misses. The radio channels and/or telephone numbers are monitored at all times.

Immediate medical attention			
	Phone number	Extension	Radio VHF
OSF First aid station	2- 467 6400	6400	Channel 1 at OSF 3 from Chajnantor
AOS First aid station	2- 467 6532	6532	Channel 3 from Chajnantor
EMERGENCY	2- 467 6555	555	Channel 1 at OSF 3 from Chajnantor
Safety Officer on Duty	2- 467-6 409	6409	Channel 1 at OSF 3 from Chajnantor
	2-467-6438	6438	
	2-467-6512	6512	
	2-467-6497	6497	
Safety Manager	2- 467-6531	6531	Channel 1 at OSF 3 from Chajnantor
Security	2-755284	6284	Channel 1 at OSF 3 from Chajnantor
Satellite Phones	AOS 881622412016 Safety Officer 881622412017 Safety Manager 881622427616		



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ROUTINE MEDICAL ATTENTION

- Persons with illnesses or injuries that do not require immediate medical attention but need medical consultation must visit the site polyclinic.
- Members of Personnel requiring medical attention shall not return to work activities until released by a medical professional.

TRANSPORT TO NEAREST HOSPITAL

- The nearest full service hospital is in Calama. San Pedro de Atacama is equipped with a polyclinic.
- The Site Paramedic is responsible to contact emergency support services according to the ALMA polyclinic procedures.

REPORTING A VEHICLE ACCIDENT (OFFSITE)

- If involved in an accident in an ALMA vehicle or a rental vehicle on official ALMA business, do not assume liability or agree to settle any claim. Produce your operator's license, car registration, etc., and provide the name of the insurance carrier and the policy number and follow this procedure:
 - At the scene of the accident, call the police and have an accident report taken. Do not attempt to move the vehicles until the police arrives unless causing a hazard.
 - Write down the names and addresses of all witnesses.
 - Exchange driver information, being sure to obtain insurance carrier and his/her policy number.
 - Note license plate numbers of cars involved.
 - Immediately upon return to the site, inform your Supervisor and the Safety Office to report the accident. You are required to complete an accident form for insurance purposes. At that time, bring all pertinent documentation (police report, sketch of accident, rental agreement, etc.) to the Safety Office.

IN AN EMERGENCY SITUATION

- Do not panic.
- If trained identify yourself as a First Aider and assist the injured.
- Assess the immediate possible hazards.
- Make the area safe for yourself and others.
- If you are alone, first assist the injured and then go for help.
- If there are more people at the scene of the emergency, each one should take care of a task starting by going for help.
- If at all possible, call for help – 555 or Radio Channel 1

RULES TO FOLLOW

- Do not panic, act fast, confident and professionally.
- If the area is not safe, secure it first, or move the victim as little as possible, handle gently.
- Provide first aid if trained, every second counts.



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- Reassure the victim and those around to help. Keep the victim warm and as comfortable as possible.
- Do not allow people to crowd around.
- Do not remove clothes unnecessarily.
- Arrange the transport of the victim to the care of a doctor or a hospital a.s.a.p.

EMERGENCY PROCEDURES ESTABLISHED AND POSTED NEAR TELEPHONES

- Accident procedures
- Fire procedures.
- Other emergency procedures (out of water, major falls of ground, environment, etc.)
- Emergency telephone numbers and contacts

BASIC STEPS

- Shut down all equipment and leave the area to a pre-determined location (Safety Zone, see picture below).
- Count heads to ensure all workers are accounted for.
- Notify the Site Manager on Duty (MOD) and relevant supervisor .
- Do not re-enter the area until authorized by the owner's representative.
- Keep on spectators away from the site.

Figure 4: Safety Zone Sign



NOTE: The safety zone is a pre-determined safe area where everyone must go to immediately after either an emergency or a serious event (fire, earthquake, etc).

The signal to follow this procedure is generally given by the siren; Under certain circumstances the event itself triggers the procedure (e.g. earthquake).



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EMERGENCY WORK STOPPAGE:

Chilean law 16.744 requires that work activities be stopped immediately in case of a work-related fatal or major non-fatal accident. Those accidents must be immediately reported to the Labor authority (Inspección del trabajo) and the Regional Health Authority (Secretaría Regional Ministerial de Salud). In those cases, work may only start again once the Chilean authorities have inspected the area and verified that any potential problems have been resolved.

The above is without prejudice to the rights and immunities of ESO and AUI/NRAO, as set out in the Agreement between the Government of Chile and ESO for the purpose of Establishing an Astronomical Observatory in Chile concluded on 6 November 1963, and Chilean law 15.172, respectively, as well as all implementing measures, modifications or amendments thereto, and all other applicable rules of the laws of Chile, the ALMA partners and international law..

4) Responsibilities

The following Accident Reporting Flowchart details the responsibilities for reporting accidents and injuries that occur at the ALMA site.

MANAGEMENT

Managers and Supervisors are responsible to:

- Report all incidents, accidents, near miss to the Safety Office.
- The Site Manager on Duty will manage Emergencies, Crisis with the Safety Office.
- The ALMA Director is responsible to ensure the appropriate authorities are contacted in event of a serious or fatal accident.
- The ALMA Director will ensure that the Executives are informed of serious accidents.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Trigger and supervise emergencies with the support of the rescue brigade.
- Manage the emergencies with the Site Manager on Duty.
- Follow-up on all official reports.
- Provide liaison support with designated authorities.
- Report to the Executives all accidents affecting their staff, property or contractual relations.



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- Paramedics will immediately go to the scene, and ensure that the care of any patient is priority.
- Paramedics will initiate all necessary medical care paperwork and ensure that outside medical support (hospital) has information necessary to initiate workers compensation benefits for injured persons.

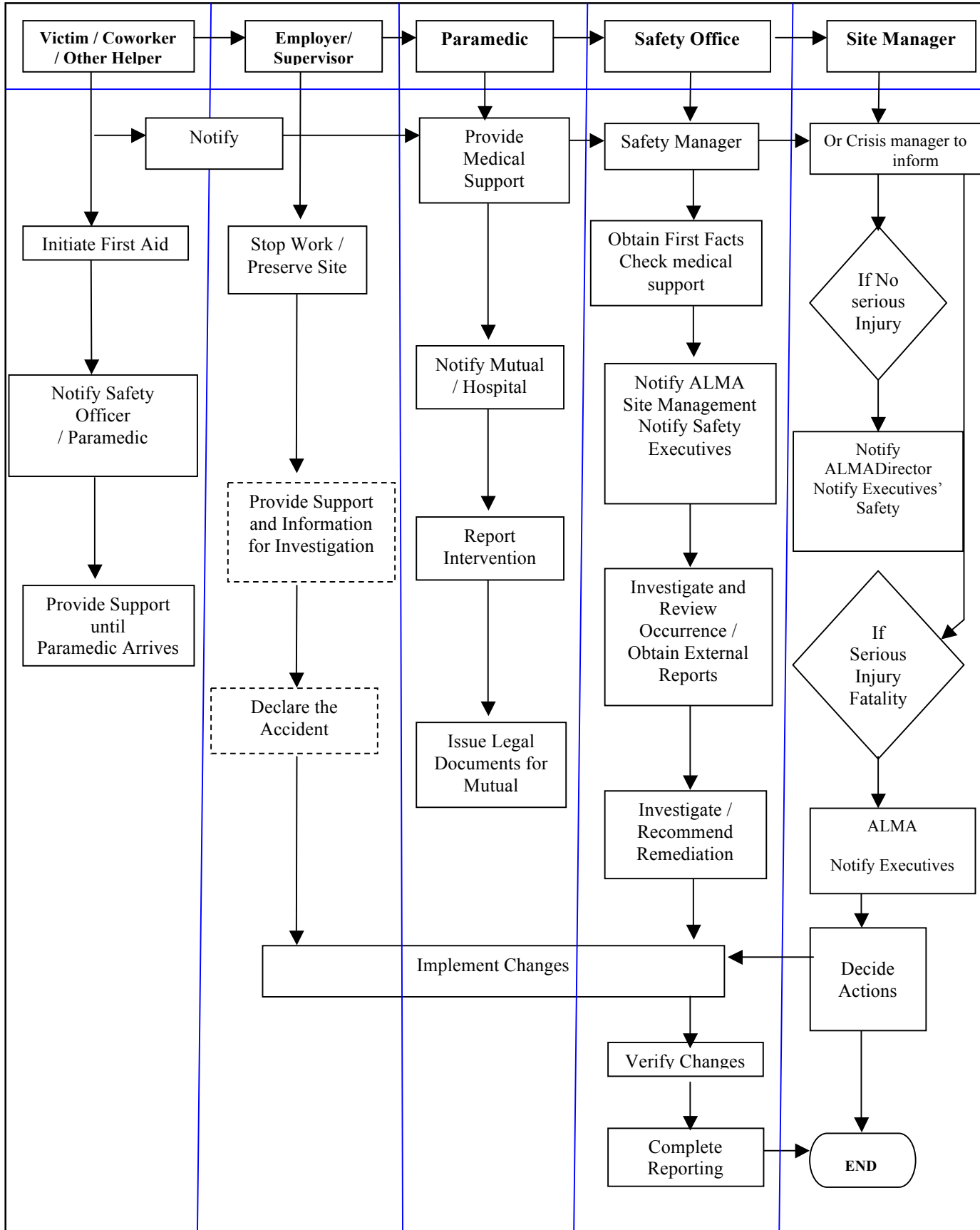
INDIVIDUALS

Every employee at ALMA must:

- Report accidents and provide first aid as the level of skill allows.
- Call for medical care and assist to ensure the scene of the accident is preserved for investigation.



Figure 5: Accident Reporting Flowchart





1 - Emergency Preparedness Procedure

1-4 Inclement Weather and natural disaster Procedure

1) **Purpose** - This procedure establishes the methods to determine weather status and communicate inclement weather and natural disaster information to affected personnel.

2) **Scope**

These procedures are applicable for work at the ALMA site. This includes work at the Operations Support Facility as well as the Array Operations Site. These guidelines are applicable for visitors and employees alike. References include:

- Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.

3) **Rules/Requirements**

INCLEMENT WEATHER

Inclement weather can occur in the Chajnantor Plateau area. Volatile weather can exist any time of the year, and as such, contingencies must be made to deal with such events. Inclement weather and natural events that may exist in this area include:

- Earthquake (See ALMA Emergency Plan –EDM Document: ALMA Earthquake Prevention plan-ALMA-10.08.03.00-001-A- PLA– Section 1-5 – Emergency Preparedness Policy and Emergency Plan)
- Lightning (See Section 1-5 – Emergency Preparedness Policy)
- Thunderstorms and high winds
- Heavy snow or ice storms
- Flash floods (Risk to damage the road – Road inspection is required after heavy rain)
- Landslide (Idem- The road maintenance team inspect the road before the traffic restarts)
- Volcano (The risk is very low - The Lascar is at a safe distance)
- Heat wave (See Section 5-1: – Health and Medical Requirements)

MONITORING WEATHER

- The Safety Office will take all reasonable measures to monitor weather conditions at ALMA and take measures to keep ALMA staff advised of any conditions that may impact safety or operations.
- Currently the APEX web page provides a source of weather information for the Chajnantor Plateau. During inclement weather, the Safety Officer will monitor this or similar information regularly. See <http://www.apex-telescope.org/weather/index.html>
- ALMA personnel must be aware of changing weather conditions at the ALMA site, particularly during the Bolivian winter (Feb/March). ALMA weather station at OSF can be seen at <http://weather.aiv.alma.cl>
- It is strongly recommended that each Supervisor individually monitor weather conditions in the area, as well as news and alerts that may be introduced via internet, radio, or television.



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DETERMINING SITE OPERATING STATUS

- Supervisors are advised to monitor conditions and the ALMA Safety emergency radio channel.
- In the event of a severe weather event that impacts operations, the Safety Office shall communicate with the Site Manager, the Array Lead Engineer, the Control room Operator and any other group which might have a need for information.
- The Safety Manager communicates what actions should be taken to address a severe weather event according to established procedures and the emergency plan .
- The decision to release employees during inclement weather shall be taken by the appropriate Supervisor.
- An email message shall be sent from the Safety Office to all ALMA Chile users if there's a change in the site operating status.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Verify site road and site conditions by sending teams in well equipped vehicles to the AOS when work requires.
- Report the findings to the Safety Office and if conditions permit, forward information to the affected Supervisors.
- Prepare procedures for prompt response to emergency weather.
- Monitor weather conditions at the ALMA Site.
- Monitor the ALMA Safety emergency radio channel.
- The release from employees job duties during inclement weather shall be approved by the Supervisors and/or manager.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Communicate with Supervisors, the Camp Facilities Manager, Construction Lead, and any other group which might have a need for information.
- Determine what action, if any, should be taken to address a severe weather event.
- Monitor weather conditions that impact the ALMA area. See next Section 1.5
- Advise the Supervisors of any conditions that may impact operations or safety.
- Send email messages to ALMA Chile users if there's a change in the site operating status.
- Update the Weather Line (phone) with the most up-to-date opening information.

INDIVIDUALS

Every employee at ALMA must:

- Report any significant changes in weather or work conditions to the Safety Office.



1 - Emergency Preparedness Procedure

1-5 Natural Disaster

1) **Purpose** - This document establishes the guidelines for responding to natural disasters.

2) **Scope**

These guidelines are applicable for all ALMA employees, Executive staff, and visitors under the charge of an ALMA employee; whenever any of the following inclement weather conditions or natural disasters occur:

- Earthquake (See ALMA Emergency Plan –EDM Document: ALMA Earthquake Prevention plan-ALMA-10.08.03.00-001-A- PLA and Emergency Plan)
- Lightning
- Thunderstorms and high winds
- Heavy snow or ice storms
- Flash floods (Risk to damage the road – Road inspection is required after heavy rain)
- Landslide (Idem- The road maintenance team inspect the road before the traffic restarts)
- Volcano (The risk is very low - The Lascar is at a safe distance)
- Heat wave (See Section 5-1, Health and Medical Requirements – “Physical Exam Requirements & High Altitude Policy”)

References include:

- Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
- Tokyo Labor Standards Federation, ‘Text of Sanitary Supervision – Labor Health’

3) **Rules / Requirements**

GENERAL

- The Safety Office will maintain emergency supplies including:
 - Flashlights with batteries
 - Radios
 - First-aid kit
 - Emergency phone numbers
 - The Safety Office is responsible for the production, maintenance and training of all ALMA emergency procedures and rules and for the emergency communication plan.
 - Under the supervision of the Safety Office every work group or team and individual at ALMA should:
 - Make evacuation plans.
 - Establish a meeting place to gather if there is a natural disaster.
 - Follow the evacuation orders when issued by ALMA authorities.
 - Carry out emergency trainings.



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EARTHQUAKE:

- Identify gas, electric and water main shutoff locations.
- Train employees how to turn off utilities if there is a leak or electrical short.
- Secure bookcases, cabinets, tall furniture, file cabinets, etc. to wall studs.
- Brace or anchor heavy electronics and other heavy items.
- Secure items that might fall.
- Keep heavy or fragile items to lower shelves.
- Fasten drawers and cabinet doors with latches or locks.
- Brace overhead light fixtures.
- Strap the water heater to wall studs and bolt down any gas appliances.
- Look for other non-structural steps to take to reduce chances for injury and loss.

LIGHTNING

- New structures must take into consideration RD-7, Earthing, Bonding, and Protection against Lightning and LEMP of ALMA Buildings and Structures.
- Use the Flash/Bang (F/B) technique to measure lightning distance. Five seconds from seeing the lightning flash to hearing the associated thunder is equal to 1.61 km.
- Use the National Lightning Safety Institute, NLSI, 30/30 Rule. When you see lightning, count the time until you hear thunder. If the time is 30 seconds or less (9.66 km), go immediately to a safe place.
- Wait 30 minutes or more after hearing the last thunder before leaving the safer location. A “Safe Location” is a properly protected building or telescope.
 - The safest place commonly available is a large, fully enclosed, substantially constructed building which can conduct lightning current safely to ground.
 - If you can’t reach a substantial building, get in an enclosed vehicle with a solid metal roof and metal sides. Close the windows, lean away from the door, put your hands in your lap and don’t touch any other car part.
 - Convertibles, cars with fiberglass or plastic shells, and open-framed vehicles are not suitable lightning shelters. A fully enclosed metal vehicle is a safe location because of the (partial) Faraday Cage effect.
- Do not touch any metal conductor exposed to the outside because it could become a lightning conduit.
- Stay away from corded telephones, electrical appliances, lighting fixtures, ham radio microphones, electric sockets and plumbing.
- Don’t watch lightning from open windows or doorways.
- Be alert to changes in sky conditions.
- When outside:
 - Proceed from higher to lower elevations.
 - Avoid wide-open areas and tall, isolated objects like poles and light posts.
 - Avoid water-related activities such as swimming (including indoor pools).
 - Do not remain in open vehicles like tractors and riding lawnmowers (sun roofs offer no protection).
 - Do not use unprotected open structures such as picnic pavilions, and rain shelters.
 - Avoid contact with metal fences, metal bleachers, or other long metal structures.



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- If in a group, spread out so there are several body lengths between each person. Once spread out, stay away from other people, remove metal objects, crouch with feet together, head tucked, and placing hands on ears to reduce acoustic shock from nearby thunder.
- When the immediate threat of lightning is past, head to the safest place possible.
- When planning outdoor work activities, obtain the weather forecast.
- Work shall cease and personnel shall immediately proceed to a Safe Location under the following conditions:
 - A lightning strike is observed within a 9/10 km range of the work location.
 - The storm is observed to be approaching the work site or;
 - The range and direction, as described above, is determined by a lightning sensing device or;
 - Upon notification by or from a Safety Officer or Supervisor.
 - Report the lightning threat to the Supervisor and notify them of the decision to stop work and go to a Safe Location.
 - Upon notification, Supervisors shall notify all other personnel working outdoors and advise them of the lightning threat. If conditions for these personnel match those described above, work shall cease immediately and the personnel are required to proceed to a Safe Location.
 - Personnel may resume work when an “All Clear” notification is given by a Safety Officer or Supervisor or when the source of lightning has moved and NO lightning strikes are observed within a 9/10 km radius for over 15 minutes. Lightning injuries:
 - Call for emergency help immediately.
 - All deaths from lightning strikes result from cardiac arrest and/or stopped breathing; begin CPR or mouth-to-mouth-resuscitation.
 - Strike victims do not pose any electric hazard to a care giver.
 - If the storm’s lightning is ongoing and represents a continuing risk to responders, consider moving the victim to a safer location

STORMS

- According to the National Weather Service, a thunderstorm is “severe” when winds reach or exceed 93 km/hr or produce hail 2 cm in diameter or larger.
- Plan work activities accordingly, which may include postponing planned activities.
- Reduce speed when driving in a thunderstorm or pull off to the shoulder of the road away from tall objects, such as trees, which could fall due to wind or lightning.
- Turn on emergency flashers and remain in the car until the storm passes.
- Avoid driving on roads covered by water.
- When bad weather comes up at Chajnantor:
 - If the visibility is $> 100\text{m}^*$ the work continues.
 - If the visibility (V) is: $5\text{m} < V < 10\text{m}$ and the wind $> 10\text{m/s}$ the outside work stops
 - Staff stays sheltered (inside AOS/TB or other shelter)
 - If the visibility is $< 5\text{m}$ with a wind $> 10\text{m/s}$ the staff caravans down to the OSF.

* $1\text{m} = 3.28\text{ ft}$

* $10\text{m/s} = 36\text{ km/h} = 22.37\text{ mi/h}$



COLD, SNOW OR ICE STORMS

- Ensure vehicle is equipped and serviced as per the manufacturer's recommendations.
- When extremely cold, and especially if there are high winds, try to stay indoors.
- Make trips outside as brief as possible.
- Wear tightly woven clothing to reduce body-heat loss caused by wind. See ALMA winter clothes policy. The Observatory provides cold weather work clothing to Members of Personnel where this is deemed necessary for the efficient and safe performance of their normal duties.
- Wool, silk, or polypropylene inner layers of clothing hold more body heat than cotton.
- Stay dry—wet clothing chills the body rapidly.
- Excess perspiration will increase heat loss, so remove extra layers of clothing whenever you feel too warm.
- Avoid getting gasoline or alcohol on skin. These materials on skin increase heat loss from the body.
- Do not ignore shivering. It's an important first sign that the body is losing heat. Persistent shivering is a signal to return indoors.
- Cold weather puts an extra strain on the heart. Follow your doctor's advice about working in the cold.
- If Stranded:
 - Stay in a vehicle if storms create poor visibility or if roadways are ice covered.
 - Tie a brightly colored cloth to the antenna as a signal to rescuers and raise the hood of the car (if it is not snowing).
 - Move anything needed from the trunk into the passenger area.
 - Wrap in extra clothing, blankets, or newspapers.
 - Stay awake to be less vulnerable to cold-related health problems.
 - Run the motor (and heater) for about 10 minutes per hour, opening one window slightly to let in air. Make sure that snow is not blocking the exhaust pipe—to reduce the risk of carbon monoxide poisoning.
 - Do not eat snow because it will lower your body temperature.
 - Huddle with other people for warmth.
- Hypothermia:
 - Get into a warm room or shelter.
 - Remove wet clothing.
 - Warm the center of the body first—chest, neck, head, and groin—using skin-to-skin contact under loose, dry layers of blankets, clothing, towels, or sheets.
 - Warm beverages can help increase the body temperature, but do not give alcoholic beverages. Do not try to give beverages to an unconscious person.
 - After body temperature has increased, keep dry and wrapped in a warm blanket, including the head and neck.
 - Get medical attention as soon as possible.
- Frostbite:
 - Get into a warm room as soon as possible.
 - Unless absolutely necessary, do not walk on frostbitten feet or toes—this increases the damage.
 - Immerse the affected area in warm—not hot—water.
 - Or, warm the affected area using body heat. For example, the heat of an armpit can warm frostbitten fingers.



- Do not rub the frostbitten area with snow or massage it at all. This can cause more damage.
- Don't use a heating pad, heat lamp, or the heat of a stove, fireplace, or radiator for warming. Affected areas are numb and can be easily burned.

FLASH FLOODS

- Turn off utilities at the main and close gas valves if evacuation appears necessary.
- Don't drive or walk through a flooded area.
- If the car stalls, abandon it immediately and climb to higher ground.
- Stay away from downed power and electrical wires. Electric current passes easily through water.
- Don't try to swim to safety; wait for rescuers to come.
- Before entering a flooded building, inspect foundations for cracks or other damage. Don't go in if there is any chance of the building collapsing.
- Upon entering the building, don't use matches, cigarette lighters or any other open flames, since gas may be trapped inside. Instead, use a flashlight.
- Keep power off until an electrician has inspected the system for safety.
- Floodwaters pick up sewage and chemicals from roads and buildings. If flooded, protect health by cleaning up right away.
- Until declared safe, boil water for drinking and food preparation before using.

MUDSLIDE / LANDSLIDE

- Slides can occur during periods of intense rainfall or rapid snowmelt. They usually start on steep hillsides, liquefy and accelerate down the hill.
- Every person should become aware of the potential for mudslides.
- Preparation:
 - Become familiar with the land. Find out if you're in a slide prone area.
 - Watch the patterns of storm-water drainage on slopes nearby, and especially where runoff water converges, increasing flow over soil-covered slopes.
- During Intense Storms:
 - Watch hillsides for signs of land movement, such as small slides or debris flows.
 - If in areas susceptible to landslides and debris flows, leave if it is safe to do so.
 - Listen for any unusual sounds that might indicate moving debris.
 - If near a channel, be alert for an increase or decrease in water flow or a change from clear to muddy water. Changes may indicate landslide activity upstream.
 - Be especially alert when driving. Embankments along roadsides are particularly susceptible to landslides. Watch the road for collapsed pavement, mud, fallen rocks, and other indications of possible debris flows.
- During a Slide:
 - Quickly move out of the path of the landslide or debris flow. Moving away from the path of the flow to a stable area will reduce your risk.
 - If escape is not possible, curl into a tight ball and protect your head. A tight ball will provide the best protection for your body.



- After a Slide:
 - Stay away from the slide area. There may be danger of additional slides.
 - Check for injured and trapped persons near the slide, without entering the direct slide area. Direct rescuers to their locations.
 - Watch for flooding, which may occur after a landslide or debris flow.
 - Look for and report broken utility lines to management to get utilities turned off as quickly as possible, preventing further hazard and injury.

VOLCANO

- Be prepared for the hazards that can accompany volcanoes:
 - Mudflows and flash floods
 - Landslides and rock falls
 - Earthquakes
 - Ash fall and acid rain
- If caught indoors:
 - Close all windows, doors, and dampers.
 - Put all machinery inside a garage.
- If trapped outdoors:
 - Use a dust mask or hold a damp cloth over your face to help breathing. Volcanic ash can irritate your respiratory system.
 - Wear goggles to protect your eyes.
 - Keep skin covered to avoid irritation from contact with ash.
 - Seek shelter indoors.
 - Wear long-sleeved shirts and long pants.
 - Avoid valleys and low lying areas.
- Clear roofs of ash fall: Ash fall is very heavy and can cause buildings to collapse. Exercise great caution when working on a roof.
- Avoid driving in ash fall. Driving will stir up ash that can clog engines and stall vehicles.

HEAT

- **Heat Exhaustion** results when fluids or salt are not replaced. The worker with heat exhaustion still sweats but experiences extreme weakness, giddiness, nausea or headache. The skin is clammy and moist, the complexion may be pale or flushed and the body temperature is normal or slightly higher.
- **Heat Stroke**, is a serious hot environment health problem caused by failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. **Victims of heat stroke are in very serious danger of dying unless treated promptly.**
- Engineering Controls:
 - Provide air-conditioned rest areas.
 - Increase air movement if temperatures are more than 35° C (fans).
 - Reduce physical demands of work task through mechanical assistance.
- Administrative Controls:
 - Assess the demands of all jobs and monitor hot days.
 - Increase the frequency and length of rest breaks.
 - Schedule hot jobs to cooler times of the day.



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- Provide cool drinking water and remind workers to drink often.
- Assign additional workers or slow down work pace.
- Train workers to recognize the signs and symptoms of heat stress and use a “Buddy System” as people are not likely to notice their own symptoms.
- Pregnant workers and workers with a medical condition should discuss working in the heat with their doctor.
- Personal Protective Equipment:
 - Wear light clothing to allow free air movement and sweat evaporation. Long sleeves are strongly recommended in view of UV exposure.
 - A wide-brimmed hat will provide shade and keep the head cool.
 - In a high radiant heat situation reflective clothing may help.
 - For very hot environments, consider air, water or ice-cooled insulated clothing.
 - Vapor barrier clothing greatly increases the amount of heat stress on the body, and extra caution is necessary.
 - Chilean law: UV protection : to provide sun block to the employees

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure Personal Protective Equipment is available.
- Keep up with forecasts. Plan the work activities accordingly, which may include postponing or canceling planned activities.
- Identify locations where the gas, electric and water main shutoffs are. Train employees in how to turn them off if there is a leak or electrical short.
- Look for non-structural steps to take to reduce chances for injury and loss.
- Carry out all necessary hazard / risk assessments.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide a disaster supply kit and ensure emergency supplies are maintained.
- Carry out the hazard/risk assessment in conjunction with the corresponding area manager and/or supervisor.
- Make evacuation plans and have them well distributed.
- Develop an emergency communication plan.
- Inform staff of these requirements.
- Ensure staff is provided opportunities for first aid and CPR training.
- Ensure site conditions are safe prior to providing an “All Clear” notification.
- Train employees in the requirements of this policy.

INDIVIDUALS

Every ALMA employee must:

- Follow the requirements of this policy.
- Be responsible for the safe use of PPE.
- Take a First Aid and CPR Training Course as required for specific job categories.
- Follow evacuation orders when issued by ALMA authorities.



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- Contact the Safety Office in event of changing weather conditions.
- In case of a catastrophe, check for injured and trapped persons, without entering the direct area. Direct rescuers to their locations.

WIND STORM

Objective

To establish the necessary safety measurements to assure ALMA's project personnel well being as well as project belongings.

Scope

This procedure is to be used at any part of the ALMA site, being this: the OSF, AOS, and Roads. This procedure must be complied by all project staff, vendors, and visitors. Visual warnings are to be posted outside the OSF, the AOS the Chajnantor gate and at the SHE Wiki page.

Related Documents and Drawings

Applicable Documents

The following list of documents is applicable to this document to the extent specified. Each applicable document will be identified as "AD" numbers. The most recent version of the document is valid.

Appl. Doc.	Title	Document Number/Name
[AD 01]	Technical Specification for the Design, Manufacturing, Transport and Integration on Site of the ALMA ANTENNA TRANSPORTER	ALMA-37.01.00.00-003-B-SPE
[AD 02]		

Reference Documents

The following list of documents is for reference purposes in relation to this document and to the extent specified. Each document will be identified as "RD" numbers. The most recent version of the document is valid.

Ref. Doc.	Title	Document Number/Name
[RD 01]	ALMA Site Emergency Plan	ALMA-10.08.03.00-002-A- PLA
[RD 02]		

List of Acronyms and Abbreviations

For a complete set of acronyms and abbreviations, please go to the [ALMA AIV](#) web page.

Verb Convention



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"Shall" and "must" are used when a specification or provision is mandatory. The verbs "should" and "may" indicate a specification or provision that is not mandatory. Definitions

a. Project Staff:

- All personnel involved in the construction and/or operations of the ALMA project. It includes any Executive partners, contractors, and subcontractors.

b. Emergency:

- An unforeseen or sudden occurrence, which demands immediate remedy or action. It affects the normal functioning of the ALMA project construction and/or operation; and can cause harm or damage to project staff or any project material. It could also affect the normal balance in the project environment or surroundings.

c. Alert:

- Any situation that demands to be watchful and prompt to meet danger or emergency.
 - Alert 1: strong breeze to gale. Green Flag. Wind speeds from 43 to 86 km/hr (12 -24 m/s).
 - Alert 2: Storm, gale – violent storm. Orange Flag. Wind speeds from 90 to 119 km/hr (25–33 m/s).
 - Alert 3: Hurricane – force. Red Flag. Wind speeds over 120 km/hr (over 34 m/s)

d. Work at heights:

- Any job carried out above ground that needs a ladder, a transitory platform, permanent platform, a manlift or any type of crane to reach the working area. Height will be considered from 1.80 m above ground.

e. Anemometer:

- Instrument used to measure wind speed.

f. Instant Wind Speed:

- Velocity of the wind taken at any time with the anemometer.

g. Wind category:

- Wind category is defined after measurements of 60 seconds during intervals of 30 minutes. Wind gusts will not defined by category.

Responsibilities

Safety Manager:

- Provide all the necessary tools and information to the SHE office to comply with this procedure (flags, alarms, signals, radios)
- Make sure that all SHE personnel abide by and execute all described in this procedure.
- Must provide support in case of any evacuation, and keep the site manager informed at all times.

Safety Officer on Duty:

- Measure the wind speed as required upon AIV request, by using the hand held anemometer.



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- Verify weather conditions through the Internet sites available to the project. Forecasts of ground wind speed levels above 12 m/s will be informed via email the day before.
- Declare/revoke the corresponding alert level (number) and communicate this situation via phone and email to the SHE manager, the Site Manager. Then inform all site personnel via email and radio about the current alert status.
- Order the security guard supervisor to place/remove the required colored flag. This will depend on the present wind condition hazards and the flag will be in the guard's control at both the OSF and AOS.
- Gather the emergency brigade whenever an alert two is declared via channel 16

Site Manager:

- Transfer office to the SHE office as soon as an alert two is declared.
- Collaborate and participate with the SHE office in all decision taking while the emergency is in place.
- Provide all the necessary goods required during the emergency.
- Communicate with the necessary managers, IPTs, and executives as needed, together with any outside authority.
- Verify that the SHE office has placed all communications.
- Verify that this procedure is carried out accordingly.

Security Guards:

- Place/remove the corresponding alert flag upon request from the SHE Officer.
- Supervisor will report to the SHE office as soon as alert I is declared.

Emergency Committee:

- Gather at the Emergency container as soon as an emergency III is declared.
- Coordinate with the Site Manager and SHE manager all necessary actions to be taken as the emergency develops.
- The committee will take the decision of:
 - Site evacuation
 - Resource allocation (food, water, power, Vehicles, emergency brigade, fuel)
 - Shift changes
 - Road clearing
 - Any situation that has arisen from the emergency
- The committee will take all the necessary precautions to maintain the observatory in operations with regards to the situations mentioned in the previous numeral.

Managers and Supervisors:

- Will make sure that all their personnel have been informed about the alert level declared by the SHE office. The Supervisor will measure the wind speed on site with the anemometer, and will duly notify the SHE Officer on duty about any wind speed above 15 m/s.



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Category	Flag	Wind speed ¹		Land conditions	Control measures	Vehicles
		m/s	Km/hr			
I strong breeze to strong gale	Yellow	12-24	43-86	<p>10.8–13.8 m/s Umbrella use becomes difficult. Empty plastic garbage cans tip over.</p> <p>13.9–17.1 m/s Effort needed to walk against the wind.</p> <p>17.2–20.7 m/s Cars veer on road. Progress on foot is seriously impeded.</p> <p>20.8–24.4 m/s Construction/temporary signs and barricades blow over.</p>	<ol style="list-style-type: none"> All outdoor lifting tasks must be stopped when the wind speed reaches 17 m/s. This includes the use of the FESV, crane trucks, cranes and forklifts. Working with suspended equipment on the antennas and man-lift works will be stopped when wind speed reaches 12 m/s SHE will inform the forecast by email and assure that all outdoor works have been stopped. Only interior works will be allowed (inside antennas, pedestals and receiver cabin). When walking, avoid unnecessary walks and use handrails where available on outdoor walkways. The maximum wind speed for the safe operating of the ALMA Antenna Transporters shall be 17 m/s measured with the AT anemometer. AIV limit for on ground outdoor work at the AOS is 20 m/s. Minimum PPE must be worn at all times. Hardhat must be accompanied with chinstrap, and goggles and/or safety glasses must be used. 	<ol style="list-style-type: none"> If visibility is possible vehicles are allowed on the road. When parking, place vehicle against the wind; this way, when doors are open they will not be violently hit by the wind force When getting off any vehicle only open one door at a time. Take turns for opening the doors so everyone can get safely from the vehicle. No load is allowed on any pick up or truck beds. If it is necessary to park on the side of the road and/or shoulder, hazard lights must be turned on.
II Storm, whole gale – violent storm	ORANGE	25-33	90-119	<p>24.5–28.4 m/s Poorly attached asphalt shingles and shingles in poor conditions are peeled off roofs.</p> <p>28.5–32.6 m/s Widespread damage to vegetation. Many roofing surfaces are damaged; asphalt tiles that have curled up and/or fractured due to age may break away completely.</p>	<ol style="list-style-type: none"> Only authorized and/or emergency vehicles will be allowed to transit in the affected area. People will be requested to stay inside their offices. Brigade assembles at the SHE office. 	<ol style="list-style-type: none"> Access road to affected area will be closed. Authorized vehicles to transit will have to travel by pairs

¹ The Wind Chill Factor info may appear in the ALMA weather station but will not be included in this procedure due to different criteria such as temperature.



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Category	Flag	Wind speed ¹		Land conditions	Control measures	Vehicles
		m/s	Km/hr			
III Hurricane – force	RED	>34	>120	Very widespread damage to vegetation. Some windows may break; mobile homes and poorly constructed sheds and barns are damaged. Debris may be hurled about.	<ol style="list-style-type: none"> Stay inside and away from windows. Emergency Committee assembles No one is allowed to be outside 	<ol style="list-style-type: none"> Only emergency vehicles are allowed to move around affected areas Bus coming in from Calama airport will be stopped in Calama and will not be allowed to leave the site.

Special Situations

During work at Chajnantor²

Refer to [AD 01].

- If the visibility is > 100m the work continues.
- If the visibility (V) is: $5\text{m} < V < 10\text{m}$ and the wind > 10m/s the outside work stops – Staff stays sheltered (inside AOS/TB or other shelter)
- If the visibility is < 5m with a wind speed of > 10m/s, then transport the staff caravans down to the OSF.

Safety actions before the storm

- Upon the event of a storm, make sure your property is secure. Remove any loose roofing materials and objects, patios or roofs that could be blown away.
- Secure objects and/or portable structures on your property that could fall or be blown away.
- Secure or move your garbage and recycle containers to minimize litter throughout the project and to keep the ALMA road clear of debris.

Safety actions during the storm

- Forecast will be informed and followed up by the SHE office considering the following link:
 - <http://www.eso.org/gen-fac/pubs/astclim/forecast/meteo/verification/Chajnantor/evolution.html>
- If the value of the wind speed on real time – shown on the ALMA weather station (<http://weather.aiv.alma.cl/all/30min.php>) – is over 12 m/s, the information will then be confirmed with a handheld anemometer or the AT anemometer³ according to the job performed. SHE office will solve any other discrepancy.
- If a high wind warning is issued, securely shut the windows and brace outer doors.
- Authorized vehicle(s) will turn on emergency flashers.
- Keep emergency phone numbers handy. Establish an out-of-area contact that all household members can reach in an emergency, should you get separated.

² Conditions remain as mentioned in the table. This situation considers visibility.

³ There are additional instruments (AT anemometer) in case the safety officer is not on site.



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- Under strictly necessary mobilizations the security staff will manage transportation when visibility is less than 5 m. The security supervisor and the camp guard will lead convoys coordinated in conjunction with the main entrance and Chajnantor control guard.

Safety actions after the storm

- ALMA's SHE office will constantly keep the site manager informed about the state(s) of the windstorm.
- After the wind alert has been called off, the SHE will perform inspections to all areas affected by the storm.



2 - Environmental Protection

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2. ENVIRONMENTAL PROTECTION

2-1 Above and Underground Storage Tanks

- 1) **Purpose** - The purpose of this procedure is to establish the requirements for monitoring, recordkeeping, and reporting for aboveground and underground storage tanks (ASTs and USTs).
- 2) **Scope** - This procedure is applicable to all temporary and permanent ASTs and USTs at the ALMA site. A storage tank is defined as the container used for the storage of petroleum products. This procedure is not applicable to hazardous waste tanks.

3) Rules / Requirements

PERMITS

- Each tank must have the appropriate permits for operation.
- Construction or installation of new tanks is prohibited without authorization from the Site Manager on Duty.
- If a new installation is approved, the Safety Office shall ensure that the design and construction of the tank complies with applicable safety requirements.
- New installations must have completed pre-operational inspections and testing requirements as specified in the contract documents.
- An annual inspection must be carried out by an independent notified body to verify conformity with applicable regulations (certificate of conformity from the SEC – Superintendencia de Electricidad y Combustible).

MONITORING

- All USTs must have continuous electronic monitoring connected to an alarm.
- If electronic monitoring is not functioning properly, the following manual procedures are to be utilized.
 - Gauge the tanks at the same time every day.
 - Do not allow the gauge stick to strike the bottom of the tank.
 - Repeat the gauge process until two consecutive like readings are obtained.
 - Enter all data on a monitoring log book.

SPILLS AND LEAKS

- Aboveground storage tanks will be placed inside pools capable of holding spills up to a similar volume as the tank.
- Any unauthorized release shall be removed from the secondary container within the shortest possible time.
- In the event of a spill or leak, the Safety Office must be contacted and a spill report generated indicating the material released, the cleanup used, and the method of repair.
- Any spills must be reported within one day of discovery.



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CLOSURE

- Any tank that is being discontinued from use must be closed.
- The Safety Office must be notified of any intent to close a tank to ensure proper procedures are followed.

4) Responsibilities

MANAGEMENT

Line Managers and Supervisors are responsible to:

- Ensure each new tank is appropriately permitted for operation.
- Ensure new installations have completed the pre-operational inspections and testing requirements.
- Ensure that manual monitoring procedures are utilized if electronic monitoring fails.
- Ensure any unauthorized release is cleaned within the shortest possible time.
- Notify the Safety Office of any intent to close a tank.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Ensure all ASTs are properly labeled and equipped with alarms.
- Determine that the secondary containment is sufficient in size to hold the entire contents of the tank.
- Log all tank inspection results.
- Log any release of petroleum product from an AST.
- Ensure that the design and construction of new tanks comply with applicable requirements.
- Ensure monitoring is conducted and detailed monitoring records are maintained.
- Ensure absorbents are present and continuously available.

INDIVIDUALS

Every ALMA employee must:

- Receive training before any involvement in management of ASTs or USTs.



2 - Environmental Protection

2-2 Hazardous Waste Management

- 1) **Purpose** - The purpose of this procedure is to ensure that hazardous waste is properly handled, stored, and transported by authorized personnel.
- 2) **Scope** - This procedure is applicable to all ALMA construction and operation activities as well as the transport of hazardous waste at the ALMA site.
 - Directive 80/1107/EEC – Protection of workers from exposure to chemical, physical, and biological hazards.
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.

3) Rules / Requirements

WASTE STREAM DETERMINATION

- New materials with the potential to be hazardous materials shall be reviewed by the Safety Office before purchase.
- The ALMA Safety Office shall inventory and categorize each waste stream.
- The inventory shall include a description of the waste
 - Common name
 - Shipping name, hazard class
 - Special handling instructions
 - Segregation requirements
 - Label and marking requirements
 - Transport placard requirements

ACCUMULATION TIME

- The individual or group generating hazardous waste is responsible to comply with the requirements of this section.
- Waste containers must be properly manifested and removed from the central storage area before the 30th day of storage.
- Containers must be marked with the date of storage / accumulation date.

STORAGE SITE REQUIREMENTS

- The Safety Office is responsible to inspect storage sites for hazardous waste to confirm compliance.
- The accumulation site must have an impervious surface in case of spills or leaks.
- Release of hazardous wastes onto bare soil, any wastewater system, or waterway is prohibited.
- Warning signs must be posted to prevent unauthorized entry into a hazardous waste storage area. Access is restricted to authorized personnel.



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- No more than one 208-liter-container of any hazardous waste may be accumulated.
- All waste containers must be labeled.
- Every waste container must be in good condition and kept closed.
- The Supervisor of the area where the storage is permitted is responsible for proper management of the waste.
- Sites where hazardous waste is stored must have emergency facilities including spill cleanup materials.
- Storage areas must be equipped with bonding and grounding equipment.
- Wastes must be separated according to hazard class.
- The Safety Office shall inspect hazardous waste storage sites weekly.
- Any discrepancies in periodic inspections must be documented and corrected.

MANIFESTS / SHIPMENT

- The Safety Office is responsible to ensure that the hazardous waste manifests are completed for each offsite shipment.
- The Safety Office shall maintain copies of each manifest and track the manifest status for any missing shipments
- Only authorized waste haulers are permitted to transport hazardous waste.

TRAINING

- Any employee required to handle hazardous waste must receive training before any involvement in the management of hazardous waste.
- Training must include at a minimum:
 - Hazardous waste requirements
 - Emergency preparedness
 - Proper waste management practices
 - Labeling information
 - Recordkeeping

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure authorized employees receive approved personal protective equipment to handle hazardous waste materials.
- Ensure unauthorized persons are prevented from entering restricted areas.
- Mark and label containers with the date of storage / accumulation date.
- Ensure appropriate emergency facilities are available and maintained.
- Ensure that only authorized waste haulers are permitted to transport hazardous waste.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Inventory and categorize each waste stream for handling and storage.
- Review all new materials before purchase.
- Inspect hazardous waste storage sites regularly and document the inspection results.
- Ensure hazardous waste manifests are completed for each offsite shipment.



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- Maintain copies of each manifest and track the manifest status for any missing shipments.

INDIVIDUALS

Every ALMA employee must:

- Receive training before any involvement in management of hazardous waste.
- Report any leaks or spills of hazardous waste.
- Avoid producing hazardous waste.



2 - Environmental Protection

2-3 Wood and Solid Waste Management

- 1) **Purpose** – This procedure provides guidance for handling, storage, and disposal of wastes that can be expected to be found on site. These wastes include recyclable and refuse wastes.
- 2) **Scope** - This procedure is applicable to all solid waste generated at the ALMA sites. Hazardous wastes, medical wastes, special waste and sanitary sewer wastes are not covered by this policy.

Wooden waste: SAG (Sociedad Agrícola y Ganadera in Chile) Resolution 133 –NIMF 3;15.

3) Rules / Requirements

DEFINITIONS

- Almost any discarded material constitutes solid waste. It includes any material that is collected, stored, or treated before disposal; burned as a fuel, treated, land filled, recycled, or considered inherently waste-like. The waste can be in a liquid, gaseous, or solid form.
- A waste is considered non-hazardous if it does not meet any of the criteria for hazardous waste. Even if the waste is not hazardous, it may still require special handling and disposal.

WASTE HANDLING

- Do not move or dispose of any material until the waste type is correctly identified.
- Properly package and label the material in drums or other approved containers according to requirements for that specific material.
- Ensure liquid waste containers are properly closed and sealed to prevent spillage.
- Avoid mixing different or unidentified wastes.
- Clean the facility grounds on a regular basis to minimize the possibility that runoff will carry refuse into surface waters or storm drains.
- Keep all lids and doors closed on containers and covers.

WASTE DISPOSAL

- Do not dispose items using an inappropriate disposal method; i.e., pouring used oil into a sink.
- Scrap materials of little or no value, such as building materials, broken concrete, etc., shall be transported to an open landfill.
- The Camp Facilities Manager manages all aspects of non-hazardous waste disposal.
- Putrescible waste (organic waste such as food waste) shall not be stored on site more than 7 days between collections for disposal.



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- Non-putrescible wastes (inorganic wastes such as construction debris), other than wastes accumulated for recycling, shall not be stored more than 90 days between collections for disposal.
- Appliances may not be accumulated for more than 60 days prior to salvage or disposal.
- Janitorial services shall deposit waste collected from indoor trash receptacles daily into outdoor metal containers (dumpsters).
- A waste collection and disposal contractor shall remove the trash from the dumpsters once per week or more frequently if needed.
- Wastes handled by the solid waste disposal subcontractor will be disposed at a permitted solid waste management facility.
- Waste shall not be disposed on site.
- Waste should not contain excessive quantities of free liquids. Free liquids need to be absorbed on solid material before being placed in a sanitary landfill.

RECYCLING

- Ensure that recyclable waste is segregated and placed in appropriate containers for collection.
- **Excess tools, equipment, and usable materials should be turned in through the Camp Facilities Manager for internal redistribution.**
- Wood and Construction Materials
 - Wood shall be collected and recycled if possible. There is no central collection area, but the Camp Facilities Manager will collect the wood, arrange for reclamation, reuse, or its disposal.
 - SAG (Sociedad Agrícola y Ganadera in Chile) authorizes the reuse (shipments to foreign countries) of wooden boxes when they have not been modified and no non-treated wood has been added.
 - SAG carries out inspections at airports and ports. If they find that imported boxes have not been treated, or that they do not have the proper marks, they ask that they be burned on site, requiring to see pictures of the burning to ascertain compliance.
 - For collection and removal of other large materials or bulk items such as construction materials, the Camp Facilities Manager should be contacted.
- Recyclable Batteries
 - After a battery becomes unusable, it may be disposed of properly, handled as hazardous waste, or recycled, according to its constituents.
 - All lead-acid batteries (also know as wet-cell batteries) should be recycled.
 - Contact the Safety Office for recycling of batteries.
- Scrap Metal
 - Scrap metals that are recycled include aluminum, copper, lead, steel, and any other non-contaminated materials.
 - The Camp Facilities Manager manages this activity and is responsible to contact and arrange pickup by scrap haulers or other vendors.
 - Scrap metals should not be thrown in the trash.
- Used Oil and Oily Wastes
 - Disposal of oil at ALMA involves recyclable used oil, oil-contaminated debris, and oil-contaminated soil.
 - Oil-contaminated materials must be handled as special wastes.
 - Used oil that can be recycled is managed by the Safety Office.



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- All used oils must be accumulated in the storage shed at the OSF adjacent to the maintenance garage.

4) Responsibilities

MANAGEMENT

Management and Supervisors are responsible to:

- Ensure that staff is aware of waste management practices.
- Ensure that contractors remove unused chemicals and waste products from the site upon job completion in accordance with the project specifications.
- Manage site recycling collection services.
- Manage site refuse collection services.
- Manage the excess property items.
- Ensure that MSDS (Material Safety Data Sheets) are available for all chemicals and substances brought to the site.
- Provide MSDSs to the Safety Office.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Assist in determining whether any solid waste is hazardous waste.
- Manage the used battery collection and disposal activities.
- Manage the collection and disposal of special wastes.
- Manage site practices for recycling or reuse of used oil.
- Inspect waste collection areas periodically.
- Manage medical wastes.
- Track waste accumulation quantities and other information to ensure compliance with all regulations.

INDIVIDUALS

All employees are required to:

- Ensure that solid waste from their work area is properly identified, segregated, and disposed.
- Observe and follow warning signs posted at hazardous waste accumulation areas.
- Identify potentially harmful ingredients of the waste stream by consulting the MSDS for that product.



2 - Environmental Protection

2-4 General Environmental Management and Light Pollution

- 1) **Purpose** – This procedure establishes the basic environmental guidelines and responsibilities for the ALMA site.
- 2) **Scope** – These guidelines are applicable for all ALMA, contractor, and visitor activities that may impact the environment including the site flora, fauna, or archaeological sites. References include:
 - Environmental Impact Study for the “Atacama Large Millimeter Array, ALMA Project” and Addenda presented by European Southern Observatory (ESO) and Associated Universities, Inc. (AUI) to the Regional Environmental Commission, COREMA, Region II.
 - Light pollution: Chilean Supreme Decree N° 686 – 7th of December 1998

3) Rules/Requirements

GENERAL REQUIREMENTS

- All projects will consider possible environmental effects at the earliest stages of planning.
- ALMA will construct, operate and evaluate all facilities to assure the existence of efficient methods to reduce environmental risks.
- ALMA will take all reasonable measures to fulfill the commitments stipulated in the EIS and the resolution of COREMA on environmental issues.
- ALMA will conduct self-evaluations and periodic reviews of the environmental management procedures.
- ALMA will regularly communicate about activities related to the environment to employees, users, public and pertinent authorities.
- Contracts with third parties, participating in any phase of the Project, will include clauses committing contractors to comply with ALMA’s environmental policies.
- ALMA will notify all users of the responsible use of the site and of the requirements to protect the environmental resources.

LIGHT POLLUTION

- The " Norm of Emission for the Regulation of Light Pollution; (Chilean Government Supreme Decree N° 686 - 7th of December 1998, ” came into force on October 1st, 1999. This regulation establishes the legal framework for the protection of the sky, in the context of the environmental legislation destined to protect "dark skies" necessary for the practice of professional astronomy in the Chilean regions of Antofagasta, Atacama and Coquimbo.
- The purpose of the regulation is to:
 - Permit reasonable uses of outdoor lighting for nighttime safety, utility, security, and enjoyment while preserving the ambiance of the night;
 - Curtail and reverse any degradation of the nighttime visual environment and the night sky;



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- Minimize glare and obtrusive light by limiting outdoor lighting that is misdirected, excessive, or unnecessary;
- Conserve energy and resources to the greatest extent possible;
- Help protect the natural environment from the damaging effects of night lighting.
- All outdoor lighting fixtures (luminaires) shall be installed in conformance with this regulation and with the provisions of the building code, the electrical code, and the sign code, as applicable and under permit and inspection, if such is required.

COMMENT: PRACTICAL CONSIDERATIONS

- The idea that more light always results in better safety and security is a myth. One needs only the right amount of light, in the right place, at the right time. More light often means wasted light and energy.
- The lowest wattage of lamp that is feasible should be used. The maximum wattage for most commercial applications should be 250 watts of high intensity discharge lighting, but less is usually sufficient.
- Whenever possible, turn off the lights or use motion sensor controlled lighting.
- Incorporate curfews (i.e. turn lights off automatically after a certain hour when businesses close or traffic is minimal). This is an easy and fast way to initiate dark sky practices.

MAXIMUM LAMP WATTAGE AND REQUIRED LUMINARY OR LAMP SHIELDING

- All lighting installations shall be designed and installed to be fully shielded (full cutoff), except as in exceptions below, and shall have a maximum lamp wattage of 250 watts for commercial lighting, 100 watts incandescent, and 26 watts compact fluorescent for residential lighting.
- In residential areas, light should be shielded such that the lamp itself or the lamp image is not directly visible outside the property perimeter.

LIGHTING THAT IS EXEMPT FROM THESE REGULATIONS

- Exit signs and other illumination required by building codes.
- Lighting for stairs and ramps, as required by the building code.
- Signs are regulated by the sign code, but all signs are recommended to be fully shielded.
- Low voltage landscape lighting, but such lighting should be shielded in such a way as to eliminate glare and light trespass.

ADDITIONAL REQUIREMENTS

- Lighting attached to single-family home structures should not exceed the height of the eave.
- Residential pole height restrictions can be considered to control light trespass on adjacent properties.

DEFINITIONS

- **Glare:**
Intense and blinding light. Causes visual discomfort or disability.
- **Landscape lighting:**
Luminaries mounted in or at grade (but not more than three feet above grade) and used solely for landscape rather than any area lighting.



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- **Obtrusive light:**
Spill light that causes glare, annoyance, discomfort, or loss of visual ability. Light pollution.
- **Luminary (light fixture):**
A complete lighting unit consisting of one or more electric lamps, the lamp holder, any reflector or lens, ballast (if any), and any other components and accessories.
- **Fully shielded (full cutoff) luminary:**
A luminary emitting no light above the horizontal plane.
- **Spill light:**
Light from a lighting installation which falls outside the boundaries of the property on which it is located. Usually results in obtrusive light.

OTHER RESOURCES FOR ESTABLISHING OUTDOOR LIGHTING GUIDELINES

- [Model Lighting Ordinance \(MLO\)](#)
- Outdoor Lighting Zones
- IDA Lighting Code Handbook
- [Directory of Ordinances and Other Regulations](#)

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that employees follow proper work practices to minimize the impact of operations to the environment.
- Ensure that contractors and visitors are aware of the procedures to protect the environment.
- Ensure that the Safety Office is promptly advised of projects that may impact the environment.
- Enforce the “Dark Sky” regulations.

SAFETY OFFICE

The Safety Office is responsible for the following:

- Ensure that environmental inspections are conducted.
- Train personnel in the practices to protect the environment.
- Develop and provide awareness information for visitors for the protection of the environment.
- Review plans for construction or renovation to identify potential impacts on the environment.
- Ensure that appropriate authorities are notified of site activities relative to the requirements of the Environmental Impact Study.
- Maintain an environmental file that records all inspections, site visits, and actions taken.
- Control the implementation of the “Dark Sky” regulations.

INDIVIDUALS

All employees are required to:

- Become familiar with the environmental practices at the site.



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- Ensure that work performed does not adversely impact the environment.
- Notify a Supervisor if work activities have the potential to damage the environment.
- Implement the “Dark Sky” regulations.



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ALMA Environmental Protection Checklist

	Y	N	Comment
Vehicles/Equipment			
Is vehicular traffic in technical areas limited?			
Is night traffic restricted?			
Are all road signs in place and legible?			
Is the site and surrounding area kept clean and in good condition to allow traffic?			
Industrial Waste			
Are waste garbage and residual substances removed after operations are complete?			
Are all areas cleaned frequently to avoid accumulation of wastes?			
Are industrial wastes stored in containers with labels and degree of danger?			
Petroleum Products			
Are waste paint and solvent drums stored in salvage yards?			
Is waste grease from vehicle and equipment lubrication placed in plastic bags?			
Are floors and sewers free from oil pollution?			
Are building exteriors where maintenance occurs, inspected and free from visible evidence of petrol pollution?			
Waste water			
Are any chemical toilets in use?			
Are chemical toilets maintained by specialized and authorized companies?			
Flora/Fauna			
Are signs in place 20m from protected plant species?			
Are warning signs in place to protect fauna?			
Are animal crossings kept unobstructed?			
Archaeological			
Are archaeological sites protected at least 50m from the boundaries?			
Are the signs at archaeological sites in place and legible?			
Spill Prevention			
Are catch basins used to prevent liquid chemical or petroleum spills?			
In case of a spill, are chemical agents available to neutralize the spilled item?			
Monitoring and Reporting			
Is the staff trained on care for the environment?			
Are environmental emergencies reported within 24 hours?			



2 - Environmental Protection

2-5 Wildlife and Archaeological Sites

- 1) **Purpose** – The purpose of this procedure is the protection of wildlife, and archaeological sites which may be found at the ALMA site.
- 2) **Scope** – These guidelines are applicable for all ALMA, contractor, and visitor activities that may impact the site flora and fauna. References include:
 - Environmental Impact Study for the “Atacama Large Millimeter Array, ALMA Project” and Addenda presented by European Southern Observatory (ESO) and Associated Universities, Inc. (AUI) to the Regional Environmental Commission, COREMA, Region II.

3) Rules/Requirements

GENERAL REQUIREMENTS

- If any archaeological site, endangered plants or animals are discovered, notify the Safety Office immediately.
- Signs will be posted at sites along the road and any areas near the ALMA facilities where protected species of flora and fauna, or archaeological sites are known to be located.
- The Safety Office will ensure that monthly monitoring of damage to plants is performed.
- The Safety Office will ensure that monitoring of the known vicuña crossings is conducted.
- The Safety Office will ensure random inspections are performed to ensure there is no damage to dens and that animals are not disturbed.

CONSTRUCTION AND THE ENVIRONMENT

- All contractors and visitors will be provided with information regarding the protection of endangered species.
- All personnel are prohibited from collecting or disturbing any plants, animals, or archaeological materials.
- If flora needs to be relocated due to construction activities, coordinate the effort with the Safety Office.
- All ground disturbing activities are strictly limited to the areas defined on the construction drawings. If possible, construction sites will be fenced or flagged.
- Keep animal crossings unobstructed.
- Parking and construction storage must also be contained within the designated areas.
- Biological monitors are authorized to stop work to protect the environment.
- If disturbance to wildlife cannot be avoided during construction, notify the Safety Office before commencing the work if possible.



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WILDLIFE

- Do not handle, touch, or approach any wild animal. Animals may appear docile, but if provoked, may attack. Animals may appear dead but may be sleeping or ill.
- Do not feed any animals or leave food out for them.
- Pay special attention when walking throughout the facility especially at night.
- Avoid brushy areas, trash piles, and wood storage areas.
- Use a flashlight to check dark unoccupied areas such as equipment cabinets, electrical panels, and antennas. Look closely for spider webs.
- Wear gloves when working with lumber or other stored items where spiders or scorpions may hide.
- Report rodents or rodent droppings to the Camp Facilities Manager for control.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that environmental protection signs are maintained and posted.
- Ensure that contractors and visitors are aware of the procedures necessary to protect the environment.
- Notify the Safety Office if construction activities may impact the environment.

SAFETY OFFICE

The Safety Office is responsible for the following:

- Ensure that monthly monitoring of damage to plants is performed.
- Ensure that monitoring of the known vicuña crossings is conducted.
- Ensure random inspections are performed to verify there is no damage to dens and that animals are not disturbed.

INDIVIDUALS

All employees are required to:

- Report any damage to the environment, cultural resources, dead animals or damaged flora to the Safety Office.



2 - Environmental Protection

2-6 Wastewater Management

- 1) **Purpose** – This procedure establishes the management of wastewater generated at the ALMA site.
- The wastewater treatment plant is located at the OSF.
 - All of the sanitary sewer systems in the vicinity of the OSF are plumbed through underground sewer system.

Future expansion at the OSF is also planned for connection into this system.

- 2) **Scope** – These guidelines are applicable for all sanitary sewage wastewater discharges from the ALMA site. References include:
- Environmental Impact Study for the “Atacama Large Millimeter Array, ALMA Project” and Addenda presented by European Southern Observatory (ESO) and Associated Universities, Inc. (AUI) to the Regional Environmental Commission, COREMA, Region II.

3) Rules/Requirements

GENERAL

- Floor drains from showers, toilets, and sinks must be connected directly to the water treatment plant.
- Wastewater from remote locations or locations with potential to damage the water treatment balance is first collected in a catch tank. These locations include:
 - Telescope assembly areas.
 - The Array Operation Site due to the remote location.
- Wastewater from these locations must first be examined for damaging contaminants and then transported to the water treatment plant for handling.
- Visible discharge from the water treatment facilities is prohibited.
- All treatment and collection facilities must be protected from the effects of weather on the facilities.
- Wastewater shall not result in or cause any perceptible color, odor, taste, or foaming on the surface or ground waters.

KITCHEN DRAINS

- Kitchen drains must be connected to a separator to ensure the grease and oils are removed prior to discharge to the water treatment plant.
- A contractor is responsible to clean out the grease traps and properly dispose of the grease waste.
- The kitchen grease traps must be cleaned every two months and the waste manifests provided to the Camp Facilities Manager and the Safety Office.

STORMWATER



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- Storm water drainage is not to be connected into the water treatment facilities.

WASTEWATER TREATMENT PLANT

- The waste water treatment plant is a three level plant that has a capacity for 340 persons.
- The active process requires healthy bacteria to treat the waters.
- Bacteria samples must be collected by trained, authorized, and properly protected individuals.
- The Camp Facilities Manager is responsible for the maintenance and operation of the water treatment plant.
- Waste sludge generated is dried in a secured drying field.
- Small quantities of dried sludge waste may be disposed of with the site trash and land filled.
- Water effluent is emptied directly into water tanker vehicles for use in wetting the road surfaces, under the condition that the effluent complies with the Chilean water code regulations for irrigation water.

PROHIBITED SANITARY SEWER DISCHARGES

- Some liquid waste, such as oil, chemicals, and/or grease, can cause a shock load on a wastewater treatment facility that, in turn, causes unacceptable effluent.
- Only domestic waste water may be discharged to drains, sinks, and toilets.
- Wastewater that does not meet the discharge specifications must be disposed of by alternative methods.
- Water may not be added to unacceptable materials for the purpose of diluting the waste.
- The following wastes are prohibited from disposal into the sewage system.
 - Flammable liquids, solids, or gases
 - solvents
 - oil-based paints
 - latex paint, small quantities from rinsing paintbrushes can be discharged
 - fuel oils, lubricants
 - Toxic or poisonous liquids, solids, or gases
 - anti-freeze
 - pesticides
 - Wastes with a pH < 5.0 (acid materials)
 - Solids or viscous substances that may block sewer system lines. Separate solid debris from cleaning operations, if possible, and put in the regular trash. (examples: sand, straw, tar, rags, paper items, metals, glass, shavings)
 - Excessive discharges can overload the sewer system; avoid discharge of significant quantities of unpolluted water such as rainwater and snowmelt.
 - Petroleum or mineral based oils
 - motor oil
 - animal or vegetable based oils
 - fats or greases
 - Wastes with excessively high BOD (Biological Oxygen Demand) or COD (Chemical Oxygen Demand) or decomposable organic content.
 - carbonaceous material (vegetable based oils)
 - oxidizable nitrogen (fertilizers)



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- Strongly odorous wastes
- High temperature wastes that may increase treatment plant influent 40° C or higher
- Wastes that require excessive amounts of chlorine to treat or disinfect, medical or biological wastes
- Wastes that produce excessive discoloration
 - Dyes, inks
 - pH indicator solutions
- All other materials that could disrupt the operation of the treatment plant

MONITORING

- Monitoring of the water treatment facility is required. It includes the average number of people working at the site each month.
- Results must comply with Chilean water code (section irrigation water)
- Send a report to the Safety Office for filing and forwarding to the appropriate authorities.
- Results of external sampling analysis will be maintained with the Safety Office and must be posted at the Water Treatment Plant.
- An annual report is required and will include any modifications to the system, treatment or disposal facilities.
- Daily sample and record the bacteria content.
- The bacteria levels must be compared to the optimum plant operating chart bacteria levels.
- Water effluent test results must be recorded daily at the treatment plant.
- The water is monitored for the following:
 - pH (pH)
 - Chlorine (Cloro Libre)
 - Total Suspended Solids (Sólidos Suspendidos Totales)
 - Biological Oxygen Demand (Demanda Bioquímica de Oxígeno)
 - Oils and Grease (Aceites y Grasas)
 - Phosphor (Fósforo)
 - Total Nitrogen (Nitrógeno Total Kjeldahl)
 - Fecal Coliform (Coliformes Fecales)
 - Legionella (as directed by the Safety Office)

TEMPORARY FACILITIES (PORTA JOHNS)

- Only approved temporary facilities are permitted.
- Mobile facilities are disposed of by a licensed contractor and the waste hauled to Cascal in Antofagasta.
- Areas where mobile facilities are likely to be used include the security shed, construction areas, road construction, transporter operations, remote facilities.
- The disposal of the waste from temporary facilities must be reported and recorded.

4) Responsibilities

MANAGEMENT

The Camp Facilities Manager and the site management are responsible to:

- Ensure proper operation and maintenance of the wastewater treatment plant.



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- Ensure monitoring is conducted at appropriate intervals.
- Ensure proper disposal of wastes generated from the treatment facility.
- Ensure the water treatment facility is adequately secure.
- Provide sampling and monitoring reports to the Safety Office.
- Ensure no person enters any water treatment pit, tank, or other enclosed spaces without authorization.
- Ensure that any temporary sanitary facilities are properly managed and authorized.

SAFETY OFFICE

The Safety Office is responsible for the following:

- Prepare periodic reports to the appropriate authorities.
- Notify the authorities of planned modifications to the water treatment facilities.

INDIVIDUALS

All employees are required to:

- Ensure that prohibited items are not disposed of into the water treatment system.
- Notify the Safety Office of any waste materials that require additional handling and treatment prior to proper disposal.



2 - Environmental Protection

2-7 Groundwater Protection

- 1) **Purpose** – This procedure details the requirements to assure acceptable water quality at ALMA.
- 2) **Scope** – This procedure is applicable for all water sources of the ALMA site.
 - Environmental Impact Study for the “Atacama Large Millimeter Array, ALMA Project” and Addenda presented by European Southern Observatory (ESO) and Associated Universities, Inc. (AUI) to the Regional Environmental Commission, COREMA, Region II.

3) Rules/Requirements

GENERAL REQUIREMENTS

- Avoid connecting hoses to unprotected faucets as it can allow contamination to be drawn into a building's drinking water system.
- Do not remove or modify hose connections or exterior faucets, without coordinating with Facilities Management.
- Report water leaks (such as from water faucets) to Facilities Management or Supervisor.
- Avoid spills of oil or other substances that may contaminate surface or groundwater.
- Provide secondary containment for all oils or chemicals stored outdoors, even temporarily.
- Avoid exposing to weather any substance that could get into storm drainage systems.
- Keep exterior containers covered and sealed.
- Ensure that pest control services premix all preparations prior to coming on site. Remove leftover pesticides from the site upon completion of the job.

SURFACE WATER AND STORM WATER

- Discharge only unpolluted waters such as rainwater or groundwater to the environment.
- Facilities Management should ensure that on-site and offsite facilities are kept from being inundated in the event of a significant rainfall.
- Prevent open containers from being exposed to rainfall.
- Prevent releases of environmentally harmful materials to surface water or ground water.

CONSTRUCTION ACTIVITIES

- Work near existing water lines or sources may contaminate water supplies. Contact Facilities Management to identify utilities and potential problems prior to starting work.
- Runoff from disturbed areas is to be controlled by temporary measures until construction of permanent controls is complete.



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- The contractor shall inspect all measures periodically, as well as after each runoff-producing rainfall event.
- Immediately repair or cleanup any problems with the control devices.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that pollution prevention measures are addressed in all activities, such as secondary containment for storing potentially environmentally harmful materials.
- Maintain and manage water systems that connect to domestic water, including fire protection and sprinkler systems, irrigation, and cooling water.
- Arrange connections to the drinking water supply system and resolve any backflow prevention issues.
- Oversee storm water discharges to ensure surface water is not contaminated.

SAFETY OFFICE

The Safety Office is responsible for the following:

- Approve all temporary shutdowns of any water systems that could affect fire systems and ensure that all systems are restored to operating status.
- Maintain environmental permits, records, and reporting programs.
- Assist in obtaining agreements with government entities for land removal activities.

INDIVIDUALS

All employees are required to:

- Work with their Supervisor and the Safety Office to identify a waste stream and decide on an approved disposal method.
- Avoid prohibited discharges to the sanitary sewer system.



3- Fire and Life Safety

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3. FIRE AND LIFE SAFETY

3-1 Fire Extinguishers

- 1) **Purpose** – This procedure establishes the requirements for the use, operation and maintenance of portable fire extinguishers.
- 2) **Scope** - These procedures apply to the placement, use, maintenance, and testing of portable fire extinguishers at ALMA. The distribution requirements do not apply to extinguishers provided on the outside of workplace buildings or structures. References include:
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
 - Directive 92/58/EEC – Relating to the provision of safety and health signs.
 - EN 13478 – Fire prevention
 - Decreto Supremo N° 594, Aprueba Reglamento Sobre Condiciones Sanitarias Y Ambientales Básicas En Los Lugares De Trabajo, Párrafo 3°.

3) Rules / Requirements

GENERAL

- Portable fire extinguishers must be approved by a recognized testing laboratory.
- Extinguishers must be the proper type for the class of fire expected;
- Locate extinguishers where they are readily accessible for immediate use and in sufficient quantity and size to deal with the expected fire;
- Inspect and maintain extinguishers on a regular basis so that they are kept in good operating condition; and operated by trained personnel who can use them effectively.

FIRE CLASSIFICATION

Classification of Fire Types

NB.: The classification of fires differs slightly from that in force in other parts of the world. For comparison and disambiguation, see http://en.wikipedia.org/wiki/Fire_classes.



A **Class A** fire includes ordinary combustibles, such as wood, paper, some plastics and textiles. This class of fire requires the heat-absorbing effects of water or the coating effects of certain dry chemicals. Extinguishers suitable for **Class A** fires are identified by a triangle containing the letter "A." If in color, the triangle should be green.



A **Class B** fire involves flammable liquid and gas fires such as oil, gasoline, etc. These fire extinguishers deprive the fire of oxygen and interrupt the fire chain by inhibiting the release of combustible vapors. Extinguishers suitable for **Class B** fires should be identified by a square containing the letter "B." If in color, the square should be red.



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ELECTRICAL



EQUIPMENT

A Class C fire involves live electrical equipment which requires the use of electrically nonconductive extinguishing agents. Once the electrical equipment is de-energized, extinguishers for Class A or B fires may be used. Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If in color, the circle should be blue.

COMBUSTIBLE



METALS

A Class D fire involves combustible metals such as magnesium, titanium, sodium, etc., which require an extinguishing medium that does not react with the burning metal. Extinguishers that are suitable for Class D fires should be identified by a five-point painted star containing the letter "D." If in color, the star should be yellow.



A Class K fire extinguisher is used on fires involving cooking fat, grease, and oil. These fire extinguishers work when alkaline mixtures such as potassium acetate or potassium carbonate are applied to burning cooking oils. The mixture combines with the fatty acid to create a soapy foam on the surface which holds in vapors and steam and extinguishes the fire. These extinguishers are identified by the letter K.

FIRE EXTINGUISHER TYPES

- Fire extinguishers use a picture/labeling system to designate which types of fires they are to be used on.
- There are three main types or classes of fire extinguishers, each of which extinguishes specific types of fire:
 - **Dry Chemical** extinguishers are usually for multiple purpose use. They contain an extinguishing agent and use a compressed, non-flammable gas as a propellant.
 - **Water** extinguishers contain water and compressed gas and should only be used on Class A (ordinary combustibles) fires.
 - **Carbon Dioxide** (CO₂) extinguishers are most effective on Class B and C (liquids and electrical) fires. As the gas disperses quickly, these extinguishers are only effective from 1-2 m. The carbon dioxide is stored as a compressed liquid.
- Prohibited Fire Extinguishers:
 - Any extinguisher having a shell construction of copper or brass joined by soft solder and/or rivets.
 - Any extinguisher that must be turned upside down to rupture a cartridge or to start an uncontrollable pressure generating chemical reaction to expel the agent.
 - Extinguishers that use chlorobromomethane (Halon 1011) or carbon tetrachloride as an extinguishing agent. These agents are toxic and carbon tetrachloride may cause cancer and can produce phosgene gas when used on electrical fires.

FIRE EXTINGUISHER LOCATION

- Select and position fire extinguishers based on the potential type and size of fire that can occur.
- The following chart contains requirements for classes of fires and travel distance to an extinguisher. There is no distance requirement for Class K extinguishers. They are typically located at the point of possible cooking fire ignition.



Travel Distances to Fire Extinguishers

Fire Class	Travel Distance
Class A*	22.9m or less
Class B	15.2m or less Based on appropriate hazard
Class C	Based on appropriate hazard
Class D	22.9m or less
Class K	Not specified

*ALMA may use standpipe systems connected to a sprinkler for emergency use instead of Class A portable fire extinguishers. This must provide total coverage of the area to be protected, and employees trained at least annually in their use.

- To prevent fire extinguishers from being moved or damaged, mount them on brackets or in wall cabinets with the carrying handle placed 1-1.5 m above the floor.
- Mount larger fire extinguishers lower, with the carrying handle about 1 m from the floor.
- Locations that contain Class B flammables, such as workshops, storage areas, garages, warehouses, or service areas, must determine the size, amount and distribution of extinguishers based on the degree of hazard associated with the flammable liquids and gases in the area.

Size and Distance to Extinguishers Based on Hazard Class B Fires

Hazard	Extinguisher	Spacing
Low - Small amounts of flammable liquids used for copy machines, etc., that are stored safely and kept in closed containers.	5-B	9.14 m
	10-B	15.24 m
Moderate - The total amount of flammable liquids are present in greater amounts than expected under low-hazard locations. This can include garages, workshops, or support service areas.	10-B	9.14 m
	20-B	15.24 m
High - Locations where flammable liquids are present and used in large quantities. This includes areas used for storage, production, woodworking (finishing), vehicle repair, or where painting, dipping, and coating, operations are performed with flammable liquids.	40-B	9.14 m
	80-B	15.24 m

CARE AND MAINTENANCE

- A monthly inspection of the fire extinguisher is required.



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- The group responsible for the space is responsible to ensure monthly inspections are conducted.
- The monthly inspection can be performed by any designated individual and includes:
 - Fire extinguishers are in their assigned place;
 - Fire extinguishers are not blocked or hidden;
 - Fire extinguishers are mounted properly;
 - Pressure gauges show adequate pressure (CO2 extinguisher must be weighed to determine if leakage has occurred);
 - Pin and seals are in place;
 - Fire extinguishers show no visual sign of damage or abuse;
 - Nozzles are free of blockage.
 - Operating instructions on nameplate legible and facing outward.
 - Rock all dry powder extinguishers gently top to bottom to make sure the powder is not packing.
- The Safety Office will review that annual testing and inspections are carried out.
- Record the annual maintenance date and keep these records for one year after the recorded date or the life of the shell of the extinguisher.



HYDROSTATIC TESTING

- Hydrostatically test fire extinguishers according to the following schedule.
- Hydrostatically test portable extinguishers if the cylinder or shell threads are damaged, if there are signs of corrosion that has caused pitting, or if the extinguisher shows signs of exposure to high heat or fire.
- Remove from service any extinguisher or component that fails a hydrostatic pressure test.
- Hydrostatically test all hose assemblies at the same interval as the extinguisher if it is equipped with a shutoff nozzle at the discharge end.
- Hose assemblies passing a hydrostatic test do not require any type of stamping.

Hydrostatic Test Frequency

Type of Extinguisher	Test Interval (Years)
Cartridge operated water and/or antifreeze	5
Stored pressure water and/or antifreeze	5
Dry chemical with stainless steel	5
Carbon dioxide	5
Dry chemical, stored pressure, with mild steel, brazed brass or aluminum shells	12
Dry chemical, cartridge or cylinder operated, with mild steel shells	12
Dry powder, cartridge or cylinder operated with mild steel shells	12



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RECORDKEEPING

- The Safety Office will keep a record of the inspections of the fire extinguishers on the premises for a period of not less than one year.
- The monthly record shall indicate the date of inspection, the person performing the inspection and any deficiencies noted.
- Each extinguisher must have a record that includes the name of the agency that performed the hydrostatic test, the test date, and serial number of the fire extinguisher.
- Keep the records until the extinguisher is hydrostatically re-tested or until the extinguisher is taken out of service, whichever comes first.

TRAINING

- The Safety Office will provide training on the principles and use of extinguishers.
- Training should be completed after the employee is first hired and annually thereafter.
- Provide training for each employee who volunteers to use fire prevention equipment.
- Employees must demonstrate an understanding of the training and the ability to use the equipment properly before they are allowed use of the equipment.
- All untrained personnel are expected to immediately evacuate the building upon alarm.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure extinguishers are operated only by trained personnel.
- Conduct monthly inspection of the fire extinguishers.
- Assure that facilities under their control are in compliance with this Policy.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Ensure fire extinguishers are approved and appropriate for the hazards present.
- Locate extinguishers where they are readily accessible and in sufficient quantity and size to deal with the expected fire.
- Ensure prohibited extinguishers are not used.
- Conduct annual maintenance or more often if conditions warrant.
- Hydrostatically test fire extinguishers according to the appropriate schedule.
- Remove from service all extinguishers or components that fail a hydrostatic pressure test.
- Maintain records of monthly inspections and hydrostatic testing.
- Provide an educational program to employees.

INDIVIDUALS

Every ALMA employee involved in the use of fire extinguishers must:

- Participate in training as required.
- Not use fire prevention equipment without appropriate training.
- All untrained personnel must immediately evacuate the building upon the alarm.



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3- Fire and Life Safety

3-2 Fire Prevention

- 1) **Purpose** – This section establishes the guidelines to prevent fire incidents at the ALMA site.
- 2) **Scope** - These procedures apply to all facilities at the ALMA site. All personnel are expected to comply with these procedures to minimize the frequency and severity of fire incidents. References include:
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
 - Directive 92/58/EEC – Relating to the provision of safety and health signs.
 - EN 563 – Temperatures of touchable surfaces
 - EN 13463 – Potentially explosive atmospheres
 - EN 13478 – Fire prevention

3) Rules / Requirements

GENERAL

- All employees are expected to participate in scheduled fire drills.
- The Safety Office will conduct fire drills least twice per year.
- In the event of a fire alarm, all employees are expected to follow any specific requirements established for their work areas.
- Fire evacuation maps are to be posted in each building. The Safety Office will ensure posted information is current and maintained in good condition.
- Fire alarm information and emergency contacts shall be posted in each facility.
- Supervisors must review fire information regularly with each of their employees.

FIRE PREVENTION

- No smoking is permitted in any ALMA facility, vehicle, or residence area.
- Indoor use of open flames is banned, unless waived by Safety Office (e.g. Christmas candle, or chafing dish)
- Smoking or open flames are prohibited in areas where flammable solvents, liquids, or other flammable materials are stored, transported, or handled.
- Smoking or open flames are prohibited within an unsafe distance of any area where smoking or open flame may cause a fire.
- Signs warning against smoking and open flames shall be posted so they are easily seen.
- Flammable liquids must be stored according to the instructions given on the MSDS, and the compatibility requirements of the product and handled properly.
- All heat sources must be insulated or isolated from combustible materials.
- Solvents with low flash points are not permitted to be used.
- Locate battery charging rooms in well ventilated areas.
- Vehicles must be turned off before fueling.



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- Fire fighting equipment must be appropriately located and regularly maintained by certified personnel.
- Any flammable liquid spills must be cleaned up promptly.
- The use of flammable liquids, for example, Isopropyl Alcohol and thinners, may be authorized for cleaning of equipment. For these types of flammable materials, it is essential that the ALMA Safety Office be consulted prior to use to assure safe use and handling.
- Polyethylene packaging should be treated with care in storage and exposure to any ignition sources. Burning plastic packaging can off-gas hazardous fumes which may also have an adverse impact on sensitive electronic equipment.

BASIC FIRE PROCEDURES⁴

- Do not panic.
- Contact Fire Control, ALMA's safety office or your Supervisor immediately, reporting all possible details, e.g. material burning, cause (if known), size and type of fire (electrical, oil), location, your name, etc.
- Try to extinguish it if you can do it safely and quickly.
- In case of danger, evacuate

HOUSEKEEPING

- Maintain all corridors clear and clean, allowing unobstructed movement of personnel and fire protection equipment.
- Keep combustible waste materials to a minimum and dispose of it daily.
- Keep grounds around buildings free of weeds, trash, and unnecessary combustible materials.
- Keep work areas clean and free of debris.
- During construction, keep scrap materials reasonably cleared from the worksite.
- Place flammable wastes in covered containers separate from normal debris.
- Dispose of all waste promptly.

MATERIALS STORAGE

- Secure all storage racks with the load limit clearly defined.
- Store containers in the proper orientation to prevent tipping.
- Do not store any materials within .91 m of any electrical panel.
- Do not store any materials in a manner to block corridors, emergency exits or operating controls.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Review fire action regularly with each of their employees.
- Maintain the housekeeping of all areas in their responsibility.
- Assure that facilities under their control are in compliance with this Policy.

⁴ Note: In addition to these basic fire procedures, each employee must be familiarized with their working area's specific fire procedures.



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SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide an educational program to familiarize employees on the principles and use of fire prevention and organize (train, maintain, supervise) the ALMA Fire Brigade
- Conduct periodic fire drills.
- Post and update fire evacuation maps and emergency contact information.

INDIVIDUALS

Every ALMA employee must:

- Participate in scheduled fire drills.
- Follow any specific requirements for evacuation established for their work areas.
- Follow the requirements for non-smoking areas.



3- Fire and Life Safety

3-3 Flammable and Combustible Liquids

- 1) **Purpose** – This procedure is to provide guidance for the storage, use, and handling of flammable and combustible liquids.
- 2) **Scope** - This procedure is valid for all flammable and combustible liquids brought into or used at the ALMA site. This policy is applicable to contractors and staff. References include:
 - NFPA 30 and ISO norms

3) Rules / Requirements

STORAGE

- Keep all containers, other than point-of-use containers, in approved storage cabinets.
- Allow only trained, authorized people into storage areas.
- Inspect incoming containers to ensure that they are not damaged and are properly labeled. Do not accept delivery of defective containers.
- Store containers of flammable and combustible liquids away from operations areas.
- Keep containers closed when not in use.
- No more than 10 liters is permitted to be stored outside of the flammable liquid storage area and no more than one day's supply in the immediate work area.
- Return leftover material to the proper storeroom or storage cabinet at the end of the day.
- Storage of flammable liquids is not permitted in refrigerators unless the refrigerator is specifically wired and labeled as safe for flammable materials.
- Store flammable and combustible liquids in areas that are:
 - Well ventilated to reduce vapor concentrations.
 - Free of ignition sources.
 - Cool (temperature controlled) and dry.
 - Supplied with adequate firefighting and spill clean-up equipment.
 - Away from exits, or main aisles leading to exits.

Flammable and Combustible Liquid Classes

	CLASS	FLASH POINT	BOILING POINT
Flammables	IA	<22.8C	<37.8C
	IB	<22.8C	>37.8C
	IC	>22.8C - <37.8C	-
Combustibles	II	>37.8C - <60C	-
	IIIA	>60C - <93.3C	-
	IIIB	>93.3C	-



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Maximum Allowable Size Flammable Containers

Container Type	Class IA	Class IB	Class IC	Class II	Class III
Glass	.47 liters	.95 liters	3.8 liters	3.8 liters	18.9 liters
Metal (other than DOT drums or approved plastic)	3.8 liters	18.9 liters	18.9 liters	18.9 liters	18.9 liters
Safety Cans	7.6 liters	18.9 liters	18.9 liters	18.9 liters	18.9 liters
Polyethylene DOT spec. 34 or as authorized by DOT exemption	3.8 liters	18.9 liters	18.9 liters	227 liters	227 liters
Metal Drum DOT spec.	227 liters	227 liters	227 liters	227 liters	227 liters

VENTILATION

- The Safety Office will assess flammable and combustible liquids storage, handling, use and disposal to determine if ventilation controls and control methods are adequate.
- Exhaust of a flammable cabinet storage by diffusion is not permitted.
- A storage cabinet is not required to be vented for fire protection. If not vented, the vent openings shall be sealed with the bungs supplied with the cabinet.
- If the storage cabinet is vented, the cabinet shall be vented directly outdoors.
- Ventilation must be ducted and must lead to an explosion proof blower to exhaust fumes to the atmosphere.
- The space owner is responsible to perform regular cleaning of the ducts, filters, plenums, etc. to decrease the severity of any fires and the likelihood of spontaneous combustion.
- If a storage cabinet is ventilated and vent caps are removed, flame arrestors are required.

SAFETY CANS

- Portable safety cans for carrying, storing and dispensing flammable and combustible liquids are commercially available in capacities from 0.5 to 25 liters. Their use is compulsory.
- Safety cans have spring-mounted spout caps that automatically open when the vapor pressure builds up, to allow vapors to escape and prevent rupture or explosion.
- The cap-operating mechanisms also cause the spout cap to close automatically when finished filling or pouring from the safety can, or if the can is dropped.
- Every user is responsible to check all containers used for flammable and combustible liquids regularly to make sure that they are not damaged, that spring-operated mechanisms are working properly and that flame arresters are not broken.
- Safety cans may have wire mesh flame arrester screens inside the cap spouts. These prevent flashbacks from reaching the liquid in the cans.
- Approved safety cans are made from metal or very low conductivity plastic.



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LABELING

- Properly label all containers used for flammable and combustible liquids to prevent accidentally mixing one chemical with another. (Safety information in English and Spanish)
- Keep the label clean so that it can be easily seen at all times.
- Never use a container for any liquid except the one that is marked on the label.
- Do not use unsuitable containers such as jars, saucers, open cans, buckets or pails. Open containers allow hazardous vapors to escape.
- Do not use breakable containers as they increase the chance of serious spills.

DISPENSING

- Dispense from only one container at a time. Finish dispensing one material before starting to dispense another.
- Be sure containers are closed after dispensing to control hazardous vapors and avoid accidental spills.
- Never dispense flammable and combustible liquids near ignition sources.
- All drums and containers subject to static accumulation must be bonded and grounded when dispensing.
- Dispense flammable liquids only under a fume hood or in an approved storage room.
- Flammable and combustible liquids must be dispensed only by using approved drum pumps.
- When dispensing flammable liquids, the area must be free of ignition sources and must be posted as a NO SMOKING area.
- Portable fire extinguishing equipment must be available at dispensing areas.

DISPOSAL

- Store waste flammable and combustible liquids in the same way as unused flammable and combustible liquids.
- Clean drums made of compatible material can be used to store waste liquids if they are vented, grounded and bonded similarly to dispensing drums.
- Place cloth, paper and other solid materials that are soaked with flammable and combustible liquids in approved oily waste disposal cans. Do not overfill them, and empty them at least at the end of every workday to reduce the chance of spontaneous combustion.
- Be careful with "empty" flammable and combustible liquid containers. They may contain enough liquid to create an explosion hazard.
- Do not perform any work (welding, cutting, drilling, soldering) on an "empty" liquid container until all liquid and vapors have been cleaned out. Contact the chemical manufacturer or supplier for the best way to do this.
- Combustible liquids are not to be poured into a drain due to the potential for formation of gas pockets in the trap.

HOUSEKEEPING AND EQUIPMENT MAINTENANCE

- Keep all areas where these liquids are stored, handled or used clear of burnable materials.
- Use an approved safety drip can below each drum faucet to catch spills or drips from worn or damaged faucets.
- Clean up liquid spills immediately.



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- Remove any obstructions that prevent containers with lids held open by fusible links from closing fully.
- Make sure that flammable and combustible liquids are not left where they could block or otherwise prevent people from escaping in case of a fire.
- Do not use safety containers that are damaged in any way. If repairs cannot restore safety containers to a safe condition, discard the containers once they have been properly cleaned.
- Naked flames, flammable gases and liquids, and volatile liquids should not be used in an oxygen-enriched atmosphere at high altitude like inside AOS/TB.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that all safety devices are functional and replaced as needed.
- Allow only trained, authorized people into storage areas.
- Assess flammable and combustible liquid storage, handling, use, and disposal to determine if existing controls and labeling are adequate.
- Perform regular cleaning of the ducts, filters, plenums, etc. to decrease the severity of any fires and the likelihood of spontaneous combustion.
- Check all containers used for flammable and combustible liquids regularly to make sure that they are not damaged.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Inspect storage areas regularly for any deficiencies.
- Dispose of flammable wastes through hazardous waste collection and disposal companies.

INDIVIDUALS

All employees are required to:

- Eliminate possible ignition sources.
- Keep all areas where these liquids are stored, handled or used clear of burnable materials.
- Make sure that flammable and combustible liquids are not left where they could block or otherwise prevent people from escaping in case of a fire.
- Inspect all incoming containers to ensure that they are not damaged and are properly labeled.



3- Fire and Life Safety

3-4 Emergency egress

- 1) **Purpose** – This document establishes the requirements to maintain a safe and adequate means to exit a facility during an emergency.
- 2) **Scope** - These guidelines apply to all ALMA facilities and all occupants and users of the ALMA facilities. References include:
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
 - Directive 89/655/EEC – Requirements for new machinery.
 - Directive 92/58/EEC – Relating to the provision of safety and health signs.
 - EN 13478 – Fire prevention
 - EN 14122 – Permanent means of access to machinery, stairs, guardrails, ladders

3) Rules / Requirements

HOUSEKEEPING

- Travel from the exit to the street must be continuously free of all obstructions.
- Only storage, items, and processes that conform with this Policy are permitted.
- The following items are subject to immediate removal by Camp Facilities Manager. Occupants shall be notified of violations.
 - Any items blocking an exit door or access to an exit door.
 - Any items located within a stairwell or stair enclosure.
 - Items that restrict the width of any part of a corridor to less than 1.12 m.
 - Any items that obstruct fire emergency equipment.
 - Any items determined to be an immediate fire or life safety hazard.
- The following items and processes are not acceptable in any corridor or elevator lobby. Unacceptable items are subject to removal by the Camp Facilities Manager within 30 days after violations are observed. Occupants shall be notified of violations.
 - Any item which obstructs utility panels, utility valves, or electrical receptacles.
 - All chemicals materials or storage or use of compressed gas cylinders.
 - Equipment which would present hazards, such as equipment that uses volatile materials, hazardous chemicals, or steam, or unguarded equipment.
 - Any items which move easily or could fall over and cause an obstruction.
 - Unapproved workstations (including copiers, office equipment, coffee stations, desks), break areas, and waiting areas.
 - Combustible materials outside of enclosed cabinets. This includes journals, papers, books and boxes.
 - Any item(s) in a quantity that presents a fire or life safety hazard.

EXIT MAINTENANCE

- Exits must permit the prompt escape of occupants in case of fire or other emergency.



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- No locks, chains, or fastenings to prevent escape from the inside are permitted in signed emergency egress paths.
- Exit doors must swing in the direction of travel if located in signed emergency egress paths, or where hazardous operations are conducted. Final exit doors to be provided with panic bars.
- All exit doors and paths of exit in signed emergency egress paths must be designed with respect to the occupancy to be evacuated, but at least 71.1 cm in width.
- The exit must be clearly visible and the route to it clearly indicated so everyone readily knows the direction of escape from any point.
- Draperies or similar decorative hangings must not obstruct the view or access through any means of egress or escape.
- Mirrors are prohibited in or near a means of egress if it may confuse the egress.
- Exits must not be decorated or covered in a way that would obscure or confuse the door.
- All signed emergency egress paths must have adequate and reliable illumination.

EXIT MARKING

- Mark access to exits by visible signs and arrows.
- Doors, passageways or stairways that are not exits and can be mistaken for an exit, must be marked with a sign reading "Not An Exit" or similar designation.
- Exit signs must be clearly visible, distinctive in color, and easily distinguished from decorations, interior finish, and other signs.
- Decorations, furnishings, or equipment that impair the visibility of exit signs are prohibited; Any brightly illuminated sign, display, or object near the egress sign that detracts attention from the egress sign so that it is not noticed is prohibited.
- Every exit sign must be according ISO 7010, and be illuminated by a reliable light source.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Inspect facilities periodically and report any deficiencies to the Safety Office.
- Remove non-compliant items from stairwells and corridors.
- Assure that facilities under their control are in compliance with this Policy.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Maintain records of all inspections.
- Provide or coordinate awareness training for facility occupants.
- Inspect stairwells and corridors for compliance with this Policy.
- Remove hazardous materials when necessary.

INDIVIDUALS

Every ALMA employee must:

- Maintain means of egress in compliance with this Policy.



4- Hazard Communication

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4. HAZARD COMMUNICATION

4-1 Piping and Utility Marking

- 1) **Purpose** - This procedure establishes the requirements for labeling piping systems for liquids and gases.
- 2) **Scope** - This procedure is applicable for all ALMA facilities and work areas where liquid or gas piping is present. References include:
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
 - Directive 92/58/EEC – Relating to the provision of safety and health signs.
 - EN 457 – Auditory danger signals
 - EN 842 – Visual danger signals
 - EN 981 – Auditory, visual, and information signals
 - ANSI A13.1 – Piping marking
 - ANSI standard Z53.1 - Safety Colors

3) Rules / Requirements

PIPING LABELS

- All piping systems shall be identified according to their contents.
- All new piping shall be installed with labeling that meets the requirements in this policy.
- All identification labels, signs and other devices shall be in English and Spanish.
- Existing pipe identification shall be upgraded to these standards whenever it is extensively modified (re-insulated, for example).
- Slip-on labels are acceptable for pipe markings.

PIPING SYSTEM COLORS

Pipe Markings

Material Properties

Letter Color on Field Color

Inherently Hazardous Materials

Extreme Pressure or Temperature
Corrosive or Caustic
Toxic or Creates Toxic Gas
Explosive or Flammable

Black on Yellow

Low-Hazard Materials

Liquid or Liquid Mixture

White on Green



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Gas or Gaseous Mixture

White on Blue

Materials for Fire Suppression

Sprinkler Water, Carbon Dioxide, Foam, etc.

White on Red

Gaseous oxygen

Black on white

LOCATION OF PIPE LABELS

- Near valves, flanges, and changes in pipe direction.
- At both sides of ceiling, wall, or floor penetrations.
- At any line entry point.
- At frequent intervals on straight pipe runs; every 15 m is typical, so they are visible from the point of normal approach.
- Arrows at one or both ends of the label to indicate direction of flow.

MARKING OF CONCEALED UTILITIES

- Color-coded surface marks (paint or a similar coating) should be used to indicate the locations and route of buried lines.
- To increase visibility, color-coded vertical markers (temporary stakes or flags) should supplement surface marks.
- Use white marks to show the location or boundary of a proposed excavation.
- Small flags, painted symbols, lines, arrows and other markings on the ground or on floors and walls indicate that utilities have been located, and special precautions shall be employed as the area is disturbed.
- For locations of buried or concealed utilities, use the color-marking scheme below.

RED - Electric Power Lines, Cables, Conduit and Lighting Cables

YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials

ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit

BLUE - Potable Water

GREEN - Sewers and Drain Lines

PURPLE - Reclaimed Water, Irrigation and Slurry Lines

PINK - Temporary Survey Marking

WHITE - Proposed Excavation

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Designate areas, activities and occupations which require marking.
- Identify all new and existing piping systems according to their contents.
- Mark concealed utilities according to these requirements.
- Keep plans and drawings of piping systems



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SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide and locate piping system labels to alert and inform employees of hazards.
- Select labels with appropriate dimensions, verbiage, and construction for use at the site.

INDIVIDUALS

Every ALMA employee must:

- Follow informational labels to prevent accidents and injuries.
- Report any areas needing hazard signage to the Safety Office or a Supervisor.
- Report any damaged or missing labels to the Safety Office.



4 - Hazard Communication

4-2 Signs and Placards

- 1) **Purpose** - This policy establishes the requirements for the use of signs and placards for identification and warning of potential hazards.
- 2) **Scope** - This policy is applicable for all ALMA facilities and work areas where potential hazards have been identified. References include:
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
 - Directive 92/58/EEC – Relating to the provision of safety and health signs.
 - EN 457 – Auditory danger signals
 - EN 842 – Visual danger signals
 - EN 981 – Auditory, visual, and information signals
 - ANSI Z-235 – Hazard alert messages

3) Rules / Requirements

SIGN PLACEMENT

- Locate signs to alert and inform employees of hazards to avoid the hazard and take appropriate action.
- Place signs so that they are legible, do not create a distraction, and are not a hazard in themselves: for example, low-hanging or protruding into a walkway.
- Avoid placing signs on or adjacent to moveable objects like wheeled equipment, removable partitions, which can be moved and obscure the sign.

SIGN CONSTRUCTION

- Where illumination is necessary under emergency conditions, the signs should be equipped with emergency (battery operated) illumination, luminescent or both.
- Signs should have rounded corners, be free of burrs and splinters, and the fasteners have no protruding parts that could cause abrasions or lacerations.

SIGN SIZE

- Overall sign size is governed by the size of the letters and graphics.
- Letters must be as large as possible for the intended viewing distance.
- Minimum letter height for the signal word (Danger, Caution, Notice, etc.) is one unit of height for every 150 units of safe viewing distance.
- Minimum letter height for other words on the sign shall be one unit of height for every 300 units of safe viewing distance.

HAZARD ALERT LIGHTS AND/OR AUDIBLE WARNING DEVICES

- Required in specified hazard areas to warn against remaining in or entering the space.



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- Required for transient conditions where a sign alone may be insufficient to attract attention. (example, exclusion area beneath a crane lift)
- Required to be in operation and clearly visible when an antenna has no potential for motion. During normal antenna operations, no antenna lights will be illuminated.
- The alert light and accompanying sign identifying the hazard must be on or adjacent to the final barrier that an employee would encounter when approaching a hazard.
- The alert light must reflect the status of equipment or a hazardous condition inside the barrier.
- Alert light/beacon designations:
 - RED identifies danger and indicates personnel entry is not allowed.
 - YELLOW/ AMBER is for caution situations limiting access of personnel and warning them to be on the alert. (ex. Laser Controlled Areas)
 - BLUE or GREEN designates safe access to antennas.

NOTE: These criteria for lights apply only to warning devices used for safety purposes and **do not** include lights used at control consoles to indicate equipment status.

INFORMATION CONTENT OF HAZARD SIGNS

- Signal words designate a hazard severity and are listed below.










-  DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.
 -  WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 -  CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
 - NOTICE Signs
 - Safety Instructions
 - Fire Safety: alarm and suppression equipment location
 - Directional Arrows
 - Special Purpose Signs
- All safety signs must be ISO pictograms, otherwise they shall be worded in English and Spanish



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Examples for Safety Signs in Common Use

Geometric shape	Meaning	Safety colour	Contrast colour	Graphical symbol colour	Example of use
 Circle with diagonal bar	Prohibition	Red	White ^a	Black	<ul style="list-style-type: none"> — No smoking — No unauthorized vehicles — Do not drink
 Circle	Mandatory action	Blue	White ^a	White	<ul style="list-style-type: none"> — Wear eye protection — Wear personal protective equipment — Switch off before beginning work
 Equilateral triangle	Warning	Yellow	Black	Black	<ul style="list-style-type: none"> — Danger hot surface — Danger acid — Danger high voltage
 Square  Rectangle	Safe condition Means of escape Safety equipment	Green	White ^a	White	<ul style="list-style-type: none"> — First aid room — Fire exit — Fire assembly point
 Square  Rectangle	Fire safety	Red	White ^a	White	<ul style="list-style-type: none"> — Fire alarm call point — Fire fighting equipment — Fire extinguisher
 Square  Rectangle	Supplementary information	White or the colour of the safety sign	Black or the contrast colour of the relevant safety sign	Symbol colour of the relevant safety sign	As appropriate to reflect message given by graphical symbol



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Identify areas where information signs, placards, and warning lights/beacons are needed.
- Identify work activities that generate a temporary change in normal conditions that require signage.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide and locate warning signs to alert and inform employees of hazards.
- Place signs so that they are legible, do not create a distraction, and are not a hazard in themselves.
- Select signs with appropriate dimensions, verbiage, and construction for use at the site.

INDIVIDUALS

Every ALMA employee must:

- Follow signs, placards and warning lights to prevent accidents and injuries.
- Report any areas needing hazard signage to the Safety Office or a Supervisor.
- Report any damaged or missing signs to the Safety Office.



5- Health and Medical requirements

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5. HEALTH AND MEDICAL REQUIREMENTS

5-1 Physical Exam Requirements and High Altitude Policy

- 1) **Purpose** - This policy establishes the requirements for high altitude medical exams at the ALMA site, informs about the risk for human being and precautions to be taken.
- 2) **Scope** - Annual high altitude medical exams are required for the following:
 - Members of Personnel under contract with Executives with a duty station at the ALMA site
 - Members of Personnel under contract with Executives with a duty station in ALMA/SCO and a cause to visit the ALMA site going above 3000 m (above the OSF)
 - Members of Personnel of Executives with a cause to visit the ALMA site going above 3000 m (above the OSF)
 - Contractors and subcontractors required to work on the ALMA site above 3000 m (above the OSF), as specified in their contracts, have to comply with their national legislation and the provisions of their workplace accident insurance (social security).
 - Executive staff with a cause to visit the ALMA site and whose activities include going above 3000 m (above the OSF). This policy is not intended to replace any requirements established by the Executives. Visitors with no professional cause, and self-employed will sign a liability waiver.

References include:

- Directive 80/1107/EEC – Relating to protection of workers from exposure to chemical, physical, and biological exposure.
- Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
- Norma ACHS Para La Evaluación de Salud Por Exposición A Hipoxia Hipobárica (ACHS Regulation For Health Evaluation Of Exposure To Hyperbaric Hypoxia)
- Labor Aptitude And Altitude: Norms Of Handling For Occupational And Pre-Occupational Evaluations. Dr Cristián Bustamante Retamal
- MEDICAL TECHNICAL REPORT on ALMA PROGRAM, from Andrés E. LLarena MD, Anesthesia & Hyperbaric Medicine, Head of Hyperbaric Medicine Unit, Hospital Naval “Almirante Nef”, Viña del Mar

3) Rules / Requirements

ACUTE MOUNTAIN SICKNESS

- Acute Mountain Sickness - AMS is a term applied to a group of symptoms likely to occur in un-acclimatized people who make direct ascents at high altitude. It also occurs in people who partially acclimatize then make an abrupt ascent to a higher altitude.



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- High Altitude Pulmonary Edema - HAPE is abnormal fluid accumulation in the lungs resulting from mal-adaptation to altitude. HAPE rarely occurs below 2,500 m.
- High Altitude Cerebral Edema - HACE is swelling of the brain thought to be caused by hypoxia-damage to brain tissue. HACE generally occurs above 3,500 m but has been recorded at 3,100 m.

MEDICAL EXAM REQUIREMENTS

- Every individual meeting the requirements defined in this section must consult a physician (according to their organization agreement) to complete a high altitude medical examination.

The following tests shall be done as a minimum:

	Less than 40 years old	40 years and older old
Examination by a physician	Every year	Every year
Questionnaire on altitude experience	Every year	Every year
Hemoglobin level	Every year	Every year
ECG without stress condition	Every year	Every year
Creatinine level	First exam + Every 5 years	First exam + Every 2 years
Glycemia level (urine and blood)	First exam + Every 5 years	First exam + Every 2 years
PA chest X-ray (if requested by physician)	First exam + Every 5 years	First exam + Every 2 years
Pulmonary function test	First exam + Every 5 years	First exam + Every 2 years
ECG under stress conditions	First exam + Every 5 years	First exam + Every 2 years

- Proof of medical clearance has to be provided prior to commencement of work. The attending physician must verify and certify that the individual has no medical conditions that make it inadvisable for them to work or ascend to 5000 meters (or over 3000m) above sea level. The annual medical certificate must be sent to the ALMA Safety Office.

ABSOLUTE CONTRAINDICATIONS (permanent conditions not subject to change within a timeframe relevant to company needs; one such condition is sufficient contraindication).

- Background of cerebral ischemia.
- Chronic respiratory insufficiency (any one of the following: arterial PO₂ less than 50mmHg, vital capacity less than 50% of predicted value, maximum respiratory minute volume less than 40l, FEV₁ equal to or less than 1lt, cor pulmonale, cyanosis).
- Severe renal insufficiency (Creatinine clearance less than 40 ml/min)⁵.
- Unstable coronary artery disease.
- Malign arterial hypertension.

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Creatinine clearance (Cockcroft formula) = $\frac{(140 - \text{Age}) \times \text{Weight (KG)}}{72 \times \text{serum creatinine}}$

The result is expressed in ml/min, and the figure is multiplied by 0.85 for women.



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- Pulmonary arterial hypertension (any etiology).
- Hemoglobinemia greater than 18.7 gr/dl in men, or greater than 18 gr/dl in women.
- Severe anemia (Hb less than 8 gr/100ml).
- Thromboembolisms or blood clots.
- Background of pulmonary and/or cerebral edema resistant to prophylaxis by acetazolamide, nifedipine and/or corticoids.
- Epilepsy with seizure in the last year.
- Morbid obesity (BMI > 40)⁶.
- Serious uncompensated arrhythmias (e.g., high-frequency, severe ventricular arrhythmias in general, symptomatic WPW, supraventricular arrhythmias with compromised hemodynamics).
- Pregnancy.
- Recent (less than 6 months) acute myocardial infarction.
- Decompensated cardiac insufficiency, or grade III or IV compensated.

RELATIVE CONTRAINDICATIONS - (modifiable in the short term).

- Well-controlled epilepsy, no seizure in last year.
- Compensated psychiatric disorders.
- Presence of cardiovascular risk factors.
- Insulin-dependent diabetes mellitus (evaluate isolation of workplace).
- Decompensated type-II diabetes mellitus.
- Severe hypertriglyceridemia (greater than 800 mg%).
- Decompensated systemic arterial hypertension.
- Any uninvestigated cardiac pathology.
- Other anemias (with hemoglobinemia greater than 8gr/dl).

HEALTH CERTIFICATION (HAME)

- The medical certificate must mention that the worker is “Acceptable for executing his (her) work at 5000 (or above 3000) meters above the sea level”
- If the conclusion is “Acceptable with restrictions”, inform ALMA and provide the corresponding restriction(s). This conclusion will have relative contraindication(s), or condition(s). Restrictions may be temporary, permanent and restricted levels of altitude.
- The medical certificate is valid for 1 year, unless a specific lesser term is presented in the Report of the evaluating doctor.
- The form shall indicate the beginning and end of the one year period.



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**Evaluación de Salud Anual para Altitud Geográfica
(Annual Altitude Health Evaluation)**

* Based on the AHCS Norm for Medical Examinations

INFORMACIÓN PERSONAL / PERSONAL INFORMATION	
Nombre: <i>Name:</i>	Fecha: <i>Date:</i>
EXÁMENES REALIZADOS / TESTS PERFORMED	
	Consulta Médica (Incluye índice de masa) / <i>Medical Checkup(Including body mass)</i>
	Electrocardiograma de reposo por medico cardiologo (examen inicial con test de esfuerzo + cada 2/5 años) <i>Resting Electrocardiogram with cardiologist report (stress test for the first exam + every 2/5 years)</i>
	RX thorax AP (examen inicial +cada 2 a 5 años) <i>PA Chest X-ray (First exam + every 2 or 5 years)</i>
	Perfil Bioquímico / <i>Biochemical Profile</i> (examen inicial +cada 2 a 5 años)
	Orina Fisiológico / <i>Urine Test</i> (examen inicial +cada 2 a 5 años)
	Hemograma completo / <i>Blood Test - Cada año- Every year</i>
	Espirometría basal / <i>Basal Spirometry</i>
	Encuesta de altitud / <i>Altitude Survey</i>
	Perfil lípido / <i>Lipid profile</i>
	Otros / <i>Others</i>
RESULTADOS (por favor marque la evaluación correcta) / RESULTS (please mark correct evaluation)	
	Apto: Exámenes no muestran aparentemente ninguna condición que contraindique asignaciones a gran altura. <i>Acceptable: The examination does not show condition(s) which contraindicate altitude assignment.</i>
	Apto con restricciones: Favor entregar las restricciones correspondientes al caso. <i>Acceptable with restrictions: Please provide the corresponding restriction(s).</i>
	Autorización Pendiente: Requiere diagnóstico médico, manejo o estabilización. <i>Pending authorization: Requires medical diagnosis, management or stabilization.</i>
	No Apto: Examen arroja contraindicación(es) para el trabajo en altura. <i>Non-Acceptable: There are condition(s) in the examination which contraindicates work at altitude.</i>
INSTRUCCIONES ESPECIALES / SPECIAL INSTRUCTIONS	
1.	Los resultados de los exámenes realizados deben ser entregados al Empleado y no enviados a la Empresa. <i>Results should be delivered to the employee and not sent to the employer.</i>
2.	Por favor devuelva este formulario, marcado CONFIDENCIAL, a: <i>Please forward this form, marked CONFIDENTIAL, to:</i>
Observatorio ALMA Alonso de Cordoba - 3107 VITACURA – SANTIAGO - CHILE	
Esta Evaluación de Salud tiene validez hasta: dd/mm/aaaa <i>Health Evaluation valid until: dd/mm/yyyy</i>	
INFORMACIÓN SOBRE EL DOCTOR / PHYSICIAN INFORMATION	
Nombre y firma del médico tratante: <i>Physician Name and Signature:</i>	



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INFORMATION CONFIDENTIALITY

Exam information must be handled to preserve employee confidentiality, but provide information to define work aptitude, or implement preventive measures such as work modification. The medical exam certificate will be filed with the Safety Office in the ALMA polyclinic.

MEDICATIONS

No preventive medication shall be provided by ALMA paramedics to assist in altitude issues. The ALMA Safety Office and paramedics follow the ALMA medical protocol prepared and approved by expert physicians. Employees follow the recommended prescription as established by their physician.

OSF CLINIC EXAM PROTOCOL

- Individuals must be checked at the OSF before ascension above 3000 m, by the ALMA Paramedic.
- The frequency of the check-up at the OSF is based on the following:
 - Every affected person going above 3000 m for the first time.
 - Every person that visits the site above 3000m less than monthly.
 - Any individual that feels unwell or has a desire to be checked.
- Individuals presenting the following characteristics may not ascend (ALMA Paramedics protocol):
 - Systolic blood pressure level greater than 160 or diastolic pressure greater than 100mm Hg. “Prophylactic” anti-hypertension treatment will not be administered.
 - Heart rate greater than 95 beats per minute or lower than 45 beats per minute.
 - A blood oxygen saturation level below 70%, or below 80% when showing symptoms of headaches, dyspnoea, tachycardia, blood pressure changes.
 - Anyone with a blood pressure level less than that described above, but showing symptomatic indications.
 - Any person in the camp or during the check-up who shows signs of altitude sickness (fatigue, dyspnoea, headaches, sleep disruption, tachycardia, palpitations).
 - Patients with a history of AMI (acute myocardial infarction), without the authorization of an attending heart specialist. The authorization should expressly state that it is for an altitude level of about 5000 meters.
 - Patients with a history of any form of cardiac insufficiency.
 - Diabetic patients should be assessed via a hemogluco-test before ascending. Decompensated diabetic patients cannot ascend (a hemogluco test above 200 mg/dl).
- The OSF First aid station is only designed to stabilize injuries not provide surgery.

GENERAL REQUIREMENTS FOR ALTITUDE

- Before Ascending:
 - Spend one night at approximately 2500 meters (e.g. Calama, St Pedro de Atacama or OSF) before ascending in order to help acclimatize.
- Work day length:
 - Strictly limit work hours at the 5000 m site not to exceed 4 hr a day for the first day; 6 hr for the second day; 8 hr for the third day to a week after, and 10 hr afterwards. This defines strict upper limit to the work day length



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irrespective of selfish decision (or non-decision) of the leader of the party, easing the mental conditions of those who cannot determine their work day lengths by themselves. This also improves the overall efficiency of the work at high altitude, and will aid support team at the base camp for early detection of accidents or unusual conditions, if any.

- Go to sleep early the night before.
- Avoid drinking coffee or alcohol.
- You must not be suffering from any acute respiratory infection.
- Eat a light breakfast and start early in the morning.
- Drink abundant water without carbonation, or gas, during the trip.
- Hydration should be self controlled by urine observation. Urine being nearly colorless indicates appropriate hydration. For the latter purpose mineral water without gas or fresh fruit juice should be consumed in quantities not less than 3 L daily. ALMA provisions water to the staff.
- Sun exposure:
 - Prevent unnecessary exposure to UV
 - Seek shade as much as possible while outside.
 - Avoid prolonged exposures near reflective surfaces
 - Some medications can increase UV sensitivity. Certain antibiotics, birth control pills, diuretics, antihistamines and antidepressants may cause increased sensitivity to the Sun. Take extra precautions if you are taking any of these medications.
 - Wear a sunscreen that has at least a Sun Protection Factor (SPF) of 15 or higher.
 - Remember to apply sunscreen to lips, ears and exposed scalp.
 - Reapply 2 or 3 times a day.
 - Choose clothes that cover the arms, legs and neck
 - Wear hats. A hat brim of 10 cm or greater is recommended.
 - Wear protective eyewear. Sunglasses with UV-blocking filters are very important.
 - In several buildings of ALMA you can find safety provision:, safety sunglasses, hats and sun cream.
- At Altitudes:
 - Do not visit the site if you are already feeling unwell as the stress of high altitude could exacerbate the condition, especially for any chest infection or respiratory problem.
 - Do not expose yourself unnecessarily to the cold.
 - Do not perform strenuous exercise.
 - Never sleep at a high altitude without ALMA authorization.
 - Eat light and non-flatulent foods, preferably carbohydrates.
- Altitude Illness:
 - If a member of the party appears to be in distress with severe symptoms of high altitude illness, immediately drive them down from elevation. In serious cases use the hyperbaric bag if appropriate.
 - Use emergency oxygen bottles from the Safety Office and have a third person administer oxygen to the sick person during descent. See Section 5-3.
 - If necessary, the Alma paramedic can decide to take the patient to the hospital in Calama or medical clinic in San Pedro de Atacama.

ALTITUDE TRAINING REQUIREMENTS



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- All employees must read the high altitude instructions to become familiar with the symptoms of high altitude medical conditions that could develop at ALMA.
- Each employee and official visitor must sign the form indicating the material was read and understood.
- All personnel that regularly work at elevation must be trained in response to high altitude illnesses and first aid. The course may cover the following topics:
 - Introduction to acclimatization and high altitude sickness
 - Basic altitude physics
 - Physiology of respiration. Oxygen transport at sea level and altitude.
 - Reduced work efficiency in high altitude and preventive measures
 - Normal acclimatization to altitude
 - Patho-physiology of altitude sickness. High altitude pulmonary and cerebral edema.
 - Treatment of altitude sickness (medical, non-medical, physical). Emergency medication and emergency equipment
 - Prophylaxis of altitude sickness (medical, non-medical)
 - Practical exercises with emergency oxygen supply and hyperbaric chamber (Certec-Gamov bag)
 - AED (Automatic External Defibrillator) use. Anyone can apply the AED for workers showing heart disease signs, but must not remove the electrode pads and turn off the AED before arrival of the paramedic. The paramedic takes over the operation of AED and makes a final decision for him/her.

4) Executive Staff Physical Exam Requirements

INTRODUCTION

- Executive staff members arriving at the ALMA site must be in compliance with their respective organization policy requirements for high altitude physicals.
- Any Executive staff member visiting the ALMA site in the capacity of a tourist must also comply with the next paragraph of this document.

MEDICAL EXAM REQUIREMENTS FOR EXECUTIVE STAFF

- All Executive staff members with cause to access above 3000m (above the OSF) must meet one of the following conditions:
 - Provide a signed copy of the medical certificate indicating that the individual is cleared for access to 5000 meters elevation, or
 - Exceptionally sign a certification indicating that the employee has met the requirements of the Executive policies regarding high altitude exams, and that there is no known medical condition that makes it inadvisable for them to visit the site.

OSF CLINIC VISIT REQUIREMENTS

- All Executive staff working at the ALMA site must follow the requirements established in Section before ascension to the AOS site. (See Section 5-3: Oxygen Use at Very High Altitude (Chajnantor)).
- If there is no copy of the medical exam available, the Executive staff member will be requested to sign a [certification](#) at this time in order to access above 3000 meters.
- If the screening is not passed, access is not permitted.



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- A copy of the signed certification will be provided to the Executives HR department.

5) Contractors Physical Exam Requirements

INTRODUCTION

- These requirements apply to any contractors or vendors ascending to the AOS.
- The policy does not apply to the control of non authorized visitors that cross into the site from locations other than the official entry location(s), ignoring informative board signs.

MEDICAL REQUIREMENTS FOR CONTRACTORS AND DELIVERIES

- Access for visitors to the ALMA Project site must be authorized through the ALMA headquarters office in Santiago, Chile. For additional information on the procedures for visiting the site, see the ALMA Safety page for visitors.
<http://wikis.alma.cl/twiki/bin/view/ALMASafety/WebHome>
- Access for visiting contractors must be coordinated with the ALMA Safety Office.
- Inform the Safety Office at least 24 hours in advance in order to prepare High Altitude equipment, training and health examination procedures with the paramedic.
- Contractors ascending beyond the OSF to the AOS are required to either present a medical certificate from their occupational physicist certifying on the basis of a high altitude exam, and that there is no known medical condition that makes it inadvisable for them to perform work at 5000m (beyond 3000m) , or provide a certificate signed by their HR department stating that their employee meets the legal requirements and those of their workplace accident insurance (social security) to perform work at 5000m (beyond 3000m).

VENDORS / DELIVERIES

- Procurement Officers must inform vendors when deliveries are expected above 3000m.
- Delivery drivers must be informed by the vendors of all necessary information regarding high altitude risks, preventive medicine, medical screening at ALMA OSF and the exclusion criteria outlined in this Safety Manual.
- Delivery drivers will be expected to sign a waiver and release if they have no high altitude medical certificate.
- Regular transporters must provide the driver's high altitude certificate.
- It is required that persons making deliveries above 3000m stay one night at Calama or San Pedro elevation before driving beyond 3000m.
- All deliveries must comply with road traffic code, enter by the ALMA main entrance and stop for screening at the OSF before driving beyond 3000m.
- Delivery personnel will be escorted by ALMA staff.

6) Visitors and self-employed Free-Lancers Requirements

INTRODUCTION



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- These requirements apply to any authorized visitors and self-employed free-lancers ascending beyond the OSF to the AOS.
- The policy does not apply to the control of non authorized visitors that cross into the site from locations other than the official entry location(s), ignoring informative board signs.

MEDICAL REQUIREMENTS FOR VISITORS AND VISITING CONTRACTORS

- Access for visitors to the ALMA Project site must be authorized through the ALMA headquarters office in Santiago, Chile. For additional information on the procedures for visiting the site, see the ALMA Safety page for visitors.
<http://wikis.alma.cl/twiki/bin/view/ALMASafety/WebHome>
- Inform the Safety Office at least 24 hours in advance in order to prepare High Altitude equipment, training and health examination procedures with the paramedic.
- Authorized visitors to the AOS are required to read the informative pamphlet provided by the Safety Office, participate in the OSF's paramedic medical check up and sign an [acknowledgement and release](#) waiver before being escorted to the AOS.

7) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that all employees are aware of the requirements of this policy.
- Ensure that individuals assigned to work tasks are medically fit to perform the task.
- Ensure contractor compliance.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Keep records and schedule Annual High Altitude Exam for all ALMA employees in coordination with Human Resources JAO.
- Issue notices to registered employees that are due for annual physical exams. See procedure: "Coordination of the HAME for ALMA staff"
- Provide training in the policies to Supervisors and affected personnel.
- Ensure all persons follow the site requirements for polyclinic visitation.
- Ensure that individuals going over 3000 m meet the high altitude requirements.

INDIVIDUALS

Every ALMA employee must:

- Every individual affected by this policy is required to report any change in physical ability to perform the assigned work tasks.
- Every individual must report to the clinic when feeling unwell.
- Be aware of the individuals he/she is working with and monitor their health.
- Each individual must ensure their training is up to date.
- Each individual must comply with the yearly medical requirement.



5 - Health and Medical Requirements

5-2 Symptoms and Treatment for AMS

1) **Purpose** - This information assists in the identification of Acute Mountain Sickness (AMS).

2) **Scope** - This information is applicable for all ALMA employees, visitors and contractors.

References include:

- Directive 80/1107/EEC – Relating to protection of workers from exposure to chemical, physical, and biological exposure.
- Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
- Norma ACHS para la Evaluación de Salud por Exposición a Hipoxia Hipobárica (ACHS Regulation for Health Evaluation of Exposure to Hyperbaric Hypoxia)
- Labor Aptitude and Altitude: Norms of Handling for Occupational and Pre-Occupational Evaluations. Dr Cristián Bustamante Retamal
- MEDICAL TECHNICAL REPORT on A.L.M.A. PROGRAM, Andrés E. LLarena MD, Anesthesia & Hyperbaric Medicine, Head of Hyperbaric Medicine Unit, Hospital Naval “Almirante NeF”, Viña del Mar

3) Rules / Requirements

INTRODUCTION

- Relevant aspects of high altitude physical activity include: oxygen, extreme temperatures, solar radiation, dry air, and psychological reactions population to these items.
- The most important challenge to the well being of workers performing work at the AOS is the relative lack of oxygen.
- To some extent, all workers will suffer physiological and metabolic changes that diminish the capability to perform both physically and mentally.
- These physiological & metabolic changes also contribute to risk of severe high altitude related diseases. Considering the nature of construction, this increases the chance of having accidents.
- Trauma at altitude is difficult to manage due to metabolic and physiological status of the workers which cut short basal body responses to injury, and also due to the environmental challenges that high altitude offers for pre-hospital medical rescue.

PREVENTIVE MEDICINE

- Every worker must have proper Preventive Medicine examinations prior to be included in the group of workers at the high site. In general terms, the medical risks that the workers will be facing are:
 - Acute Mountain Sickness (AMS), which can be recognized by headache, shortness of breath and difficult breathing; Nausea and Vomiting; Dizziness; Fatigue; Lethargy and poor concentration; Unspecific not well being or not feeling well, so called “Malaise”
 - Mild medical conditions such as:



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- Metabolic disorders which include initial plasma alkalosis because of hyperventilation, but later acidosis.
- Dehydration due to enhanced diuresis and hyperventilation, poliglobulia (increased number of red cells in blood) and more concentrated plasma.
- Problems concerning corneal injuries due to hypoxia, high radiation and air dryness that might lead to sight loss and corneal ulcers if not prevented properly.
- Some behavioral disorders, irritability and mood changes as also been described.
- High Altitude Pulmonary Edema (HAPE), may appear if a worker continues working with established AMS. Pay attention to the “macho” concept of hiding symptoms.
- High Altitude Cerebral Edema (HACE), which may happen if a worker with a mild or severe case of HAPE, would keep on performing physically demanding tasks.
- The two last conditions are life-threatening, and require immediate treatment, emergency medical management and mandatory evacuation to a full equipped medical facility.

MEDICAL SURVEILLANCE AT THE HIGH SITE

- Maintain continuous medical vigilance of the work group at all times.
- If AMS symptoms are detected, immediately transport the worker to the site Paramedic.
- AMS should be initially treated with supplemental oxygen and acetazolamide as well as an analgesic for headaches, and the worker must rest until full recovery is achieved.
- Advice found in literature for these cases is to put the patient into the equivalent of a lower altitude environment, whether this is done in a “hyperbaric (isobaric) bag”, or exposure to an enriched O₂ air in a closed environment.
- Should there be an injured worker affected by severe AMS, HAPE, HACE, he or she should receive immediate treatment by medical personnel.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that all employees, contractors and visitors are aware of the information in this policy.

INDIVIDUALS

Every ALMA employee must:

- Every individual affected by this policy is required to report any change in physical ability to perform the assigned work tasks.
- Every individual must report to the clinic when feeling unwell.

Be aware of the individuals he/she is working with and monitor their health.



5 - Health and Medical Requirements

5-3 Oxygen Use at Very High Altitude (Chajnantor)

- 1) **Purpose** - To provide clarification and guidance for the proper maintenance and use of supplemental oxygen for work or visits beyond the Operation Support Facility, OSF.
- 2) **Scope** - This procedure is valid for all Members of Personnel under contract with Executives, contractors and Executive staff working above 4000 m. Supplemental oxygen for visitors may be requested from the Safety Officer. Visitors accessing the Array Operations Site, AOS, must comply with Section 5-1 (Physical Exam Requirements and High Altitude Policy) and Section 10-2 (AOS Access Requirements), for access requirements. Contractors must also comply with these rules.

Nevertheless, it is essential that contractors determine the risks associated with the work and determine when the use of supplemental oxygen is required.

3) Rules / Requirements

GENERAL

- One set equipped Oxygen bottle shall be individually provided for all work activities at the high site.
- An Oxygen meter shall be provided for all group of workers or individual in order to check their oxygen concentration in the blood.
- Supplemental use of oxygen is mandatory for all drivers commuting for more than 2 hours at the high site.
- Supplemental oxygen is mandatory for all workers involved in hazardous operations, antennas moves, confine spaces work and all long (>2h) outdoors stays at high site.
- Supplemental oxygen is recommended for work and travel between the OSF and AOS as soon as the level of O₂ concentration is < 80%
- The ALMA Safety Office shall maintain an adequate number of complete sets with regulators (conservers), including nasal cannula and bottles of medical grade oxygen.
- The medical grade oxygen shall be obtained from AGA depot, or equivalent.
- The regulators shall be model OM-401A, or equivalent.
- The flux meter shall be calibrated weekly by the Safety Officer and the record of calibration recorded.
- The oxygen bottles shall have a carrying case available. (P = 160b = ~ 2300 Psi)
- The ALMA Safety Office shall also maintain personal aerosol oxygen on site to be used by visitors when visits are < 2hours at the high site.
- An adequate number of pulse oxygen meters shall be available for use.
- All employees working at the AOS on a regular basis shall be trained in the use of supplemental oxygen.
- IPTs and Team Supervisors may require the use of oxygen for specific tasks as hazards are identified in the Job Hazard Analysis.
- Specific tasks requiring the use of supplemental oxygen may also be identified by the Safety Department.



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- In areas where supplemental oxygen is generated, distributed, and maintained through a central system, the use of portable supplemental oxygen is not required.
- The nasal cannula and masks are personal (See Section 5.6 – Health and Medical Requirements) and it is required all employees ending their shift to bring the used mask and or cannula to the Safety Office. The nasal cannulas shall be cleaned and sterilized by the paramedic.

SUPPORTING INFORMATION

- In High Altitude Medical Biology, 2001 Spring, ‘**Safe upper limits for oxygen enrichment of room air at high altitude.**’ Dr. J.B. West, University of California San Diego, addresses fire in oxygen enriched areas. See <http://www.liebertonline.com/doi/abs/10.1089/152702901750067918>
- Common sense (and ALMA rules) requires that there should be no cigarette smoking, and that flammable gases and liquids not be used in an oxygen-enriched atmosphere. Volatile liquids may require special handling at high altitude, and there is some evidence that they may ignite more easily at high altitude, and their vapors may spread more readily than at sea level, even in the absence of oxygen enrichment.
- The rule is that naked flames, flammable gases and liquids, and volatile liquids should not be used in an oxygen-enriched atmosphere at high altitude.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Investigate any reported problems.
- Ensure that supplemental oxygen is provided as required in this policy.
- Determine requirements for O2 use within the IPTs.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Ensure that all oxygen systems are functional and replaced as needed.
- Distribute oxymeters and supplemental oxygen to employees working at elevation as requested.
- Provide oxygen use training for employees that regularly work at the AOS.
- Maintain and service the supplemental oxygen for use at the AOS.
- Verify oxygen and carbon dioxide sensing devices in oxygenated facilities.

INDIVIDUALS

All individuals are required to:

- Promptly return used oxygen cylinders and equipment for refill to the Safety Office.
- Attend training sessions provided.
- Evaluate personal physical status periodically when working at elevation.
- Take preventive measures to test pulse oxygen levels and secure supplemental oxygen when feeling unwell.



5 - Health and Medical Requirements

5-4 Alcohol, Drugs and Tobacco misuse

- 1) Purpose:** – The ALMA procedure on the general alcohol and drug ban is designed:
- to increase awareness of alcohol and drug misuse within the organization,
 - to help eliminate abuse of alcohol and illegal drugs on ALMA premises, and
 - to reinforce safety rules prohibiting the consumption of alcohol on ALMA premises.

In particular the policy aims to achieve the following objectives:

- Support the provisions and measures relating to health and safety, as per the ALMA Internal Regulations for Hygiene and Safety and the corresponding Regulations of the ALMA Executives;
- Prevent alcohol and drug consumption affecting the workplace e.g. absentee-ism, impaired performance, injuries in the workplace, potential risks for fellow staff members, all persons present on site and observatory equipment, etc., and train supervisors to recognize the first signs and deal with them appropriately;
- Seek to identify problems at an early stage and thus minimize risks to the health and safety of ALMA staff and potentially safeguard the health and safety of fellow staff members and others.

- 2) Scope** – These guidelines are applicable for all ALMA activities. References include:
- Use And Abuse Of Alcohol, And Alcohol As A Factor Of Work Accidents, Dr. Roberto Aravena O., Physician / Surgeon, Rut: 10.063.364-7
 - Article 30 of Supreme Decree N° 72, Ministry of Mining (Chilean law)

3) Rules/Requirements

3.1 ALCOHOL BAN

Alcohol use is associated with a very high risk of accidents. Any person who has consumed alcohol is a risk at work, even with a minimum consumption.

- Tests results for measuring the breath alcohol levels are comparable with the results of blood samples (blood level of alcohol).

3.2 ALMA SITE ALCOHOL RESTRICTIONS AND REGULATIONS

- It is forbidden to bring, possess, consume or dispose (e.g. sell, donate, trade or share) alcoholic beverage at the ALMA site.
- It is forbidden to be under influence of alcohol at work. There will be NO TOLERANCE of this conduct. ZERO ALCOHOL is required of vehicle drivers and people at their workplace.
- Systematic alcohol tests shall be performed on drivers entering the site from 8:00 p.m. to 8:00 a.m.,
- Persons, not driving, entering the site after 8:00 p.m. and before 8:00 a.m. - including ALMA shuttle passengers - may be randomly selected for an alcohol test.
- Systematic alcohol tests shall be performed at the entrance on truck drivers carrying “dangerous” goods.



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- Breath alcohol checks may be performed to anyone by the Security or Safety staff randomly at any time at the entrance or on the ALMA site, whether under the circumstances described in this chapter or when there is a reason to suspect that someone is under the influence of alcohol.
- If at the entrance the Blood Alcohol Content (BAC) is $> 0.1\%$, or $> 0.0\%$ for drivers, the person will not be allowed to enter the ALMA site. S/he will be asked to stay at the guard house until getting back $< 0.1\%$, or until the following morning.
- When the BAC is $> 0.0\%$ when tested between 7 a.m. and 8 a.m., before returning to work s/he must be tested again at the Polyclinic before s/he starts the task in the ALMA project.

3.3 DRUG ISSUE

- Illegal drugs are prohibited on the ALMA site at all times.
- Drug test is required for all Contractors new employees before their first working day.
- Any Contractor employee who works within the ALMA site may be asked to take a drug test. His or her Supervisor or the Contractor's safety advisor will request that the test be performed by the paramedic who is on duty at the ALMA first aid station. Any Site Supervisor or safety expert may make such a request. In order to do so, they must ask the Supervisor or the safety expert of the company in which he or she works, for permission.
- A form will record the date, time, and complete information for the person requesting the test, the worker being tested, and the paramedic and ALMA safety officer on duty. The form must also clearly indicate whether or not the employee has agreed to submit to the test.
- A urine sample will be taken and tested in the presence of the paramedic and ALMA safety officer who are on duty at the time. The polyclinic will be equipped with chlorimetric equipment for conducting this test.

3.4 PERSONS SUSPECTED OF BEING UNDER THE INFLUENCE DURING WORK HOURS

If a supervisor or manager has reason to suspect that a person under his/her supervision is under the influence of alcohol or illegal drugs, the person will be separated temporarily from his/her job function as a precaution. If the Manager on Duty agrees that there is a valid reason, the person will be asked to submit to an alcohol and/or drug test, as appropriate. If the BAC is 0.0% and/or the drug test renders a negative result, the person may return to work. If the result is $> 0.0\%$ for alcohol, or positive for illegal drugs, the person may request that a second test be carried out as soon as possible, using different testing equipment or kit. The lower of the results of the two tests will be final. If the person refuses to undertake such a test they will be presumed to be under the influence of alcohol or illegal drugs, and will be treated as such under this section.

3.5 CONSEQUENCES

- Any person registering a positive BAC $> 0.00\text{g/l}$ - (0.0%) for alcohol must not carry on any work on the ALMA site until a negative control is registered at the polyclinic.
- Any person registering at the gatehouse a positive control $> 1.00\text{g/l}$ (0.1%) for alcohol shall be prohibited entering the ALMA site. This person must stay at the gatehouse or be transported to a safe offsite location until registering a BAC below 0.1% (or 0.0% for drivers).



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- If Contractors' employee tests positive for drug use or refuses to submit to the test, he or she may be dismissed immediately and removed from ALMA premises. The company for which the employee works may decide to take additional measures. If necessary and duly authorized, law enforcement officers will be called in to assist in dismissing the individual in question.
- ALMA Employees found to have a BAC above the limits as set out in the preceding paragraphs 3.2 or found to be under the influence of illegal drugs will be asked to meet with HR. The persons' supervisor and/or manager, as appropriate; the ALMA Director and the relevant Executive will be duly informed.
- See also the Section 10-4 – Vehicle use at the ALMA Site for other driving penalties.

3.6 TOBACCO

- It is forbidden to smoke inside the buildings, rooms, dorms of the ALMA Project as well as in all other ALMA locations where this is clearly indicated.
- People smoking outside must use the ashtrays provided for that purpose.

Penalties:

- For the first complaint a warning and reminder is sent to the corresponding Supervisor.
- For the second complaint the warning is repeated and formally sent to the corresponding Member of Project manager.
- A third complaint results in dismissal from the site.
- In case there is evidence that a Contractor or visitor disabled the smoke detectors for smoking it will result in dismissal from the site, or a corresponding recommendation to the respective Executive's DG for Members of Personnel under contract with Executives.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure employees are not on the ALMA site under the influence of alcohol or drugs.
- Ensure that alcoholic beverage or drugs are not brought into the site.
- Ensure employees cooperate with the alcohol and drug tests performed systematically and randomly.
- Ensure that any employee testing positive for alcohol or drugs is prohibited from working that day.
- Provide discipline to affected employees as appropriate
- Approach the matter in confidence with the staff member when there is concern about possible alcohol or drug misuse (as defined in 3.0) and to take appropriate action to help them.
- If a member of staff admits to a substance abuse problem, he/she must be advised of the help available to them. The corresponding Manager, Director (as appropriate) and the ALMA Human Resources Department must be notified. Human Resources will then notify the corresponding Executive.

ALMA Human Resources



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- Will assist and advise the managers and supervisors in their responsibilities and provide them with the corresponding training.
- Will provide periodically awareness sessions for all staff on alcohol and drugs consumption and effects from misuse.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Inform Supervisors of any infringements and conduct the test. Inform the Site Manager, and ALMA HH.RR about the results, in case drug use or alcohol use above the limits set out in this chapter are detected.

INDIVIDUALS

All employees are required to:

- Participate in the alcohol and drug testing.
- Comply with the restrictions detailed in this policy.

Help Available

Practical support is available to those experiencing problems, for example, employees may be referred to an appropriate advisory service. The organization encourages staff to seek specialist help if they feel that they have an alcohol or drug problem. They may contact specialist centers directly, or contact their Human Resources Officer for further information.



5 - Health and Medical Requirements

5-5 Hyperbaric Chamber

- 1) **Purpose** – This guidance document provides information on the use of Hyperbaric Chambers for the treatment of Acute Mountain Sickness, AMS.
- 2) **Scope** – These guidelines are applicable for treatment of AMS using the Gamow Hyperbaric Chamber. References include:
 - Medical Commission of UIAA, Official Guidelines, Vol 8, Portable Hyperbaric Chambers, P. Baertsch, F. Berghold, JP. Herry, O. Oelz, 2000

3) Rules/Requirements

INTRODUCTION

- Portable hyperbaric chambers are used to help treat severe forms of altitude illness.
- They are air-impermeable bags that completely enclose the patient, and are inflated to a pressure above ambient atmospheric to simulate a physiological "descent."
- The extent of the "descent" depends on the altitude at which the bag is used; as an example, at 4250m, the inside of the bag is equivalent to 2100m.
- They are constructed from light weight fabrics and inflated using a hand or foot pump thus providing rapid pressurization of patients simulating a descent.

GAMOW BAG DESCRIPTION

- The original portable hyperbaric bag is bright red coated nylon fabric cylinder with a long zipper to allow entry.
- Small clear windows allow viewing in/out of the chamber.
- Conversation is slightly muffled by the fabric, but it is easy to talk to patients.
- Inflation is with a raft foot-pump, to 2 psi (105 mmHg) above ambient pressure.
- Relatively lightweight (the bag, pump, and daypack carrying case is roughly 7 kg). Fast and easy, you can have someone in the bag and "descended" in one to two minutes.
- Due to the location of the reinforcing straps (yellow in photo), it can be difficult to get a patient in and out of the bag.



LIMITATIONS AND TREATMENT PREFERENCES

- Prevention of AMS by adequate acclimatization is preferable to treatment.
- The hyperbaric chamber is not suitable for prevention or treatment of mild AMS because it prevents or slows down acclimatization.
- Only trained persons should treat a patient with the portable hyperbaric chamber.
- The priority sequence of emergency measures with cases of severe AMS / HAPE / HACE should always be:
 - Descent / evacuation,



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- Oxygen / drugs,
- Hyperbaric chamber.
- Hyperbaric treatment should only be used as an emergency measure and is no substitute for descent or evacuation.
- Pumping requires a considerable effort at altitude to maintain the pressure and airflow.
- The risk of leakage of air from the zipper and valve areas if the bag is not handled properly.
- **Absolute contraindications** to using the bag include lack of spontaneous respirations, as you can't ventilate the patient from outside the bag.
- **Relative contraindications** to using the bag are middle ear congestion, inability to protect the airway in a deeply comatose patient, and claustrophobia.

TYPICAL TREATMENT PROTOCOLS INCLUDE

- Insulate the chamber from the ground.
- The patient should urinate and defecate before going inside the bag.
- Put the patient into the bag,
- Seal the zipper shut.
- Inflate the bag with the foot pump.
- Instruct the patient to breathe normally and to “pop” his ears by swallowing as the bag is inflated.
- Two pop-off pressure valves set to 2 psi (not adjustable) start to hiss when maximum pressure is reached, and prevent over-pressurization of the bag.
- Keep the patient at pressure for one hour.
- Unless the bag has a CO₂ scrubber system, pump several times per minute to flush fresh air through the bag to prevent CO₂ buildup - this is a significant effort at 4000 - 5000 m.
- At the end of the hour, remove the patient from the bag and assess. Hyperbaric treatment normally results in a significant improvement within 60 to 90 minutes.
- If there is no improvement within 120 minutes, consider AMS complications or additional conditions.
- Continue additional cycles of “descent” and assessment until the patient is clinically improved enough to not need further hyperbaric treatment and is able to descend.
- HAPE typically requires 2-4 hours of hyperbaric treatment, and HACE typically requires 4-6 hours of hyperbaric treatment.
- Compressing and decompressing the bag done slowly, while talking to the patient.
- Slow down if s/he experiences ear pain.
- Patients with severe HAPE may not tolerate lying flat; this problem is addressed by putting the bag on a rigid surface (such as a bed) and propping one end up 30-40 cm.
- For maximum therapy, put oxygen inside the bag with the patient. Do not hook oxygen up to the pump intake.
- The treatment with oxygen plus drugs is generally favored in cases of extreme HAPE / HACE (in particular with loss of consciousness).
- If cold, put a sleeping bag in with the patient.
- Conversely, if in the sun, shade the bag, as the sun is intense at altitude and will “cook” the patient.



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- To avoid rebound in severe cases of HAPE, the patient should be as exertion-free as possible after successful treatment in a hyperbaric chamber; avoid walking short distances unless essential for descent.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure employees follow ALMA requirements for ascent and acclimatization.
- Encourage staff members to become trained in the use of the chamber.
- Ensure that the bag is properly used when needed.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Assess any patient that uses the chamber.
- Provide the training for the staff working at the high site.
- Record the use of the chamber and ensure the chamber is properly maintained.

INDIVIDUALS

All employees are required to:

- Participate with the paramedics in administration of this policy.



5 - Health and Medical Requirements

5-6 Portable Oxygen Therapy

- 1) **Purpose** – This guidance document provides information on the delivery and benefits of oxygen therapy at altitude. Oxygen therapy is used to maintain the necessary oxygenation levels to avoid tissue hypoxia.
- 2) **Scope** – These guidelines are applicable for treatment of AMS using portable oxygen therapy. References include:
 - Oxigenoterapia: Administración en Situaciones de Hipoxia Aguda, Carolina Botella Dorta, Médico de Familia, C. S. La Laguna-Mercedes. Servicio Canario de la Salud, 17/01/2005.
- 3) **Rules/Requirements**

INTRODUCTION

- When partial O₂ pressure in arterial blood reaches levels greater than 60 mmHg the hemoglobin saturation is approximately 90%.

OXYGEN DELIVERY SYSTEM

- Compressed O₂ is stored at high pressures and this pressure must be reduced before delivery so as not to damage the delivery apparatus.
- At ALMA, portable breathing oxygen is delivered from pressure cylinders.
- A manometer and a pressure-reducing valve must be fitted on a pressure cylinder.
- The manometer measures the oxygen pressure inside the cylinder via a needle on a graduated scale and also regulates the oxygen pressure released from the cylinder.
- The flow meter or rate-of-flow indicator is normally connected to the pressure-reducing valve, to allow control of the liters per minute (flow) leaving the oxygen supply source.
- The flow can be indicated via a graduated scale which rises and falls as the flow changes.
- Compressed oxygen is stored and to achieve this, it must be liquefied, cooled and dried. Before delivering the O₂, it should be humidified so that it does not dry up the airways.
- A humidifier is used, to which sterile, distilled water is added.

AIRWAY FEED

- By means of the delivery system, oxygen gas can be fed into the airways.
- There are several available on the market, distinguished by complexity, cost and precision in providing O₂.
- Generally speaking, ALMA uses low flow systems (cannula or nasal prongs and simple oxygen masks) to assist in prevention and treatment of hypoxia.



- The O₂ concentration inhaled cannot be known since it depends on the oxygen flow being delivered, the volume flow, and the user's frequency of breathing at that time.
- Low flow systems must not be used on patients with hypoxemia and hypercapnia who require an accurate FiO₂ delivery.

Nasal cannula
Figure 24.3.4.1-3

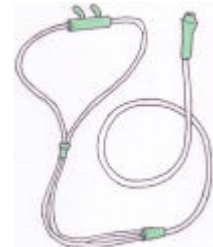


Fig. 1



Fig. 2



Fig. 3

CANNULA OR NASAL PRONG USE

- The most used system to deliver low flow oxygen. It is cheap, user-friendly and generally well tolerated. It is possible to work, speak, and eat without interrupting oxygen delivery.
- Oxygen flow achieved with this device oscillates between 1-4 liters per minute, which constitutes a theoretical FiO₂ of 24-35%.
- Nasal prongs are flexible plastic tubes (Fig. 1), which are inserted into the nostrils and secured to the user's face.
- Have the material ready: Cannula, oxygen supply and paper towels.
- Wash your hands.
- If the user is a patient, let them know about the technique to be performed and ask them to cooperate. Ask them to exhale through their nose.
- Connect the far end of the cannula to the oxygen supply.
- Insert the prongs of the cannula into the nostrils. (Fig. 2)
- Pass the tubes of the cannula over the ears and adjust the cannula with the pin so that it rests beneath the chin. (The tubes should rest on the face and neck without pressure or discomfort. (Fig. 3)
- Choose the prescribed oxygen flow on the flowmeter.
- Subsequent care. Regularly control the position and adjustment of the nasal cannula since it can easily become loose.
- Monitor the areas above the outer ears and the nasal mucus (lubricate the nostrils if necessary).

OXYGEN SAFETY MEASURES (See also Section 6-2 - Compressed Gas Safety)

- Oxygen is not a flammable gas; however it makes other materials burn longer.
- O₂ speeds up combustion. Keep away from combustible material; do not use fat or oil.
- Slowly open the tap.
- Close the tap when the bottle is not in use or is empty.
- Keep the bottle away from fire and do not expose to sunlight.
- Handle with care.
- Always use the protective cap.

OXYGEN FLOW CONCENTRATIONS

- Generally speaking, in acute hypoxia situations, the recommended oxygen delivery is the following:
 - FiO₂ of 24-28% if the patient has a history of chronic respiratory failure.
 - FiO₂ of 40-50% in all other cases (heart diseases, suspected pulmonary thromboembolism and asthma).
- According to the oxygen delivery device to be used, the oxygen flow to obtain the required FiO₂ will have to be selected on the flowmeter.



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- In Table 1 oxygen delivery concentrations are set out according to the oxygen flow and the delivery device.

Oxygen Concentrations by Different Delivery Devices		
	Flow O ₂ (l/min)	FiO ₂
Air atmosphere (without O ₂ delivery)	0	0,21
Cannulas or nasal prongs	1	0,24
	2	0,28
	3	0,32
	4	0,36
	5	0,40
Simple mask	5-6	0,40
	6-7	0,50
	7-8	0,60

FiO₂ = Fractional concentration of delivered oxygen expressed in per 1.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure employees are trained in the use of portable oxygen.
- Ensure employees use oxygen as appropriate for the tasks selected.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- The site paramedics are responsible to provide oxygen to any patients as needed.
- Ensure that sufficient oxygen systems are available and properly maintained.

INDIVIDUALS

All employees are required to:

- Report any problems with the oxygen distribution system to the Safety Office.
- Wear portable oxygen as required by the specific task.
- Return used oxygen equipment to the Safety Office for refill and maintenance.



6 - Hazardous Materials

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6. HAZARDOUS MATERIALS

6-1 Hot Work (Welding, Grinding and Cutting)

1) **Purpose** - The purpose of this procedure is to establish a procedure for permitting of hot work and establish safe welding and cutting procedures.

2) Scope

- This policy applies to all welding, hot cutting, and abrasive grinding on site by employees, users, temporary help, or contractors.
- At ALMA, there are two locations in which hot work is permitted- The first is a permanent permissible area such as a weld shop. The second is a temporary work area with safeguards defined using a Hot Work Permit.
- Pedestal and stationary grinders mounted in permanent machine shop areas are not covered by this policy.
- References include:
 - Directive 80/1107/EEC – Relating to protection of workers from exposure to chemical, physical, and biological exposure.
 - Directive 89/391/EEC – Introduction of measures to encourage improvements in the safety and health of workers at work.
 - EN 13478 – Fire prevention
 - EN 50060 – Power sources for manual arc welding with limited duty
 - EN 50078 – Torches and guns for arc welding
 - ISO 5175:1987 - Equipment used in gas welding, cutting and allied processes -
- Safety devices for fuel gases and oxygen or compressed air

3) Rules / Requirements

GENERAL

- Ensure that welding, cutting, brazing, and grinding of metal activities are carefully planned, coordinated, and the hazards controlled.
- Job Hazard Analysis and the Hot Work Permit are used to ensure that hazards are identified and mitigated before work is started.
- Do not cut or weld in explosive atmospheres (gases, vapors, or dusts).
- Do not cut, weld, braze, or grind near combustible or flammable fluids.
- Do not cut, weld, braze, or grind on drums, barrels, tanks, or other used containers.
- Do not mix aluminum grinding dust and iron or steel grinding dust. Such mixtures can, under special conditions, explode. Separate grinding wheels should be used for aluminum grinding.
- Keep objects which have been heated by hot work away from combustibles and people until they cool.
- Ensure adequate ventilation during the hot work process.
- Protect workers from electrical shock by maintaining electrical welding equipment in good repair. Repair damaged leads promptly.



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- Ensure that all compressed gases and fuels are stored and transported properly, and that any regulators, valves, hoses, and fittings are in good repair, and that all hoses are properly fitted with anti-flash back arrestors or valves just in front of the torch.

INSPECTIONS

- Inspect cracks and holes in the work area to ensure that no personnel or combustible material shall be exposed to sparks should they pass through a penetration.
- If the object to be worked cannot be moved to a routine welding area, move all combustible material at least 10 m from where the hot work shall take place.
- If combustibles cannot be moved, cover the combustibles with appropriate guards.
- Sweep floors clear of combustible material. If the floor itself is combustible, cover it with noncombustible material, such as sand.

PERSONAL PROTECTIVE EQUIPMENT

- Use protective clothing such as face shields, leather gloves and aprons designed to prevent burns by protecting skin and clothing from slag, sparks, and radioactive heat.
- Face shields must have the appropriate opacity for the type of weld being performed.
- Wear cotton or cotton blend fabric when welding. Polyester or nylon clothes are not permitted.
- Provide flash protection (walls or curtains) if work is in the vicinity of other personnel.

SPECIAL CONDITIONS

- Be aware that hot work in confined spaces requires a confined space permit.
- When passing through a fabrication work area, be aware that welding may be in progress, and stay on marked walkways.
- When in an area with arc welding in progress, do not look at the arc or its reflection.
- If you encounter exposure to a welding arc, correct the situation with the welder, Supervisor, or Safety Officer.
- Shut down ducts or air handling equipment that might carry sparks from the work area.

FIRE EQUIPMENT

- Do not cut or weld in buildings when the sprinkler system is impaired.
- Maintain suitable fire extinguishing equipment when welding and cutting is performed.
- A fire watch is required if hot work is performed where combustible materials are closer than 10 m to the point of operation or if wall or floor openings within 10 m expose combustible materials in adjacent areas, or if people are in these adjacent areas.
- A 30 minute fire watch is required upon completion of the work.

QUALIFICATIONS

- Hot work operators must be properly instructed by their Supervisor to operate welding, brazing, grinding, and/or cutting equipment at ALMA.
- Fire watch is a person trained in the use of the available fire extinguishers and familiar with:
 - Inherent hazards of the work site and of the hot work operation.
 - The two closest exit routes from the building.
 - Use of the building fire alarm system (closest pull station).
 - Emergency procedures in the event of fire.



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- The Supervisor or designee must be knowledgeable in welding, brazing, cutting, and grinding, and be able to apply the Hot Work Permit to ensure that the proposed work area is safe for hot work. The designee cannot be the worker performing the hot work.
- Supervisors of the work must ensure that the individuals planned to conduct the hot work are fully trained and familiar with the safety requirements of this policy.

HOT WORK PERMIT

- When hot work is to be performed, a Hot Work Permit is required and must be posted in a conspicuous place near the work.
- All work activities that use welding, hot cutting, brazing and as well as spark-producing grinding and cutting operations are restricted and require written authorization by means of the Hot Work Permit, unless performed in an area established as a weld shop.
- The permit is valid for a specific duration, not exceeding 5 consecutive days.
- By issuing the permit, the Supervisor indicates that specific actions have been taken to render a specific area fire safe.
- If the permit conditions cannot be met, do not allow hot work to be performed.
- The Supervisor must re-inspect the work area every day and initial the posted permit for it to remain valid.

OXYGEN-FUEL GAS WELDING AND CUTTING

- Only personnel who are qualified and have been properly instructed by their Supervisor may operate oxygen-fuel gas welding equipment.
- Store oxygen cylinders at least 6 m from fuel-gas cylinders and combustible material. An alternative is to separate oxygen cylinders from the hazards by a non-combustible barrier at least 1.5 m high having a fire resistance rating of at least one-half hour.
- Secure all gas cylinders properly.
- Prior to use, each oxygen-fuel gas rig must be tagged to indicate that it contains:
 - Backflow protection provided by an approved device which prevents oxygen from flowing into the fuel-gas system or fuel from flowing into the oxygen system.
 - Flash-back protection provided by an approved device that will prevent flame from passing into the fuel-gas system.
 - Back-pressure protection provided by an approved pressure-relief device set at a pressure not greater than the pressure rating of the backflow or the flash-back protection device, whichever is lower. The pressure-relief device must be integrated into one common device performing all three functions.
- Do not permit oil or grease to come into contact with oxygen cylinders, valves, or fittings.
- Gauges on oxygen regulators must be marked "USE NO OIL".

ARC WELDING AND CUTTING

- Only properly qualified personnel who are instructed by their Supervisor may operate arc welding equipment.
- Welders shall use only arc welding equipment which meets standards set by a recognized authority such as ANSI or Underwriters Laboratories.
- Do not exceed voltage limits specified by the equipment manufacturer.
- Protect personnel from accidental electrical contact with welding lead terminals by such means as recessed openings, heavy insulating sleeving, and mechanical protection.



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- Ensure all foot switches have guards to prevent accidental operation.
- Ensure that the secondary and casing of all portable welding transformers are grounded by conductors capable of carrying the full welding current.
- Dry and test machines which become wet for electrical faults before reuse.

RESISTANCE WELDING

- Only qualified persons may operate resistance welding equipment.
- Only a qualified electrician may install resistance welding equipment. A correct installation includes a safety-type disconnect switch or circuit breaker which is conveniently close to the machine to shut off each power circuit for servicing.
- Keep doors and access panels of resistance welding machines and control panels locked and interlocked to prevent unauthorized persons from contact with electrical power.
- Ensure that the secondary and casing of all portable welding transformers are grounded.

GROUNDING OF WELDING EQUIPMENT

- Welding machines used at ALMA shall be the "isolated output" type (i.e. no direct galvanic connection between the AC power ground and the output terminals).
- All welding machines shall be checked annually to ensure a minimum isolation of 100K ohms exists between the "Work Piece Return" terminal and the frame of the welding machine or the AC power ground lead - measured at 500 volts DC;
- If testing is successful, that a sticker bearing the test results, date of test, and signature of person performing the test be prominently affixed to the welding machine.
- Check the AC ground wiring visually and electrically to insure it is correctly bonded (resistance < 0.3 ohm) from the welding machine frame to the ground pin of the AC power plug.
- If testing is unsuccessful, tag the machine out-of-service until it can be reworked to meet the isolation and ground-bonding requirements or discarded.
- All permanent and semi-permanent welding tables and stand-alone welding fixtures are to be bonded to Building Steel using #6AWG copper wire, or larger. This wire should be bare or color-coded green and attached to the work table and Building Ground by solid mechanical means. The Work Piece Return cable from the welding machine shall be attached only to the work table or work piece.
- When welding at temporary locations or in the field, attach the Work Piece Return lead to the work piece, work piece fixture, or conductive frame as close as practical to the point of actual welding. Portable welding stands (e.g. for pipe, etc.) attached to the Work Piece Return are to be jumpered between Building Ground and the point of Work Piece Return attachment.



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Hot Work Permit

Instructions: This form is to be provided to the Safety Office before starting the job and be returned after its completion.

Describe work to be performed: _____	Building: _____ Area _____	Start Date: _____ Expiration Date: _____ (valid for no more than 5 days from date of issue)
---	-------------------------------	---

Authorization (PAI Signature/Initials)	First Day	Day 2	Day 3	Day 4	Day 5
Final Check on work area made after completion of hot work	Signature	Initials	Initials	Initials	Initials

The permission granted by this permit is good for one day pending a daily re-inspection by the PAI.

Item	Yes	No
Is equipment to be used in good operating condition?	<input type="checkbox"/>	<input type="checkbox"/>
All flammable, combustible materials moved or removed (10m)?	<input type="checkbox"/>	<input type="checkbox"/>
Are all remaining combustibles wet down or sanded or otherwise shielded?	<input type="checkbox"/>	<input type="checkbox"/>
Are all wall and floor openings covered?	<input type="checkbox"/>	<input type="checkbox"/>
Have other potentially affected persons been notified?	<input type="checkbox"/>	<input type="checkbox"/>
Do workers have proper Personal Protective Equipment available?	<input type="checkbox"/>	<input type="checkbox"/>
Does the area have adequate ventilation?	<input type="checkbox"/>	<input type="checkbox"/>
Is the work on enclosed equipment?	<input type="checkbox"/>	<input type="checkbox"/>
Special precautions taken on enclosed equipment: _____		
Have potentially affected hazardous processes (cryogenics, electrical, gases) been controlled?	<input type="checkbox"/>	<input type="checkbox"/>
Identify hazardous processes and the controls used: _____		
Fire Safety		
Is the sprinkler system operational?	<input type="checkbox"/>	<input type="checkbox"/>
Do smoke alarms/sprinklers have to be disabled to prevent false alarms?	<input type="checkbox"/>	<input type="checkbox"/>
If yes, coordinate with Facilities before authorizing work		
Are fire extinguishers nearby?	<input type="checkbox"/>	<input type="checkbox"/>
Where are the fire extinguishers?		

What kinds of fire extinguishers are present?		

Do workers know how to initiate a fire alarm?	<input type="checkbox"/>	<input type="checkbox"/>
Where is the nearest fire alarm pull station?		

Is a fire watch required?	<input type="checkbox"/>	<input type="checkbox"/>
Why is the fire watch needed? _____		
Is the fire watch personnel trained?	<input type="checkbox"/>	<input type="checkbox"/>

Special conditions, precautions, and comments

Names of Authorized Worker(s)



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Establish permissible areas for hot work.
- Ensure that approved equipment, such as torches, manifolds, and regulators, are used during hot work.
- Ensure that personnel are appropriately trained and aware of the hazards and mitigations associated with hot work.
- Ensure that the welding equipment is inspected annually.
- Recognize and address the effect of operations on other nearby activities.
- Coordinate hot work activities with the Safety Officer and Facilities.
- Ensure that contractors are advised on the hazards regarding flammables, combustibles, and hazardous conditions that may be encountered during hot work.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Maintain records of all elements of the hot work program.
- Inform staff of these requirements to ensure conformance.
- Coordinate the hot work activities with the Fire brigade.

INDIVIDUALS

Every ALMA employee, visitor and contractor carrying out “Hot Work” must:

- Receive training before any involvement in hot work.
- Not operate welding, cutting, or brazing equipment without specific authorization.
- Follow all guidance of any authorizing Hot Work Permit.
- If serving as a Fire Watch, remain present and undistracted during hot work operations.
- Be alert for any condition that could lead to a fire, including possible problems in adjacent areas.
- Guard passersby from welding hazards.
- Interrupt the work when a hazardous condition develops, and deal with the situation appropriately.
- Remain on the scene after completion of hot work in order to detect, extinguish or report a fire resulting from stored heat.



6 - Hazardous Materials

6-2 Compressed Gas Safety

- 1) **Purpose** - These guidelines provide information on the safe usage of compressed and liquefied gases and protect employees from potential hazards associated with gas and cylinder usage.
- 2) **Scope** - These guidelines apply to all ALMA employees who use or otherwise handle compressed or liquefied gases, or systems that use compressed or liquefied gases. References include:
 - ISO 11120:1999 – Gas cylinders, Refillable seamless steel tubes for compressed gas transport, of water capacity between 150 l and 3000 l
 - ISO 11755:2005 – Gas cylinders, Cylinder bundles for compressed and liquefied gases (excluding acetylene)

3) Rules / Requirements

INSPECTION

- Cylinders must be hydrostatically retested every five or ten years. The Safety Office will check that the cylinder was last tested within the required time.
- The date of each test must be stamped on the cylinder.
- Acetylene cylinders are not tested hydrostatically. Instead, they receive careful visual inspections.
- Inspect all incoming cylinders before storing to ensure they are undamaged and properly labeled.
- Check that the cylinder labels are intact and match other identifying markings on the cylinder. Do not rely on cylinder color to identify the gas.
- Inspect the cylinder valve by looking through the ports in the valve cap. Do not accept rusted or otherwise damaged valves and fixtures.
- Inspect hoses and manifolds frequently, and replace worn hoses and connections.
- Ensure that equipment is compatible with cylinder pressure and contents.
- Check all cylinder-to-equipment connections before and during use, to be sure they are tight, clean, in good condition and not leaking.

HOUSEKEEPING

- Never hang clothes or equipment on a compressed gas cylinder.
- Never use oxygen or compressed air to remove dust from clothing or equipment.
- Promptly remove combustible wastes including wood, paper or rags, from the work area.

Properly and promptly dispose of "empty" or unlabelled cylinders.

OPERATION

- Remove the valve cap only after the cylinder has been safely installed.
- Before installing a regulator on a compressed gas cylinder, vacuum the valve port clean or crack the valve gently to expel any foreign material. Do not perform this task if the gas in the cylinder is toxic, reactive, or flammable.



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- Open valves on all cylinders slowly. Rapid opening of valves results in rapid compression of the gas in the high-pressure passages leading to the seats.
- Stand clear of pressure regulator gauge faces when opening the cylinder valves.
- Keep removable keys or handles from valve spindles or stems in place while the cylinders are in service so the valve can be closed quickly in an emergency.
- Use only recommended keys or handwheels to open valves. Do not use pipe wrenches or similar tools on handwheels.
- Never use homemade adaptors or force connections between the cylinder valve outlet and gas handling equipment.
- In general, do not lubricate any cylinder valves, fittings, or regulator threads, or apply jointing compounds and tape. Use only compounds recommended by the gas supplier.
- When closing, turn the valve just enough to stop the gas flow. Never force the valve shut.
- Never use oxygen to purge pipelines or to provide ventilation.

HANDLING PRECAUTIONS

- Ground combustible gas cylinders (e.g., water pipe) to prevent static electricity buildup.
- Keep the protective cap that comes with a cylinder of gas on the cylinder when not in use or connected to a regulator or manifold.
- Secure the ends of the hose with a hose restraint to prevent whipping in case the hose or fitting fails. In occupied areas, support and secure the tubing at least every 2 m.
- Do not use open flame to leak-check a gas cylinder; use soap or leak-detection solution.
- Do not drop gas cylinders or allow to strike each other or other objects.
- Do not strike an electric arc on a cylinder. Arc burns can make the metal brittle and weaken the cylinder.
- Never tamper with cylinders. Do not repaint them, change markings or identification, or interfere with valve threads or safety devices.
- Do not handle oxygen cylinders with greasy, oily hands or gloves. The reaction between oxygen and hydrocarbons can be violent, even when small quantities are involved.
- Never use a gas cylinder as a roller for moving materials or for supporting other items.
- Cylinders not needed for current use should not be stored in buildings.
- All equipment used with compressed gases must be clean, properly designed and maintained, and made from materials compatible with the gas used.

STORAGE

- **Gas cylinders shall at all times be properly secured** with straps, bars, or chains connected to a wall bracket or other fixed surface, or by use of a cylinder stand.
- Recommended maximum retention periods for gases are 36 months for liquefied flammable gases, flammable gases, and oxygen.
- Always restrain cylinders in an upright position to a solid structure wherever they are stored, handled or used.
- Make sure the chain is high enough on the cylinder to keep it from tipping over.
- Avoid overcrowding in storage areas or storing cylinders in out-of-the-way locations.
- Avoid elevators, staircases or main traffic routes where cylinders may be dangerous obstacles
- Store cylinders upright on solid, dry, level footings.



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- Ensure that containers stored or used in public areas are protected against tampering and damage.
- Use a storage basket for smaller cylinders (<5 L).
- Nitrogen gas or liquid must be stored in a well ventilated area where a massive leak cannot decrease the oxygen below 18% in the atmosphere. Storage of nitrogen inside a laboratory or inside a non ventilated area is forbidden except when oxygen detector and alarms are installed.

COMPATIBILITY

- Cylinders shall be separated by compatibility of contents.
- Keep oxidizers separate from combustibles or flammables by a minimum distance of 6.5m or by a non-combustible barrier at least 2m high with a fire-resistance rating of at least one-half hour.
- Keep away from electrical circuits and ignition sources such as sparks, flames or hot surfaces
- Keep away from heat and sun, including steam or hot water pipes to prevent excessive pressure buildup.
- Do not subject cylinders to freezing temperatures, unless they are designed for this.
- Store full cylinders separately from empty cylinders and allow only trained, authorized people into storage areas.
- Do not stockpile gas, especially flammables, poisons, or corrosives, beyond the amount required for immediate use.

POSTING AND HAZARD IDENTIFICATION

- Label cylinders with suitable warning signs
- Use stencils, shoulder labels, cautionary side-wall labels, or tags to identify the contents of all gas cylinders.
- Mark the hazard classification or the name of the gases being stored in container storage areas.
- Post "NO SMOKING" signs where appropriate.
- Mark partial cylinders with the remaining product pressure.

GASES CYLINDERS' COLOR CODE

- Helium cylinders have a brown shoulder.
- Nitrogen cylinders have a black shoulder.
- Oxygen cylinders have a white shoulder.
- Acetylene cylinders are maroon.
- Argon cylinders have a dark green shoulder.
- Carbon dioxide cylinders have a grey shoulder.
- Chlorine cylinders have a yellow shoulder.
- Hydrogen cylinders have a red shoulder.
- Nitrous oxide cylinders have a blue shoulder.

TRANSPORT / MOVING

- All transport devices should have a chain, belt, or some way of securing cylinders to prevent them from falling.
- Never move a cylinder while a regulator is attached. Regulators should be removed and valve protections caps should be secured in place before moving cylinders.
- Avoid pulling cylinders by their valve caps,.



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- Close cylinder valves before moving cylinders.
- Do not move cylinders by carrying, rolling, sliding, or dragging them across the floor.
- Do not transport oxygen and combustible gases at the same time unless they are properly secured in a hand truck and capped and/or if they are properly secured to side rails in an approved transport vehicle.
- Ensure that gas cylinders are transported so that they do not tip, fall or roll.
- Secure cylinders in suitable cradles or skid boxes before raising them with cranes, fork trucks, or hoists.
- Do not use magnets, chains, or wire slings alone to lift gas cylinders.
- Never lift a cylinder by the valve protection cylinder cap.
- Lifting a standard cylinder, or any larger cylinder, requires two people.
- Cylinders are to be transported in a standing secure position.

REFILLING

- Do not transfer or mix gases in commercial gas cylinders, or transfer gases from one DOT cylinder to another.
- Do not use vendor-owned cylinders for purposes other than as a source of gas. These cylinders may only be pressurized by the owner.

CYLINDER NOT IN USE

- When a cylinder is not being used, close the valve and secure the valve protector in place.
- Never leave pressure on a hose or line not in use. Close the cylinder valve before removing the gas discharge equipment and vent the pressure from the entire system.

EMPTY CYLINDERS

- Properly label and dispose of empty cylinders.
- Use a cylinder status tag to indicate whether the cylinder is "FULL," "IN SERVICE," or if it has "RESIDUE." This tag is to be installed and must remain on the cylinder. Clearly label the cylinder "empty" or "MT."
- Place the "empty" cylinder in a storage area separate from that used for full cylinders.
- Keep incompatible materials away from the "empty" cylinder.
- When a cylinder is empty (not less than 25 psi residual pressure), close the valve, remove the regulators (purging it if necessary to safely remove toxic or corrosive gases), replace the protective cylinder cap, and label the tank "EMPTY."
- When a compressed gas cylinder is "empty," handle it as though it is full since it does contain gas.

EMPTY LIQUEFIED GASES

- Pressure in liquefied gas cylinders is constant at a given temperature as long as any liquid remains in the cylinder. The only way to know how much material remains in a liquefied gas cylinder is to weigh the cylinder. The empty (tare) weight of the cylinder is stamped on its neck or valve stem.
- Record the net weight of the cylinder contents on a card attached to it.
- As with non-liquefied and dissolved gases, never empty the cylinder completely. Keep a small amount of material in the cylinder to maintain a slight positive pressure.

4) Responsibilities



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MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that personnel involved are appropriately trained and aware of the hazards and mitigations associated with compressed gases.
- Ensure cylinders are hydrostatically retested as needed.
- Inspect all incoming cylinders before storing to ensure they are undamaged and properly labeled.
- Inspect storage facilities periodically and report any deficiencies to the Safety Office.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Maintain records of all inspections.
- Inform staff of these requirements to ensure conformance.

INDIVIDUALS

Every ALMA employee, visitor and contractor involved in the use of compressed gas must:

- Receive training before any use of compressed gas.
- Carefully check all cylinder-to-equipment connections before and during use.
- Ensure housekeeping is done in areas where compressed gas cylinders are maintained.
- Ensure compressed gases are appropriately stored and compatibilities are monitored.
- Ensure the cylinders are appropriately labeled with content information.
- Follow the requirements for safe transport of cylinders.



6 - Hazardous Materials

6-3 Nitrogen Liquefied and Gas Safety

1) **Purpose** - These guidelines provide information on the safe usage of liquefied/gases nitrogen to protect employees from potential hazards associated with nitrogen usage.

2) **Scope** - These guidelines apply to all employees working on the ALMA sites who use or otherwise handle liquefied/gases nitrogen, or systems that use liquefied/gases nitrogen. References include:

- ISO 11120:1999 – Gas cylinders, Refillable seamless steel tubes for compressed gas transport, of water capacity between 150 l and 3000 l
- ISO 11755:2005 – Gas cylinders, Cylinder bundles for compressed and liquefied gases (excluding acetylene)

3) Rules / Requirements

LIQUID NITROGEN PROPERTIES:

- Liquid Nitrogen has a boiling point of 77.3K (-195.8°C)
- Volume of expansion liquid to gas (at 15°C, 1 atm.) = 682.1
- Sg = 0.808 (77.3K).
- Density of liquid (normal boiling point, 1 atm.) = 0.807 g/cc
- Colorless, Odorless liquid similar in appearance similar to water.

KNOWN OR EXPECTED HAZARDS

a) Temperature Related

- The **extremely low temperature** of the liquid can cause severe burn-like damage to the skin either by contact with the fluid, surfaces cooled by the fluid or evolving gases. The hazard level is comparable to that of handling boiling water.
- The low temperature of the vapor can cause damage to softer tissues *e.g.* eyes and lungs but may not affect the skin during short exposure.
- Skin can freeze and adhere to liquid nitrogen cooled surfaces causing tearing on removal.
- Soft materials *e.g.* rubber and plastics become brittle when cooled by liquid nitrogen and may shatter unexpectedly.
- **Liquid oxygen** may condense out of ambient air in containers of liquid nitrogen or vessels cooled by liquid nitrogen. This can be extremely hazardous because of the pressure rise on the slightest degree of warming above the boiling point of oxygen (- 183°C) and the possibility of **explosive reaction** with oxidisable material.
- Thermal stress damage can be caused to containers because of large, rapid changes of temperature.

b) Vapor Related

- Large volumes of nitrogen gas are evolved from small volumes of liquid nitrogen (1 liter of liquid giving 0.7 m³ of vapor) and this can easily replace normal air in poorly ventilated areas leading to the danger of asphyxiation. It should be noted that oxygen normally constitutes 21% of air. Atmospheres containing less than 10% oxygen can



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result in brain damage and death (the gasping reflex is triggered by excess carbon dioxide and not by shortage of oxygen), levels of 18% or less are dangerous and entry into regions with levels less than 20% is not recommended.

- Oxygen condensed into leaking containers can explode on heating following resealing or blockage with ice.

RISKS

- For an untrained person, the risk of injury is moderate with cryogenic burns the most likely injury. However, in exceptional circumstances when large amounts of material are spilled in an enclosed space, asphyxiation may be fatal.

WHO IS LIKELY TO BE INJURED?

- The most likely injury is to the person using the material although following major spillage all inhabitants of a room may be affected.

PRECAUTIONS

Operation

- Liquid nitrogen should only be used in a well-ventilated areas. This is especially true when filling a warm container or transfer tube or inserting a warm object, as large volumes of nitrogen gas are evolved. The safe volume of liquid nitrogen stored or used in any enclosed space is described later.
- The dispensing of liquid nitrogen from the supply tank may be carried out only by those trained to do so.
- Only containers or fittings (pipes, tongs etc.) that have been designed specifically for use with cryogenic liquids may be used as non-specialized equipment may crack or fail. In particular, food type vacuum flasks must not be used as they can implode resulting in flying glass fragments.
- All glass Dewars must be protected against the possibility of flying glass fragments, arising from failure by mechanical or temperature stress damage, by sealing all exposed glass either in an insulated metal can or by wrapping with adhesive tape.
- Warm dewars should be filled slowly to reduce temperature shock effects and to minimize splashing. Storage dewars should not be over-pressured when filling a globular dewar. The minimum pressure required to maintain a flow of liquid should be used.
- Containers of liquid nitrogen must be suitably vented and unlikely to block due to ice formation.
- Care must be taken to avoid the formation of liquid oxygen in cold-traps that are open to air or the increase of liquid oxygen content in a flask of liquid nitrogen that has been cold for a long period. (Liquid oxygen has a blue water-like appearance). Solid carbon dioxide (dry ice) should be considered as an alternative coolant in situations where liquid oxygen could accumulate. However, most liquid nitrogen containers are closed except for a small neck area and the nitrogen vapor issuing from the surface forms a barrier which keeps air away from the liquid thus preventing oxygen contamination.
- Skin contact with either liquid nitrogen or items cooled by liquid nitrogen should be avoided as serious burns may occur. Care must be taken with gloves, wrist-bands or bracelets which may trap liquid nitrogen close to the skin.
- Personal Protective Equipment, especially safety glasses, must be worn to protect against splashes, freezing vapor, failure of glass apparatus or brittle failure of items cooled by liquid nitrogen.



Personal Protective Equipment

The following equipment should be worn when handling or dispensing liquid nitrogen:

- Face shield or safety glasses.
- Dry insulated gloves when handling equipment that has been in contact with the liquid. Nota Bene there is dispute over the advisability of wearing gloves while handling liquid nitrogen because there is a possibility that gloves could fill with liquid and therefore prolong hand contact which would make burns more severe. If gloves are worn they should be loose fitting and easily removed.
- Lab coat or overalls are advisable to minimize skin contact and also trousers over shoe/boot tops to prevent shoes filling in the event of a spillage.

Storage - Avoidance of Oxygen Depletion/ Asphyxiation

- **Liquid nitrogen may only be used only in a well-ventilated area.** However, there may be occasions e.g. transport of Dewars in lifts, when this may not be possible. To avoid the danger of oxygen depletion, the following should be noted:
 - **Safe limit in an unventilated space:** Calculate the room volume in m^3 and the max volume of nitrogen in m^3 (this can be found from the volume of liquid in liters x0.7). If the volume of nitrogen amounts to >0.15 of the room volume, special precautions or ventilation are required.
 - **Spillage during filling:** during filling assume that 10% of the final volume may be spilled.
 - **Loss during storage:** the boil off loss from a 5l Dewar is expected to be 0.2l per day.
 - **It is mandatory** to use of **oxygen meters** and associated **alarm** inside such areas.

Transport:

- **Transport of liquid nitrogen in lifts.** To avoid in possible risks from nitrogen boil off during, for example, a prolonged period of lift breakdown, dewars of liquid nitrogen **must not be accompanied in lifts**. Rather, two people should be used to transport the dewars, one to load and one to receive at the destination floor. To prevent others from entering the lift, the fitted straps should be pulled across the entrance.
- **Liquid nitrogen must** be transported by a qualified transporter inside the appropriate truck with a separated driver cabin.- Labels and easily understandable symbols must be posted, based on the classification criteria and must be visible on the vehicle. Safety Data Sheets must be in possession of the driver.
- No hazardous materials may be **transported** in any vehicle for which the primary design and purpose is for the transportation of personnel.

Training

- New users of liquid nitrogen should receive instruction in its use from experienced members of the technical staff. Formal training is required before use of the product.

LEVEL OF RISK REMAINING

- There remains a significant risk in using liquid nitrogen from the inadvertent condensation of oxygen into a closed system. It is recommended that whenever possible some other coolant is used e.g. solid carbon dioxide/liquid traps or baths - the preferred liquids for such baths are isopropanol or glycols. It is recommended that such baths be used in preference to liquid nitrogen when long term storage is envisaged.



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5) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that personnel involved are appropriately trained and aware of the hazards and mitigations associated with nitrogen use.
- Ensure cylinders are hydrostatically retested as needed.
- Ensure that dewars are located in well ventilated areas.
- Inspect all incoming cylinders and dewars before storing to ensure they are undamaged and properly labeled.
- Inspect storage facilities periodically and report any deficiencies to the Safety Office.
- Ensure the staff uses PPE as required.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Maintain records of all inspections.
- Inform staff of these requirements to ensure conformance.

INDIVIDUALS

Every ALMA employee, visitor and contractor involved in the use of liquefied/gas nitrogen must:

- Receive training before any use.
- Use only in a well-ventilated area or meeting all safety requirements (Oxygen level monitoring and alarm system)
- Ensure housekeeping is done in areas where nitrogen is maintained.
- Ensure the cylinders and dewars are appropriately labeled with content information.
- Follow the requirements for safe transport.
- Use the adapted protective equipment



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6 - Hazardous Materials

6-4 Chemicals

1) Purpose - These guidelines provide information on the safe usage of chemicals to protect employees from potential hazards associated with usage.

2) Scope - These guidelines apply to all employees working on the ALMA sites who use or otherwise handle chemicals, or systems that use chemicals.

3) Rules / Requirements

- Purchases of Hazardous Material (HazMat) never used before at ALMA must have the prior approval of the Safety Office.
- The Material Safety Data Sheet (MSDS) must be delivered with the product.
- Hazardous substances must be clearly labeled and always stored in the correct containers.
- Safety Data Sheets must be maintained where it can be easily consulted.
- Non-ALMA personnel bringing hazardous substances into ALMA Sites must declare, via the ALMA contact person, the type (identification) and quantity of those substances.
- When not in use, containers for hazardous substances shall be kept closed and in a safe manner, separated by classes, keeping incompatible materials separated. Secondary containment must be used with bulk chemicals.
- The amount of hazardous materials, either in workplace or in storage areas, shall be kept to a minimum, consistent to the work schedule.
- At least annually, the person responsible for the area where the hazardous substances are stored must carry out an inventory. Chemicals with expired shelf lives and deteriorated or leaking containers should be disposed of safely.
- Adequate PPE should be used when handling chemicals. PPE must afford adequate protection against the risk from those hazardous chemicals to which the wearer is exposed, throughout the period during which such equipment is necessary, having regard to the type of work.
- Further information is given in the Hazardous Substances Safety Rule – Doc. N. °

CHEMICALS PROPERTIES:

Search for a card into the International Chemical Safety Cards (ICSC) in the link below:

http://www.ilo.org/safework/info/publications/WCMS_113134/lang--en/index.htm

Type in the textbox any part of a chemical's **name**, or its complete four-digit **ICSC number** in the format **nnnn**, or its **CAS number** in the format **CAS nnnn-nn-n** (with correct hyphenation) and click on the **Search** button to find it. The card(s) matching your selection criterion will be listed on the subsequent page.

KNOWN OR EXPECTED HAZARDS

a) Chemical Substitution of hazardous agents:



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For the cancerigenic and mutágenos chemical agents the substitution principle is applied still more of strict form since it stops being a priority in the set of preventive actions to become a legal imperative "whenever it is technically possible" on the prevention of risks derived from cancerigenic and mutágenos agents in the work.

b) Chemical Hazard Classifications:

- **Health Hazards** are those that can affect the immediate or long term health of an employee if exposed to a specific chemical. Acute effects of exposure are those that present symptoms when exposure occurs, such as when skin is exposed to an acid. Delayed or long term health effects can also occur from chemical exposure, such as cancer. Health effects for any given chemical will depend on the toxicity, duration of exposure and amount of exposure.
- **Fire Hazard** ratings range from non-flammable to highly flammable. The NFPA ratings are based on the material flashpoint and the temperature at which the chemical vapors will ignite.
Naked flames, flammable gases and liquids, and volatile liquids should not be used in an oxygen-enriched atmosphere at high altitude like inside AOS/TB.
See Section 3.3 - Flammable and Combustible Liquids
- **Reactivity** ratings describe the hazards of the material stability - some chemicals will explode or react violently if exposed to heat or shock
- **Other Hazards** - special markings are required if the material is radioactive, an oxidizer, acid or base or will react when exposed to other materials.

PRECAUTIONS

Hazard Controls include:

- Labeling of all chemicals
- Proper chemical storage containers & areas
- Segregation of incompatible chemicals
- Personal Protective Equipment
- Use of chemicals by training and authorized employees
- Use of minimum amount necessary
- Bonding & Grounding of flammable liquid containers

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The selection of the proper chemical-resistant glove begins with an evaluation of the job application. Factors that influence this selection are:

- the type of chemicals to be handled (or used)
- frequency and duration of chemical contact
- nature of contact (total immersion or splash only)
- concentration of chemicals
- temperature of chemicals
- abrasion/resistance requirements
- puncture-, snag-, tear-, and cut-resistance requirements
- length to be protected (hand only, forearm, arm)
- dexterity requirements
- grip requirements (dry grip, wet grip, oily)
- cuff edge (safety cuff, knit wrist, or gauntlet)
- color requirements (to show contamination)
- thermal protection (for example, when handling anhydrous ammonia)



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- size and comfort requirements

STORAGE

Containment of hazardous materials is required for the protection of the environment from contamination as well as for the protection of employees who work in areas where hazardous materials are stored and used.

Do you have damaged or leaking drums of liquid waste materials?

- Packages of hazardous materials that are damaged or found leaking and hazardous materials that have been spilled or leaked may be placed in a metal removable head salvage drum that is compatible with the lading and shipped for repackaging or disposal.

Do you have secondary containment to protect against leakage of hazardous liquid waste?

- Container storage areas must have a containment system that is designed and operated in order to have sufficient capacity to contain 10% of the volume of containers or the volume of the largest container, whichever is greater. Containers that do not contain free liquids need not be considered in this determination.

Do you have approved safety containers for the safe use and temporary storage of flammable liquids?

- Safety can means an approved container, of not more than 20 liters capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

Do you have adequate means of electrically bonding your containers during filling operations?

- "Class I liquids shall not be run into containers unless the nozzle and containers are electrically interconnected. The provisions of this section shall be deemed to have been complied with where the metallic floor plates on which the container stands while filling are electrically connected to the fill stem or where the fill stem is bonded to the container during filling by means.

TRANSPORT:

- **Chemicals must** be transported by a qualified transporter inside the appropriate truck with a separated driver cabin.- Labels and easily understandable symbols must be posted, based on the classification criteria and must be visible on the vehicle. Safety Data Sheets must be in possession of the driver.
- No hazardous materials may be **transported** in any vehicle for which the primary design and purpose is for the transportation of personnel.

TRAINING

- New users of chemicals should receive instruction in its use from experienced members of the technical staff. Formal training is required before use of the product.

SPILLS AND LEAKS

- Any unauthorized release shall be removed from the secondary container within the shortest possible time.
- In the event of a spill or leak, the Safety Office must be contacted and a spill report generated indicating the material released, the cleanup used, and the method of repair.



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- Any spills must be reported immediately to ALMA JAO.
- Follow the chemical emergency plan and Section 2.2 Hazardous Waste Management

CLOSURE

- Any tank that is being discontinued from use must be closed.
- The Safety Office must be notified of any intent to close a tank to ensure proper procedures are followed.

4) Responsibilities

MANAGEMENT

Employers that use or store hazardous chemicals must have a program to ensure the information is provided to exposed employees.

Line Managers and Supervisors are responsible to:

- Ensure each new chemical is appropriately permitted for operation.
- Ensure new installations have completed the pre-operational inspections and testing requirements.
- Ensure that personnel are trained and procedures are utilized.
- Ensure any unauthorized release is cleaned within the shortest possible time.
- Inspect storage facilities periodically and report any deficiencies to the Safety Office.
- Ensure the staff uses PPE as required.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Ensure all cabinets are properly labeled and equipped with.
- Ensure an inventory of hazardous materials at Safety Office is kept and regularly updated. Folders with the complete list of hazardous materials, dedicated safety instructions and the complete hazardous Materials Safety Data Sheets (MSDS) have been produced for every room containing hazardous materials.
- Ensure absorbents are present and continuously available.
- Inform staff of these requirements to ensure conformance.

INDIVIDUALS

Every ALMA employee, visitor and contractor involved in chemical handling must:

- Receive training before any use.
- Comply with all safety requirements
- Ensure housekeeping is done in areas where chemical is maintained.
- Ensure chemicals are appropriately labeled with content information (MSDS).
- Follow the requirements for safe transport.
- Use the adapted protective equipment
- Receive training before any involvement in chemical handling.



7- Materials Handling

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7. MATERIALS HANDLING

7-1 Cranes and Hoists

- 1) **Purpose** – This procedure is to establish the requirements for lifting equipment.
- 2) **Scope** - This procedure is valid for all lifting operations including lifts of special or major facility or antenna components as well as routine minimal hazard lift operations. This policy does not cover any personnel lifts or suspended work platforms.

3) Rules / Requirements

DEFINITIONS

- **Personnel Lift** - Any lift involving a platform holding personnel.
- **Complex/Unusual Lift** - Any lift outside the normal parameters of the work or in a location with limited room to work and/or clearances for equipment to operate.
- **Potential High-risk Lift** - Any lift that exceeds 90% of a crane's rated capacity. Due to its location it could pose an unacceptably high risk to personnel or equipment in the area of the operation as determined by the Supervisor of the team assigned the task.
- **Critical Lift** - Any lift that meets the above criteria and/or has two or more cranes working in tandem to accomplish the lift or involves high value equipment, components or facilities. Loss of the lift would greatly impact the work schedule if material was damaged or destroyed.

TRAINING

- Staff needs to get a general fork lift truck driver/ crane operator training and must receive a certificate from a notified body which demonstrates that the operator is properly instructed.
- Operating gantry cranes and diesel fork lift trucks require a certificate from a notified body which demonstrates that the operator is properly instructed.
- "Small manually operated" lifting devices do not require a certificate from a notified body as well as manually operated fork lifts.
- Staff needs to pass a vision test.
- To finally be able to use a specific truck/ crane there need to be a safety briefing at the site for the specific truck/ crane the operator will use with an instruction in which area the operator is allowed to use the truck/ crane and how to proper behave at the site. This has to be documented.

CRITICAL LIFTS

- A Lift Plan is required for all critical lifts at least 24 hours prior to the planned lift.
- The Plan must be prepared by a certified person, with the Safety Office and the responsible group.
- The Lift Plan must be documented and include specific written procedures.
- The approved Plan must be onsite prior to the actual lift.



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- During critical lifts, a designated individual with safety responsibility must be present to monitor the lift operations.
- If rented equipment is used, a copy of the certification inspection must be attached to the Lift Plan.
- Cranes used frequently for critical lifts must be load tested annually.
- Cranes used infrequently for critical lifts must be load tested prior to the actual lift if more than a year since the last load test.
- All rigging equipment used in critical lifts must be proof load tested annually.
- Each lifting tool should have a label affixed with the following information:
 - Parts Name/Parts No.
 - Rated Load
 - Proof Load
 - Date of Proof Load Test
- If the lifting tool has multiple pieces of similar shape, clearly identify each piece to prevent erroneous assembly configuration.
- Each piece of a lifting tool must be plated, painted or coated to assure corrosion-proof treatment.

INSPECTIONS

- The group responsible for the lift must designate a competent person (someone able to identify hazards in the working conditions, and who has authorization to take prompt corrective measures) to inspect all lift machinery and equipment prior to and during use, to ensure safe operating condition.
- Any deficiencies shall be repaired, or defective parts replaced, before continued use.
- Maintain a record of the inspections for each hoisting machine and piece of equipment.
- Prepare a certification record which includes the crane inspection date; the signature of the inspector; a serial number, or other identifier, for the crane inspected.
- Maintain the most recent certification record on file until a new one is prepared.
- Frequent inspections - daily prior to use:
 - Components with a direct bearing on the safety of the crane and whose status can change daily with use.
 - The Supervisor and the operator shall conduct a walk around inspection, with attention to mechanical system leaks or damage (oil, hydraulic, air) and structural deficiencies.
 - Complete the Mobile Crane Inspection Checklist each shift the crane is used.
- The group responsible for crane maintenance must conduct periodic inspections of cranes/hoists - 12 month intervals:
 - Periodic inspections include the items for daily inspections.
 - Inspect the entire crane for structural damage, distortion or cracks in main frame, outrigger assemblies, and structural attachments of the upper works to the carrier.
 - Inspect all welded connections for cracks. Inspect the main chords, lacings and other structural parts which may indicate potential failure, as well as for dents, bends, abrasions, and corrosion. Check hydraulic booms for bending, side sway, or droop.
 - Inspect for worn, cracked, or distorted parts such as: pins, bearings, shafts, gears, rollers, locking devices, hook roller brackets, removable outrigger attachments lugs, and welds.
 - Inspect for excessive wear on brake and clutch system parts, linings, pawls, and ratchets.



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- Inspect all power plants for proper operation.
- Check that the counterweight is secure.
- Check that the identification number is permanently and legibly marked on jibs, blocks, equalizer beams, and all other accessories.
- Check electrical apparatus for signs of any deterioration of controllers.

OPERATIONAL

- Keep all employees clear of loads about to be lifted and of suspended loads.
- No person is allowed to ride on material hoists except for inspection and maintenance.
- Personnel lifts are permitted only when appropriately rated and certified equipment is used.
- Barricade accessible areas in the rotating superstructure swing radius to prevent access.
- Guard all exhaust pipes where contact is possible in the performance of normal duties.
- Where there can be problems with awkward loads, taglines must be used.
- Keep clear of trapping spaces between moving loads and fixed structures or machinery and in constant view of the operator.
- If a load is transported over a distance, tie the load back to the crane to reduce swing or rotation.
- The crane operator must show adequate understanding and proficient use of the load charts as related to the equipment in use and the loads being lifted.
- Standardize crane operator hand signals and post the signals at the job site.
- Load tests shall not be more than 125 percent of the rated load.
- No attachments, modifications or additions which affect the capacity or safe operation of the equipment shall be made without the manufacturer's written approval.
- Where necessary for rigging or service requirements, provide a ladder, or steps, to access the cab roof.
- If the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block, and this marking shall be clearly legible from the ground or floor.
- Crane operations must be stopped when wind speeds reach 15 m/s.

WORK NEAR ELECTRICITY

- Do not use cranes to handle materials or loads stored under electric power lines.
- Designate a person to observe equipment clearance and give warning for operations where it is difficult for the operator to maintain the desired clearance by visual means.
- Cage-type boom guards, insulating links, or proximity warning devices may be used on cranes.
- The power company or owner of the power line should de-energize the lines.
- The lines must be visibly grounded and appropriately marked at jobsite.
- Have a qualified representative of the power company or owner of the electrical power line verify the power lines have been de-energized or properly grounded.
- Install warning signs at the operator's station and on the outside of the crane to identify clearance requirements between the crane and electrical power lines.

OVERHEAD HOISTS

- Do not exceed the manufacturer's safe working load of the overhead hoist.
- Indicate the safe working load on the hoist.



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- Ensure the supporting structure to which the hoist is attached has a safe working load equal to that of the hoist.
- Arrange the support so as to provide for free movement of the hoist and not restrict the hoist from lining itself up with the load.
- Each hoist must have a limit device to stop the travel of the hook/load block before it passes the highest and/or lowest point of safe travel.
- Ensure that the area around a hoist operation is adequately protected from access by unauthorized persons.

4) Responsibilities

CRANE/HOIST OPERATORS AND SPOTTERS

Crane/Hoist Operators and Spotters are responsible to:

- Do not engage in any practice that will divert attention while operating the crane.
- Conduct an inspection of the crane/hoist and rigging equipment before operations begin.
- If not satisfied with the condition of the lifting equipment, do not operate it.
- When physically or otherwise unfit, do not engage in the operation of the crane.
- Ensure the load is secured, balanced, and positioned in the hook, slings, or lifting device.
- Notify the Supervisor of any unsafe situations or equipment.
- Use hand signals, radio or whatever method is deemed appropriate to keep operator and the Supervisor apprised of the status of the load.
- Ensure unauthorized personnel keep clear of the load.
- Only operate a crane or hoist if properly licensed and authorized to do so.
- Crane/Hoist keys must be kept in a safe place. The owner must ensure that the key is given to an authorized driver.

MANAGEMENT

Managers and Supervisors are responsible to:

- Assign the designated signaler(s).
- Arrange and monitor crane/hoist training for employees who need to use cranes/hoists.
- Do not assign tasks that are beyond the operator's ability.
- Be aware of lifts to be performed by your people.
- Ensure equipment is safe to use.
- Oversee the writing of a Lift Plan and documentation as directed by the Safety Office.
- Ensure that only those authorized and licensed to operate the equipment do so.
- Use the Mobile Crane Setup Checklist to assist with setting up and coordinating the operation of the mobile crane or have a Lift Plan.
- Check clearances and do not permit any operation near overhead power lines.
- Analyze the operation and instruct all personnel involved in proper positioning and rigging of the load.
- Notify the Safety Office before operating a crane lift of personnel.
- Ensure that advance notice of work is given to all parties affected by the work.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Develop, implement, and conduct the Crane/Hoist/Rigging Operator Training Course.



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- Advise and assist in the planning of critical, complex or unusual lifts.
- Advise in the selection of proper material handling accessories such as slings, shackles, pulleys, eyebolts, and any associated hardware used in rigging.
- Ensure equipment ordered and reviewed meets the required standards.
- Perform safety inspections on all cranes/hoists and related equipment.
- Maintain records of all crane/hoist inspections.



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Mobile Crane Setup Checklist

	Ask the operator, ground crew (riggers), and/or Supervisors appropriate questions on load charts, rigging and load weight determinations, and capacities.
	Ensure the load bearing surface is sufficient to handle the weight of the crane and the load. Check crane set up and stability of outriggers on hydraulics and/or the effectiveness of cribbing on crawlers.
	All personnel involved in the operation have appropriate PPE for the task. Note: At a minimum hard hats and safety shoes/boots are required.
	The operator is a certified crane operator.
	No power lines are located within the load radius plus the required clearance.
	Signaler is familiar with standard hand signals for controlling crane operations.
	Weather conditions are acceptable: No thunderstorms, heavy winds or rains are forecast.
	The operator is aware that he/she shall respond only to signals from the appointed signal person. However, the operator shall obey a stop signal at all times, no matter who gives it.
	The load to be lifted is within the rated capacity of the crane in its existing configuration as per the crane manufacturer's published lifting capacity.
	With loads not accurately known are to be lifted, the Supervisor responsible for the lift has ensured the weight of the load does not exceed the crane ratings at the radius at which the lift is planned.
	Operations are conducted in such a manner and speeds as to minimize dynamic effects. (Dynamic effect - loads introduced into the machine or its components due to acceleration or deceleration forces.)
	The load is attached to the hook by means of slings or other devices of sufficient capacity.
	The operator shall not leave the controls while the load is suspended.
	The area under the load is cordoned off to ensure that personnel are not permitted to stand or pass under a suspended load.
	Conduct a post-lift debriefing to evaluate the lift and critique the performance of the lift. Document the debrief and keep copies. If a lift plan was used, note any problems or incidents so the lift plan may be modified as appropriate for the next time it is used.
	If possible, rotate the crane to check all clearances and overall stability.
	Verify that high-voltage warning signs and a rating chart(s) with legible letters and figures are attached to the crane in a location accessible to the operator while at the controls.
	Check the boom angle indicator to ensure it is readable from the operator station.
	Check that all exposed moving parts are guarded.
	Inspect all wire rope (including standing ropes), drums, rigging, hardware, and attachments.
	Remove any hook that is deformed or cracked from service. Hooks with cracks, excessive throat openings of 15%, or hook twists of 10 degrees or more, must be removed from service.
	Check for freedom of rotation of all swivels.
	Visually inspect the boom and jib for straightness and any evidence of physical damage, such as cracking, bending, or any other deformation of the welds.
	Look for corrosion under any attachments that are connected to the chords and lacing. Watch for cracking or flaking of paint that may indicate fatigue of the metal. Do not attempt to straighten members by hammering or heating them and drawing them out.



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	Inspect tires for cuts, tears, breaks, and proper inflation.
	Visually check that the fuel, lubricating oil, coolant and hydraulic oil reservoirs are filled to proper levels.
	Check that the crane is equipped with a fully charged fire extinguisher and that the operator knows how to use it.
	Check operating mechanisms such as: locking mechanisms, hook roller brackets, limit switches, safety devices, hydraulic cylinders, instruments, electric wipers, seat belts, horn and lights.
	Check the turntable connections for weld cracks and loose or missing bolts.
	Check the outriggers to be sure that neither the beams nor the cylinders are distorted or cracked and that both the beams and cylinders extend and retract smoothly and hold the load.
	Inspect and test all brakes and clutches for proper adjustment and operation.
	Inspect boom hoist lockout and other operator aids, such as anti-two-block devices and load moment indicators, for proper operation and calibration.
	While the engine is running, check all gauges and warning lights for proper readings and operate all controls to see that they are functioning properly.
	Check for any broken or cracked glass that may affect the view of the operator.
	Inspect hoist chains, including end connections for excessive wear, twist, distorted links interfering with proper function, or stretched beyond manufacturer's recommendations.
	Sheave grooves shall be smooth and free from surface defects, cracks, or worn places that could cause rope damage.
	Lower load blocks must be equipped with close fitting guards.
	Hooks and blocks must be permanently labeled with rated capacity
	Flexible hoses must be sound, show no signs of blistering or deformation to the outer covering, and no leaks at threaded or clamped joints that cannot be eliminated by normal tightening. No evidence of excessive abrasion or scrubbing on the outer surfaces of hoses, rigid tubing, or hydraulic fittings.



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Lift Plan



Lift Description: _____

Lift Supervisor: _____

Lift Date: _____

Lift Criteria	Notes/Comments
1. What item(s) will be lifted?	
2. Are there any special precautions?	
3. What is the weight of each item and total weight of the load?	
4. Where is the center of gravity located? Note: Center of gravity is the point at which the object will balance. A stable load is one in which the center of gravity of the load is directly below the main hook and below the lowest point of attachment of the slings.	
5. List each piece of equipment, accessory, and rigging component, by type and rated capacity that will be used during the lift.	
a. Crane	
b. Hoist	
c. Fork Truck	
d. Slings (identify the configuration used: choker, basket, or vertical, and angle (see Figure 1 below))	
e. Shackles	
f. Eye Bolts/Swivel Eyes	
g. Turnbuckles	
h. Spreader Bars	
i. Hook (Type and load limit)	
j. Other (Special lifting fixture, below the hook lifting devices, multi leg bridle, etc)	
6. Are there designated checkpoints or hold points?	
7. If yes, list them and their estimated instrument readings, as relevant, to check job progress against the plan.	
8. How will you rig the load?	
9. Will tag lines be needed to control the load?	
10. What personnel will you need to assist with the lift?	
a. Crane operator	
b. Riggers	
c. Spotters	



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d. Tag Line Handlers	
e. Fork truck driver	
f. Other	
11. Safety equipment (hard hats, safety shoes, gloves)	
12. Mobile Crane location	
a. Will crane be set up on concrete? If yes, can concrete support the weight of the crane and the load?	
b. Will crane be set up on asphalt? If yes, will cribbing be needed (for asphalt temp > 32.2° C)?	
c. Will crane be set up on gravel or rough ground? If yes, cribbing will be required.	
13. Are any of the structures listed below located in the area of the crane set up? If yes, indicate their location on the Load Path Sketch.	
a. Manholes	
b. Underground voids	
c. Pipe chases	
d. Overhead obstructions or power lines	
14. Additional information	



7 - Materials Handling

7-2 Rigging

- 1) **Purpose** – This policy establishes the program for ensuring rigging equipment is properly inspected and maintained.
- 2) **Scope** - This Section applies to slings used with material handling equipment for movement of material by hoisting. Slings covered include alloy steel chain, wire rope, metal mesh, natural or synthetic fiber rope, and synthetic web (nylon, polyester, and polypropylene). Rigging refers to hardware used to attach a load to a lift device and the process of attaching a load to a hook using adequately rated and properly applied slings and hardware.

3) Rules / Requirements

SELECTION, USE AND INSPECTION OF SLINGS

- Base sling selection on the size and type of the load, and the environmental conditions.
- Consider the size, weight, shape, temperature, and sensitivity of the material being moved, and the environmental conditions under which the sling will be used.

CHAIN SLINGS

- Alloy steel chains are strong and able to adapt to the shape of the load.
- Care should be taken when using chain slings because sudden shocks will damage them resulting in sling failure and possible injury to workers or damage to the load.
- Chain slings that exhibit any stretching, nicks, gouges, cracked, bent, or elongated links or components, and excess wear must be removed from service.
- Hooks, rings, links, or other attachments, when used with alloy steel chains, shall have a rated capacity at least equal to that of the chain.

WIRE ROPE AND MESH SLINGS (wire rope, metal mesh)

- Wire rope is composed of individual wires that have been twisted to form strands. Strands are then twisted to form a wire rope.
- Wire rope strength is a function of size or diameter of the rope, grade, and construction.
- Fatigue failure of wire rope is caused by development of small cracks during small radius bends. Use blocking or padding to increase the bend radius to prevent fatigue failure.
- The ability of wire rope to withstand abrasion is depends on the size and number of wires used in the rope. Smaller wires bend and offer greater flexibility, but are less able to withstand abrasion. Larger wires are less flexible, but withstand abrasion better.
- Clean wire rope slings periodically to remove abrasive grit and then lubricated.
- Wear leather gloves when working with wire rope is strongly recommended, to help prevent injury to hands from broken wires.
- Wire rope should not have broken or cut strands, bird caging, kinks or signs of wear.



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- Inspect wire rope connections that are corroded, cracked, bent, or improperly connected.
- Each wire rope used in hoisting or lowering, or in pulling loads, shall consist of one continuous piece without knot or splice.
- Do not use wire rope if, in a length of eight diameters, the visible broken wires exceed 10 percent of the total wires, or if the rope shows excessive wear, corrosion, or defect.

FIBER ROPE WEB (natural fiber rope, synthetic fiber rope, synthetic web)

- Fiber rope and synthetic web slings are used primarily for temporary work.
- Fiber rope slings that show excessive wear or elongation, distortion of end fittings, cuts, gouges, worn surface areas, torn stitching, brittle or discolored fibers, melting, or charring must be discarded.
- A buildup of powder-like sawdust on the inside of a fiber rope indicates excessive internal wear and that the sling is unsafe.
- If the rope fibers separate easily when scratched with a fingernail, it indicates that the sling has suffered some kind of chemical damage and should be discarded.
- Synthetic web slings should be stored by hanging on hooks or brackets.
- Never store slings in damp or dirty areas or subjected to corrosive materials, welding light, weather, temperatures exceeding 82° C or UV rays from sunlight unnecessarily.
- Fiber rope slings, except for wet frozen slings, may be used in a temperature range from minus -28.88° C to plus 82.2° C without decreasing the working load limit.
- Clamps not designed specifically for fiber ropes shall not be used for splicing.
- Do not use fiber rope slings where end attachments have sharp edges or projections.
- Do not use web slings where fumes, vapors, or liquids of acids or caustics are present.

RIGGING EQUIPMENT INSPECTION AND MAINTENANCE GUIDANCE

- All loads shall be rigged by a qualified rigger.
- Do not abuse slings by dragging on the ground, through oil, chemicals, or water, running over them, contact with welding or burning slag, or overexposure to UV light.
- Rigging equipment shall not be loaded in excess of its recommended safe working load.
- Rigging equipment, when not in use, shall be removed from the immediate work area so as not to present a hazard to employees.
- Protruding ends of strands in splices on slings and bridles shall be covered or blunted.
- When used for eye splices, the U-bolt shall be applied so that the "U" Section is in contact with the dead end of the rope.
- Slings shall not be shortened with knots or bolts or other makeshift devices.
- Do not use makeshift fasteners, formed from bolts, rods, or other such attachments.
- Eyebolts shall only be used for a straight load. If there are angled loads, use swivel eyes.
- Only rigging equipment in good condition and is not suspect or counterfeit may be used.
- All shackles, turnbuckles, eyebolts, links, rings, metal clamps, and other similar rigging hardware shall be checked periodically for safety.
- All rigging equipment shall be stored and maintained in accordance with manufacturer's recommendations.
- Slings (e.g., wire rope, synthetic web or rope, metal mesh, and chain) and rigging hooks shall be inspected at least annually by a qualified inspector.
- Slings must have a documented inspection history, with records readily available.



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- Label slings for identification with a durable tag (synthetic or metal) permanently affixed. Equipment not properly labeled shall not be used. Manufacturer-supplied serial numbers or individualized markings that identify the equipment meet the labeling requirement.

LOAD RIGGING

- Determine the weight of the load. Do not guess.
- Determine the proper size for slings and components.
- Pad sharp edges to protect slings.
- Do not use slings, eye bolts, shackles, or hooks that have been cut, welded, or brazed.
- Determine the center of gravity, and balance the load before moving. Keep attachment points of rigging accessories as far above and away from the center of gravity as possible.
- Initially lift the load only a few centimeters to test the rigging and balance.
- The center of gravity of an object is that point at which the entire weight is considered concentrated. To make a level lift, locate the hoist hook directly above this point. If the hook is too far to either side of the center of gravity, dangerous tilting will result, causing unequal stress in the sling legs. Correct load imbalances immediately.
- The smaller the angle between the sling legs and the horizontal, the greater the stress on the individual sling legs. Increased stress decreases the weight that can be safely lifted with any given sling. Large loads can be safely moved by keeping this angle as large as possible and, when necessary, distributing the weight of the load among more sling legs.
- The rated capacity of a sling varies depending upon the type of material the sling is made of, the size of the sling, and the type of hitch. The rated capacity of a sling must not be exceeded, under any circumstances.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure equipment is properly maintained.
- Ensure workers use safe lifting techniques.
- Establish procedures and check lists for operation, inspection, care and maintenance of equipment.
- Ensure workers are trained.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Assist in identifying areas where hoisting and rigging techniques are used.
- Provide worker training.
- Review the inspection records and maintain the inspection files.

INDIVIDUALS

All employees are required to:

- Know how to perform necessary equipment inspections.
- Know how to maintain equipment.
- Use safe lifting techniques.
- Use approved procedures and check lists.



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7 - Materials Handling

7-3 Material Storage and Handling (Manual and Mechanical)

- 1) **Purpose** – This procedure provides guidance for the proper storage of materials and the procedures for manually handling or lifting materials and equipment.
- 2) **Scope** - This procedure is valid for all work areas within the ALMA project. **Manual lifting Norm X35-109 90/269/EEC**
- 3) **Rules / Requirements**

MATERIALS STORAGE

- A 50 cm clearance is required between the top of storage and sprinkler heads.
- A one meter clearance is required between storage and any heating unit.
- In a location where there is material storage, lights must have shades or guards.
- Smoking is not permitted in warehouse or storage areas.
- Store heavy and frequently used materials at waist height.
- Do not store materials at floor level. Leave the lowest shelf unused if necessary.
- From FIRE PREVENTION (Section 3-2 – Fire and Life Safety)
 - Flammable liquids must be stored according to the compatibility requirements of the product and handled properly.
 - Secure all storage racks with the load limit clearly defined.
 - Store containers in the proper orientation to prevent tipping.
 - Do not store any materials within .91 m of any electrical panel.
 - Do not store any materials in a manner to block operating controls, exits, or aisles.
- From COMPRESSED GAS SAFETY (Section 6-2 – Hazardous Materials)
 - Cylinders shall be separated by compatibility of contents.
 - Keep oxidizers separate from combustibles or flammables by a minimum distance of 6.5 m or by a non-combustible barrier at least 2m high with a fire-resistance rating of at least one-half hour.
 - Indoor storage areas must have walls, floors and fittings made of suitable materials.
 - Keep away from electrical circuits and ignition sources such as sparks, flames or hot surfaces.
 - Keep away from heat and sun, including steam or hot water pipes to prevent excessive pressure buildup.
 - Do not subject cylinders to freezing temperatures, unless they are designed for this.
 - Store full cylinders separately from empty cylinders and allow only trained, authorized people into storage areas.
 - Do not stockpile gas, especially flammables, poisons, or corrosives, beyond the amount required for immediate use.
- From WALL AND FLOOR OPENINGS (Section 12-2 - Working Surfaces)



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- All places of employment, passageways, storerooms, and service rooms shall be kept clean and orderly and in a sanitary condition.
- Load rating limits shall be marked on plates and conspicuously posted.
- Do not place on any floor or roof of a building or other structure, a load greater than that for which such floor or roof is approved.
- The floor of every workroom shall be maintained in a clean and, so far as possible, a dry condition.

MATERIALS HANDLING

- Do not operate any equipment if you are not trained to use it.
- Check for the availability of mechanical aids before lifting or moving loads.
- Keep the equipment in good operating condition. It saves effort while transporting loads.
- Choose a sturdy frame hand truck with larger wheels to move materials in rough terrain.
- Use a pump truck to move materials stored on pallets.
- Move and empty drums with tilting drum cradles and drum dollies.
- Unload as close as possible to the place where material will be needed.
- Use ramps to avoid lifting and dragging over edges.
- Use containers that allow fluids to pour or empty without lifting the container.
- Use "Come-Alongs" to move heavy load. Ensure load is fully on the skid to prevent drag or resistance.
- Use an extended handle to lift, shift or move objects without bending.
- Ensure that there is enough room to turn around to prevent twisting.
- Use adjustable supports or suspenders to operate heavy tools.

MANUAL LIFTING

- The workplace must be adequate to be able to safely lift any item under ergonomic circumstances.
- Manual lifting of more than 25 kg always involves problems (gender equality, risk increase, oxygen problems in high altitude, etc.).
- ALMA personnel lifting limit is 25 Kg.
- Nevertheless, the employer must organize the work in order to reduce the difficulty and the risk for the worker.
- 90/269/EEC clearly says that the organization has to perform a risk assessment for the workplace inclusive participation of the occupational health doctor before work starts and under consideration of all preventive measures.
- When lifting, keep your back reasonably straight, bend you knees, and grasp the load firmly. Raise (and lower) the load by using your legs, not your back. Avoid twisting your body while lifting, moving or setting down a load (if required, turn your feet) keeping the arms and elbows close to your body. Moves should be slow and steady – not jerky.
- Size up the load and get help if needed.



Instructions for Assessment of Health Risk in Manual Handling of Loads

Workplace/position:

a). Assessment on the duration of handling work

Regularly repeated handling of loads	Summary time for holding or carrying the loads	Time assessment (points)
< 10 times in shift	< 30 min	1
10–40 times in shift	30 min – 1 hour	2
40–200 times in shift	1 hour – 3 hours	4
200–500 times in shift	3 hours – 5 hours	6
≥ 500 times in shift	≥ 5 hours	8

b) Assessment on the weight of the load to be handled

Weight of the load to be handled (men)	Assessment on weight (points)
< 10 kg	1
10–20 kg	2
20–30 kg (25 kg ALMA limit)	4
30–40 kg	7
≥ 40 kg	25

c) Assessment on posture

Illustrative figure	Posture	Assessment on posture (points)
	<ul style="list-style-type: none"> – standing posture, the upper body is neither turned nor bent – the load is held against the body – standing posture or few steps are made 	1
	<ul style="list-style-type: none"> – upper body is bent front up to 30° or turned – the load is held against the body – sitting, standing or longer walking 	2
	<ul style="list-style-type: none"> – upper body is bent front up to 30° or bowed posture – the load could not be held against the body or it will be lifted above the shoulders – sitting or standing 	4



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	<ul style="list-style-type: none"> – turned upper body bowed far front – the load could not be held against the body – standing on the unstable footing, kneeling or crouching 	8
--	---	---

d) Assessment on work environment conditions

Ergonomic conditions of work environment	Assessment on conditions (points)
<ul style="list-style-type: none"> – sufficient space for work – the floor is even and not slippery – good lighting 	0
<ul style="list-style-type: none"> – insufficient space for work: work space less than 1.5 m², low ceiling etc. – unstable posture; slippery, uneven or slanting floor 	1

e) Calculation

The relevant assessments are entered to the tables in points and the calculation will be made.

$$(\text{assessment on weight}) + (\text{assessment on posture}) + (\text{assessment on conditions}) = (\text{sum}) \times (\text{time assessment}) = (\text{risk rate})$$

f). Determination of risk level

The risk level and the relevant further activities are determined based on the risk rate.⁷

Risk rate	Risk level	Description of health risk and necessary action
< 10	1	Minor burden, minor health risk
10–25	2	<ul style="list-style-type: none"> – moderate burden – certain category of workers might be overburdened, whereas their work should be reorganized and the workplace ergonomically rearranged
25–50	3	<ul style="list-style-type: none"> – major burden – occurrence of potential physical overburden of also physically fit worker⁸ – changes in work organization and ergonomic rearrangement of workplace needed⁹
≥ 50	4	– excessive burden

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⁷ In general case the risk of overburden of bone and muscular structure with risk rate increases. At the same time the clear border between the risk levels is missing, as it depends on the individual handling technique, training and physical abilities of the worker.

⁸ The employees older than 40 years or younger than 21 years, workers with health disorder and so called “new” workers.

⁹ See § 4 of the current regulation.



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	<ul style="list-style-type: none">- obvious physical overburden- changes in work organization and ergonomic rearrangement of workplace needed- to complete the work up to making rearrangements
--	---

Date of assessment:

Name and surname of the conductor of the assessment and position:

.....



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NORM X35-109 RECOMMENDATION

Weight units limit according the age and sex when carrying loads regularly:

Men 18 – 45 years old	25 kg
Men 45 – 65 years old	20 kg
Ladies 18 – 45 and men 15 – 18	12.5 kg
Ladies 15 – 18 and 45 – 65	10 kg

Weight limit according the age and sex when carrying loads not regularly:

Men 18 – 45 years old	30 kg
Men 45 – 65 years old	25 kg
Ladies 18 – 45 and men 15 – 18	15 kg
Ladies 15 – 18 and 45 – 65	12 kg

MECHANICAL LIFTING

- Know the weight of the object to be lifted.
- Get rigging instructions from your Supervisor before starting.
- Know the capacity of the lifting device that you intend to use.
- Use tag lines to control loads.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that only authorized personnel are permitted in storage areas.
- Ensure that employees are familiar with and follow this policy on materials handling.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Review this policy annually and ensure that appropriate updates are made.
- Inspect work areas regularly for any deficiencies.

INDIVIDUALS

All employees are required to:

- Follow the requirements of this policy.



8- Operations Safety

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8. OPERATIONS SAFETY

8-1 Food Handling Areas

- 1) **Purpose** – This procedure is to detail the requirements for safe storage and handling of foods.
- 2) **Scope** - This Section applies to all dining facilities, food preparation and food handling areas designated at the ALMA site. This Section does not apply to the consumption of foods in private residential rooms or offices, nor the handling of potable water.

3) Rules / Requirements

- Schedule visits and maintenance work in food handling areas to assure all personnel comply with these requirements.
- **Food service health staff must be checked at the policlinic by the paramedic before the shift**
- Food service staff must report applicable health info to the person in charge if there is a diagnosed illness or symptoms. **(contagious illnesses and injuries)**
- **Employees must be trained in standard operating procedures**
- Do not wash hands in the food prep sink or in service sinks.
- Do not wear jewelry: it can be a reservoir of pathogens, and they may also fall into food. However, a plain ring is permissible.
- **It is forbidden to use of any kind of jewelry, brooch, mobiles**
- Only authorized personnel are permitted to use food processing machines.
- Cutting and chopping machinery must be appropriately guarded.

FOOD HANDLING AND STORAGE

- **Food transportation must be done in closed pick up, clean, dry and free of odor.**
- Frozen food must be received frozen **-18 Celsius degrees** and free of previous temperature abuse, **above 12 Celsius degrees.**
- **Cooking, washing, rinsing, Ice for food cooling, sanitize must be done with drinking water (Norma NCh 409).**
- **Cooking temperature must be above 70 Celsius degrees.**
- Food packages must be in good condition to protect the food.
- Ice for food cooling purposes must be made from drinking water.
- **Cans can not be dent.**
- Keep raw animal food separate from other raw ready to eat foods.
- **Wash and sanitize** food packages before opening them.
- Prevent accidental opening of food packages when opening the containers.
- The working container must be labeled with the common name of the food.
- **Wash and sanitize** fruits and vegetables before serving to remove soil and other contaminants.
- Package food may not be in direct contact with foods because of seepage.
- Protect food in clean, dry location, not exposed to splashes, dust or other contamination.
- Food storage must be at least 15 cm above the floor **and separated from wall and ceiling.**
- **Food must be stored in reefers, cold cameras, visicoolers and storage rooms, and** may not be stored in locker rooms, dressing rooms, garbage rooms, mechanical rooms, under exposed sewer lines, under leaking water lines, or under open stairwells.



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- Unused food cannot be reserved, except for food in a container or bottle, such as catsup, cereals or crackers.
- Discard food that is inappropriately dated, or bearing no date.
- Food weighing more than 20 kg must be transported on carts.
- Walk in refrigerators must be cleaned weekly.
- All stoves, ranges, griddles **must be cleaned after each service**; **extractor fan must be dismantled every weekend** or more often as conditions require.

UTENSILS

- Use separate utensils for each food type.
- Utensils should be completely within the container of sealed bins such as for sugar, flour, etc.
- Soiled tableware can not be used to get second helpings.
- Utensils and food contact surfaces must be safe, durable, corrosion resistant, smooth and non absorbent.
- **Do not use wooden utensils for preparation or handling, spoons, rolling pin**
- Wood and wood wicker may not be used as a food contact surface except for hard close grained wood (like Maple) may be used for cutting boards, or rolling pins.
- Wood may be in contact with food surfaces only as a crate for storage of uncut raw fruit and vegetables, or any other food that required the removal of rinds, peels, husks, or shells before use.
- Equipment food contact surfaces and utensils must be **washed and sanitized** to sight and touch, and free of encrusted grease deposits and other soil accumulations.
- Food contact surfaces and utensils must be cleaned before each use of a different type of animal food, each time there is a change from working with raw foods to ready-to-eat foods, between working with raw fruits and vegetables and with potentially hazardous food, and before using or storing a food temperature sensing device.
- **Cutting board must be sanitized before and after used, keep in sanitizer solution.**
- **Cutting boards of different colors must be used for raw meats and seafood, cooked meats, raw poultry, vegetables; and dairy products, sausages and bakery**
- Equipment and utensils must be **washed and sanitized before and after used, and dried with paper towel.**
- Present knives, forks, and spoons so only the handles are touched by employees or consumers.
- **Kitchen knives must be kept in support of stainless steel knives**

LINENS

- Linens and napkins may contact food only when they are used to line a container and if replaced each time the container is refilled for a new consumer.
- Cloths used for wiping food spills must be used for no other purpose.
- Wiping cloths need to be free of visible debris.
- Linens that do not come in contact with food needs laundered if they become wet, sticky, or visibly soiled.
- Wet wiping cloths must be laundered daily.
- Linens and napkins must be laundered after each use.
- Keep soiled linens in a clean nonabsorbent receptacle or washable laundry bag.
- Do not use a cloth to dry utensils; however, utensils may be polished with a clean and dry cloth.

CLEANING



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- Sponges are not to be used in contact with cleaned and sanitized or in-use food contact surfaces.
- **Sponges must keep clean and dry in a plastic container.**
- There must be three compartments required for a sink for washing, rinsing, and sanitizing.
- Sink compartments need to be large enough to immerse the largest equipment and utensils.
- A 2 compartment sink may be used if the washing is limited to batch operations, the number of items is limited, the cleaning and a detergent sanitizer are used to sanitize.
- The drain board must be large enough to accommodate all soiled and cleaned items that accumulate during operations.
- If equipment cannot be moved, it must be designed and installed to allow for cleaning.
- Warewashing equipment be cleaned before use, throughout the day at sufficient intervals to ensure it performs the intended function, and if used, at least every 24 hours
- Warewashing sinks may not be used to wash hands.
- Warewashing sinks must be cleaned before and after each time it is used to wash cloths or wash produce or thaw food.
- **It is forbidden the use of steel savings.**

4) Responsibilities

MANAGEMENT - Managers and Supervisors are responsible to:

- Ensure that only authorized personnel are permitted in storage areas.
- Schedule visits and maintenance work to assure all personnel comply with these requirements.
- Ensure that food service employees are trained and familiar with this policy on food service requirements.
- Allow staff to have enough time and appropriate means to change dirty clothes and wash their hands before going to the dining room.
- Make sure those having "colaciones", have the means to eat them in a healthy manner.
- Convey all comments or complaints regarding unhealthy conditions to Safety and the Hospitality Services Manager.
- Include food health regularly in the morning safety meetings.

SAFETY OFFICE - The ALMA Safety Office is responsible to:

- Review this policy annually and ensure that appropriate updates are made.
- Inspect food service preparation areas regularly for any deficiencies.

INDIVIDUALS

- Report applicable health info to the person in charge if there is a diagnosed illness or symptoms (gastrointestinal, lesion).
- Ensure food is received in good condition.
- Ensure equipment and utensils are kept clean and in good condition.
- **Protect yourself and those around you.** Make yourself the first protection barrier against food contamination: Wash your hands before each meal, use alcohol gel, don't sneeze or cough over the food, and wear clean clothes at the dining room.
- **Stay healthy everywhere:** When having colaciones (packed snacks or meals) or eating outdoors, make sure your hands and the place you are eating are clean. Use alcohol gel for your hands if you can't wash them.
- **Trust your senses.** Refuse and report any food which is not well cooked, has any strange taste, smell or color, or physical evidence of contamination. Make sure corrective action is taken.



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- **Protect the others:** Report any unhealthy condition to your supervisor, Safety, and Hospitality Services Manager.
- **Provide feedback:** Use the catering@alma.cl and/or the suggestions book at the dining room to convey complaints or suggestions regarding food handling and serving, as well as the staff, premises and utensils condition.



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Food Service Sanitation Inspection Checklist

Inspected by:
 Date Inspected:

Food service permit	
Operational permit posted	
Inspected every 6 months	
Inspection report posted	
FOOD	
Sound condition, not spoiled	
Obtained from sources that comply with labeling	
FOOD PROTECTION	
Protected from dust, insects, rodents, unclean utensils, unnecessary handling, cough and sneeze, flood/drainage, overhead leakage	
Food temp below 7.2 C or above 60 C	
Frozen food -18 Celsius degrees	
Cold food between 0 – 5 Celsius degrees	
Hot food above 65 Celsius degrees	
FOOD STORAGE	
Stored in original container	
Stored 15 cm above floor, separated from wall and ceiling	
No food under sewer water lines or toilet rooms	
No packaged food in contact with water or ice	
FOOD PREPARATION	
Prepare food with approved utensils	
Prepare food on cleaned, rinsed, sanitized surfaces	
Wash fruit/vegetables prior to cook or serve	
Wash and sanitize fruit/vegetables prior to cook or serve	
Metal stem type thermometer used for internal temp, holding, refrigeration	
FOOD DISPLAY and SERVICE	
Condiments provided in individual containers or approved dispenser	
Ice dispensed by tongs, scoop	
Meals dispensed by tongs, scoop	
Food on display protected from consumer	
PERSONNEL	
No communicable disease	
Employees wash hands	
Employees must wear cap, mask and disposable gloves	
Clean outer clothing	
Hair restraints used, caps	
Food and drinking consumed only in dining area	
No Tobacco	



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EQUIPMENT AND UTENSILS	
Multi use equipment corrosion resistant, cleanable and dismantle.	
Food contact surface cleanable, smooth and non absorbent	
No threaded areas in food contact equipment	
Food contact surfaces accessible for cleaning	
Ventilation filter hoods readily removed for cleaning	
No equipment under exposed sewer lines, stairwells	
Aisles clear	
CLEANING SANITIZING AND STORAGE OF EQUIPMENT AND UTENSILS	
Tableware cleaned after each use	
Kitchenware and food contact surfaces cleaned after each use	
Utensils washed periodically	
Utensils must be kept clean and in a dry space	
Food contact surfaces wash and sanitized before and after each use	
Food contact surfaces cleaned at least once a day	
Food contact surfaces free of grease	
Clean cloths for wiping food spills with no other purpose	
Non food contact cleaning cloths for no other purpose	
Dishwasher cleaned daily	
After sanitizing, air dry utensils	
Utensils touched only by handles	
Cups, bowls only handled to touch outside surfaces	
Cleaned utensils stored 15 cm above floor in dry location	
Cleaned utensils protected from splashes	
No utensils placed under sewer lines, non potable lines	
Glasses, cups stored inverted (gloves)	
Handle of utensils presented to customer	
Single service items stored 15 cm above floor	
Single service utensils individually wrapped or dispensed from approved container	
No food, utensils stored in toilet facility or vestibule	
SANITARY FACILITIES AND CONTROLS	
Grease traps accessible for cleaning	
Available toilet facilities	
Toilets completely enclosed with self closing doors	
Waste receptacle easily cleanable	
Lavatories within 6.1 m of each food prep area	
Lavatories in toilet rooms	
Sinks for hand-washing not to be used for food prep	
Each lavatory equipped with hot and cold water	
Hand soap available	
Sanitary towels available	
Frying oil removed in a special container	
Garbage removed in black plastic bags	
Removed garbage bags with 3 / 4 of its capacity	
Garbage can with pedal and lid	



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Garbage separate for papers, cutting like can and glass, and organic material	
Garbage in leak proof, cleanable (liners may be used)	
Trash containers in food service areas kept covered	
Outside containers cleanable with lids	
Sufficient garbage containers	
Soiled dumpsters cleaned regularly	
Garbage inaccessible to rodents	
No outside storage of plastic bags, paper bags	
Refuse storage rooms easily cleanable, rodent proof	
Sufficient storage in outside storage for refuse	
Dumpster on smooth non absorbent surface	
Garbage disposed of frequently	
Premises prevent presence of rodents, insects	
Openings to outside tight fitting free of breaks	
CONSTRUCTION AND MAINTENANCE OF PHYSICAL FACILITIES	
Floors smooth, durable, washable non absorbent	
No carpet in food prep, wash, food storage, or toilets	
Mats non absorbent, grease resistant, readily cleaned	
Exposed service lines do not obstruct cleaning	
Walls, ceilings, doors, windows, skylights in good repair	
Concrete blocks finished surface and sealed	
No exposed studs in refrigeration units, food prep	
No exposed utility lines in refrigeration units, food prep	
All ceiling fixtures easily cleaned	
Floors cleaned between meals	
Light shielding on all food prep and service areas	
Sufficient ventilation	
Change room provided for employees	
No excess poisons present	
Poison containers labeled	
Detergents, sanitizers, cleaning agents separate from caustics, acids, insecticides	
No poison stored above foods	
Medications stored away from foods	
Area kept free of litter	
No unauthorized traffic	
No food service areas in sleeping quarters	
Sleeping quarters separated from food service by self closing doors	
Clean clothes stored in clean place	
Soiled cloths stored in washable laundry bags, or non absorbent containers	
Cleaning tool stored away from food and linens	
No live animals permitted in the establishment	



8 - Operations Safety

8-2 Maintenance Safety (Job Hazard Analysis and Standard Operating Procedures)

1) **Purpose** – This procedure is to define the process and circumstances for completing a Job Hazard Analysis and development of Standard Operating Procedures.

2) **Scope**

- This Section applies to all activities involving potentially hazardous locations or operations. This includes installation, service, maintenance of equipment used with hazardous materials, high voltages, high temperatures, high pressures, cryogenics, or other forms of energy.
- NOTE that a Job Hazard Analysis is not equivalent to the Risk Analysis required for development of new products.

3) **Rules / Requirements**

JOB HAZARD ANALYSIS

- A Job Hazard Analysis (JHA) is a procedure which helps identify potential hazards associate with a job task. Other terms used to describe this procedure are Job Safety Analysis (JSA), or Safety Hazard Analysis and Job Hazard Breakdown.
- The terms "job" and "task" are used interchangeably to mean a specific work assignment.
- The JHA will be prepared by the responsible Supervisor with support from the Safety Office.

JOB SELECTION

- Ideally, all jobs should be subjected to a JHA. Factors to be considered in assigning a priority for analysis of jobs include:
 - Accident frequency and severity.
 - Potential for severe injuries or illnesses.
 - Newly established jobs.
 - Modified jobs: new hazards may be associated with changes in job procedures.
 - Infrequently performed jobs.

BASIC STEPS

- Do not to make the steps too general, or omit specific steps and associated hazards.
- Record each step in sequence by watching the worker do the job, if possible. Make notes about what is done rather than how it is done. Each item is started with an action verb.
- The worker to be observed should be experienced and capable in all parts of the job.



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- The job, not the individual, is being studied to identify hazards and make modifications to eliminate or reduce them.
- The job should be observed during normal times and situations.
- When complete, discuss the breakdown of steps with the participants (including the worker) to ensure that all basic steps have been noted and are in the correct order.

IDENTIFY POTENTIAL HAZARDS

- Once the basic steps have been recorded, identify potential hazards at each step.
- Based on observations of the job, knowledge of accident and injury causes, and personal experience, list the things that could go wrong at each step.
- Potential hazards are listed in the middle column of the worksheet, numbered to match the corresponding job step.
- To help identify potential hazards, consider the following types of accidents (this is not a complete list):
 - Caught in or between objects
 - Slip trip or fall from the same level
 - Slip trip or fall from height
 - Tools, machines, or equipment hazards
 - Struck by, struck against
 - Strain from lifting, pushing, or pulling
 - Exposure to extreme heat or cold
 - Excessive noise or vibration problem
 - Danger from falling objects
 - Lighting problem
 - Weather conditions
 - Contact with hot, toxic, or caustic substances
 - Dusts, fumes, mists, or vapors in the air

DETERMINE PREVENTIVE MEASURES

- Use specific statements to describe the action to be taken and how it is to be performed. Avoid use of general statements such as "be careful" or "use caution".
- The recommended measures are listed in the right hand column of the worksheet, numbered to match the hazard in question.
- Once the analysis is completed, the results must be communicated to all workers who are, or will be, performing that job.
- The final stage in a JHA is to determine ways to eliminate or control the hazards identified. The generally accepted measures, in order of preference, are:

Eliminate the hazard

- Choose a different process
- Modify the process
- Substitute with less hazardous substance
- Improve environment (e.g. ventilation)
- Modify or change equipment or tools

Contain the hazard

- If the hazard cannot be eliminated, prevent contact by using enclosures, machine guards, worker booths or similar devices.

Revise work procedures

- Consider modifying steps which are hazardous, changing the sequence of steps, or adding additional steps (such as locking out energy sources).

Reduce the exposure



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- These measures are the least effective and should only be used if no other solutions are possible. One way to minimize exposure is to reduce the number of times the hazard is encountered. An example would be modifying machinery so less maintenance is necessary.

STANDARD OPERATING PROCEDURES

- When an activity is a normal operation in a specific location, then a Standard Operational Procedure (SOP) is recommended.
- A SOP can be used to document and address the control of the hazards, establishing work procedures, and obtaining appropriate approvals.
- Managers and Supervisors should write SOPs to spell out how to conduct certain routine recurring activities or processes--for example, transporting a dewar of liquid nitrogen, to standardize the manner in which the recurring task is handled, so that every time it is done, it is done both efficiently and safely.
- SOPs focus on the work itself, but each SOP specifically includes the requirements of the JHA.
- If a hazard associated with an activity is not fully addressed by existing SOPs, it is considered unusual, and must be assessed.

SAFETY PERIODICAL MAINTENANCE

Periodical control must be completed with respect to the safety devices which are set up on machinery, hazardous equipments, electrical equipments, lifting devices, fire protection, hazardous materials, high voltages, high temperatures, high pressures, cryogenics, or other forms of energy.



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Job Hazard Analysis

Job Title _____

Date _____

Task Evaluated _____

JHA# _____

Prepared By: _____

Reviewed by _____

Approved by _____ Supervisor

_____ Site Manager on Duty (MOD)

_____ Safety Office

<u>Task Item Number</u>	<u>Job/Task Description</u>	<u>Potential Hazard Identification</u>	<u>Required Precautions</u>
1			
2			
3			
4			
5			
6			
7			
8			
9			



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure identified hazards in your work area are evaluated and mitigated appropriately.
- Periodically re-evaluate tasks for hazards, particularly when a job changes, or when an accident, injury, or near-miss occurs.
- Develop SOPs for common recurring activities or processes.
- Develop JHAs for unusual or operationally unique hazards.
- Implement approved SOPs and ensure personnel are aware of the procedures, and those affected are appropriately trained.
- Review JHAs and SOPs periodically or whenever there is a change that affects the work activity.
- Forward the JHA/SOP to the Safety Office for archiving.
- Involve Safety Office staff and workers in development of JHAs and SOPs.
- Approve all JHAs and SOPs involving work principally under your responsibility.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Review all new JHAs and SOPs verifying the indicated risk classifications, and recommend either approval or disapproval.
- Provide assistance in developing JHAs and SOPs.
- Establish a regular schedule for reviewing and updating JHAs and SOPs.

INDIVIDUALS

All employees are required to:

- Know the actual and potential hazards of the work you perform.
- Learn to recognize hazards to reduce the probability of accidents.



8 - Operations Safety

8-3 Antenna and Transporter Operations and Access – E-Stop Operation

- 1) **Purpose** – Access to antennas and/or Transporter is required for various maintenance and operational procedures. This procedure is designed to provide and establish the requirements for safe access to the antennas and/or transporter.
- 2) **Scope** - This procedure is applicable for all activities where access to an antenna and/or transporter is required. Access includes work around, on, or adjacent to an antenna structure.
See also “**Antennas safe access procedure**”:

3) Rules / Requirements

WEATHER

- Work activities on the exterior of the antenna are strictly limited during rain, ice, snow, and high winds (greater than 15 m/sec).
- Access during inclement weather will require the specific approval of the Supervisor in charge in consultation with the Safety Office.

BEFORE ACCESSING THE ANTENNA

- Get authorization from Controlling Group Lead, Team Lead and Operator on duty.
- Minimum safety gear required:
 - Hard hat
 - Safety shoes
 - Exclusive radio on channel
 - Lock with ID locking card
- No individual may access the antenna alone; you must always have a partner.
- Ensure that the Antenna is in a safe configuration before entering the hazardous area (see Antenna Safe Access Procedure and Check list:).
- Follow the vendor lock-out/tag-out procedure.

ROUTINE ACCESS

- The team-task leader is responsible for his/her group technical activity achievement.
- Safety Supervisor is responsible for the operation's safety; and other task group members, depending on the scope of the work.
- During installations/handlings, team-task leaders must be clearly identified by wearing a red jacket (LEAD); and Team Safety Supervisors, a yellow jacket (SAFETY).
- Routine access is defined as access on, around, or in the antenna structure when the antenna is not in observing mode. Compliance is required for any individual entering any demarcated area around the antennas and/or transporter, including fenced areas.
- To maximize safety the access is restricted. A limited list of operators is required
- Any work that occurs in the restricted area around any antenna must be scheduled.



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- Do not park any vehicle within 20 meters of the antenna. The antenna service vehicle and transporter are permitted to approach the antenna only after the antenna has been locked out and verified that antenna motion cannot occur.
- Maintenance vehicles are permitted within the restricted area only during periods of assembly or maintenance when the local drives are disabled and antenna movement and/or transporter is not possible.
- At no point in time are visitor vehicles, busses and tour vehicles permitted within the restricted zone.
- Every individual working on or in the antenna and/or transporter must be fully trained in and comply with the requirements for antenna Lockout (See Section 13-3).
- All maintenance activities require compliance with the two-person requirements as defined below in this Section.
- All work on the antenna must be performed by qualified personnel in accordance with maintenance standard operating procedures and job hazard analysis requirements.
- Fork lift /man lift drivers must have the appropriate authorization, certificate, license up to date. A copy of the document shall be registered at the ALMA safety office.

NON-ROUTINE ACCESS

- In some cases specific work activities must be performed during inclement weather or when the antenna servo is active. In such cases, the access will be strictly controlled.
- Any persons needing access in these conditions must coordinate the work with the Safety Office and the Supervisor of Operations.
- A Job Hazard Analysis (See Section 8-2) must be completed to evaluate the hazards of the proposed task and the means to minimize the risks.
- Each worker must be aware of the location of and operation of the emergency stop buttons.
- All non-routine activities require compliance with the two-person requirements as defined below in this Section.

TRANSPORTER

- Get authorization from the Team Lead and Operator on duty.
- Wear the appropriate safety gear.
- Keep away from hazardous areas.

EMERGENCY STOP OPERATION

- Emergency stop buttons are to be used when a hazardous or potentially hazardous situation is detected. They are integrated in the Antenna interlock system.
- Activation of the emergency stop completely removes power from all the motor drives and causes the brakes to be engaged.
- Activation of an emergency stop is independent of any other control circuits; it is effective even if the main electronics chassis is not working or powered down.
- Emergency stop buttons are activated by a single human action.
- The switches are located in at the following locations:
 - In the receiver cabin
 - Two on the antenna base
 - One on each set of elevation drive motors
 - One on each azimuth drive motor
 - At the local control front panel
 - On the Portable Control Unit (PCU). This portable control unit provides emergency stop control.



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- The control panel of each antenna displays information regarding the status of Emergency Stop(s). The status of all emergency stops is monitored by the utility module.
- For remote e-stops, the utility module receives commands from the Ethernet IP and output a control bit to remote set an emergency stop. (The emergency stop activation is independent of the ACU operation. This function MAY NOT disengage any locally set emergency stop.) Reset of this emergency stop may not change the state of the antenna..
- It is possible to disengage the device only by an appropriate operation, and disengaging the device does not restart the machinery but only permit restarting.
- Once activated, the emergency stop requires human clearance, or reset, of the depressed button at the physical location of the pressed e-stop.
- Emergency stops are failsafe.
- When the antenna and the transporter are joined, the interlock cable is specified to connect the emergency stop systems of the antenna and the transporter. When connected, actuation of an emergency stop button on the antenna issues an emergency stop on the transporter and vice versa.

COMPLETION OF THE WORK

- Upon completion of the work activity, the individual in charge must:
 - Ensure that all tools and equipment are accounted for.
 - Get the procedure(s) specific to the work.
 - Inspect and ensure the area around the antenna and/or Transporter is clear of vehicles, equipment and personnel.
 - Verify that every individual has removed their personal lock.
 - Ensure that all security devices, emergency stops activated, and device interlocks are cleared.
 - Ensure that access doors are secured.
 - Personally notify the on-duty operator that the antenna is “All Clear”
 - A coordinator will hand off each step to the person assigned responsible,
 - A recognizable person shall be appointed as safety representative during the operation.

SPECIAL CONDITIONS

- Antennas and/or transporter shall not be normally operated beyond the limits or with safety devices bypassed to complete a work activity.
- If a special project requires defeating the limits or safety devices, the Safety Office must be notified.
- During the project, the Supervisor in charge must be present.
- A Job Hazard Analysis (See Section 8-2) must be completed to identify the hazards of the proposed task and assess, eliminate or minimize the risks.
- The entire work party must be briefed on the planned operation and the means to safely stop work activities.
- During the work, safety observers must be designated and present to observe the motion of the antenna to ensure safe operation.
- The designated safety observers shall be within ready access to emergency stop buttons.
- Only slow antenna movement speeds are permitted.

TWO PERSON RULE

- The isolated and elevated locations of much of the equipment on the antennas and/or transporter make it advisable that, some tasks which could be completed by a single person, be performed by two persons in order to increase safety.



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- No employee should perform any task alone if the individual feels that the job cannot be completed safely without assistance or the presence of a second person.
- In general, the two-person rule shall be in effect under the following conditions:
 - All work at the AOS.
 - Transport of an antenna.
 - Working from any elevated platform, antenna, scaffolding, or building roof.
 - Working with any energized electrical circuits above 408 volts AC. The second person does not need to be a Qualified Person.
 - Accessing any parts of the antenna under hazardous weather conditions, such as high winds, heavy rains, and snow and/or ice on the structure.
 - Work outside of regular working hours.
 - Work in confined spaces.
 - Maintenance work in all areas that are out of the normal traffic flow. Routine visual checks in these areas will not require two persons.
- The Safety Office may determine additional areas requiring two-person rule compliance.
- Generally, if the assistance of the second person is not required to complete the task, the second person must be within hailing distance of the person performing the task.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure work on the antenna is limited according to procedures during inclement weather.
- Ensure that any work team entering the restricted area around any antenna has appropriate authorization, qualifications and trainings.
- Complete a Job Hazard Analysis when necessary to evaluate the hazards of the proposed task and the means to minimize the risks.
- Ensure work is performed according to approved procedures and check lists.
- Ensure that all tools and equipment are accounted for and notify operations when the work is complete.
- Coordinate with the Safety Office for special projects.
- Brief the work party on the planned operations.
- Organize the team work and make sure the work time limit is respected.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Determine areas where compliance with the two-person rule is mandatory.
- Assist in the planning and review of JHAs for work activities on the antenna.
- Control implementation of the safety rules

INDIVIDUALS

All employees are required to:

- Use approved procedures and check lists.



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- Observe all warning tags and not tamper with any equipment or locks.
- During the work, perform the job of safety observer.
- Each person performing work must be aware of the location of and operation of the emergency stop buttons.
- Ensure communication is maintained with all team members.
- Respect the work time limit and inform the supervisors in case of delay.



8 - Operations Safety

8-4 Communication Procedures

- 1) **Purpose** – This procedure describes the communication practices at ALMA. Effective communications assures prompt information to minimize adverse effects of an emergency.
- 2) **Scope** - This procedure is applicable for all activities at the ALMA site.

3) **Rules / Requirements**

DURING OPERATIONS, AOS / OSF COMMUNICATION

- During Operations, communication with any team performing work must be maintained.
- Radio communications between isolated operations staff in the OSF and the Chajnantor work team shall be possible at any time.
- If the radio employee of the work group has to leave the working area by any reason, work will stop and the team doing the work will return to the AOS technical building..
- A log shall be kept at the OSF of the hourly communications check in. A copy of each daily log shall be given to the Safety Officer.
- The teams working at the AOS shall have a fully charged, hand held radio and a vehicle-mounted radio available in all vehicles used to drive to the high site.
- The radios shall be tested at the beginning of each work period.
- A firm schedule of work locations must be determined.
- All employees who perform work tasks at the AOS shall daily attend a task safety session with the responsible Supervisor, to review all task requirements.

TWO-WAY RADIOS

- In emergencies, the Safety Office may require strict radio silence on all channels except as needed for emergency communication.
- The base radio station channel 1 at the OSF monitors channel 3 at Chajnantor to ensure that communications are satisfactory and to facilitate taking prompt corrective action when communications are unsatisfactory.
- ALMA uses multiple channels for two-way radio communications.

USE OF RADIOS IN THE ALMA PROJECT

- ALMA uses multiple channels for two-way radio communications.
- ALMA currently has 17 channels, four of which operate with a relay link.
- Channel 1 at the OSF up to ~ km 40 or 3 at the high site is the official channel for contacting the Safety Department.
- Channel 1-3 should be used for short, brief communications. Users who need to send lengthier messages should use a specific Channel attributed for direct communication (short distance).
- Channel 2 (OSF) and 4 (Chajnantor) can also be used for Operations long distance call or as an emergency back up channel.
- Users are asked to verify the channel before using the radio



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- To initiate a transmission, press the PTT button and then begin speaking. For improved communication, in Spanish use the word “atento” (“come in”) followed by the name of the person or company when initiating communication and the word “cambio” (“out”) when signing off.
- Saying the word "over" or "go-ahead" indicates that you are done speaking and expect a response.
- The person called should identify himself or herself just as the calling party did.
- Hold the radio vertically in front of your face when transmitting and/or receiving messages.
- The radio should remain off when the battery is being charged. It therefore is recommended that users charge the battery only at night.
- In case of emergency, use Safety channel to contact the safety Department.
- When communicating via radio, verify that the channels are not in use so as not to interrupt other messages.
- Staff traveling to or from Chajnantor is required to carry a radio at all times and inform the OSF guard (Radio channel 1) who is on duty upon leaving for and arriving at the site. Staff must check in with ALMA OSF guard at km 21, 31, 41 and upon arrival when traveling to or from Chajnantor.

EMERGENCY COMMUNICATION

To see the emergency communication procedures, please refer in this document to Chapter 1, Section 1-3 “Emergency Procedures/ Contacts”.

COMMUNICATION PROTOCOL

- Before transmitting, ensure that you are not interrupting someone else's communications.
- ALMA’s default radio communication language is English
- Clearly identify the person you are calling and identify yourself.
- Once communications are established, it is not necessary to use both first and last names.
- To protect personal privacy, **DO NOT** announce the names of injured or ill persons over two-way radios. Two-way radio conversations can be monitored off site.
- It is appropriate to use a position rather than the name of an individual. For example, when needing to communicate with the Safety Office, address "Safety".

RADIO MAINTENANCE

- If there are problems with the handheld radio, contact the Safety Office for a replacement.
- Report improperly functioning base radios or vehicle radios to your Supervisor for repair.
- Problems with the repeater must be reported to the Safety Office.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Implement communication with any team performing work.
- Ensure teams and individuals working at the AOS carry a fully charged hand held radio.
- Determine a firm schedule of work locations.
- Monitor the base radio station to ensure that communications are satisfactory and to take prompt corrective action when needed.
- Coordinate repairs and maintenance of broken radios.



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SAFETY OFFICE

The ALMA Safety Office is responsible to:

- In emergencies, enforce strict radio silence except as needed for emergency communication.
- Ensure emergency communication system always operating.

INDIVIDUALS

All employees are required to:

- Know the radio communication protocol, and exercise good radio etiquette.
- Be capable of conducting emergency communication in English
- Report improperly functioning base radios or vehicle radios.
- Ensure personal privacy is protected in case of an emergency.



8 - Operations Safety

8-5 Housekeeping

- 1) **Purpose** – This procedure outlines the requirements for ensuring the ALMA site is maintained in a clean, healthy, and safe condition. Housekeeping must be practiced regularly and consistently.
- 2) **Scope** - This procedure is applicable for all activities at the ALMA site. All places of employment shall be kept clean to the extent that the nature of the work allows.

3) **Rules / Requirements**

From FIRE PREVENTION (Section 3-2 – Fire and Life Safety)

- Maintain aisles unobstructed for personnel transit and fire equipment protection.
- Keep combustible waste materials to a minimum and disposed of daily.
- Keep grounds around buildings free of weeds, trash, and unnecessary combustible materials.
- Keep work areas clean and free of debris.
- During construction, keep scrap materials reasonably cleared from the worksite.
- Place flammable wastes in separate covered containers from normal debris.
- Dispose of all waste promptly.

From FLAMMABLE AND COMBUSTIBLE LIQUIDS (Section 3-3 – Fire and Life Safety)

- Keep all areas where these liquids are stored, handled or used clear of burnable materials.
- Use an approved safety drip can below each drum faucet to catch spills or drips from worn or damaged faucets.
- Clean up liquid spills immediately.
- Remove any obstructions that prevent containers with lids held open by fusible links from closing fully.
- Make sure that flammable and combustible liquids are not left where they could block or otherwise prevent people from escaping in case of a fire.

From MEANS OF EGRESS (Section 3-4 – Fire and Life Safety)

- Items in stairwells, blocking exit doors, restricting corridors, or blocking fire emergency equipment constitute serious hazards.
- The way of approach and way to travel from the exit to the street must be continuously maintained free of all obstructions or impediments.
- The following items are subject to immediate removal by Facilities Management. Occupants shall be notified of violations.
 - Any items blocking an exit door or access to an exit door.
 - Any items located within a stairwell or stair enclosure.
 - Items that restrict the width of any part of a corridor to less than 1.12 m.
 - Any items that obstruct fire emergency equipment.
 - Any items determined to be an immediate fire or life safety hazard.
- The following items and processes are not acceptable in any corridor or elevator lobby. Unacceptable items are subject to removal by the Camp Facilities Manager within 30 days after violations are observed. Occupants shall be notified of violations.



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- Any item which obstructs utility panels, utility valves, or electrical receptacles.
- Storage or manipulation of ALL chemical materials.
- Storage or use of compressed gas cylinders.
- Equipment which would present hazards, such as equipment that uses volatile materials or hazardous chemicals, equipment that may produce steam, or equipment with unguarded belts, pulleys and/or gears.
- Any items which move easily or could fall over and cause an obstruction.
- Unapproved workstations (including copiers, office equipment, coffee stations, desks), break areas, and waiting areas.
- Combustible materials outside of enclosed cabinets. This includes journals, papers, books and boxes.
- Recycling materials outside of approved recycling containers.
- Any items in a quantity that presents a fire or life safety hazard.

From COMPRESSED GAS SAFETY (Section 6-2 – Hazardous Materials)

- Never hang clothes or equipment over a compressed gas cylinder.
- Never use oxygen or compressed air to remove dust from clothing or equipment.
- Promptly remove combustible wastes including wood, paper or rags, from the work area.
- Properly and promptly dispose of "empty" or unlabelled cylinders.

From WALL AND FLOOR OPENINGS (Section 12-2 – Working Surfaces)

- Keep all places of employment, passageways, storerooms, and service rooms clean and orderly and in a sanitary condition.
- Load rating limits shall be marked on plates and conspicuously posted.
- Do not place on any floor or roof of a building or other structure, a load greater than that for which such floor or roof is approved.
- Maintain the floor of every workroom in a clean and, so far as possible, a dry condition.
- Where wet processes are used, maintain drainage and provide gratings, mats, or platforms.
- Keep every floor, working place and passageway free from protruding nails, splinters, holes, or loose boards.

WASTE (See also Section 2-2: Hazardous Waste Management and Section 2-3: Wood and Solid Waste Management)

- Wastes must be disposed of at frequent intervals.
- Containers must be provided for collection and separation of all refuse.
- Covers must be provided on containers used for flammable or harmful substances.
- Any receptacle used for putrescible waste must be constructed so it does not leak and may be thoroughly cleaned and maintained in a sanitary condition.
- Waste receptacles must be equipped with a solid tight-fitting cover, unless it can be maintained in a sanitary condition without a cover.
- Every workplace must be maintained to prevent the entry of rodents, insects, and other vermin. A continuing and effective extermination program will be instituted where their presence is detected.

GENERAL HOUSEKEEPING REQUIREMENTS

- Materials must not be stacked within 46 cm of fire sprinkler heads or fire system discharge nozzles.
- All stored materials must be stacked in stable piles. Materials such as pipe that could roll must be chocked or braced to prevent rolling.



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- Where live electrical parts present a contact hazard, do not perform housekeeping duties at distances to the parts if there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided.
- Do not use electrically conductive cleaning materials (including conductive solids such as steel wool, and metalized cloth) in proximity to energized parts unless procedures are followed which will prevent electrical contact.
- Keep storage areas free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage
- Place all chemicals in proper storage areas at the end of each workday.
- Do not store chemicals in aisles, on desks or laboratory benches, on floors or in hallways, or in fume hoods which are also used as workstations.
- Promptly clean up spills and properly dispose of the spilled chemical and cleanup materials.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that all work areas are maintained in a safe and healthy condition.
- Ensure that housekeeping is a regular part of all duties for employees.
- Enforce the requirements of this policy for areas in their control.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Inspect work areas regularly to verify that appropriate housekeeping controls are exercised.

INDIVIDUALS

All employees are required to:

- Ensure their work areas are kept clean and tidy



8 - Operations Safety

8-6 Excavation Safety

- 1) **Purpose** – This procedure outlines the requirements for the safe practices associated with excavation activities.
- 2) **Scope** - This procedure is applicable for all ALMA excavation activities.
- 3) **Rules/Requirements**

DEFINITIONS

- Benching - A method to protect employees from cave-ins by excavating the sides of an excavation to form horizontal levels or steps, near-vertical surfaces between levels.
- Cave-in - Separation of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield, and its sudden movement into the excavation by falling or sliding, in sufficient quantity so that it could entrap or otherwise injure a person.
- Competent person – Someone able to identify hazards in the working conditions, and who has authorization to take prompt corrective measures. A competent person should be able to demonstrate training, experience, and knowledge of:
 - soil analysis,
 - use of protective systems,
 - conditions that could result in cave-ins,
 - failures in protective systems,
 - other hazards including those associated with confined spaces.
- Excavation - Any man-made cut, trench, or depression formed by earth removal.
- Shield - A structure that is able to withstand forces imposed on it by a cave-in and protect employees. Shields can be permanent or portable and moved along as work progresses.
- Shoring - A structure such as a metal hydraulic, mechanical or timber system that supports the sides of an excavation and is designed to prevent cave-ins.
- Sloping - A method to protect employees from cave-ins by forming sides of an excavation that is inclined away from the excavation to prevent cave-ins.
- Trench - A narrow excavation in relation to its length. In general, the depth is greater than the width, but the width of a trench is not greater than 5 meters.

GENERAL

- A competent person shall be placed in charge of all excavations.
- Underground utilities must be located and marked before excavation begins.
- Employees are not allowed in the excavation while heavy equipment is digging.
- All employees on an excavation site must wear hard hats and S3 grade safety shoes.
- Employees are not allowed to work under loads being lifted or moved by heavy equipment used for digging or lifting.
- Employees are required to stand away from equipment being loaded or unloaded to avoid being struck by falling materials or spillage.
- Equipment operators or truck drivers may stay in their equipment during loading and unloading if the equipment is properly equipped with a cab shield or adequate canopy.



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- Do not undermine sidewalks and pavement unless a support system or protection is provided to protect employees from possible collapse.
- Install all shoring from the top down and remove from the bottom up.
- Backfill the excavation as the removal of the support system progresses.
- Install shields to restrict lateral movement of the shield in case of a sudden lateral load.
- Employees are not permitted to be in a shield while it is being moved.

INSPECTIONS

- Document inspections made by a competent person. The following specifies the frequency and conditions requiring inspections:
 - Daily and before the start of each shift;
 - After events that could increase hazards, e.g. snow, rain, thaw, earthquake, etc.;
 - When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or other similar conditions occur;
 - When there is a change in the size, location, or placement of the spoil pile; and
 - When there is any indication of change or movement in adjacent structures.

SPOIL

- Do not place temporary spoil closer than 0.6 meters from the surface edge of the excavation, measured from the base of the spoil to the cut.
- Place permanent spoil further than 2 meters from the excavation.
- Place spoil so that it channels run-off water away from the excavation.
- Place spoil so that it cannot accidentally run, slide, or fall back into the excavation.

SURFACE CROSSING OF TRENCHES

- Surface crossing of trenches is discouraged.
- If trenches must be crossed, walkways or bridges must be provided for foot traffic.
- Walkways need to have a safety factor of 4, a minimum clear width of 0.51 m, be fitted with standard rails, and extend a minimum of .61 m past the surface edge of the trench.

INGRESS AND EGRESS

- Provide trenches 1.3 meters or more in depth with a fixed means of egress.
- Spacing between means of egress must be such that a worker will not have to travel more than 7.5 meters to the nearest means of egress.
- Secure ladders and extend a minimum of 1m above the landing.

EXPOSURE TO VEHICLES

- Provide employees exposed to vehicular traffic with and require them to wear suitable garments with reflectorized or high-visibility materials.
- Use trained flag persons, signs, signals, and barricades when necessary.
- Fence and barricade trenches left open overnight.
- Use stop logs if there is a danger of vehicles falling into the trench.
- Grade soil away from the excavation for vehicle control and channeling of run-off water.

HAZARDOUS ATMOSPHERES AND CONFINED SPACES

- Employees shall not be permitted to work in hazardous and/or toxic atmospheres. Such atmospheres include those with:
 - less than 19.5% oxygen,
 - combustible gas concentration greater than 20% of the lower flammable limit,



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- concentrations of hazardous substance airborne contaminants.
- If there is any possibility that the trench or excavation could contain a hazardous atmosphere, conduct atmospheric testing prior to entry.
- Conduct testing before employees enter the trench and test regularly to ensure that the trench remains safe.
- The frequency of testing should be increased if equipment is operating in the trench or if welding, cutting, or burning is done in the trench.

STANDING WATER AND WATER ACCUMULATION

- Remove employees from the trench during rainstorms.
- Inspect trenches carefully by a competent person after each rain and before employees are permitted to re-enter the trench.
- Divert surface water away from the trench.
- Use water pumps to remove standing water must be monitored at all times while in use.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that a trained competent person is in charge of all excavations.
- Verify that underground utilities are located before excavation begins.
- Ensure that the installation and removal of shoring is properly performed.
- Ensure that inspections are properly performed and documented.
- Ensure that excavations are tested for hazardous atmospheres when needed.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Inspect work areas regularly to verify that the requirements for safe excavations are followed.
- Provide training for employees designated as competent persons for excavations.

INDIVIDUALS

All employees are required to:

- Wear proper personal protective equipment while working in excavations.
- Follow the requirements of safe work procedures as outlined in this policy.



8 - Operations Safety

8-7 Outdoor Work (Protection from Elements)

- 1) **Purpose** – This procedure outlines the guidelines for the safe work practices for outdoor work activities and conditions at the ALMA site.
- 2) **Scope** – These guidelines are applicable for all ALMA outdoor work activities that may be affected by exposure to solar radiation and heat hazards. References include:
 - Section 1-5 – Weather and Natural Disaster
 - The Chilean law, Decreto Supremo n°594 párrafo 3, artículo 99-100 punto 5, regarding physical agents, ambient temperature factor and wind speed, which result gives a cooling factor able to bring serious or fatal consequences for those workers exposed to such climatical conditions.

3) Rules/Requirements

OUTDOOR HEAT/COLD AND RADIATION HAZARDS

Exposure to extreme hot or cold is dangerous to health. Extreme of heat and cold can be more than uncomfortable.

- At very cold temperatures, the most serious concern is the risk of hypothermia-dangerous over cooling of the body.
- Individuals who work in a cold environment are at greatest risk for cold-induced injuries/illnesses.
- de-hydration;
- sunburn to skin and eyes;
- skin lesions/disorders;
- increased risk of cataracts from UV radiation;
- skin cancer;

ULTRAVIOLET (UV) RAYS

- UV rays are classified into UVA, UVB, and UVC based on the wavelength (longest to shortest, respectively)
- The shorter the wavelength, the more energy and the more potential for damage to human health.
- As the elevation increases, the intensity of the rays increases.
- Overexposure to UV rays is related to the rise in incidence of skin cancers, and is widely accepted as the underlying cause for harmful effects on the skin, eye and immune system.

LIMIT TIME IN SUN

- The sun's UV rays are the strongest between 10 a.m. and 4 p.m. To the extent possible, limit exposure to the sun during these hours.
- Heavy manual work can stress the body particularly when the temperature reaches 30C. Schedule work so it is performed under shade, indoors or is physically less demanding.



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- Inform staff of the need for protection when cloudy or when exposure to the sun may not be obvious when working near reflective surfaces such as snow, sand, or panels.
- Discuss the tasks to be performed and organize the work schedule around the temperature.

SHADE

- Seek shade when UV rays are the most intense.
- Where possible, use natural shade from trees, buildings and other structures
- If there is no natural shade, erect canopies, tents or other shade structures.
- Vehicles and machinery such as tractors should be fitted with shade canopies.
- Vehicles should be fitted with air conditioned cabs where possible.

PROTECTION

- Ensure that sunscreen, sunglasses and hats are available to all staff required to work outdoors.
- Carry spare sets of such protection if possible as contingency.
- Clothing for protection of skin from UV light is loose-fitting and allows sweat to evaporate.
- Closely-woven fabrics of light colors are recommended. Cotton is the best fabric. Long-sleeve shirts and long trousers give good skin protection.
- Exposed parts of the body should be protected by other means. Fingerless gloves offer protection to the hands for working outdoors.
- The recommended hat has an all-round brim and is made of natural fibers in a light color. A flap fitted to the hat will protect the neck.
- Sunglasses that protect against UV light penetration and also give impact protection are recommended.

SUNSCREEN

- The recommended sunscreen cream is a broad spectrum, waterproof type with a high sun protection factor (30 or 50+).
- For maximum effectiveness, apply sunscreens on clean dry skin 15 minutes before going out into the sun. Re-apply every two hours when working outdoors.
- When profuse sweating occurs, sunscreen creams may need to be reapplied more often.

REST BREAKS

- Workers performing manual work during hot weather should take regular breaks.
- New or inexperienced workers may need to take more frequent rest breaks until they become acclimatized to the conditions.
- Take rest breaks in a cool place as close as possible to the work is being carried out.
- If the work is some distance from the base, allow the staff to go inside the nearest cool building (air conditioned building if possible) or shaded area to rest and have cool drinks.
- SHORT work periods followed by SHORT rest breaks are better than long work periods followed by long rest breaks.
- Take regular cool drinks when working in the heat to replace sweat lost and avoid dehydration.
- Cool water dispensers should be provided in appropriate locations.

DRY AIR

- At higher elevations, the humidity decreases.
- Skin and mucous membranes can become damaged due to the dry air.
- Dry air can increase the risk of fire through static discharge. This makes the practice of bonding and grounding especially important at the ALMA site.



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that employees working in the elements are afforded opportunities for rest breaks.
- Organize the work schedule to limit time in the sun.
- Ensure that the appropriate personal protective equipment is available and worn by employees.
See Section 9: PPE- Personnel Protective Equipments
- Ensure that water is provided for breaks.
- Carry spare sets of such protection if possible as contingency.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Ensure that sunscreen, sunglasses and hard hats are available to all staff that is required to work outdoors.

INDIVIDUALS

All employees are required to:

- Wear proper personal protective equipment for outdoor work.
- Wear appropriate sunscreen.
- Carry enough drinkable water for their consumption.



8 - Operations Safety

8-8 Optical Fiber Systems (Lasers)

1) **Purpose** – This policy provides for safe handling and use of Optical Fiber Communication Systems (OFCS) lasers at ALMA.

2) **Scope** – These requirements are applicable for all work performed on OFCS systems. References include:

- OPTICAL FIBER COMMUNICATION SYSTEMS (OFCS): Designing Fiber Optic Telecom Products To IEC 60825-2, 3rd Edition, Thomas M. Savino, N.C.E., Curtis-Straus LLC
- IEC INTERNATIONAL STANDARD, 60825-2, Third edition 2004-06, SAFETY OF LASER PRODUCTS – Part 2: Safety of optical fiber communication systems (OFCS)
- DIRECTIVE 2006/25/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 DIRECTIVE 2006/25/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation)

3) Rules/Requirements

REGULATORY REQUIREMENTS

- For lasers, the international safety standard is IEC 60825.
- For optical communications equipment, the standard used in ALMA is IEC 60825-2. National standards may be proposed for use.

LASER CLASSIFICATION

- The IEC 60825-1 Classification system describes a laser in terms of potential harmful effects. Class 1 lasers are considered the safest, while Class 4 is considered as the most potentially harmful.
- The following Table gives an overview of the Class definitions.

**Laser Class Definitions
Table**

Class	Output
1	Considered as safe to eye and skin under all reasonably foreseeable conditions of operation.
1M	Considered as safe to eye and skin under all reasonably foreseeable conditions of operation, provided they are not viewed with magnifying optics of any kind.
2	Will not cause permanent eye damage under reasonably foreseeable conditions of operation, provided that exposure may be terminated by the blink reflex of the eye. Therefore the wavelength range is limited to visible light (400nm to 700nm).
2M	Will not cause permanent eye damage under reasonably foreseeable conditions of operation, provided that exposure may be terminated by the blink reflex of the eye, and that these devices are not viewed with magnifying optics of any kind.



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3R	Direct intrabeam viewing is potentially hazardous to the eye; has wavelength range of 302.5 nm to 106 nm (Near uv - NUV).
3B	Unsafe for eye exposure at all wavelengths, but generally not powerful enough to damage skin during a short exposure. Class-3B lasers must be equipped with a key switch and a safety interlock.
4	Powerful enough to burn skin, cause fire, and ionize the air

- An OFCS is inherently considered as a Class 1 under normal usage conditions. When fiber connectors are in place and an enclosure is around the equipment, there is theoretically no light leakage.

LOCATION TYPE

- Controlled access – access to the protective housing (or fiber) is highly controlled, and only trained personnel are allowed access. Examples include optical cable ducts and switching centers.
- Restricted access – access to the protective housing (or fiber) is normally inaccessible to the general public but accessible to authorized personnel who may not have laser safety training. Examples include industrial and commercial premises.
- Unrestricted access – there are no measures restricting general access to the protective housing (or fiber, since in an OFCS the fiber can serve as the protective housing). Examples include non-secured areas in business premises where public may have access.
- Using these location types, identify areas of possible exposure to potentially hazardous light from an Optical Fiber Communications System.
- All lasers must be inventoried semiannually and updated as needed by LSO. The inventory shall include the following:

**Laser Inventory Form
Table**

Make/Model Serial Number	Laser Classification	Source Laser Location	Power Output, mW	Accessible Area General Location	Accessible Area Specific Location	Location Type
SN-12345	3B	TBD	TBD	Antenna Vertex Room	FE Rack	Restricted

* Note that more than one accessible area may be identified for each source laser.

HAZARD LEVEL

- Hazard level refers to the potential hazard from laser emissions at any accessible location in an end-to-end OFCS during “reasonably foreseeable” failure or fiber disconnection.



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- Faults resulting in emission of radiation in excess of the hazard level are not considered if they are for a limited duration only and it is not reasonably foreseeable that access to the radiation will occur before the product is taken out of service.
- Hazard Levels are divided into four groups. Each indicates the maximum level of laser/LED radiation that could become accessible in the event of a reasonably foreseeable event. For example, Hazard Level 1 indicates that a particular accessible location in an OFCS could expose someone to no more than Class 1 levels of laser/LED radiation; a Hazard Level 2 rating means that an accessible location within the OFCS could expose someone to no more than Class 2 emission levels; etc.
- Where multiple communications systems are present, the hazard level for the location must be the highest of the levels present.
- The assessment may be made by making physical measurements, or by calculation of the maximum emitted powers of the laser/LED under the appropriate conditions, e.g. simulated fiber cable break.

FAILURE MECHANISMS

- A reasonably foreseeable event can be predicted fairly accurately and the occurrence probability is not low. Examples of reasonably foreseeable events are:
 - component failure
 - fiber cable break
 - optical connector disconnection
 - an open accessible door or cover
 - operator error or
 - inattention to safe working practices.
- Hazard levels are calculated using worst-case single mode fiber.
- Detailed hazard and safety analysis of the system is needed down to circuit level using methods such as failure modes effects and criticality analysis (FMECA).
- The fiber optic group is responsible for this analysis and the associated documentation.

METHODS TO REDUCE OR CONTROL HAZARD LEVELS

- There are specific requirements for each Hazard Level for each of the location types.
- If equipment is a Hazard Level 1, there are no special requirements for any location.
- If no design measures are taken or mitigating fault analyses made, the default Hazard Level is determined by the Class of laser in the equipment.
- Higher hazard levels require the equipment to be installed in more restricted access locations.
- There are several design techniques to control or reduce the available power at the connector. These include:
 - **Protective housing** - Each OFCS must have a protective housing to prevent access to laser radiation in excess of hazard level 1 limits under normal operating conditions.
 - **Cable Design** - If the potential hazard at any accessible location in an OFCS is hazard level 1M, 2M, 3R or 3B, the fiber optic cable must have mechanical properties appropriate to its physical location.
 - **Cable connectors** - Requirements for cable connectors may be achieved by the mechanical design of the connectors, or by the positioning of the connector, or by use of a tool for disconnection.
 - **Automatic Power Reduction (APR)** - With APR, it is possible to take a laser output that is ordinarily at high levels and use it in any location. There is a specific time interval allowed for the reduced hazard level to be reached. When an APR is used, the hazard level during the shutdown period should be assessed.



- **Labeling** - Optical fiber cables must be marked to distinguish them from cables carrying other services e.g. electricity. Distinguish OFCS fiber in fiber cables if they are the only potentially hazardous fibers in the optical infrastructure.
- Sleeving, a tag or a tape shall be associated with each optical connector if the hazard level at the location is in excess of hazard level 1. The sleeving, tag or tape must be colored yellow, with an appropriate warning label.
- Groups of connectors such as patch panels may be labeled as a group, with a single clearly visible hazard label rather than labeling each connector. If a group of connectors is enclosed in a box, a label must be visible both before and after the access panel is opened, which may require the use of more than one label.
- If the size and design of the product make labeling impractical at the connector, then it should appear near the marking plate of the equipment and in the product's manual or package.
- Labeling or marking is not required in:
 - unrestricted locations for hazard level 1M or 2M;
 - restricted locations for hazard level 1M or 2M, if the requirements for cable connectors in unrestricted locations are met;
 - controlled locations for hazard level 1M or 2M.

LASER INFORMATION REQUIRED

Each laser at ALMA must have the following information, where applicable:

- Description of design features to prevent access to hazardous levels of optical radiation.
- Instructions for assembly, maintenance and safe use, including warnings concerning precautions to be taken to avoid possible exposure to hazardous radiation.
- A statement, in SI units, of the power propagating in the fiber at all locations in the system, together with the maximum modulation frequency.
- The range of operating wavelengths within the optical fiber communication system.
- The reaction time of any automatic power reduction system.
- Legible reproductions of labels and warnings used at locations in an optical fiber system.
- A clear indication of all locations of apertures and fiber connectors.
- A listing of controls, adjustments and procedures for operation and maintenance.
- Safe operating procedures and warnings concerning known malpractices, malfunctions and hazardous failure modes with explicit instructions on safe procedures to be followed.

GENERAL BASIC PRECAUTIONS

The following working practices may be regarded as good practice when working on an OFCS:

- Notify the LSO of the purchase of any laser, regardless of the Class.
- Follow the directions of any posted laser warning sign.
- Never position your body so your eyes are at or below the same level as the beam.
- No laser users under the age of 18.
- Do not stare with unprotected eyes or with any unapproved collimating device at the fiber ends or connector faces, or point them at other people.
- Use only approved filtered or attenuating viewing aids.
- Cover any single or multiple fiber end(s) not terminated with material appropriate for the wavelength and power when not being worked on. Ends should not be exposed.
- Always attach end caps to unmated connectors.
- Do not cleave ribbon fibers as an unseparated ribbon, or use ribbon splicers, unless authorized.
- Collect all fiber off-cuts and dispose of them in an approved container. The container itself should be disposed of in an approved manner.



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- Follow only approved instructions for operating and maintaining the system.
- Use only approved methods for cleaning and preparing optical fibers and connectors.
- Do not make any unauthorized modifications to any OFCS or associated equipment.
- Report damaged or missing optical safety labels to management.
- For equipment with key control, place keys under control of a person who will ensure their safe use, storage and overall control. Retain spare keys under strict control procedures by a Manager.
- Use test equipment of the lowest class necessary and practical for the task.
- Where possible, shut down optical transmission or test equipment, put into a low-power state or disconnect before any work is done on exposed fibers, connectors etc.

WORKING PRACTICES FOR HAZARD LEVEL 3B

- Entry points to controlled areas with a hazard level of 3B must have a sign bearing a warning label and the explanatory label bearing the words “Hazard level 3B”;
- There must be a sign limiting access to authorized persons only and explaining the existence of a potential hazard.
- Working on an energized system with hazard level 3B allocated is not permitted.
- Service or maintenance operations require a permit to work system.
- Use approved optical power meter to check that there is no optical power in the fiber.
- Use only indirect viewing aids. Do not use microscopes or eye loupes;
- Only trained staff is permitted to work on OFCS in a location with hazard level 3B.
- Staff installing, operating or maintaining OFCS and any associated test equipment in locations with hazard level 3B must ensure that untrained personnel are protected.

PERSONAL PROTECTIVE EQUIPMENT

- Laser protective eyewear includes goggles, face shields or glasses with filter materials or reflective coatings to reduce potential ocular exposure below the Maximum Permissible Exposure (MPE) level.
- Wearing glasses designed for one laser wavelength, other than the one you are operating, may be as dangerous as not wearing any eye protection.
- Eye protection devices must be used when engineering controls are inadequate to eliminate the possibility of potentially hazardous eye exposure (i.e., whenever levels of accessible emission exceed the appropriate MPE levels.)
- If laser protective eyewear is required for a given procedure, then **LASER SAFETY EYEWEAR MUST BE OBTAINED BEFORE THE LASER CAN BE TURNED ON!**
- The person responsible to turn on the laser and make sure the safety features are operational during the process is also responsible for proper laser eye protection.
- Where there are visitors to a laser controlled area, and there is the possibility of hazardous diffuse reflections that can exceed the exposure limit, require the use of eye protection for all visitors.
- Label all laser protective eyewear with the optical density value and wavelength for which protection is afforded.

LASER STANDARD OPERATING PROCEDURES

The standard operating procedures required for lasers must contain the following information:

- List of authorized laser personnel
- Training and qualification requirements
- Define laser-specific hazards



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- Define and attach layout of the laser controlled area
- Define room lighting conditions for normal use and alignment procedures
- Define primary beam path (open or enclosed) and all likely beam paths
- Address all credible non-beam hazards
- Procedures for normal use (brief)
- Maintenance procedures
- Alignment procedures (detailed)
- Off-normal and emergency procedures (i.e. beam loss, fire)
- Describe all controls, administrative and engineering
- If a recommended control is not used, the rationale must be documented
- Maximum permissible exposure limit
- Optical density
- Nominal hazard zone
- Equipment labels
- Area signs

LASER SAFETY TRAINING PROGRAM

- Safety and training programs must be instituted for staff working on fiber optic communication systems with a hazard level 3B.
- The LSO is responsible to make training available to all users. Users include operators, technicians, engineers, maintenance, and service personnel.
- The training program must be appropriate to the Class of laser radiation accessible during the required task(s) of the personnel.
- Laser area Supervisors shall maintain the names of all persons trained and date of training and inform the LSO of training completions and requirements.

MEDICAL SURVEILLANCE

- Medical surveillance requirements are limited to those that are clearly indicated to have potential for exposure to laser radiation.
- If ophthalmic examinations are undertaken, they should be carried out by a qualified specialist and should be confined to workers using Class 3B and Class 4 lasers;
- A medical examination by a qualified specialist must be carried out immediately after an apparent or suspected injurious ocular exposure. This will be supplemented with a full investigation of the circumstances under which the accident occurred;

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Maintain an inventory of all lasers under your control and forward a copy to the LSO (class 3 & 4).
- Develop and maintain a SOP for all laser activities.
- Control all work on Class 3B lasers using a permit system.
- Inspect laser controls prior to start up, after any modifications, and at least semi-annually. Document inspections.
- Ensure that visitors are protected at all times from any laser radiation.
- Ensure that laser users have appropriate medical certification prior to the start of laser work.



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- Maintain a list of trained, qualified and approved users for lasers under your control.
- When alterations are made to an OFCS, determine whether the alteration could affect the hazard level.
- Ensure that APR, if used, is in appropriate working condition.
- Ensure that suitable access controls and warning labels are employed on controlled and restricted locations.
- Identify the location type at all accessible locations of the entire OFCS;
- Ensure that the hazard levels are not exceeded for those location types under reasonably foreseeable events;
- Ensure that access to restricted and controlled locations is appropriately addressed.
- Report the introduction of any new lasers to the ALMA Safety Office.

SAFETY OFFICE

- The Laser Safety Officer (LSO) has responsibility and authority to manage the overall laser safety program. An LSO is not required for operation of Class 2 or 3R laser system. Nor is an LSO usually required if maintenance and Class 3R. If service is performed on a laser product with an enclosed Class 3B or 4 lasers, it is necessary to designate an LSO.
- Ensure that any work on the OFCS is appropriately permitted.

INDIVIDUALS

Individuals are responsible to:

- Follow all warning signs and notices with respect to the safe use of OFCS.
- Wear appropriate personal protective equipment when working on OFCS systems.



9 - Personal Protective Equipment

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9. PERSONAL PROTECTIVE EQUIPMENT

9-1 PPE General Requirements

- 1) **Purpose** - This procedure establishes the requirements for the assessment of hazards, selection and use of approved head, hand, foot, and clothing personal protective equipment (PPE), and employee training.
- 2) **Scope** - This policy is applicable for everyone that works at the ALMA Site. Executive staff and visitors are covered by this policy when visiting areas where PPE is required. References include:
 - Directive 89/656/EEC – Minimum requirements for use of PPE at the workplace.ISO 20345:2004 Personal protective equipment -- Safety footwear
 - ISO 22608:2004 Protective clothing -- Protection against liquid chemicals -- Measurement of repellency, retention, and penetration of liquid pesticide formulations through protective clothing materials
 - ISO 20346:2004 Personal protective equipment -- Protective footwear
 - ISO 20347:2004 Personal protective equipment -- Occupational footwear:Executive Decree No. 954, Approving the Regulations on Basic Sanitary and Environmental Conditions in the Workplace.

3) Rules / Requirements

GENERAL REQUIREMENTS

- The best approach to the protection of personnel is to eliminate the hazard. Where this is not feasible, personnel are required to wear the appropriate PPE.
- PPE must be worn when permanent engineering controls have not eliminated the hazard. This includes temporary work and emergency actions.
- All PPE must be of approved design and construction.
- PPE must be maintained and kept clean and used properly.
- Where areas are posted, the appropriate PPE must be worn.
- For tasks where the hazards have not been identified, the Supervisor must conduct a pre-job hazard assessment as described below to determine the PPE requirements.
- ALMA will provide affected workers, at no cost, personal protection appropriate to the risk.

HAZARD ASSESSMENT

- Conduct a walkthrough survey of the space to identify sources of hazards to workers.
- Document the body part impacted and a description of the source of the hazard.
- Describe any identified protection requirements.
- Review the completed hazard assessment with the ALMA Safety Office.

HEAD PROTECTION

- Use hard hats to protect workers from impact, flying particles and electric shock.
- The use of bump caps is not allowed except in areas where confined space restricts mobility.



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- Approved hardhats must be worn at all times where construction activities are in progress, inside antennas' areas and Warehouse, everywhere where handling or loading equipment is being carried out and all other hazardous areas.
- Residential and office areas are considered locations where hard hats are not necessary.
- Persons working at machinery must also consider means to protect long hair from contact with moving parts. Protective caps binding the hair should be used.
- Supplementary hardhat equipment including liners, chin straps, and sweatbands must be used as specified by the hard hat manufacturer.
- If a face shield is necessary in an area where a hard hat is also necessary, the user must use a face shield that combines with a hard hat.
- It is not permitted to modify hard hats in any way.
- Hard hats must be worn and fit properly. It is not permitted to wear hard hats backwards on the head.

HAND PROTECTION

- Persons handling materials or equipment likely to puncture, cut, abrade or irritate hands or arms, must wear suitable gloves to provide protection from such injury.
- The gloves used shall be appropriate to the hazard to which the worker is exposed and provide an adequate level of protection.
- Persons handling chemical substances which may be absorbed through the skin must wear hand protection made of a material appropriate for protection from the substance being handled.
- Consider the wearer's need for dexterity. It may be advisable to reduce the size and thickness of the glove to allow the user to perform manipulations safely.
- Caution is required in using gloves around moving equipment. Gloves should not be worn by anyone whose hands are exposed to moving parts in which they could be caught.
- Gloves with metal parts or reinforcements must not be worn around electrical apparatus.

FOOT PROTECTION

- Protective footwear protects the feet from heavy or rolling objects. Required for Antennas' access, operations and Sites Erection Facilities (SEF)
- Protective footwear may also incorporate conductive or non-conductive properties, sole puncture resistance (S3), slip resistance, and insulation features.
- Where employees are exposed to a moderate risk of foot injuries from falling objects or crushing actions, employees are required to wear safety-toe footwear.
- Sandals (or alike) are not allowed at any construction, workshop, or digging / excavation, antennae area
- Closed-toe shoes shall be worn in all laboratory operations where there is a likelihood of exposure to spilled chemicals.
- Employees are required to obtain safety-toe footwear on their own and reimbursed by their departments. Reimbursement for safety shoes will be given once a year. Only shoes that comply with Chilean regulation regarding certification will be reimbursed (Norma Chilena 721 del INN 1997). The safety department will have to approve the model and brand of the shoes so the reimbursement process can be carried out.
- Slip resistant footwear must be worn in the kitchen operations and areas where there are wet working surfaces.
- Sandals, clogs, canvas or nylon type shoes, and open toe shoes are not permitted outside office spaces at the OSF.



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- Temporary or probationary employees who require safety-toe foot protection may be provided safety toe caps that reasonably adapt and fit over regular work shoes.
- Electrical Hazard Safety footwear shall provide protection against open circuits of 600 volts or less under dry conditions. No metal parts shall be incorporated in the sole or heel of the shoe.
- Steel toe shoes or ACM (Advanced Composites Materials) are required in construction areas.

PROTECTIVE CLOTHING

- Possible hazardous exposures can occur in different environments. When there is a possibility of exposure hazards, special protection must be considered and used.
- Examples of protective clothing include aprons, lab coats, gloves, and chaps.
- Disposable clothing may be used to protect where contamination is a concern.
- Consider non-conductive clothing for use in areas where conductive issues are present.
- The Observatory provides cold weather work clothing to employees which are deemed to be necessary for the efficient and safe performance of the normal duties of those employees. See Cold Weather Clothing Procedure.

TRAINING

- Employees that are required to wear PPE must be trained.
- Training includes when PPE is needed, what PPE is necessary, proper use and care of PPE, limitations of PPE.
- Each employee must demonstrate understanding of the training and an ability to use the PPE.
- Retraining is necessary only when there are changes in the program or inadequacies are noted.
- Training must be recorded and certified.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Designate areas, activities and occupations which require PPE. Evaluate all their work areas and tasks and assess the risk for injuries, plus slips and falls and electrical shock where use of PPE may have an impact.
- Ensure appropriate, approved PPE is being worn.
- Provide adequate storage and care capability for PPE.
- Ensure PPE requirements are being followed.
- Ensure that PPE is not contaminated.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Inform staff of these requirements.
- Maintain records of the required assessment.
- Train employees required to wear PPE.
- Provide consultation and guidance to management for all PPE program elements.
- Audit the PPE program and assist management in developing effective strategies for needed improvement.

INDIVIDUALS

Every ALMA employee must:



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- Be responsible for the safe use of PPE.
- Wear the required and approved PPE as part of their daily uniform.



9 - Personal Protective Equipment

9-2 Eye and Face Protection

- 1) **Purpose** - This procedure establishes the requirements for the assessment of hazards, selection and use of approved eye and face personal protective equipment, PPE, and employee training.

- 2) **Scope** - This procedure is applicable for everyone that works at the ALMA Site. Executive staff and visitors are covered by this policy when visiting areas where eye and face protection is required.
References include:
 - Directive 89/656/EEC – Minimum requirements for use of PPE at the workplace.
 - ISO 4850:1979 Personal eye-protectors for welding and related techniques -- Filters -- Utilization and transmittance requirements

3) Rules / Requirements

GENERAL REQUIREMENTS

- The best approach to the protection of personnel is to eliminate the hazard. Where this is not feasible, personnel are required to wear appropriate eye and face protection.
- Persons that wear corrective eyeglasses should wear protective lenses over the corrective lenses.
- Complete eye protection includes the use of side shields.
- Employees and visitors must be provided with and use approved eye and face protection in all areas where required.
- Only ALMA provided or issued PPE is permitted.
- Visitor spectacles are not to be worn by employees in lieu of proper safety lenses.
- Contact lenses cannot be worn in place of appropriate eye protection . Contact lenses do not provide sufficient protection from foreign bodies or chemicals in the eye.
- Any employee working in the vicinity of operations requiring eye protection must wear approved protection.

USE OF EYE PROTECTION

- Employees are required to wear appropriate eye protection during tasks that could expose them to potential eye injuries.
- Eye protection areas at ALMA is required in all areas where eye injuries may occur as a result of the work activity. Safety glasses must be worn in the following circumstances:
 - Machining operations
 - Electrical and electronic testing
 - Soldering
 - Working with compressed air
 - Using hand tools
 - Under welding helmet
 - Chemical operations
 - **Sun ray exposure**



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- Side shields are required in machine shop areas.
- Chemical protective eyewear must be worn during all spraying or chemical handling operations.
- Full face shields must be worn when handling corrosive or highly hazardous materials.
- Glasses with tinted lenses are required when employees are exposed to glare and harmful solar radiation during outdoor operations.
- Laser operations require specialized eyewear protection.

SIGNS AND LABELS

- Operations requiring eyewear or face protection must be appropriately labeled.
- If an entire area does not require eyewear, then the operations requiring protection must be labeled.
- Warning signs must be posted at the appropriate locations such as entrances to such areas to inform employees that they are entering an area where eye protection is required.

EYEWEAR ADMINISTRATION

- Single vision plan prescription safety glasses shall be provided to employees at no cost.
- Prescription eyewear must be equipped with side shields. Side shields are required in machine shop areas and other posted areas.
- Replacements shall be provided if eyewear is damaged or whenever there is a prescription change, but no more frequent than annually.
- Replacement eyewear for glasses damaged at work shall be replaced at no cost to the employee. Replacement glasses must be of equal or lesser value than the original pair.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Designate areas, activities and occupations which require eye protection.
- Perform a job hazard analysis to determine the need for eye protection.
- Authorize employees to purchase eyewear.
- Ensure employees and visitors are provided with eye and face protection where required.
- Label operations requiring eyewear or face protection.
- Ensure appropriate, approved eyewear is being worn.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide standard safety eyewear.
- Inform staff of these requirements and assist in determining eyewear requirements for hazardous areas.
- Provide consultation and guidance for eyewear program elements.
- Make sure that Sun block cream is available at the site.

INDIVIDUALS

Every affected person must:

- Follow the requirements of this policy.
- Wear the approved eyewear as required.



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- Wear approved eyewear when working near operations requiring eye protection.
- Protect the skin against the sun ray exposure. Sun block cream is available at the site.



9 - Personal Protective Equipment

9-3 Hearing Conservation - NOISE – See also 9.6- Ergonomics

- 1) **Purpose** - This procedure establishes the program for hearing protection from occupational exposure to noise during work operations.
- 2) **Scope** - This procedure is applicable for everyone that works at the ALMA Site. Executive staff and visitors are covered by this policy when visiting areas where PPE is required. Visitors are covered by this policy when visiting a hearing conservation area. References include:
 - Directive 80/117/EEC – Provides for the protection of workers from exposure to chemical, physical and biological hazards.
 - Directive 86/118/EEC – Relating to the exposure to noise
 - Directive 89/656/EEC – Minimum requirements for use of PPE at the workplace.

3) Rules / Requirements

GENERAL REQUIREMENTS

- Every attempt must be made to reduce the noise level to acceptable levels using engineering controls and design methods.
- Exposure reduction may be accomplished by administrative methods.
- Personal protection shall be provided in the form of ear plugs or muffs. Use is mandatory where specified.
- Cotton inserts are prohibited at ALMA due to their low attenuation capability.
- Ear plugs need to be properly fitted for each individual.
- Hearing protection must be worn in areas where monitoring indicates the potential for exposures to high noise levels.
- Areas where noise levels exceed or equal 80 dBA must be posted with warning signs, and hearing protection offered.

LIMITS

- No employee may be exposed to an 8 hour time weighted average above 85 dBA.
- Past this level, hearing protection has to be worn by employees.
- No person is permitted to be exposed to any noise level in excess of 140 dB.
- The following table details the maximum exposure limits for the ALMA site.

Maximum Exposure Limits (Noise)

Duration (Hours / day)	Sound Level (dBA)
8	85
4	88
2	91



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1	94
1/2	97
1/4	100
7.5 minutes	103

MONITORING

- Any excessively noisy area must be reported to the Safety Office.
- The Safety Office will conduct monitoring when there are indications that the exposure to noise equals or exceeds 80 dBA.
- Initial monitoring may be performed using handheld sound level meters.
- If initial monitoring indicates potential to exceed the above listed exposure limits, then a sampling program must be performed to identify exposed employees.
- Instruments used to monitor the sound levels must be calibrated before use.
- The use of personal sampling may be used to determine the exposure levels.
- Monitoring must be repeated when there is a change in operations.
- Affected employees may participate in the monitoring.
- Each affected employee shall be notified of the results of monitoring and any corrective actions planned.

AUDIOMETRIC TESTING

- All employees exposed at or above the 80 dBA level shall be included in the audiometric testing program.
- Testing is provided at no cost to the employee.
- Audiograms shall be compared to the employees baseline to determine if there is a threshold shift of 10dB or more at the 2000, 3000, and 4000Hz sound levels.
- If there is a threshold shift, the employee shall be notified within 21 days.
- Such employees shall be required to go through retraining on the use and care of hearing protection.
- Each such employee shall be provided with hearing protection with greater attenuation if possible.
- Refer the affected employee to medical evaluation as appropriate.

TRAINING

- Training for affected employees shall consist of the following as a minimum:
 - The effects of noise on hearing.
 - Purpose of hearing protection including limitations, use and care of PPE.
 - The purpose and procedures for audiometric testing.

RECORDKEEPING

- The Safety Office maintains records of all elements of the hearing conservation program.
- Employee exposure measurements must be maintained indefinitely.
- Audiogram records must be maintained as confidential medical information.
- Audiograms must include the employee name, date of audiogram, examiner, date of calibration, and the employee's most recent noise exposure assessment.



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Designate areas, activities and occupations which require hearing protection.
- Perform a job hazard analysis to determine the need for hearing protection.
- Ensure that employees and visitors are provided with approved hearing protection in all areas where required.
- Reduce noise levels to acceptable levels using engineering controls and design methods.
- Ensure hearing protection is worn in areas where monitoring indicates the potential for exposures to high noise levels.
- Post areas where the noise level exceeds or equals 80 dBA, and provide appropriate PPE.
- Report any excessively noisy area to the Safety Office.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide hearing protection.
- Assist in determining appropriate hearing protection requirements for hazardous areas.
- Refer affected employees to medical evaluation as appropriate.
- Notify affected employees of the results of monitoring and planned corrective actions.
- Include employees exposed at or above the 80 dBA level in audiometric testing program.
- Notify employees if there is a threshold shift in audiograms.
- Conduct monitoring when there are indications that the exposure to noise equals or exceeds 85 dB.
- Calibrate instruments used to monitor the sound levels before use.
- Use personal sampling to determine the exposure levels.

INDIVIDUALS

Every ALMA employee must:

- Be responsible for the safe use of PPE (mandatory above 85 dBA)
- Report any excessively noisy area to the Safety Office.
- Wear approved hearing protection devices when working in the vicinity of noisy operations.
- Participate in training on the use and care of hearing protection.



9 - Personal Protective Equipment

9-4 Respiratory Protection

- 1) **Purpose** - This procedure establishes the program for the use and care of respiratory protection during work operations. Additionally, this policy establishes the program for selecting, medically evaluating, and training affected personnel.
- 2) **Scope** - This procedure is applicable for everyone that works at the ALMA Site. Executive staff and visitors are covered by this policy when visiting areas where PPE is required. Visitors are not permitted to enter areas at ALMA where respiratory protection is required. References include:
 - Directive 89/686/EEC – Personal protective equipment

3) Rules / Requirements

SELECTION

- Supervisors shall evaluate the need for respirators with a hazard assessment of the workspace.
- Respirator cartridge selection must be based on the contaminants present.
- Consideration shall be given to the need for particle removal, gas and vapor removal, and oxygen levels.
- The Safety Office will make the final determination of the need for respiratory protection.

FIT TESTING

- Generally, follow instructions of the manufacturer.
- Proper fit of respirators is essential.
- Respirators and straps must be in place and worn appropriately.
- No beards or facial hair are allowed to interfere with the face seal.
- Perform a pressure fit test every time the respirator is worn.
 - Cover air inlets with the palms.
 - Breathe gently to set the facial seal.
 - Hold your breath for 10 seconds.
 - If the respirator maintains the seal, the seal is adequate.
 - Cover the exhalation valve with the palms of the hand.
 - Exhale gently: pressure indicates the face seal is adequate.
- All employees required to work under respiratory protection must participate in a fit test as part of the training requirements.
- Annual qualitative fit testing is conducted and documented by the Safety Office.

MAINTENANCE

- Respirators assigned to individuals must be cleaned and sanitized by the user after use.
- Damaged respirators requiring maintenance are to be removed from service and returned to the Safety Office.
- Respirator cleaning must be performed as follows:
 - Remove any respirator cartridges before immersion in water.



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- Immerse the respirator in a warm water solution of soap.
- Gently scrub the respirator face piece with a soft brush or cloth.
- Do not scratch any face lenses.
- Remove all dirt from the exhalation valves and inlet valve seats.
- Rinse the respirator thoroughly.
- Allow the respirator to air dry.
- Visually inspect the respirator to ensure it is in good working order.
- Store the respirator in a storage bag away from sunlight, heat and contamination.
- Do not store anything on the respirator as it can deform and damage the unit.

INSPECTION

- Each individual assigned a respirator must inspect the respirator before and after use.
- Emergency use respirators must be inspected monthly and the results of the inspection documented.

MEDICAL APPROVAL

- Only individuals medically approved are authorized to wear respirators.
- Workers that are not medically certified to wear respirators are not to be assigned to jobs requiring respiratory protection.
- Each employee required to wear a respirator must be evaluated by a medical doctor for a medical opinion for fitness to wear a respirator.
- The employee must complete the medical questionnaire and complete a pulmonary function test annually.
- The attending doctor must issue a written opinion as to the ability of the employee to wear a respirator.
- All records of the medical screening shall be maintained by the Safety Office.

TRAINING

- Each user must understand and be able to apply the requirements of this policy.
- Training shall be conducted by the Safety Office and will include as a minimum:
 - The need, use, care, and limitations of the respiratory equipment.
 - Inspection requirements for the respirators.
 - Proper fit testing techniques.
 - An opportunity to wear the equipment in normal air for familiarity.
 - Selection of appropriate respirators.

EQUIPMENT

- Only approved respirators are permitted for use.
- Selection of respirators depends on the airborne contaminant present.
- Use air purifying respirators only in atmospheres with sufficient oxygen present.
- Supplied air respirators are for oxygen deficient atmospheres and higher concentrations of contaminants. At this time, air line respirators are not anticipated at ALMA.
- No employee may enter an atmosphere that is over 50% of the level considered Immediately Dangerous to Life or Health, IDLH, for the contaminant.
- Only ALMA provided respirators are permitted for use.
- Emergency response respiratory protection must only be used for emergency purposes.

RECORDKEEPING

- The Safety Office maintains records of the respiratory protection program.



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- Maintain medical approval information for the length of employment plus 30 years.
- Fit test records shall be maintained for three years.
- Training records shall be maintained for three years.
- This policy shall be reviewed annually by the Safety Office.
- Employee exposure measurements must be maintained indefinitely.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Designate activities and occupations which require respiratory protection.
- Select processes and methods that limit the necessity to wear respirators to a strict minimum.
- Perform a job hazard analysis to determine the need for respiratory protection.
- Ensure that employees are provided with approved respiratory protection where required.
- Ensure visitors are prevented from entering restricted areas.
- Reduce contaminants to acceptable levels using engineering controls and design methods.
- Post areas where respirators are required.
- Inspect emergency use respirators monthly and document the results of the inspection.
- Ensure that workers that are not medically certified to wear respirators are not assigned to jobs requiring respiratory protection.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Determine the right respirator for each hazard situation.
- Select processes and methods that limit the necessity to wear respirators to a strict minimum
- Training shall be conducted by the Safety Office.
- Maintain records of all elements of the respiratory protection program.
- Refer affected employees to medical evaluation as appropriate.
- Document and perform qualitative fit testing no less than annually.

INDIVIDUALS

Every ALMA employee and visitor must:

- Complete the medical questionnaire and a pulmonary function test annually.
- Employees are responsible for their own safe use of PPE.
- Perform a pressure fit test every time the respirator is worn.
- Participate in a fit test as part of the training requirements.
- Participate in training on the use and care of respiratory protection.
- Remove damaged respirators from service and return to the Safety Office.



9 - Personal Protective Equipment

9-5 Use of Fall Protection

- 1) **Purpose** - This procedure establishes the requirements for wearing fall protection when working on elevated work surfaces at the ALMA site.
- 2) **Scope** - This procedure is applicable for work activities such as: work on sloped roofs, towers, antennas, lifts, and unguarded scaffold. This policy is mandatory for all ALMA employees, contractors working on ALMA facilities, and visiting Executive staff. Visitors are prohibited from climbing on antennas and other elevated work surfaces where fall protection is required. References include:
 - Directive 89/686/EEC – Personal protective equipment
 - ISO 16024:2005
 - Personal protective equipment for protection against falls from a height -- Flexible horizontal lifeline systems
 - ISO 14567:1999
 - Personal protective equipment for protection against falls from a height -- Single-point anchor devices

3) Rules / Requirements

FALL PROTECTION REQUIREMENTS

- Workers working on elevated surfaces must be protected at all times.
- Fall Protection is defined as the use of fall protection devices including full body harnesses, lanyards, ladder safety devices, and anchorage points to prevent an accidental fall from elevation.
- Permanent, or collective, fall protection includes permanent prevention devices.
- The Supervisor of any employee expected to climb on elevated surfaces shall perform an analysis for appropriate fall protection in the following instances:
 - On every fixed ladder and scaffold, regardless of the height above ground level.
 - On all powered aerial devices, or lifts, regardless of height above ground level.
 - On all platforms where removable railings are not in place or are in the process of being installed.
 - On all structures where work is performed near an unprotected leading edge of floor openings, wall openings, and edges of structures.

FALL PROTECTION PRACTICES

- All individuals climbing on elevated work surfaces where fall protection is required must be trained in the use of the fall protection equipment.
- **Fall arrest protection** must be worn whenever working around an open hole 2 meters deep or more.
- **A full body harness** must be worn when working above an open hole of 2 meters deep or more.



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- **Always cover an open hole** as much as possible to carry out work around it. Do not work with an uncovered open hole overhead. Install a head cover.
- Climbers should restrict themselves to stairs, walkways, or platforms whenever possible.
- All first time climbers must be accompanied by an experienced climber.
- No one is to climb on any antenna unless necessary. Only those with a reason to climb shall be permitted to do so.
- Exercise good judgment when climbing. Do not climb when tired or ill.
- Any fall protection device subjected to a fall shall be removed from service.
- Lanyards shall only be connected to anchorage points capable of supporting 5000 pounds per worker. Anchorages must be evaluated and the analysis report provided to the Safety Office.
- Do not tie off lanyards to sharp edges.
- All fall protection must be formally inspected and documented annually.
- All employees using fall protection must have documented training.
- See the Safety Officer for guidance in the use of harnesses, lanyards, and anchorage points.

LIFELINES, SAFETY BELTS AND FULL BODY HARNESS

- Workers working on elevated surfaces.
- Employees working underground - approved belt with a “D” ring.
- Grommets and keeper must be in place.
- Never cut a belt or put holes in it.
- Make sure your belt is in perfect conditions.
- Ensure that the lifeline is securely anchored.
- Do not anchor around a sharp object.
- Never use a lifeline as a sling to lift objects.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Evaluate the need for fall protection on all work activities as part of job planning.
- Discard outdated fall restraint equipment
- Ensure appropriate emergency resources are at hand, in case an employee falls into the restraint system
- Implement appropriate fall protection including development of a written safety analysis.
- Provide and maintain fall protection for employee use.
- Ensure personnel are trained in the use of fall protection and ensure that fall protection is used when required by this policy.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Select fall protection equipment to ensure the equipment selected is compatible with existing fall protection systems.



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- Review safety analyses of the hazards identified that may require the use of fall protection.
- Provide fall protection training in the policies and use of equipment to designated personnel.
- Maintain fall protection records, and anchorage points analysis reports.

INDIVIDUALS

All individuals are responsible to:

- Wear fall protection where required.
- Inspect prior to use, any fall protection used in work activities.
- Report any damages to fall protection equipment.



9 - Personal Protective Equipment

9-6 Ergonomics at Workplace

1) **Scope** – This safety rule aims to establish the rules and regulations applicable to every workplace regarding Ergonomics:

- RD[1] Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.
- RD[2] Council Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace (first individual directive within the meaning of Article 16 of Directive 89/391/EEC).
- RD[3] Council Directive 90/269/EEC of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers (fourth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC). RD[4] Council Directive 90/270/EEC of 29 May 1990 on the minimum safety and health requirements for work with display screen equipment (fifth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC).
- RD[5] EN ISO 7730 (1994) – Thermal Comfort Standards.
- RD[6] ISO IEC 8995 (2002) – Lighting Standards.
- RD[7] Ley 19404 and Decreto 594 to comply with Chilean standard as a base.

See also:

http://ergonomics.about.com/od/workplaceergonomics/Ergonomics_for_the_Workplace.htm
<http://www.spine-health.com/wellness/ergonomics/ergonomics-office-and-workplace-overview>

2) Definitions

Ergonomics (or Human Factors). Ergonomics deal with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well being and overall system performance.

Work Related Stress. Work related stress is seen as an “emotional and physiological reaction to the unfavorable and adverse aspects of work, the working environment and work organization. Stress is a state characterized by a high level of activity and strain and which often involves the feeling of not being able to cope with the situation” (European Commission, Directorate-General V, 1997).

Strain. Stress is a natural reaction on the part of the organism to external strains of ALL kinds. This reaction is expressed physically, in experience and behavior. Strains, which include stress in humans, are called stressors.

In this context strain is seen as the influences acting on the employees from the task in hand, the work situation and environment and the organizational parameters (e.g. pressure of time). The term “strain” therefore describes the requirements, which act on employees from outside.

Manual Transport of Loads. Any transport in which the weight of the load is wholly borne by one worker; it covers the lifting and putting down of loads.



Regular Manual Transport of Loads. Any activity, which is continuously or principally devoted to the manual transport of loads, or which normally includes, even though intermittently, the manual transport of loads.

3) Work Strain and Stress

Workplace stress is one of the biggest causes of employee sickness absence.

4.1 Stress due to Work Organization and Social Factors

Among the most important stress-including factors (stressors) are pressure of time and the pressure to achieve, restricted scope for decision-making and lack of support or lack of recognition from colleagues and superiors.

All staff with supervising functions shall periodically assess the following features of the work situation, determined as they are by work organization and psychosocial factors, since they result in stress:

- A combination of quantitative overload (e.g. compression of work, work requiring close and continuous attention, work under the pressure of supervision and the need to meet deadlines) with little scope for action (lack of opportunity to intervene and exercise autonomy);
- A combination of quantitative overload with qualitative lack of demands (e.g. very monotonous work which does not fully utilizes abilities and skills);
- A combination of lack of mental demands and little scope for action;
- A lack of social support (especially from supervisors and colleagues) and a lack of recognition for achievement.

4.2 Stress due to Deficient Ergonomic Design

Shortcomings in the ergonomic design of workplaces, work equipment (machines, installations), working processes, workshops and laboratories can cause stress.

Care must be taken to consider mainly multiple strains arising from a combination of specific tasks, physical influences (noise, heat or cold, humidity, high altitude, vibration), chemical influences (hazardous substances) and biological influences (e.g. sources of infection). If, for example, demanding tasks have to be dealt with under time pressure and if noise is present as an additional stressor, stress will be triggered or reinforced by the impaired ability to concentrate and perform.

4.2.1 Workplace Space

With regard to the workplace space, offices or other rooms with permanent workplaces should have a floor space of at least 8 m^2 , if occupied by one person. In case there are additional persons permanently working together, 4 m^2 need to be added per person.

Rooms with areas up to 50 m^2 must be at least 2,50 m high. For areas above 50 m^2 the height must be at least 2,75 m and for areas with more than 100 m^2 a height of at least 3,00m is required.

Each workroom must have at least a minimum headspace of 12 m^3 (when sitting is major action), 15 m^3 (when major action is not sitting) and 18 m^3 (heavy work).

4.2.2 Workplace Design



With regard to workplace design, there are dimensional key values, which are intended to help keep the strains for the employees as low as possible.

Ideally, each employee must have at least 1,50 m² free working area at his/ her workplace. The movement area shall never be below 1,00 m width. If the free working area is below 1,50 m² the employer must provide a 1,50 m² free working area nearby the workplace.

4.2.3. Working Environment

Conditions of the working environment result in stress in different ways:

- As a real or assumed risk factor;
- As a disturbing factor which hinders performance of a task;
- In combination, as a reinforcing element with other stressors (e.g. time pressure or noise).

The following chapters provide data constrains for Thermal Comfort (temperature, humidity, air flow), Lighting and, Noise at ESO workplaces.

4.2.3.1 Thermal Comfort

The following values apply to interior conditions intended for everyday use.

General Activity	Temperature (C)			Relative Humidity (%)			Air Velocity (m/s)
	Min.	Rec.	Max.	Min.	Rec.	Max.	Max.
Administrative work	20	22	24	40	50	70	0.1
Light manual work, seated	18	20	24	40	50	70	0.1
Light manual work, standing	17	18	22	40	50	70	0.2

Table 1 – Minimum – Recommended – Maximum values for temperature, relative humidity and air flow velocity for different types of work

The temperature should not exceed 26 °C for a long period. If the values mentioned in Table 1 exceed the foreseeable temperature, relative humidity or air velocity, the respective staff with supervising functions shall take adequate organizational measures (as for example, restriction of maximum working hours, provision of free soft drinks, variability of tasks, etc.) to support the employees concerned.

4.2.3.2 Lighting

The following values apply to interior lighting intended for everyday use.

General Activity	Typical Locations / Types of Work	Nominal Luminance (Lux)
Movement of people.	Corridors, Circulation routes.	50
Work requiring limited perception of detail. Storage hall, House-technique as well as Staircases, Stairs	Storage hall, House-technique as well as Staircases, Stairs	100
Work requiring perception of detail.	Shipment, Cafeteria, Canteen, Offices, Assembly/ Integration hall	200
		500



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Work requiring perception of fine detail.	Drawing offices, factories assembling electronic components, electronic lab, mechanical workshop	750
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Table 2 – Nominal luminance for different types of work

Generally, the illumination decreases over the time. In any case, the illumination shall not fall below 0.6 of the nominal value listed in table 2.

It is recommended to make full use of natural daylight, although daylight by itself does not usually provide sufficient illumination throughout the whole working area and for the whole working day. Hence, natural and artificial light shall be combined.

4.2.3.3 Noise – See ASM section 9.3

The following values in Table 3 refer to the maximum noise levels for different types of work and apply to exposure along 8 working hours per day, 5 days per week.

Types of Work	Maximum Noise Level [dB(A)]
High quality scientific work	45
Work requiring large amount of mental concentration (e.g. general office work)	55
Work requiring verbal communication or great accuracy and attention	70
Work involving noisy equipment (Ears Protection)	80

Table 3 – Maximum noise levels for different types of work

Include employees regularly exposed at or above the 80 dBA level in audiometric testing program.

Distracting noises exceeding the limits shown in Table 3 should be removed or controlled. For example, acoustic hoods should be placed over printers and copy machines if necessary or should be placed away from the immediate working area.

Noise from technical equipment should be as low as possible. If equipment noise tends to increase, contact maintenance staff / IT helpdesk immediately.

4) Manual Material Handling – See ASM Section 7.3

- Manual material handling activities have the potential to lead to musculoskeletal disorders.
- No worker should be required or permitted to engage in the manual transport of a load, which by reason of its weight is likely to jeopardize his health or safety.
- Where the need for the manual handling of loads by workers cannot be avoided, the respective direct supervisor must take the appropriate organizational measures, use the appropriate means or provide workers with such means in order to reduce the risk involved in the manual handling of such loads.



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- Any worker assigned to regular manual transport of loads must, prior to such assignment, receive adequate training or instruction in working techniques, with a view to safeguarding health and preventing health and preventing accidents.
- Such training or instruction must include methods of lifting, carrying, putting down, unloading and stacking of different types of loads.
- Additionally, workers should have precise information on the weight of the load and the centre of gravity of the heaviest side when a package is eccentrically loaded.
- Please estimate your maximum load for manual handling prior to your handling task - See ASM section 7.3.
- Maximum Manual Handling of materials at any time is 25 Kg for all ALMA personnel
- Pregnant and/or nursing female ALMA employees are only allowed to manually handle 10 kg

- Manual Handling of loads must be performed with the use of the inferior members and not with the back. The correct posture must be that where the shoulders are pushed backwards, the back is straight and the knees are bent. The load must be held the closest possible to the body.

5) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Support their staff and periodically assess the workplace conditions and implement the necessary actions to eliminate and/or reduce potential sources of risks.

The following major key issues need to be reviewed:

- Work Strain and Stress:
 - Stress due to work organization and social factors.
 - Stress due to deficient ergonomic design:
 - Workplace design.
 - Working environment, i.e., thermal comfort (temperature, relative humidity and air flow velocity); lighting and noise.
 - Workplace Space.

Manual Materials Handling.

The assessment can be made by following the guidance provided into ASM - section 7.3.

Due to environmental constrains (Temperature, Humidity, and Building design), alternative health measures might be required at some ALMA Facilities.

- Ensure employees have received the appropriate training.
- Ensure employees and visitors are provided with approved PPE in all areas where required.

SAFETY OFFICE

Based on a workplace hazard analysis the Safety Office shall take, if required, adequate measures on a case by case basis so that employees are able to cope with the situation at their workplaces.

The ALMA Safety Office is responsible to:

- Ensure the workplace assessment is properly done.
- Assist in determining corrective actions.
- Provide PPE.
- Control the compliance to the standards.
- Keep records of any inspections and action items completion.



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INDIVIDUALS

Every ALMA employee must:

- Report any ergonomic issue to their manager and/or the Safety Office.
- Participate in all appropriate trainings.



10- SITE ACCESS POLICY

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10. SITE ACCESS POLICY

10-1 General Access Requirements

- 1) **Purpose** - To provide clarification and guidance for control and monitoring of access to ALMA.
- 2) **Scope** - This procedure is valid for access to all areas of the ALMA site. The access policy applies to employees, group visits, contractors, subcontractors, scientific staff visitors, as well as visitors in the direct charge of an authorized person. This policy is also valid for external parties authorized to use the ALMA road unless there is a separate bilateral agreement with ALMA or one of the ALMA partners or Executives. The policy does not apply to the control of casual visitors that cross into the site from locations other than the designated entry location(s). References include:
 - Directive 89/391/EEC - Introduction of measures to encourage improvements in the safety and health of workers at work

3) Rules / Requirements

GENERAL

- Access for visitors to ALMA must be authorized through the ALMA headquarters office in Santiago, Chile by the Director or his deputy, or the Site Manager at the OSF. For additional information on the procedures for visiting the site, please see <http://wikis.alma.cl/twiki/bin/view/ALMASafety/WebHome>
- Always cooperate with the barrier guard. All individuals and vehicles entering the ALMA Site are potentially subject to search.
- Any vehicle or person refusing search will be denied access.
- All persons of the ALMA camp and Contractor camp, travelling to and from San Pedro, must check-out and check-in* at the gatehouse by individually showing their ID cards to the guard.
- The First day safety training is requested before the first access, at the gate.
- The General Safety training is mandatory for all staff working at ALMA Site, before starting the work. Nobody may work alone until s/he receives this Safety training.
- Register all valuable items at the guard upon entry to the site. Do not remove any property without prior written registration.
- All vehicles entering ALMA must be registered, have a valid technical certificate and have adequate insurance.
- It is recommended that all vehicles intended for use at the AOS have a minimum 130 hp diesel engine, meet all safety requirements and be in good operating conditions.
- Use of personal vehicles is not permitted beyond the Operations Support Facility (OSF).
- All visitors must coordinate their activities with the Site Manager or MOD.
- Drivers of vehicles entering the site are subject to breath alcohol testing by the guard.
- See Section 10-4 – Vehicle Use at the ALMA Site, for established speed limits and sanctions for speeding on the site.
- Access to areas on or near the ALMA concession requires prior authorization from Site Manager or MOD and Safety Office.
- Excursions for any off road work must be coordinated with the Safety Office.



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- If walking, keep to marked roadways and/or within sight of ALMA facilities. Notify the ALMA Safety Office when leaving the roads at the AOS.
- The gates to the ALMA site closes every evening at 12:00 a.m., for inbound traffic, and open again at 7:00 a.m. outbound traffic will not be affected.
- No one will be allowed to enter the site once the gates are closed, except for travelers from beyond San Pedro de Atacama and CWG members.

IDENTIFICATION/REGISTRATION

- ALMA uses a card identification system to control entry/exit through the main site entrance.
- ALMA employees, CWG staff using the ALMA road and contractors working permanently at the ALMA site are provided a permanent identification badge.
- Each person working at the ALMA premises will be required to register and carry the identification provided by ALMA while on site.
- Everyone entering the site must have proper identification and will be permitted entry only when holding proper badging credentials, or when registered on the guard's access control file.
- All non permanent staff, contractors, sub-contractors, or visitors are required to request their Admission into the monitoring access system (Actual Trip) .
- Contractors are required to cooperate and coordinate with ALMA in this matter, at least 24 hours prior to arrival on site. Individuals that are not registered risk denial of entry.
- After notification, the visit will be registered to allow proper coordination and scheduling for needed access and accommodations.
- ALMA employees and Executive employees not working permanently at ALMA site must also coordinate their visit.
- Official Visitors must obtain ALMA Director authorization and follow the site medical requirements.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure all visitors are authorized, have a contact person at the OSF and are aware of the safety requirements.
- Investigate any reported problems.
- Maintain a record of all visitors and the type of vehicles permitted on site.
- Obtain authorization for all visitors from the ALMA Director and notify the Safety Office at least 24 hours in advance in order to prepare High Altitude equipment, training and health examination procedures with the paramedic.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Review and maintain records of all accidents involving vehicles.
- Coordinate paramedic examination and security services.
- Coordinate site visits for visitors with site security to ensure access.
- Make sure that ALMA access requirements are followed up by all.

INDIVIDUALS



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All individuals are required to:

- Drive safely and follow site requirements.
- Report any accidents or damages to the site.



10 - Site Access Policy

10-2 AOS Access Requirements

- 1) **Purpose** - To provide clarification and guidance for control and monitoring of access to the Array Operations Site (AOS) at the ALMA Observatory.

- 2) **Scope** - This procedure is valid for access to all areas of the AOS. The policy does not apply to the control of casual visitors that cross into the AOS site from locations other than the maintained designated access roadway(s). References include:
 - Directive 89/391/EEC - Introduction of measures to encourage improvements in the safety and health of workers at work

3) Rules / Requirements

GENERAL

- In inclement weather or when leaving the main road, the purpose of the visit must be reviewed with the Safety Office.
- By night and in inclement weather, the ALMA Safety Office requires the use of two vehicles to access the AOS.
- Communicate departure and arrival times to the ALMA Safety Office before departure.
- The access to the AOS TB (Technical Building) is submitted to authorization of the Supervisor in charge of the staff and operates under automatic access control. In order to get authorization to enter the building, you first need to have your badge activated in the system.
- The access for working at the AOS is submitted to the high altitude safety training, including First Aid, CPR, AED and oxygen use.
- A Safety training is also required for working inside the AOS/TB's restricted rooms. The access to this area is submitted to a procedure related to the automatic fire extinguishing system (Inergen gas) which all staff must be well acquainted with.
- Inclement weather may further restrict access as determined by the Safety Office
- Before leaving the OSF for the AOS, ensure that the vehicle is equipped with appropriate safety equipment. (see Section 10-4 - Vehicle Use at the ALMA Site)
- The site will accept deliveries, vendors, and visitors between 08:00 and 20:00. Exceptions must be scheduled in advance.
- Single vehicles joining a group already at the AOS may be permitted to travel alone to the AOS, if weather conditions and communication requirements are met.
- Any tourist's visit to the AOS is limited to a maximum of 2 hours at the high site.
- All site visits must be coordinated with the Site Manager /MOD) and Safety Office.
- Everyone ascending to the AOS must comply with the ALMA training and medical requirements. (See Section 5-1: Physical Exam Requirements and High Altitude Policy for vendor requirements).
- Visitors to the AOS are required to read an informational pamphlet, participate in the paramedic medical check and – for persons which do not have any professional cause - sign a



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release waiver before being escorted to the AOS. For additional information, see the ALMA Safety page, <http://wikis.alma.cl/twiki/bin/view/ALMASafety/WebHome>

NIGHT CONDITIONS

- Night travel to the AOS is prohibited for visitors.
- Night travel is restricted for employees and requires authorization from the Site Manager and notification to the Safety Office.
- Overnight sleep at the AOS is prohibited except in emergency situations or special agreement duly approved by Site Manager or MOD and the Safety Office.
- Regular overnight stays at ALMA must be located at the OSF.
- Work activities requiring overnight access must be coordinated with the Safety Office.
- Contractors and staff must organize their work such that the work is executed during normal site working hours.
- In case of emergencies or technical issue, work hours can be extended after sunset provided this was agreed with the ALMA Safety Office.
- No work shall be permitted beyond normal site working hours and sunset if not previously approved by the Safety Office. (Outdoor AOS/TB: 8 hours max – Indoor: 12 hours max.)
- Any work planned during night hours must be submitted in writing for approval. The request must explain in detail the reasons, the concept, the amount of workers involved, the machinery intended to use and the safety measures taken.
- The ALMA Safety Office will evaluate whether the request is appropriate and whether adequate supervision is available.

ACCESS WITH BAD WEATHER CONDITIONS (FOR TECHNICAL EMERGENCY)

- Trip must be authorized by the Site Manager, Safety Manager and Project Manager
- Inform the Site Manager and Safety Manager about:
 - The purpose of the trip confirmed by the task's team leader
 - The exact destination
- At least two vehicles must ascend together
 - Before leaving for the AOS, ensure that the vehicles are equipped with appropriate safety equipment. (see Safety Manual section 10-4 - Vehicle Use at the ALMA Site)
 - Bring all safety devices, radios, oxygen, warm suits, water and food, appropriate light.
 - The team leader shall monitor the work hours limit
- Keep permanent radio contact with safety and Security.

VEHICLE EMERGENCY

- In case of an emergency situation, immediately contact the Safety Office using the vehicle or handheld radio system.
- Upon notification, the Safety Office will dispatch the necessary support.
- If it is necessary to leave the road on foot, make and keep contact with the Safety Office before leaving your vehicle. **IF THERE IS NO RADIO CONTACT, REMAIN WITH YOUR VEHICLE.**
- At altitude, you need to conserve your energy check your arterial oxygen saturation (SpO₂), take oxygen if < 80% and keep warm.
- While waiting for support, contact the Safety Office as frequently as needed, but in no case less than every hour.

AOS TECHNICAL BUILDING ACCESS POLICY



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- 2 guards survey at the AOS TB 24 hours a day.
- The doors of the TB must be locked permanently.
- The team leader must inform the guard when a portable equipment is removed from the building (PC or any other valuable equipment).
- A work permit is mandatory before starting any work at AOS/TB.
- An access control system allows the access to the restricted areas. Your ID card must be activated in the system

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that only authorized drivers are permitted to access the AOS
- Request authorization from the Safety Office for travel between the hours of sunset and 06:00 for work requirements.
- Ensure visitors are properly escorted.
- Coordinate all site visits and work activities.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Coordinate AOS access preparation (training, paramedic, release signatures, medical requirements)
- Provide or ensure all required safety devices are available (radio, oxymeters and O2 bottles, vehicles, etc.)
- Determine if inclement weather will prevent access.
- Verify the condition of vehicle safety equipment regularly..
- Review and approve requests for access after sunset.

INDIVIDUALS

All persons are required to:

- Communicate departure, km 21, 31, 41 steps and arrival times to the ALMA Safety Office. (See Section 10-4 – Vehicle Use at the ALMA Site)
- Drive safely and follow site requirements.
- Notify the Safety Office when work plans require leaving the established ALMA roadways.
- Ensure vehicle safety equipment is present and functional prior to going to the AOS. See Section 10-4 - Vehicle Use at the ALMA Site for a listing of safety equipment.
- Comply with the ALMA training and medical requirements.
- Report any accidents, damages or unsafe equipment on site vehicles.



10. Site Access Policy

10-3 Offsite Use of ALMA Vehicles

- 1) **Purpose** - This procedure establishes the requirements for the official use of ALMA vehicles offsite and is a training support for ALMA vehicle drivers.
- 2) **Scope** - This procedure is mandatory for ALMA and Executive staff using ALMA provided vehicles.
References include:
 - Directive 89/391/EEC - Introduction of measures to encourage improvements in the safety and health of workers at work

3) Rules/Requirements

The use of ALMA vehicles is reserved for professional job related duties to authorized Members of Personnel. All users must observe the following guidelines while operating an ALMA vehicle. Violations of these guidelines shall cancel this privilege.

ALMA vehicle driving authorization is given to ALMA employees by their Manager according to the following conditions.

VEHICLE SAFETY

- Only authorized trips are permitted offsite in ALMA vehicles (A form must be signed by the driver's Managers or the Site Manager on Duty or the Safety Manager in backup).
- All drivers of ALMA Vehicles must observe any provision of the Chilean road code, be in possession of a valid driving license appropriate to the type of vehicle used and valid for all countries of the journey, and follow the requirements established for safe vehicle use.
- If travel to the AOS is desired or required, the driver must also possess and have passed a Mountain driving course / training or an equivalent driver's safety training
- Seat belts must be used by the driver and all passengers.
- Ensure all equipment inside the vehicle is fastened.
- All drivers are responsible for the security of vehicles and cargo. Do not leave keys in the vehicle or materials in plain view where they will be susceptible to theft or damage.
- Lock vehicles left unattended. Engage the alarm if fitted. Remove the radio front panel.
- Operate the vehicle in a safe manner, observing posted speed limits and the rules of the road. A traffic violation is the driver's liability.
- Do not use controlled substances or alcohol prior to or when operating a motor vehicle. Be aware of possible adverse effects of prescription drugs.
- Drive with lights on for safety in dirt roads and highways.
- No single vehicle is permitted for night travel between OSF and AOS.
- Ensure safety equipment is complete.
- Smoking is not permitted in any ALMA vehicle.

VEHICLE MAINTENANCE AND INSPECTIONS

- Employees operating ALMA vehicles are expected to make a safety check on their vehicle



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before driving. The inspection should include, at a minimum, lights, horn, turn signals, brake lights, tire condition, and adjustment of rearview mirrors.

- All heavy trucks that will operate at the high site, with more than 350 HP shall be equipped either by hydraulic retarders and/or Safety brake systems.
- Notify the auto shop for any unusual or defective items.

CELL PHONE AND OTHER ELECTRONIC DEVICE USE WHILE DRIVING

The guidelines below can help reduce the risks of using in-vehicle cell phones and other electronic devices:

- It is forbidden to operate any hand held device, including cell phones, PDAs, beepers, portable or tablet computers, while operating a moving vehicle or equipment, apart from ALMA provided radio-communication sets
- Turn off cell phones and other electronic devices when driving or stop the vehicle before starting or answering a call or using other devices.
- Do not initiate phone calls while driving.
- Choose a phone with hands-free operation and memory-dialing features.

VECHICLE CRASH OR COLLISION

- All drivers are expected to conform to the laws governing actions at the scene of a crash.
- Report all crashes, regardless of the severity to the Safety Manager and the employee's direct Supervisor. The Safety Manager and, if necessary, a review board team shall be formed to promptly review all crashes or incidents.
 - Protect the scene of the crash and take action to prevent additional collisions or injuries.
 - Pull off the roadway as far as possible unless otherwise directed.
 - Place reflectors or flares in front of and to the rear of the vehicle.
 - Contact emergency authorities immediately.
 - Administer emergency first aid, if trained to do so.
 - Alcohol testing is required for drivers involved in vehicle accidents.
 - Employees involved in the accident must be retrained.
- Obtain and record the following information at the scene of the crash:
 - Name and address of each driver, passenger, and/or witness to the crash.
 - License number of each vehicle involved.
 - Name and policy number of the insurance for each vehicle involved.

AUTHORIZED DRIVER

- General Requirements
 - Only authorized trips are permitted offsite in ALMA vehicles.
 - Contractors are not permitted to drive ALMA vehicles without ALMA management approval.
 - Only designated or authorized drivers engaged in the course of business are permitted to drive ALMA vehicles.
 - Students and visitors are not permitted to drive ALMA vehicles.
 - The Department leader or Manager may authorize their staff for offsite use during the daytime. Afterhours use of vehicles must be authorized by the Site Manager or the Safety Manager.
 - The authorization form must be signed and given to the guard at the main gate.
- An Authorized Driver is any person age 18 or older that regularly drives an ALMA vehicle. An Authorized Driver must maintain a current valid driver's license, complete a Vehicle Use



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- Agreement, and have participated in the required vehicle-safety training.
- ALMA shall offer driving training to all Authorized Drivers.
- Authorized Drivers must complete a Vehicle Use Agreement. The Agreement outlines the safe driving requirements and the details of the official use of ALMA vehicles.
- Authorized visitors, researchers, and observers engaged in furthering the mission of ALMA may only utilize ALMA furnished vehicles under the same guidelines as ALMA Authorized Drivers provided they have a valid state or international driver's license.

COMMERCIAL DRIVERS

- A Commercial Driver is any employee required to drive as an essential part of their job. Shuttle and bus drivers that hold these positions shall be required to participate in annual driving training. Any person that drives a personnel transport on a regular basis that holds more than 5 passengers is required by this policy to participate in this program.
- Commercial Drivers who have unacceptable driving records shall be subject to having their jobs reviewed and possible removal from any position requiring driving in accordance with Human Resources policies.
- Each Commercial Driver who operates an ALMA vehicle is subject to random drug and alcohol testing.
- Driving the ALMA site Ambulance requires a specific Chilean certificate: minimum A2 driving license or A4 license for the rescue vehicle.
- The ALMA ambulance drivers are selected by the ALMA Facilities Manager and approved by the Safety Manager and the Site Manager or MOD.

DRIVER TRAINING AND EDUCATION

- The Safety Manager shall determine a schedule of topics for regular continuing education. Topics can include, but are not limited to:
 - Policies and procedures for operation of ALMA-owned vehicles
 - Safe driving objectives and Observatory expectations
 - Vehicle use and limitations for personal use
 - Cargo handling and security precautions
 - Driver training and crash reporting/response procedures
 - Vehicle maintenance and inspection requirements
 - Concepts of decisive driving



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ALMA OBSERVATORY VEHICLE USE AGREEMENT

Agreement between ALMA and the employee named below referred to as the Operator, for the use of an ALMA car for business use. An ALMA car is allowed for use under the following conditions:

- 1. Only authorized trips are permitted offsite in ALMA vehicles (A form must be signed by the corresponding manager. Afterhours vehicle use must be authorized by the Site Manager or the Safety Manager.
2. Any Operator of an ALMA car shall at all times be properly licensed to drive in any jurisdiction in which the car is operated. Additionally, the Operator shall notify ALMA immediately if he (she) is convicted of or pleads guilty or does not contest to a charge of driving under the influence of alcohol or illegal drugs, driving while intoxicated, or a similar offense or loses his or her driving privileges, whether permanently or temporarily, for any reason.
3. Any Operator of an ALMA car shall always follow safe driving practices and ALMA internal regulations. It is mandatory that the Operator and all passengers in ALMA vehicles shall use all available passenger restraints at all times when the vehicle is in motion.
4. ALMA will pay all operating expenses such as registration, insurance, excise tax, inspection fees, gasoline, oil, maintenance, washing and repairs. Parking and toll charges shall be reimbursed when such charges are incurred while driving on business for the Observatory.
5. The car shall at all times be operated and maintained according to the Observatory standards. All mechanical and accidental physical damages shall be promptly reported to the Safety Office.
6. The Operator shall assume full responsibility for any traffic and parking violations arising out of the use of the ALMA car. If ALMA should be required to pay any fine relating to traffic and parking violations, the Operator shall reimburse ALMA within 30 days of written notice regardless of whether or not the Operator's employment has been terminated by the Observatory.
7. The Operator shall report all accidents and damages involving the vehicle to the local police of the jurisdiction in which the accident or damage occurred and to the Safety Manager. The Operator shall also comply with any other notification requirements that may apply.
8. Carrying passengers for compensation or other consideration, except as part of an ALMA-approved car-pooling or ride-sharing arrangement, is prohibited.
9. ALMA will periodically obtain an official report of the Operator's motor vehicle record of Professional Drivers for purposes of validating license information and history of motor vehicle driving violations.

I understand and agree to comply with the above conditions for my use of an ALMA car. I understand the rules outlined herein and agree to abide by them.

Member of Personnel
Name:
Date:



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ANNUAL VEHICLE SAFETY INSPECTION

Instructions: This form must be handed in to Safety Office after inspecting the vehicle and before driving it.

Vehicle-Year	Make	Model	Color	Odometer Reading	License Plate Number	
Address				City	State	Zip Code

<u>Vehicle Inspection Checklist</u>						
Item	Pass	Repair/ Replace	Item	Pass	Repair/ Replace	
BRAKES	<input type="checkbox"/>	<input type="checkbox"/>	SAFETY FEATURES	<input type="checkbox"/>	<input type="checkbox"/>	
Failure Indicator light	<input type="checkbox"/>	<input type="checkbox"/>	1. Turn signals operational	<input type="checkbox"/>	<input type="checkbox"/>	
System Integrity	<input type="checkbox"/>	<input type="checkbox"/>	2. Head Lights	<input type="checkbox"/>	<input type="checkbox"/>	
Pedal reserve	<input type="checkbox"/>	<input type="checkbox"/>	3. Tail lights	<input type="checkbox"/>	<input type="checkbox"/>	
Disc/Drum condition	<input type="checkbox"/>	<input type="checkbox"/>	4. Brake lights	<input type="checkbox"/>	<input type="checkbox"/>	
Hoses and assembly	<input type="checkbox"/>	<input type="checkbox"/>	5. Horn	<input type="checkbox"/>	<input type="checkbox"/>	
SUSPENSION	<input type="checkbox"/>	<input type="checkbox"/>	6. Windows/windshield (Cracks/Chips)	<input type="checkbox"/>	<input type="checkbox"/>	
Shock absorbers/struts	<input type="checkbox"/>	<input type="checkbox"/>	7. Front seat safety belts (Condition)	<input type="checkbox"/>	<input type="checkbox"/>	
Springs	<input type="checkbox"/>	<input type="checkbox"/>	8. Back seat safety belts (Condition)	<input type="checkbox"/>	<input type="checkbox"/>	
Shackles	<input type="checkbox"/>	<input type="checkbox"/>	9. Door locks operational	<input type="checkbox"/>	<input type="checkbox"/>	
Modifications	<input type="checkbox"/>	<input type="checkbox"/>	WIPERS/WIPER BLADES			
STEERING	<input type="checkbox"/>	<input type="checkbox"/>	1. Wipers operational	<input type="checkbox"/>	<input type="checkbox"/>	
Lash	<input type="checkbox"/>	<input type="checkbox"/>	2. Blades contact	<input type="checkbox"/>	<input type="checkbox"/>	
Free turning	<input type="checkbox"/>	<input type="checkbox"/>	3. Blades condition	<input type="checkbox"/>	<input type="checkbox"/>	
Linkage play	<input type="checkbox"/>	<input type="checkbox"/>	TIRES – FRONT	Lft	Rt	Lft
Power system	<input type="checkbox"/>	<input type="checkbox"/>	1. Tread depth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EXHAUST SYSTEM	<input type="checkbox"/>	<input type="checkbox"/>	2. Matching	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Leaks	<input type="checkbox"/>	<input type="checkbox"/>	3. Condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Legal muffler	<input type="checkbox"/>	<input type="checkbox"/>	TIRES – REAR	Lft	Rt	Lft
Tailpipe	<input type="checkbox"/>	<input type="checkbox"/>	1. Tread depth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			2. Matching	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			3. Condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brief Comments-Refer to item number						
Signature-Inspector			Date-Inspection			



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Provide reliable transportation to authorized drivers and the resources for maintenance of vehicles.
- Assure service and maintenance logs are kept for each vehicle by the auto shop.
- Investigate, document, contact, and maintain communication with the insurance carrier.
- Authorize offsite use of ALMA vehicles.
- Ensure personnel are trained in the use of vehicles.
- Pay all operating expenses and repairs.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Verify vehicle compliance and driver safety issues and follow-up on automobile claims handling.
- Obtain the driver commitment for compliance with safe driving policies.
- Ensure the vehicle checklist is completed at least annually. Service and maintenance logs must be kept for each vehicle by the auto shop.
- Distribute driver safety literature to drivers and Supervisors of drivers.
- Train volunteer drivers in 1st aid.

INDIVIDUALS

Every driver of ALMA vehicles must:

- Report any license restrictions immediately upon revocation or suspension.
- Report violations of these guidelines to the Safety Manager.
- Make a safety check on their vehicle before driving.
- Notify the auto shop for any unusual or defective items.
- Complete a Vehicle Use Agreement.



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10 – Site Access Policy

10-4 Vehicle Use at the ALMA Site

- 1) **Purpose** - To provide clarification and guidance for the safe use of passenger and light duty vehicles at the ALMA Site.
- 2) **Scope** - This procedure is valid for all vehicular traffic on the ALMA site, including shuttles for personnel transport and ALMA-owned vehicles used off site, and heavy equipment. The policy does not apply to vehicle use of casual visitors. The policy also does not apply to the use of Heavy Equipment at the site.

References include:

- Directive 89/391/EEC - Introduction of measures to encourage improvements in the safety and health of workers at work

3) Rules / Requirements

GENERAL

- Only Authorized Drivers, with ALMA driving license as well as their corresponding municipal license, are permitted to drive on ALMA from OSF to AOS and vice versa.
- Always limit speed to allow safe driving.
- Reduce speed as per road and weather conditions.
- Heavy equipment operators are required to comply with all applicable licensing requirements and training in order to operate specific equipment.
- Only properly outfitted vehicles are permitted on the access road from the OSF to AOS. The use of four wheel drive vehicles on the ALMA site is strongly recommended.
- All heavy trucks that will operate at the site, more than 350 HP shall be equipped either by hydraulic retarders and / or Jacobs brakes systems.
- Vehicles inspection reports shall be made up by independent accredited and certified organization
- ALMA shall monitor the validity of each inspection report and stop all vehicles which would not comply or do not look safe.
- Only experienced, authorized and trained trucks drivers (with their corresponding Mountain training or equivalent driver's safety training) will be allowed to drive to the AOS.
- No alcoholic beverages or drugs are allowed in vehicles. Driving while under the influence of alcohol or drugs is absolutely forbidden.
- Smoking is not permitted in ALMA vehicles.
- Equipment and materials must be carried on load-bay of the vehicles, and shall not be tied onto the exterior.
- Do not overload vehicles.
- Manual transmission is recommended for access to AOS.
- It is recommended that vehicles should have a minimum 130hp for access to the AOS.
- Quads are prohibited from use at ALMA.
- O2 check up and use of oxygen required for drivers to/from AOS, particularly after a long stay.



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OPERATIONAL

- A fixed Base radio, with ALMA emergency channel, is required into all cars and trucks commuting to and from Chajnantor.
- Contact the Camp Guard by radio channel 1 when you begin and end your trip on the way OSF/AOS/OSF.
- Contact the Camp Guard every km 21, 31, 41 during your trip on the way OSF/AOS/OSF. (Board signs to remind you)
- As soon as the km 29 check post is operating, all vehicles shall stop for a 5min rest.
- Keep all vehicles to designated roadways. Do not drive into the Chajnantor Plateau where no roadways exist.
- Night travel is discouraged in all areas of the site.
- Do not disturb any flora or fauna while driving at the site.
- In the case of animals in the road, vehicles must stop to prevent injury to the animal and damage to the vehicle. Always be alert to the possibility that animals may cross the road.
- Obey all posted signs related to safe driving including warning signs and speed limits.
- No one is allowed to ride on any portion of a vehicle not designed for carrying passengers e.g., cargo-carrying areas of trucks.
- No hazardous materials may be transported in any vehicle for which the primary design and purpose is for the transportation of personnel.
- Hazard warning placards must be displayed for vehicles carrying dangerous goods.
- Vehicles going up the site have the right of way preference over vehicles going down.
- Heavy equipment has the right of way where the road is not marked.
- The antenna transporter always has the right of way.
- In construction areas, follow the directions of the traffic control leader.
- Keep a clear distance when traveling behind heavy equipment.
- Turn off the engine when refueling.

PARKING

- Do not park in any roadway or any location where access to facilities is obstructed.
- Do not park any vehicle near air intakes of the facilities.
- Vehicle parking on OSF/TF is restricted to ONLY those locations clearly marked for parking. All vehicles must park rear ended.
- Tickets are posted and informed by the Site Managers office, and recorded by the safety Office. Three tickets shall lead to loss of driving privilege on ALMA Site.
- Remove the ignition key from the car and lock the doors when vehicle is parked. The Security guards shall check, remove the keys left in the vehicles and bring them to the Safety Office.

SPEED LIMITS

- Between the entrance to the site and OSF
 - For light vehicles the maximum speed is 70 km/hr unless otherwise posted.
 - For personnel transportation vehicles (buses and shuttles) the speed limit is 60 km/hr unless otherwise posted
 - For loaded trucks or heavy equipment, the maximum speed is 40 km/h.
- Between OSF and AOS (Chajnantor Plateau)
 - For all vehicles, the maximum speed is 60 km/hr unless otherwise posted.
 - For loaded trucks or heavy equipment, the maximum speed is 40 km/h.
- In the area of the OSF facilities, the maximum speed is 30 km/h.



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- In construction zones, the speed limit is 40 km/hr.

WARNING:

The transporter road is not graded to accommodate high speed traffic. The roadway has a flat profile to accommodate transporter traffic. This road profile may permit loss of vehicle control at speeds exceeding the posted limits.

ILLNESS AND/OR MEDICATIONS

- If any driver is taking medication or feeling ill, he/she should consult with his/her Supervisor. If there is any doubt about a driver's capabilities due to illness or medication, an alternate driver should be assigned to replace the medically impaired driver.

VEHICLE PARKING NEAR ANTENNAS (see also Section 8-3 – Operations Safety)

- Do not park vehicles within 20 meters of any antenna. If work on the antenna necessitates that a vehicle be parked inside this zone, notify the operator on duty of the vehicle's presence, the purpose for being on the site, and the work location. Normal maintenance activities around the antennas must be coordinated with the operator(s).

ACCIDENTS

- In case of an accident on-site, contact the Site Safety Officer as soon as possible. Accident reports must be filed within 24 hours. (See also Section 1-2 – Emergency Preparedness Procedure)

SAFETY EQUIPMENT IN VEHICLES

- All vehicles used at the site, especially in winter, and according to the weather conditions are required to have the following safety equipment in place and properly working prior to ascending to the AOS:
 - Roll over protection bar inside the cabin
 - Two way radio for communication with the OSF
 - Bottled Oxygen and oxygen meter
 - Fire extinguisher
 - First Aid Kit
 - Spare tire, snow chains
 - Emergency light
 - Windshield scraper
 - Blanket
 - Shovel, tow sling(s)
 - At least two flares
 - Two candles
 - Matches or lighter
 - 4 energy bars
 - tire pressure gauge
- Site maintenance vehicles and the Safety Office car must also be equipped with the following:
 - Battery power booster or jumper cables
 - Tool box with tools
 - Shovel, pick, and axe
 - Tow and rescue slings with associated hardware
 - Winch



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MAINTENANCE

- ALMA site vehicles are required to have documented preventive maintenance in accordance with the manufacturer's recommendations or at least annually.
- Turn in vehicles scheduled for preventive maintenance as scheduled. Copies of preventive maintenance records must be available for review by the Safety Office.

DRIVING SANCTIONS

- Speeding or other infractions of the driving and road policy will result in disciplinary actions.
- First infraction is a driving suspension for the remainder of the shift (turno), plus one shift (turno), not to exceed 15 working days
- Second infraction the suspension is 30 days. It should be noted that ALMA can impose two infractions at once such as speeding and reckless driving, considering reckless driving could include speed in excess of 40% over the posted limit.
- A third violation will result in a permanent driving ban on ALMA site.
- The ALMA Site Manager on Duty has the prerogative to increase the sanction level in case of dangerous or negligent violations. He/She may also request the respective executive to increase the sanction level.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Maintain preventive maintenance including documentation of inspections and service.
- Instruct their personnel to safe driving practices.
- Allow only drivers with the necessary character requirements to drive.
- Ensure that all vehicle safety devices and equipment are functional and replaced as needed.
- Ensure that all vehicles are appropriately inspected and licensed.
- Investigate any reported problems.
- Maintain a record of authorized drivers and the type of vehicle they are authorized to drive.
- Ensure that all the vehicle safety requirements are followed.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide training for authorized drivers to ensure these requirements are commonly known.
- Review and maintain records of all accidents involving vehicles.
- Follow-up on remediation or retraining necessary to prevent a recurrence of an incident.
- Recommend standards for safety equipment for vehicles.

INDIVIDUALS

All drivers are required to:

- Promptly report loss of license privileges and ensure renewal as required.
- Check the used vehicle regularly before driving
- Drive safely and follow site requirements.
- Attend training sessions provided.
- Report any accidents, damages or unsafe equipment on site vehicles.



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11- Tools and Machinery

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11. TOOLS AND MACHINERY

11-1 Hand Tools

- 1) **Purpose** – This procedure is to provide guidance for the proper maintenance and use of portable power and hand tools.
- 2) **Scope** - This procedure is valid for all portable powered and hand tools used at ALMA. This policy is applicable to contractors and staff.

3) Rules / Requirements

GENERAL REQUIREMENTS

- Use the right tool for the job. Do not use your wrench as a hammer. Do not use a screwdriver as a chisel, etc.
- Do not use broken or damaged tools, dull cutting tools, or screwdrivers with worn tips.
- Make sure your grip and footing are secure when using large tools.
- Secure tools in a tool belt or box. Do not carry tools up ladders. Use a hoist or rope.
- Keep close track of tools when working at heights. A falling tool can kill a co-worker.
- Follow requirements for selection and use of personal protective equipment (PPE).
- Select ergonomic tools for the work task when movements are repetitive and forceful.
- Store tools properly when you stop work.
- Follow all labels and manufacturer's recommendations when using tools.

CUTTING TOOLS

- When using cutting tools, normally, the direction of force should be away from the body; however, use the tool as it is designed to be used.
- All cutting tools must have a handle: this precludes the use of both single and double edge razor blades that are not secured in an approved holding device.
- Use cut-resistant gloves and safety glasses whenever appropriate.
- Replace guards if they become damaged.

TORSION TOOLS

- Wrenches:
 - Check for secure footing and clearance for fingers.
 - Wrenches should not be hammered or struck.
 - Do not use extensions on handles for additional leverage.
 - Use an open-ended wrench as they are safer and protect the bolt head or nut.
 - Always apply pressure to the fixed-jaw side of the wrench and, whenever possible, pull the wrench toward the body.
 - Torque wrenches should have a documented calibration test performed annually. Exceeding its scale range will likely damage its calibration accuracy.
- Side cutting pliers:



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- Electricians' pliers should be insulated and the insulated grips replaced as needed.
- Jaw serrations should be sharp enough to hold wires securely.
- Screwdrivers:
 - Keep tips clean and square-edged.
 - Dispose of any screwdriver with a broken or loose handle, bent blade, or dull or twisted tip.
 - Never use any screwdriver for electrical work unless it is insulated. Be alert for small cracks in the insulation.
 - Always make a pilot hole for a screw.
 - Do not use as a punch, wedge, pinch, or pry bar.
- Vises / Clamps:
 - Fasten securely to a sturdy, immobile work bench or a similar base.
 - When sawing material held in a vise, cut as close to the jaws as possible.
 - If clamping long pieces, support the free end of the piece adequately.
 - Over tightening a clamp can break the clamp or damage the product.
 - Clamps should be stored on a rack and not in a drawer.

IMPACT TOOLS

- Fit handles securely to the head, should be smooth, free of oil, and shaped to fit the hand.
- Hammer heads should be dressed whenever they start to mushroom.
- When using a hammer, wear safety glasses.
- Never hit two hammer heads together.
- Do not use a claw hammer to strike another tool; use a ball-peen or maul hammer.
- Do not use a sledge hammer with a split handle or a chipped head.

PORTABLE ELECTRIC / POWER TOOLS

- General:
 - Be sure that the power source is "off" and unplugged before making adjustments.
 - Do not wear loose clothing, jewelry, ties, or any dangling objects, including long hair that may catch in rotating parts or accessories.
 - If it has an electrical cord, constantly stay aware of the cord's location.
 - Ensure removable parts are in good condition and securely attached to the tool before use.
 - Do not use electric tools in damp or wet areas or in metal tanks.
 - Only use electric tools that are in good repair.
 - Only use double-insulated electric tools. However, if a double-insulated tool is not available, a GFCI (ground fault current interrupter) must be used.
 - All handheld power equipment must have a switch that automatically shuts off when pressure is released.
- Circular saws:
 - Use all guards as per the manufacturer instructions. Check the guard frequently to be sure that it operates freely and encloses the teeth completely when cutting. It should also enclose the unused portion of the blade when it is cutting.
 - Do not use a circular saw that is too heavy to easily control.
 - Be sure that the switch turns the tool on and returns to the off position on release.
 - Use the correct blade for the application, and observe rotation marks on the blade during installation.
 - Use both hands to safely guide the saw.
 - Eye protection shall be worn when operating a circular saw.



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- Extension cords:
 - Use only three-prong, grounding-type plugs and three-pole receptacles that accept the tool's plug.
 - Do not use an undersized cord, as it will overheat and can damage the tool motor.
 - Consider the type of tool used and the length of extension needed.
 - Use only UL-approved extension cords.
 - Must be fully unrolled off the hasp
- Abrasive wheels, buffers, and scratch brushes:
 - Guard abrasive tools as completely as possible. For grinding, the maximum angular exposure of the periphery and sides should not exceed 180 degrees.
 - The top portion of the wheel should always be enclosed.
 - Guards should be adjustable so operators will be inclined to make the correct adjustment instead of removing the guard.
 - Keep abrasive wheels away from water and oil, which might affect its balance.
 - Protect the wheel from blows by other tools, and avoid striking the sides of a wheel against other objects or dropping the wheel.
 - Hold the wheel correctly so that it does not touch clothes or your body.
 - Wheels should be sound-tested (ring-tested) before being mounted. Discard defective wheels immediately.
 - Ensure the maximum machine rotation (RPM) does not exceed the wheel rating.
- Belt or Disc Sanders:
 - When adjusting the belt tracking on a portable sander, support and position the sander to avoid accidental contact with yourself or an adjacent object.
 - Maintain clearance between the work table and sanding disc or belt on all sides.
- Disc Grinders:
 - Use only high-strength, bonded wheels with portable straight grinders.
 - Maintain firm control of the tool and never over reach.
 - Carefully maintain balance of the machine.
 - Do not allow the grinding wheel to bend, pinch, or twist in the cut because kickback may result.
 - Proper combination of wheel and guard is critical. The wheel rated speed (RPM) must be greater than the RPM of the power tool spindles they are attached to.
 - Do not use damaged grinding wheels.
 - Watch for hot fragments thrown off the material.

AIR POWERED / PNEUMATIC TOOLS

- General:
 - Keep hands and clothing away from the working end of the tool.
 - Tools must have an excess flow check valve at the source of the air to shut off the air in event of a hose or connection failure.
 - Inspect and test the tool, air hose, and coupling before each use.
 - Use a short chain or wire to secure all air line couplings.
 - Never exceed the manufacturer's listed air pressure for the tool.
 - Compressed air is not to be used for cleaning clothing.
 - Compressed air used for cleaning chips must not exceed 30 psi at the nozzle.
- Jackhammers:
 - Jackhammer handles should be covered with heavy rubber grips to reduce vibration and user fatigue.
 - Wear safety shoes to reduce the possibility of injury.



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- Hearing protection and eye protection with side shields are required when using or working within 6 m of an operating jackhammer.

POWDER ACTUATED FASTENING TOOLS

- In selecting the proper powder load, start with the lightest powder level recommended for the tool in use.
- Increase load levels until the proper penetration is obtained.
- Proper PPE including hearing protection and eye protection must be used.
- Notify others in the vicinity when a powder actuated tool is planned for use.
- Always use the tool perpendicular to the work surface.
- Cartridges must be carried and transported in approved containers.
- Do not leave tools unattended where they might be available to unauthorized persons.
- Do not load the tool until just prior to starting the work.
- Do not use these tools in an explosive or flammable atmosphere.
- In event of a misfire, hold the tool against the work surface for a full 30 seconds, and then follow the manufacturer's directions for removal of the cartridge.
- Operators must be trained by a representative of the tool manufacturer.
- Do not use fasteners on very hard or brittle materials; likewise do not use on very thin or soft materials.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Maintain preventive maintenance and ensure tools are functional and replaced as needed.
- Orient employees to his/her job and tools.
- For selecting the appropriate work methods and tooling
- Provide adequate training for the use of any tool used by an employee.
- Ensure tools are used correctly and with the appropriate personal protective equipment.
- Ensure the correct tool is available.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Inspect work areas regularly for any deficiencies.

INDIVIDUALS

All employees are required to:

- Select the proper tool for the job.
- Check to ensure that the tool is in good working condition.
- Use tools correctly, including proper use of personal protective equipment.
- Clean and store tools properly.



11 - Tools and Machinery

11-2 Machine Tools

- 1) **Purpose** – This procedure is to provide guidance for the proper maintenance and use of stationary or fixed location power machine tools.
- 2) **Scope** - This procedure is valid for designated work areas in ALMA where machine tools are used. Machine tools include powered equipment, usually installed in a fixed location in contrast to portable power tools. Machine tools typically have electric motors producing rotational motion or hydraulic force. The policy applies to everyone who uses machine tools, works in the vicinity of machine tools, or passes through an area where machine tools are in use.

3) Rules / Requirements

GENERAL MACHINERY OPERATION

- If you have business to conduct in the area, wear appropriate PPE and remain a safe distance away from the machinery.
- Do not distract operators from their work.
- Do not attempt to use the machine tools unless you have been trained and authorized by your Supervisor and the machine shop Supervisor.
- Use the proper tool or blade for the job and the material you are working.
- Inspect and ensure that all required machinery is working properly before use.
- Ensure that the work area is kept clean and neat.
- Do not leave a machine tool running while unattended.
- Clean up spilled lubricant immediately.
- Do not wear rings, watches, loose clothing, or other apparel that can be snagged by moving objects.
- All machinery that can "walk" or tip over from vibration must be secured to the floor.
- Ensure machinery is equipped with anti-auto-restart protection as required.
- Clean and store tools properly.

MACHINE OPERATION - MANLIFTS¹⁰

- Authorized operators (IPAF - International Powered Access Federation) license)
- Secure and inspect area before moving a manlift to a work area
- Low speed.
- Can not be used as elevators for parts.
- Antennas can never be approached with the manlift if not duly locked out.
- Manlifts with collision protection system can be used for antenna dish work.

CRANES/TELE-HANDLERS/FORKLIFTS¹¹:

¹⁰ General safety rules related to elevated platforms apply.

¹¹ General safety rules related to crane/tele-handler/forklift operation and suspended loads apply



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- Only persons familiarized with Common Safety for Crane Operations (incl. hand signs) are authorized to give instructions to the crane operator.

GENERAL MACHINERY GUARDING

- Machine power controls must be equipped so they cannot operate by accidental contact.
- All machines must be equipped with an emergency stop.
- Fixed guards are required on power transmission points and hot or cold.
- Ensure that all required machine guards are in place and stay in place.
- Keep hands away from pinch points and cutting surfaces.
- Guards should not be a hazard themselves.
- Power presses, power saws, and portable power tools are examples of tools which may be equipped with guards at the point of operation.
- Ensure covers for attached light fixtures are in place and lights are functioning.
- Remove chuck keys from lathes before starting equipment. Flying chuck keys cause injuries.
- Moveable guards may be used if equipped with interlocks to prevent machine operation if guards are removed.
- Interlocks must be failsafe and only removable or bypassed with the use of a special tool.
- Only authorized persons are permitted to override an interlock.
- Each machine must require a manual reset after a power interruption.

ABRASIVE WHEEL MACHINERY

- This section does not apply to natural sandstone wheels and metal, wooden, cloth, or paper discs which have a layer of abrasive on the surface.
- Do not grind wood or aluminum on an abrasive wheel.
- Ensure machines are equipped with guards for abrasive wheels except for the following:
 - Wheels used for polishing or buffing
 - Wheels used for internal work while within the object being ground
 - Wheels 5.08 cm or less in diameter used in portable operations
 - Specific types of cones, plugs, and balls where the work offers protection
- Ensure that the guard covers the spindle end, nut, and flange projections and that it maintains proper alignment with the wheel.
- Ensure also that the strength of the fastenings exceeds the strength of the guard.
- Ensure work rests are well constructed and adjusted for wheel wear. The maximum opening between the wheel and rest is 0.32cm to prevent the work from being jammed.
- Securely clamp the work rest after each adjustment, and do not make an adjustment with the wheel in motion. The edge of the work rest must be kept horizontal.
- Grinding operations can produce sparks. Choose a location for the grinder that avoids contact with combustibles.

WOODWORKING MACHINERY

- Secure circular saw fences firmly to the table, whatever their alignment.
- Ensure that the fence remains in a line parallel with the saw, regardless of the angle of the saw with the table.
- Ensure that machine control circuits prevent restart or restoration of power after a power failure.
- Remove from service all dull, cracked or bent blades.
- Keep all knife edges and cutting heads sharp, properly adjusted, and firmly secured.
- Ensure push sticks or blocks are available in several sizes and types suitable for the work.



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- Adjust keep band-saw blade guards to the minimum opening required for the material thickness.

MECHANICAL POWER-TRANSMISSION APPARATUS

- Machinery equipped with belts, flywheels, chain drives, cranks, connecting rods, and shafting must be equipped with guards to protect employees from the moving parts.
- All exposed parts 2.13 meters or less above the working level must be guarded.
- Inspect the integrity of the guards prior to use and during operation. If safety deficiencies are detected, the equipment must be shut down and tagged out until repaired and tested.
- Keep shafting aligned and free from rust and excess oil or grease.
- Oil machinery only when not in motion.
- Ensure keys, set-screws, and other projections in revolving parts are removed or made flush or are guarded by metal cover, except for gears inside casings, and pulleys less than 50.8 cm in diameter.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure operators are of the required character requirements, properly trained and qualified prior to using each machine tool.
- Ensure equipment-specific lockout procedures are available for machinery as required, and those who operate and service machine tools know how to safely de-energize them for service and maintenance.
- Prescribe necessary personal protective clothing and equipment for machine tool operations.
- Post appropriate safety signs in the vicinity of machine tools and at entrances to the shop.
- Ensure that each machine tool has proper guards in place.
- Establish an effective preventive maintenance policy for all equipment.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Review this policy annually and ensure that appropriate updates are made.
- Inspect work areas regularly for any deficiencies.

INDIVIDUALS

All employees are required to:

- Use only those machine tools for which you are authorized.
- Verify that the machine is in working order and that proper guards are in place prior to using the machine.
- Use necessary personal protective equipment.



12- Working Surfaces

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12. WORKING SURFACES

12-1 Ladders

- 1) **Purpose** - This policy establishes the requirements for the inspection and use of ladders at the ALMA site.
- 2) **Scope** - This policy is mandatory for anyone using stationary and mobile ladders. Contractors are required to follow these requirements when using ALMA provided or installed ladders. References include:
 - Directive 89/391/EEC - Introduction of measures to encourage improvements in the safety and health of workers at work.
 - Directive 89/655/EEC – Relating to requirements for new machinery to comply with the machinery directive.

3) Rules/Requirements

STEPLADDER

- Set up a stepladder that is at least .6 m longer than the height needed.
- Do not use a stepladder if it is worn, a step is loose, or a spreader brace doesn't open fully.
- Set the stepladder on firm, level ground, and open the legs completely and lock spreader braces.
- Never use a stepladder like a straight ladder.
- Do not use a stepladder as a workplace . Analyze the risk.
- Do not use cross-bracing on the rear section of stepladders for climbing unless so designed and provided with steps for climbing on both front and rear sections.
- Do not step on the bucket shelf; it is not designed to support the weight of a person.
- Do not stand on the top two steps of a step ladder.
- Do not step over from a stepladder to a platform at height
- Never attempt to “walk” with a stepladder

EXTENSION LADDER

- When working more than 3 m from the ground or on a roof, use an extension ladder.
- Do not use the extension ladder if a rung lock or the rope-and-pulley system is faulty.
- Stabilize the bottom of the ladder; drive a stake into the ground between it and the wall, and use a rope to tie each side rail to the stake.
- If working at the eave or plan to get off the ladder onto the roof, stabilize the top of the ladder.
- When using an extension ladder, ensure the locks engage properly on both sides of the ladder.
- To position the ladder, the distance between the wall and the base of the ladder must be 1/4 of the length along the ladder from the base to its point of support (1/4 of its working length).
- If the ladder is used for getting onto a roof, there should be at least three rungs extending beyond the edge of the roof.

FIXED LADDERS



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- Fixed ladders must support anticipated loads caused by ice buildup, winds, rigging, and impact loads resulting from the use of ladder safety devices.
- Fixed ladders must meet standard construction requirements and maintain clearances appropriate for the situation.
- If the climb on a fixed ladder equals or exceeds 7.3 m, the fixed ladder must be equipped with either
 - ladder safety devices;
 - self-retracting lifelines, and rest platforms at intervals; or
 - a cage or well, and multiple ladder sections.
- Fixed ladders must be used at a pitch no greater than 90 degrees from the horizontal, measured from the back side of the ladder.

GENERAL

The following general requirements apply to all ladders, including job-made ladders:

- Use of Ladders:
 - Only one person at a time may use or work from a single ladder.
 - Before using a ladder, check the area carefully for power lines and electrical equipment.
 - Ladders with structural defects must be withdrawn from service until repaired.
 - Use only double-insulated or properly grounded electrical tools on a metal ladder.
 - Use only a dry wooden or non-conductive fiberglass ladder when working around electrical wires or equipment.
- Ladder Setup:
 - If the ground is soft or uneven, place boards under the feet of the stepladder.
 - Do not place ladders on any platform for added height.
 - Secure ladders used in passages, doorways, or where work activities or traffic may cause accidental movement, or use a barricade to keep activities away.
 - Keep the area around the top and bottom of the ladders clear.
 - Ladders must not be moved, shifted, or extended while in use.
- Ladder Care/Maintenance:
 - Maintain ladders free of oil, grease, and other slipping hazards.
 - Ladders must be inspected by a competent person (someone able to identify hazards in the working conditions, and who has authorization to take prompt corrective measures) for visible defects on a periodic basis and after any incident that could affect their safe use.
 - Portable ladders with structural defects or other faulty or defective components must immediately be marked defective, or tagged with "Do Not Use" and withdrawn from service until repaired.
 - Inspect closely for loose joints and bolts, faulty welds and cracks. Make sure the hooks and locks on extension ladders are in good condition.



LADDER INSPECTION CHECKLIST

General	Needs repair	O.K.	Date repaired
Loose steps or rungs (considered loose if they can be moved at all with the hand)?			
Loose nails, screws, bolts, or other metal parts?			
Cracked, spilt, or broken uprights, braces, or rungs?			
Slivers on uprights, rungs, or steps?			
Damaged or worn non-slip bases?			
Step ladders			
Wobbly (from side strain)?			
Loose or bent hinge spreaders?			
Stop on hinge spreaders broken?			
Loose hinges?			
Broken, split, or worn steps?			
Extension ladders			
Loose, broken, or missing extension locks?			
Defective locks that do not seat properly while extended?			
Worn or rotted rope?			



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Designate a competent person to examine ladders and ensure the ladders are maintained and used in a safe manner.
- Assess intended work at height for the safest way of access

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Annually inspect fixed ladders to verify that fall protection is in place and functional.

INDIVIDUALS

All employees are required to:

- Report any defective climbing systems including fall protection as soon as noted.
- Visually inspect ladders each time they are put into use.
- If the ladders are defective, do not use the ladder, but tag it out of service.



12 - Working Surfaces

12-2 Wall and Floor Openings

- 1) **Purpose** - At many sites where working on elevated platforms or other surfaces, there may be areas with potentially dangerous unprotected wall and floor openings. The purpose of this procedure is to provide guidance in the identification and correction of such conditions.
- 2) **Scope** - Cooperation with this policy is required for all ALMA employees, authorized visitors, and Executive staff. This policy is mandatory for all areas of ALMA. References include:
 - Directive 89/391/EEC - Introduction of measures to encourage improvements in the safety and health of workers at work
 - Directive 89/655/EEC - Relating to requirements for new machinery to comply with the machinery directive.
 - EN 14122 – Permanent means of access to machinery, stairs, guardrails, and ladders

3) Rules / Requirements

FLOOR AND WALL OPENINGS

- Protect elevated floor and wall openings over adjacent surfaces by a standard guard rail.
- A standard guard rail includes a top rail (1m), intermediate rail (45cm), and toe-board (15cm).
- Hatchways and chute floor openings must be guarded by railings and toe boards or by a hinged cover which must be closed when not in use.
- Any person working in the vicinity of unguarded floor or wall openings must be equipped with appropriate fall protection equipment.
- If unguarded floor or wall openings are found, the situation must be closed off and subsequently be reported to the ALMA Safety Office.

STAIRS

- The riser height or stair tread depth must be the same in any stairway.
- Doors and gates opening directly onto a stairway must have a platform that extends beyond the swing of the door or gate.
- Metal pan landings and metal pan treads must be secured in place before filling.
- Stairway parts must be free of dangerous projections such as protruding nails.
- Slippery conditions on stairways must be corrected.
- Treads and landings must be replaced when worn below the top edge of the pan.
- Stairs with four or more risers shall have standard stair railings or standard handrails.
- A stair rail shall be of construction similar to a standard railing.
- Fixed industrial stairs shall be strong enough to carry five times the normal anticipated live load.
- All fixed stairways shall have a minimum width of 55.9 cm.
- Fixed stairs shall be installed at angles to the horizontal of between 30° and 50°.

HOUSEKEEPING



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- Keep all places of employment, passageways, storerooms, and service rooms clean and orderly and in a sanitary condition.
- Load rating limits shall be marked on plates and conspicuously posted.
- Do not place on any floor or roof of a building or other structure, a load greater than that for which such floor or roof is approved.
- The floor of every workroom shall be maintained in a clean and, so far as possible, a dry condition.
- Where wet processes are used, drainage shall be maintained and gratings, mats, or raised platforms shall be provided.
- Every floor, working place and passageway shall be kept free from protruding nails, splinters, holes, or loose boards.

AISLES AND PASSAGEWAYS

- Aisles and passageways shall be kept clear and in good repair with no obstruction across or in aisles that could create a hazard.
- Permanent aisles and passageways shall be appropriately marked.
- Where mechanical handling equipment is used, aisles shall be sufficiently wide to prevent damage to equipment and material and permit egress in emergencies.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible for the following:

- Correct deficiencies noted in work surfaces.
- Ensure workspaces are kept clean, orderly, and sanitary.
- Ensure employees follow the policies established for safe work.

SAFETY OFFICE

The Safety Manager is responsible to:

- Provide support and training assistance to ALMA management in safe working surfaces.

INDIVIDUALS

All ALMA employee and visitors are required to:

- Any person working in the vicinity of unguarded floor or wall openings must wear appropriate fall protection equipment.
- If unguarded floor or wall openings are observed, the situation must be reported to the ALMA Safety Office.



12 - Working Surfaces

12-3 Scaffold

- 1) **Purpose** - This procedure establishes the requirements for the design, erection, inspection, and use of scaffold at the ALMA site.
- 2) **Scope** - This procedure is mandatory for all users while erecting, using, or dismantling stationary and mobile scaffold. Contractors are required to follow these requirements when using ALMA provided or installed scaffold. References include:
 - Directive 89/655/EEC – Relating to requirements for new machinery to comply with the machinery directive.
 - DIN EN 12811-1 - Temporary works equipment - Part 1: Scaffolds - Performance requirements and general design

3) Rules/Requirements

PRIOR TO ERECTION

- The responsible Supervisor must inspect the to determine ground conditions or strength of supporting structure, and for proximity of electric power lines, wind conditions, the need for overhead protection or weather protection coverings.
- Inspect equipment to see that it is in good condition and is serviceable. Do not use damaged or deteriorated equipment.
- Inspect wood plank to see that it is graded for scaffold use, is sound and in good condition, straight grained, free from saw cuts, splits and holes.
- A competent person (someone able to identify hazards in the working conditions, and who has authorization to take prompt corrective measures) with training and experience must examine fall protection, integrity of scaffold, and ensure the scaffold is maintained and used in a safe manner.

AFTER ERECTION

- A competent person must inspect the scaffold regularly, e.g. at least once a week; after substantially altered, damaged and following extreme weather.
- Record inspection results in company records or site diary.
- Ensure there are certificates for all work platforms and scaffolds prior to its use.

STORAGE / LOADING

- Do not store materials on scaffold in excess of supplies needed for immediate operations.
- Fuel heaters are prohibited on scaffold.
- Scaffold and components must support without failure, at least four times the maximum intended load. The intended load includes personnel, equipment, and supply loads.
- The intended load should never exceed the rated load.
- The maximum load capacity must be known and communicated to all employees.
- The maximum permissible load must be written on the scaffold components.



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FALL PROTECTION

- Workers on a scaffold must be protected from falling.
- Guardrail (minimum 1m – top rail; 0,45m – mid rail; 0,15m – bottom rail) systems must be installed along all open sides and ends of platforms before the scaffold is released to be used by employees other than erecting/dismantling crews.
- Workers erecting or dismantling supported scaffold must have and use fall protection unless the fall protection constitutes a greater hazard.
- A competent person must determine the feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffold.
- Ensure there is safe access to all scaffold platforms.

PPE (PERSONAL PROTECTIVE EQUIPMENT)

- In addition to hardhats, protect each employee on a scaffold from falling objects through the installation of toe boards (15 cm), screens, or guardrail systems (1 m), or through the erection of debris nets, catch platforms, or canopies that contain or deflect falling objects.
- For falling objects that are too large or heavy to be contained or deflected by the above methods, place such objects away from edges of surfaces from which they could fall and secure the materials to keep them from falling.

TRAINING

- Train workers who erect, disassemble, move, operate, repair, maintain, or inspect the scaffold by a *competent person* (see 51.3.1 for description of competent person) to recognize the hazards associated with scaffold and the performance of their duties. Training should include the following areas:
 - Electrical hazards, fall hazards, and falling object hazards in the work area;
 - Procedures for dealing with electrical hazards and for erecting, maintaining, and disassembling the fall protection systems and falling object protection systems;
 - The proper use of the scaffold, and proper handling of materials on the scaffold;
 - Maximum intended load and load carrying capacities of the scaffold used; and
 - Other relevant scaffolding requirements.

USE OF SCAFFOLDS

- General Requirements:
 - Scaffold is not to be used in winds exceeding 15 m/s.
 - The two-person rule shall be in effect when working from any platform, scaffold, or building roof. (See Section 8-3 – Operations Safety for two-person rule requirements)
 - Make sure scaffolds are sturdy, plumb, level, and square.
 - Clear work surfaces of snow, ice or slippery materials.
 - Provide all uprights with base plates to prevent slippage or sinking.
 - All planks extend at least 15.24 cm and no more than 30.48 cm over the supports.
 - Planks must be in good condition and free of visible defects.
 - Ensure 4:1 (height to width) scaffold are secured to a building or structure.
 - Effective barriers or warning notices in place to stop people using an incomplete scaffold, e.g. where working platforms are not fully boarded.
 - Scaffold being raised or lowered must be handed and not dropped or thrown.
 - Tools should be raised or lowered in pockets, pouches or buckets.
 - Damaged scaffold members must be tagged and removed from service.



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- Scaffold must be stored properly to protect and prevent damage. Storage must not be in areas where it shall obstruct traffic or cause a fire hazard.
- Rolling Scaffold:
 - Do not ride manually propelled rolling scaffold. No personnel should be on the tower while it is being moved.
 - Lock all casters before getting on the tower.
 - Work only within the platform area: do not try to extend overhead work area by reaching out over guardrail.
 - Do not bridge between two rolling towers with plank or stages.
 - Be sure floor surface is clear of obstructions or holes before moving scaffold.
 - Be sure there are no overhead obstructions or electric power lines in the path of rolling scaffold.
 - Rolling towers must only be used on level surfaces.
 - Move rolling towers by pushing at the base level only. Do not pull from the top.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Designate a competent person to examine fall protection and scaffold use.
- Inspect the scaffold regularly and maintain results of inspections.
- Inspect equipment to see that it is in good condition and serviceable.
- Determine the feasibility and safety of providing fall protection for employees erecting or dismantling scaffold.
- Ensure safe access to all scaffold platforms.
- Provide and maintain fall protection for employee use.
- Ensure personnel are trained in the use of scaffold.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Select fall protection equipment and ensure the equipment selected is compatible with existing fall protection systems.
- Review safety analyses of the hazards identified that may require the use of fall protection.
- Train workers who erect, disassemble, move, operate, repair, maintain, or inspect the scaffold to recognize the hazards associated with scaffolds.

INDIVIDUALS

All employees are required to:

- Follow the requirements of this policy.
- Wear appropriate personal protective equipment including hard hats.



13- Electrical

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13. ELECTRICAL

13-1 General Electrical Safety

- 1) **Purpose** – This procedure establishes the requirements for working with electricity, and electrical equipment. This policy is intended to supplement:
 - ALMA Electrical Design Requirements, ALMA-80.05.00.00-005-A-SPE, containing design and construction prerequisites for the safe operation procedures defined herein, and
 - ALMA General Safety Design Specification, ALMA-10.08.00.00-003-A-SPE.
- 2) **Scope** - To protect people from both direct and indirect electrical hazards, ALMA has this standardized guidance for all work involving electrical or electronic equipment.

3) Rules / Requirements Current in the Body

Effect of Current on the Human Body

Effect	Current in milliamperes	
	DC	AC (60 Hz)
Slight sensation at contact point	0.6	0.3
Perception threshold	3.5	0.7
Shock--not painful, no loss of muscular control	6	1.2
Shock--painful, no loss of muscular control	41	6
Shock--painful, let-go threshold	51	10.5*
Shock--painful, severe effects: muscular contractions, breathing difficulty	60	15
Shock—possible ventricular fibrillation (loss of normal heart rhythm)	500	100

Data do not indicate precise values. Circuit breakers trip at 15-20 amperes or higher--more than 200 times the lethal current and are intended to prevent electrical fires, not protect from shock.

EQUIPMENT

- All electrical equipment must be approved by a recognized testing lab.
- Equipment used in hazardous locations must be totally safe and approved for the location.
- All fixed location electrical equipment (transformers, etc.) must be secured to the floor.
- Any machine that will start automatically must be identified with a warning sign.
- Electric panels must be maintained clear directly in front of the enclosure for a distance of 80 cm.
- Energized electrical equipment operating at greater than 50V must be guarded against accidental contact by an approved enclosure.
- Mark entrances to electrical rooms with conspicuous signs.
- Each disconnecting means must be legibly marked to indicate its purpose.



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- Legibly mark each operating switch to identify its purpose and the equipment it controls.
- Each outlet must be legibly marked with the appropriate circuit information.

SAFE WORK PRACTICES

- Do not open enclosures of energized electrical equipment.
- Entry to Substation is restricted to Electrical Personnel or personnel accompanied by Authorized Electrical Personnel.
- Notify the Facilities Manager for any tripped circuit breakers. Do not reset circuit breakers unless authorized.
- Keep all parts of your body away from potentially energized devices.
- Visually inspect all electrical appliances and flexible cables prior to use for damage.
- Do not alter, service, or repair electric powered equipment unless trained and authorized to do so.
- Avoid any use of electrical equipment under wet conditions.
- Never assume a circuit, conduit, pipe, or other utility device is "dead" until verified by a qualified person.
- Exclude from hazardous work anyone who appears to be fatigued, ill, emotionally disturbed, or whose performance is otherwise impaired.
- Do not work with Electrical Appliances in the Rain or while standing in water.

PLANNING

- Ensure that the work is properly planned
- Understand the importance of and respect lockout and tagout of electrical systems.
- Supervisors shall assess each situation, then define and enforce an appropriate level of protection for the personnel engaged in the activity.
- Any person working on electrical equipment any elevated location 1.5 meters or more above the floor, shall take precautions to prevent a fall from reaction to electrical shock.
- ALMA has buried electrical circuits site wide. Also, most buildings have conduit in walls and floor slabs. If work requires digging or drilling into soil or penetration into walls or floors with tools or fasteners, call the Camp Facilities Manager to request utility location.
- Conduct training sessions and drills periodically to help prevent accidents and to train people to respond effectively if an accident does occur.

GROUNDING AND INSULATION

- If there is any deterioration of outer jackets, cases or cabinets, or if the insulation or barriers have been impaired, immediately take the device out of service.
- Grounding equipment requires a third conductor in the cord and in any extension cord and branch circuit into which it is plugged.
- Ground conductors are not needed for the device to operate, so there may be an undetected open ground in an appliance, its cord, or in a branch circuit. For this reason, it is important to test grounded appliances, and circuits periodically for ground continuity.
- A ground fault circuit interrupter (GFCI) is a specially constructed circuit breaker or receptacle that opens the circuit when a small imbalance in the current between the two active conductors is detected.
- GFCIs are required in all new installations including locations where receptacles are within 1.82 m of sinks or showers, exterior and rooftop receptacles.
- Provide temporary ground-fault protection where appropriate by using portable GFCIs and cord sets with built-in GFCI devices. Typical applications include outdoor use of power tools



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where permanent GFCI receptacles are unavailable and locations where personnel may contact electrical systems while in contact with water.

- GFCI devices shall be used in other locations where beneficial. This includes use of extension cords when cords are used in shops, in labs, and service buildings.
- GFCIs are not required for portable cords or surge protector cords used in an office.
- Receptacles protected by GFCIs should be verified and marked accordingly. An acceptable method is to affix a small decal to the cover plate with the message "GFCI Protected" or "GFCI."
- All GFCI manufacturers recommend that the devices be tested at least monthly to ensure they operate as designed. Use the "Test" button to verify trip action and then reset a GFCI to fulfill the testing requirement.
- If the GFCI fails to trip or cannot be reset, notify Safety Office or the Camp Facilities Manager.
- There is no special expertise required for GFCI testing. The occupants of the area or the most frequent users of the GFCI are often the best ones to test the device. It is the responsibility of the owner of a work area to ensure that the test gets done.

EXTENSION CORD SAFETY

- Always hold cords by plug when removing them from receptacles. Never "whip" a cord to unplug it.
- Store all cords indoors when not in use. Outdoor conditions--especially sunlight-- can deteriorate a cord over time.
- Unplug an extension cord when not in use.
- Keep cords out of work areas. If this situation is unavoidable, secure the cord to the floor with tape or use cord molding.
- Use extension cords only for temporary applications associated with a one-time job or transient condition. Install permanent wiring for long-term or repetitive needs.
- At construction sites, in damp areas, or in an area where a person may be in direct contact with a solidly grounded conductive object, extension cords must be protected by a GFCI.

PROHIBITED USES OF EXTENSION CORDS

- Minimize use of extension cords and avoid "Daisy Chains" of cords.
- Extension cords may not be used in place of permanent facility wiring.
- Cords shall not be attached to building surfaces, structural members or permanently concealed in walls, ceilings, or under floors - including raised computer floors.
- Do not run cords through moisture, tied to over-head pipes, across traveled roads, or across areas of high foot traffic.
- Extension cords may not be run through doors, ceilings, windows, holes in walls, or through hinged door openings in enclosures.
- If necessary to run an extension cord through a doorway or window for short-term use, protect the cord from damage; it must be removed immediately when no longer in use; and must not be a trip hazard.
- Do not use extension cords that are frayed, cut, or damaged such that inner conductors show, or that have outer sheaths which have pulled loose from their molded plugs exposing the inner conductors.
- Cords may not be repaired with electrical tape.
- Do not use extension cords in which the plug grounding prong has been removed.



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- Do not use extension cords for heat-producing appliances such as coffee pots, toasters, and space heaters. The load from these devices can approach the circuit capacity, and the added cord length increases the chance of overheating.
- All electrical extension cables shall be tested and tagged by ALMA electrician -This will apply to both ALMA and contractors.
- Cables will need to be inspected/tested on 6 monthly bases by an ALMA Electrician and a tag with the test date and next test date applied to the cable.
- All Cables found to be in poor condition must be removed from site immediately.
- Random onsite inspections of cables will continue.

POWER STRIPS

- Power strips terminate in a row or group of receptacles and are commonly used in offices to provide multiple receptacles. This use is permissible so long as the load does not exceed the current rating for the strip.
- Multiple-outlet power strips must be equipped with an integral circuit breaker; have a cord no longer than 3 m; and bear the approval marking of UL or CE.
- Power strips shall not be permanently mounted to any facility surface.
- For equipment racks, test benches, test carts, and similar apparatus, the preferred method of supplying utility power to rack-mounted instruments is with a special raceway power strip specifically designed for permanent installation.
- Coiling or winding excess cord length can concentrate and overheat the cord.
- Similarly, covering a cord with a rug or rag can trap heat and overheat the cord. This trapped heat can damage the cord and lead to a fire.

4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that annual preventive maintenance inspections are performed on HVAC and electrical installations.
- Ensure only certified and qualified individuals construct or service electrical or electronic equipment.
- Ensure all work on electrical or electronic equipment is performed de-energized.
- Ensure all work with hazardous voltage and current follows an approved written plan.
- Ensure that staff assigned to these tasks has the appropriate training and credentials.
- Identify the necessary qualifications for electrical work capable of causing injury.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide interpretations to electrical codes and standards.
- Review proposed changes to electrical policies and practices.
- Collect inspection certificates and ensure corrective actions are completed.

INDIVIDUALS

All employees are required to:

- Report any identified or suspected electrical hazards to your Supervisor.



13 - Electrical

13-2 Power Distribution Safety

- 1) **Purpose** – These requirements are used to develop and administer a power distribution safety procedure to protect personnel working on power distribution systems. This policy is intended to supplement:
- ALMA Electrical Design Requirements, ALMA-80.05.00.00-005-A-SPE, and
 - ALMA General Safety Design Specification, ALMA-10.08.00.00-003-A-SPE.
- 2) **Scope** - Equipment used to distribute electrical line power is treated separately from the electrical and electronic equipment that conditions, controls, and uses this power. Specific safety requirements apply to servicing and constructing electrical equipment. Applicable to all ALMA project personnel.

3) Rules / Requirements

DEFINITIONS

- A qualified person (QP) is in possession of a valid switching authorization from a reputed training institute or a major grid or power distribution company, has skills and knowledge of the construction and operation of electrical equipment and installations and has received safety training on the hazards involved.
- A safety watch is an individual whose sole task is to observe the worker and to quickly de-energize the equipment in case of an emergency and alert emergency personnel. This person must know when and how to de-energize the equipment. This person shall have current cardiopulmonary resuscitation (CPR) training.
- A work control document is used to support hazardous electrical work (See Section 8-2: Maintenance Safety (JHAs and SOPs))

ELECTRIC HAZARD CLASSES

- Electrical Work Restrictions or work rules are established according to hazard *class* and *mode* of work. Table 53.3.2 summarizes electrical hazard class and work mode system as well as the associated work restrictions.
- These work practices and precautions are the minimum required. Managers or Supervisors may specify more restrictive or augmented procedures.

Electrical Hazard Classes and Work Modes

	Mode of Work		
Hazard Class	1 De-energized equipment, LO/TO in place	2 Measurement, troubleshooting of energized equipment	3 Manipulative, hands-on tasks on energized equipment
I Low hazard < 50V & < 50A (low voltage, low	A qualified person (QP) may work alone.	A QP may work alone.	A QP may work alone. Management approval and general supervision required.



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power)			
II Medium hazard 50-277 VAC/DC line-to-neutral <480 VAC line-to-line stored charge > 10 joules	At least two QP must be present until it has been clearly verified that the equipment has been de-energized. Then one QP may work alone.	At least two QP must be present. Work control document approved by the cognizant Supervisor and specifying PPE and shock/arc flash boundaries.	At least two QP--including the worker(s)--must be in continuous sight and sound communication. There must be an approved work control document specifying PPE and shock/arc flash boundaries.
III High hazard 277 VAC line-to-neutral 480 VAC Line-to-line	At least two QP must be present until it has been clearly verified that the equipment has been de-energized. Then one QP may work alone.	At least two QP must be present throughout the operation. Work control document approved by the cognizant Supervisor and specifying PPE and shock/arc flash boundaries.	At least two QP--including the worker(s)--must be in continuous sight and sound communication. There must be an approved work control document specifying PPE and shock/arc flash boundaries for all work.
IV Extreme hazard > 600 VAC Line-to-line	At least two QP must be present until it has been clearly verified that the equipment has been de-energized. Then, one QP may work alone.	Approved work control document a specifying PPE and shock/arc flash boundaries. Workers must wear appropriate PPE. All equipment must be rated for use with the expected hazards. At least two QP are required, one as a Safety Watch, stationed outside normal protective barriers and with continuous sight and sound communication with the worker(s). The Safety Watch shall not be distracted from this assignment at any time.	ALMA staff will not work on Class IV equipment in Mode 3. Only <i>personnel with qualifications equivalent to commercial power utility personnel</i> will work on energized Class IV equipment, and they will follow their own procedures.

Notes:

- Voltage is line-to-neutral or line-to-line, whichever is higher.
- Class is determined by the highest voltage or current to which personnel may be exposed during servicing operations.
- Hazard Class I includes equipment with voltages > 50V, but with current capability < 5mA and stored energy < 1 joule.
- The second qualified person may serve as the safety watch.

WORK CONTROL DOCUMENTS AND ENERGIZED ELECTRICAL WORK PERMITS

- Strict operating procedures must be followed. Written work orders are required for work on high voltage.



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- Work control documents must be developed by a qualified person and requires the approval of the responsible Supervisor.
- The work control document must include the hazard analysis, hazard control boundaries, PPE, and specific steps to accomplish the task. Worker qualifications and any unusual aspects of the work must be included.
- Additional approvals are required where the electrical work may affect other operations or when the electrical workers are at risk from nearby activities.
- Include instructions for each task and job assignment, the potential hazards, and the proper use of safety equipment.

SAFE WORK PRACTICES

Five Safety Rules of electrical service work (EN 50110):

- Disconnecting
- Securing against reclosing
- Checking safe isolation from supply
- Earthing and short-circuiting
- Covering or providing barriers to adjacent live parts

- Personnel are not permitted to work in any location where contact with energized objects is possible.
- Cables which may be contacted shall be treated the same as bare connectors.
- Work on electrical distribution systems equipment will be performed de-energized unless de-energized introduces hazards or it is infeasible due to equipment design or operational limitations.
- All electrical circuit conductors will be considered energized until all sources of energy have been removed and placed under lock/tag/try, the absence of voltage verified, and where appropriate, temporarily grounded.
- Do not remove any cover panels from any equipment where there are exposed energized high voltage connections unless qualified and is required for the purpose of testing
- Instructions to workers shall be presented by the Supervisor at a pre-job briefing. Include PPE requirements and review of any work control document.
- All non-emergency work must be planned in advance.
- Emergency work must be limited to the minimum work necessary.
- Each isolation device open or closed in the work process must be locked and tagged.
- Take necessary actions to ensure the equipment is isolated from backfeeds, emergency power supplies. Isolation must be verified in each case by a QP and Tagged and Locked by the mentioned authorized person prior to Personal Locks/Tags being attached.
- Notify affected personnel prior to shutting off power and prior to restoration.
- Switching orders must be approved and signed by the Supervisor in charge and only be performed by authorized and QP.
- If restoration of power is part of the switching order, the procedure must be included in the order.
- Maintain accurate configuration records of the electrical distribution system to ensure electrical safety as arc flash hazard calculations and resulting hazard controls are based on the documented system configuration.
- Exposed wiring is an abnormal situation and should be reported to the Camp Facilities Manager or Supervisor.



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- Unqualified personnel may work at or near the boundary with the concurrence of the Supervisor in charge of the space where the live electrical part hazard exists.
- Unqualified personnel may cross the Limited Approach Boundary only if they are briefed on the hazards and continuously escorted by a qualified person.

ARC FAULT HAZARDS-FLASH PROTECTION BOUNDARIES

- Electrical workers must wear and be properly trained in the safe use and application of appropriate personal protective equipment (e.g. hard hat, face shield, flame resistant neck protection, ear protectors, flame retardant suit, insulated rubber gloves with leather protectors, and insulated leather footwear) for the possible electrical hazard with which they might face. When an electrical arc occurs, it can produce temperatures up to 19,500 ° C. This melts and vaporizes the constituents of the conductor, rapidly heating the surrounding air with potentially explosive force. Electrical explosions can be fatal within 3 m of the arc, and can cause burns up to 12.2 m away.
- No person shall open or approach opened electrical distribution equipment or switchgear within the Flash Protection Boundary unless wearing the appropriate PPE rated for the flash hazard present with that equipment.
- The Flash Protection Boundary distance will be indicated on labels on most fixed equipment and shall be included in the work control document.
- For all energized work performed within the Flash Protection Boundary, the incident energy exposure to the worker will normally be calculated and indicated on equipment labels.

ACCESS CONTROL TO SUBSTATIONS AND ELECTRICAL SWITCHBOARDS

- All sub-station will remain locked.
- Distribution of access keys to sub-station will only be to authorized personnel.
- Switchboards that are not in compliance with the “finger test” will remain Locked at all times.
- Distribution of access keys to Switchboards that are not in compliance with the “finger test” will only be to authorized and qualified personnel.
- Access to substation/yards is prohibited during Electrical storms except in the case of an Emergency Situation

SAFETY EQUIPMENT

- Safety equipment can include rubber gloves, rubber mats, safety glasses, high dielectric safety helmets, grounding sets, hot sticks, etc.
- All electrical protective equipment and safety equipment must be inspected before each use.
- High Voltage Test equipment must be inspected and tested by qualified testing service on 6 months Basis.
- Air test rubber gloves and annually test the gloves by an approved testing lab. The date of last inspection must be marked on the gloves.
- Gloves must be marked with their rated voltage must be inspected and tested by qualified testing service on 6 months Basis.
- Employees working in areas where there are electrical hazards shall be provided with, and shall use, PPE that is designed and constructed for the specific part of the body to be protected and for the work to be performed.
- In general, this requires wearing flame-resistant clothing, head and eye protection, and gloves all having a suitable rating for the voltage and arc flash hazard present.
- PPE requirements will be specified in the applicable work control document.
- Protective equipment shall be maintained in a safe, reliable condition and shall be visually inspected before each use.



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TRAINING

- Training is required for employees who face a risk of electric shock that is not reduced to a safe level. Employees in occupations listed below face such a risk and are required to be trained. Other employees who also may reasonably be expected to face comparable risk of injury due to electric shock or other electrical hazards must also be trained.
- Employees shall be trained in and familiar with the safety-related work practices that pertain to their respective job assignments.
- Employees who are not qualified persons shall also be trained in and familiar with any electrically related safety practices necessary for their safety.
- Training must include, at a minimum:
 - The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
 - The skills and techniques necessary to determine the nominal voltage of exposed live parts, and
 - The clearance distances and the corresponding voltages to which the qualified person will be exposed.

Occupation

Supervisors, Electrical and electronic engineers, Electrical and electronic equipment assemblers, Electrical and electronic technicians, Electricians, Industrial machine operators, Material handling equipment operators, Mechanics and repairers, Painters, Riggers and roustabouts and Stationary engineers.¹²

Welders.



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ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER:

Job/Work Order Number _____

(1) Description of circuit/equipment/job location:

(2) Description of work to be done:

(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:

Requester/Title Date _____

PART II: APPROVAL(S) TO PERFORM WORK WHILE ELECTRICALLY ENERGIZED:

 Supervisor

 Safety Manager

PART III: AUTHORIZATION TO PERFORM WORK WHILE ELECTRICALLY ENERGIZED

(To be completed by the Electrically Qualified Persons Doing the Work)

(1) Work control document to be used in performing the above detailed work is clear and understood:

(2) Description of the Safe Work Practices to be employed:

(3) Results of the Shock Hazard Analysis:

(4) Determination of Shock Protection Boundaries:

(5) Results of the Flash Hazard Analysis:

(6) Determination of the Flash Protection Boundary:

(7) List necessary Personal Protective Equipment to safely perform the assigned task:

(8) List the means employed to restrict the access of unqualified persons from the work area:

(9) Complete and document a Job Briefing including discussion of any job-related hazards:

(10) Do you agree the above described work can be done safely? ____ Yes ____ No (If no, return to requester) _____

Electrically Qualified Person Electrically Qualified Person

(11) Approval: _____

Supervisor

Electrical Subject Matter Expert*

Note: Once the work is complete, forward this form to the Safety Office for review and retention.

* Camp Facilities Manager/Site Manager on Duty (MOD); Electrical Engineering Manager; Safety Office Electrical Specialist



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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure that only qualified individuals construct, switch or service electrical or electronic equipment and that the work is accomplished as set forth in this policy.
- Approve the required PPE and tools for the job
- Ensure that to the extent practicable, all work on electrical or electronic equipment is performed while the equipment is de-energized.
- Ensure that all electrical work follows a work permit document with appropriate approvals.
- Review all work control documents for subcontracted work on the electrical distribution system.
- Document all modifications or additions to the electrical distribution system.
- Maintain arc flash analysis records for the electrical distribution system.
- Monitor the work of contractors to assure compliance with electrical control requirements.
- Maintain a list of electrical workers who are qualified and authorized to work on electrical distribution systems.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Provide interpretations to electrical codes and standards.
- Inventories HV test equipment
- Review proposed changes to electrical policies and practices.
- Serve as the Safety advisor to the Head of Technics and Camp Facilities Manager.

INDIVIDUALS

All employees are required to:

- Report any identified or suspected electrical hazards to your Supervisor.



13 - Electrical

13-3 Lock Out - Tag Out / Stored Energy Isolation

- 1) **Purpose** – Lock out/tag out (LO/TO) is to keep workers safe by keeping equipment from being set in motion, or preventing energy flow through a device. This section explains lock and tag procedures, and serves as a rulebook for workers who apply lock and tag at ALMA. This procedure is intended to supplement:
- ALMA Electrical Design Requirements, ALMA-80.05.00.00-005-A-SPE, and
 - ALMA General Safety Design Specification, ALMA-10.08.00.00-003-A-SPE.
- 2) **Scope** - This procedure is applicable for maintenance work on potentially energized (electrical, mechanical, pneumatic, fluid and gases, hydraulic, thermal, water under pressure, gravity) equipment and machinery. This procedure also details administrative requirements for ensuring work on damaged equipment does not occur. The procedure establishes requirements for working with contractors.
- 3) **Rules / Requirements**

GENERAL

- A lock out may only be performed by a trained, authorized employee.
- Never apply an unauthorized LO/TO mechanism.
- Never remove a safety lock or tag unless you installed it.
- Never use administrative locks or tags as a substitute for those used for maintenance/repair safety.
- Verify that your locks and tags are in place before beginning work.
- Know the equipment to be worked on, and its potential for storing or releasing energy. Be aware of the hazards and associated operational characteristics of the equipment to be locked out.
- Treat nearby electrical circuits as if they were live.
- Treat moving parts as if they were in motion and anything else that can move as if it will move.

STANDARD LOCK OUT/TAG OUT PROCEDURE

- Step 1: Determine hazards - Evaluate the type and magnitude of potentially hazardous energy, and the means to control the energy. Be alert to multiple energy sources. For servicing or maintenance a detailed and written procedure and check list (Spanish & English) must be developed to secure the System(s) along with any other systems which present a stored energy hazard.
- Step 2: Notify others - Notify all affected employees. Tell them that the equipment will be out of service until repairs or adjustments are completed.
- Step 3: Isolate energy sources
 - Secure the equipment, put all appropriate energy-isolating devices in a safe state, lock them out and attach a "DANGER" tag.



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- When not possible to attach a lock directly to the energy-isolating device itself, install a lockout mechanism.
- A lock out mechanism is an accessory attached to an energy-isolating device which permits it to accept a lock and then be secured in a safe position.
- Fill out tags completely and place them as to be immediately apparent to anyone who might attempt to operate the device. Tags must be attached by a durable means.
- When servicing or maintenance is performed by multiple individuals, each worker must install his/her own locks and tags at control points. Use multi-lock hasps as needed.
- Step 4: Remove potential energy
 - Turn all control switches/ valves off and lock controls where possible.
 - Short all capacitors and ground all inductors that may have harmful stored energy.
 - Bleed the system of its energy (steam, air, water, gas and hydraulic cylinders).
 - Block equipment that could move when energy is removed. Lower suspended loads or secure them independently. Release any stored spring tension.
 - If there is a possibility of re-accumulation of stored energy to a hazardous level, check the system frequently until the possibility of re-accumulation no longer exists, or until the LO/TO is cleared.
- Step 5: Verify lock out, ensure that the LO/TO is effective.
 - When working with fluids or gases under pressure, check all gauges.
 - When working with electrical energies, test the appropriate terminals with a suitable range voltmeter.
 - Test the effectiveness of the energy isolation by determining whether operating controls are effective.
- Step 6: Perform the needed work - Re-check the integrity of the LO/TO frequently, especially in tasks that last several days, or after work away from the equipment or system.
- Step 7: Prepare for re-energizing
 - When work is complete on the equipment or system, notify all affected people that the work is complete and ready for testing.
 - Inspect to ensure equipment has been properly reassembled, that tools, work aids, and spare parts have been collected and removed, and personnel have moved to safe positions.
 - Close cabinets and panels.
- Step 8: Remove locks and tags - When all affected people are ready, each tagger removes his/her own locks and tags.
- Step 9: Temporary testing (if necessary) - Test equipment to verify proper operation.

TAGOUT

- In the rare case where it is not possible to attach a lock to the energy-isolating device **or** to install a lock out mechanism, resort to tag out alone.
- In tag out, only the written warning--the danger tag--is attached to the energy-isolating device. It warns co-workers not to turn the power on (or off as the situation warrants).
- Tags have limited ability to protect, so additional safety measures--equivalent to lock protection--must be taken. Examples of safety measures include removing a circuit element, opening an extra disconnect device, or removing a valve handle to reduce the likelihood of accidental starting or release of energy.

CORD & PLUG ELECTRICAL EQUIPMENT



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- LO/TO requirements do not normally apply to electrical equipment that is equipped with cords and receptacle plugs if removing the plug completely de-energizes the equipment and the plug is under exclusive control at all times.
- If these conditions cannot be guaranteed, then LO/TO measures are required. Note that there are lockable "boots" to secure electrical plugs.

SPECIAL LOCK OUT SITUATIONS WITHOUT TAGS

- The ALMA policy for LO/TO permit the use of locks alone in certain *limited* situations. This may be advantageous when the lock out is brief or recurring. It is also time- and cost-effective when repetitive lockouts are associated with diagnostics and similar tasks.
- To be a candidate for a lock-only control of an energy source, the situation shall meet all of the following criteria:
 - Only one circuit or piece of equipment is to be de-energized.
 - The lockout period does not extend beyond the work shift.
 - All employees -- affected and authorized -- who are exposed to the start-up hazards of the equipment in question are thoroughly familiar with the special procedure.
 - Because the additional warning information provided by a tag is absent, other precautions *may* be needed to ensure adequate protection for workers and area occupants.

GROUP LO/TO

- Group LO/TO is a variation of the standard LO/TO procedure. Group LO/TO enables groups to lock out and tag out equipment both safely and conveniently.
- In this case, an additional step is added to the basic lockout procedure defined above. Specifically, the key from the lock attached to the energy-isolating devices is secured inside a special LO/TO box.
- Attach locks belonging to individual taggers to the LO/TO box, securing it shut and preventing access to the keys. In this way, workers are protected by one set of locks and tags, instead of each tagger having to use multiple locks and tags to secure all of the energy-isolating devices.
- This procedure is supervised by an individual designated by the responsible Supervisor as the group LO/TO coordinator. This individual is responsible for ensuring that all steps of the group LO/TO procedure are followed.

CONTRACTOR USE OF LO/TO

- If LO/TO is required to control energy sources during the work, ensure the LO/TO requirements are addressed with the contractor.
- Evaluate the contractor's LO/TO program for its adequacy.
- Ensure that the personnel assigned to the job are suitably trained and familiar with these requirements, and they have LO/TO devices, suitable for the task.
- Explain ALMA's LO/TO program, including zero-tolerance policy for violations to its workers.
- Discuss the contractor's work plan.
- If ALMA equipment or personnel in the area are affected by the pending LO/TO, install administrative LO/TO in conjunction with the contractor's LO/TO.

LOCKS AND TAGS

- All lockout and tag out materials are supplied by ALMA and are authorized for issue by Supervisors as detailed in specific training. Use of other materials is not allowed.
- Locks and tags must be instantly recognizable to everyone; standard appearance is essential.



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- When you receive a lock, immediately write your name, phone number, and work group on the label with a permanent marker, and affix it to the lock.
- Each tagger must always place his/her own lock and tag.

EVALUATION OF PROGRAM EFFECTIVENESS

- Every Supervisor must ensure that all equipment, machinery, and work processes in their area of responsibility have comprehensive written procedures to properly lockout the equipment.
- Supervisors must evaluate the maintenance/repair LO/TO procedures annually to ensure it is effective in protecting people.
- Each ALMA group ensures it has conducted an annual evaluation of its LO/TO.
- The evaluator's report shall be sent to the Safety Office.

ADMINISTRATIVE LOCK OUT/TAG OUT

- On occasion, a piece of equipment or a system must be locked or tagged for reasons unrelated to maintenance or service. This is termed administrative LO/TO. Examples include the following:
 - Equipment is defective and cannot be used without damaging it further, it is likely to fail in use, or it is suspected to be faulty.
 - Apparatus is deemed to be essential in its operational state, and any tampering or disruption will impair its proper operation.
 - Operation may result in undesirable environmental consequences.
 - An actual or potentially hazardous environment exists, and access must be restricted.
 - Equipment may require special training or authorization to use.
 - Newly installed equipment or systems have not yet been fully tested or approved for use.
- Administrative LO/TO shall be used as a means to protect equipment, the integrity of a working system, and people who may be affected by the equipment's or system's use. Administrative LO/TO does not apply to situations where locks are used for security or property control.

TRAINING

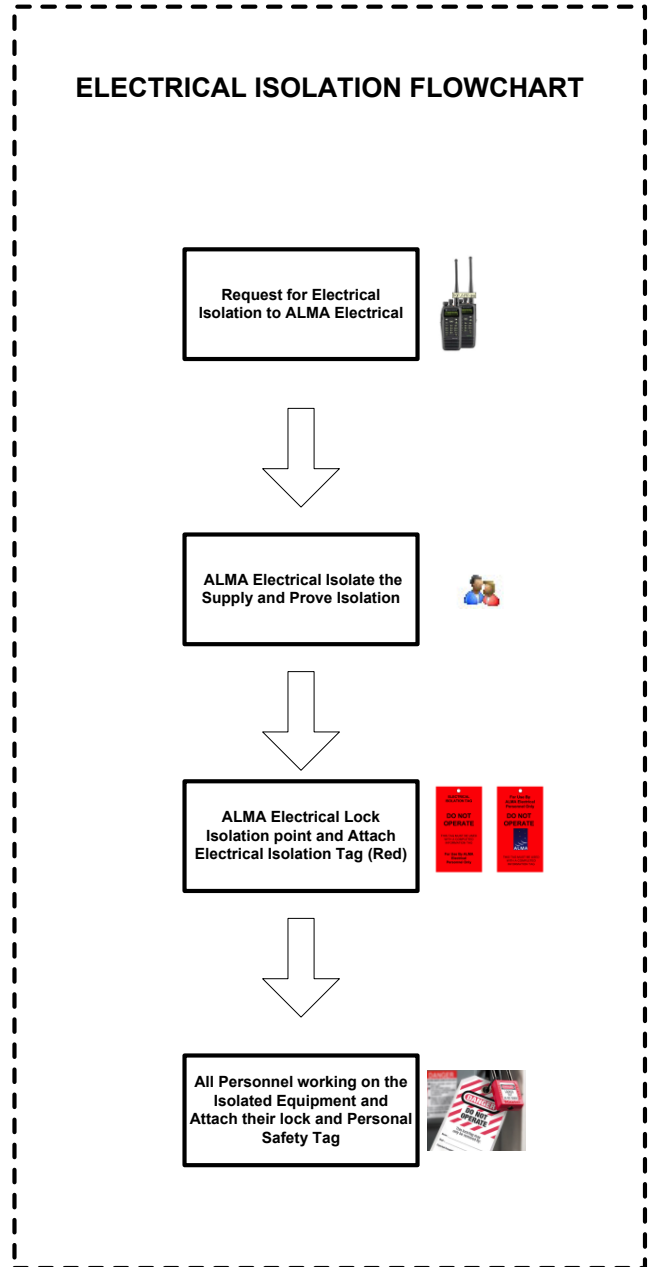
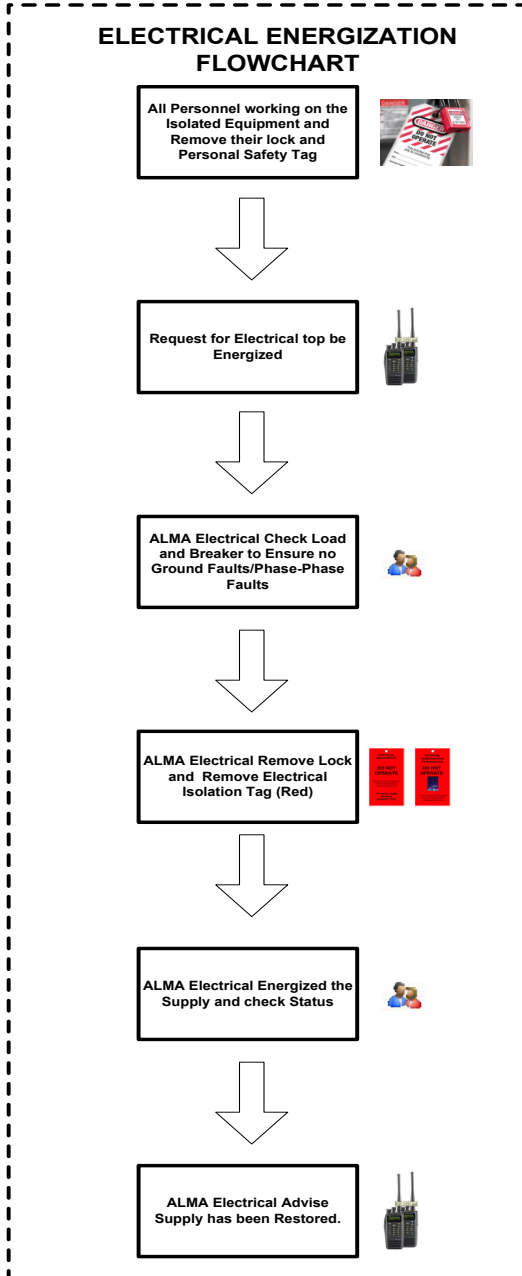
- Staff who apply LO/TO, or who supervise others (including contractors) who apply LO/TO, shall attend LO/TO Training. Attendance at the *entire* session is required.
- Many pieces of equipment or systems have unique features or special considerations for effective LO/TO.
- Supervisors/Managers who are responsible for these shall develop equipment-specific procedures and train their staff as needed.
- Different pieces of equipment that have the same LO/TO steps may be grouped into a single procedure.

SHIFT AND PERSONNEL CHANGES

In general, if a piece of equipment is locked out at shift change, the person on the next shift must apply his lock before the employee who is leaving can remove his. The procedures for shift changes must ensure the continuity of lockout/tagout protection between shifts.



Energy Release and Electrical Isolation Flowchart





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4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure employees are instructed in the significance of lockout requirements.
- Ensure written procedures and check lists (Spanish & English) exist to secure the System(s) which present a stored energy hazard.
- Label isolating devices to identify which devices apply to machines to be locked out.
- Develop equipment specific instructions that identify all sources of energy and the method to bring the equipment to a zero energy state.
- Provide equipment-specific LO/TO training appropriate for your employees.
- Ensure that worksites have sufficient LO/TO devices available for use.
- Perform inspections of your group's compliance with lock and tag procedures as part of regular Supervisory oversight.
- Ensure that each step of any group LO/TO procedure is properly carried out.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Perform lock and tag inspections during regular safety inspections
- Assist in the planning and conduct of periodic--no less frequently than annual--reviews of the application of lock and tag procedures at ALMA.
- Coordinate the observatory-wide selection and procurement of LO/TO supplies.
- Coordinate the distribution of LO/TO supplies within the group.

INDIVIDUALS

All employees are required to:

- Observe all warning tags and not tamper with any equipment or locks.
- Recognize and respect LO/TO measures.
- Only use LO/TO devices on the specific equipment you are authorized to service.
- Maintain proper training status in LO/TO for your job duties.



14- Construction Safety

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14. CONSTRUCTION SAFETY

14-1 Construction Coordination

- 1) **Purpose** – This procedure establishes the rules and regulations applicable to construction safety coordination. It establishes the minimum requirements for temporary or mobile construction sites.
- 2) **Scope** – This program applies to all work operations performed by Contractors at ALMA. References include:
 - Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.
 - Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile constructions sites (eighth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC).
 - Conditions, Rules and Regulations applicable to Contractors working at the Atacama Large Millimeter Array (ALMA) Sites, ALMA-10.00.00.00-004-C-PRO

3) Rules/Requirements

ABBREVIATIONS AND ACRONYMS/DEFINITIONS

- The following Abbreviations and Acronyms are used in this section:
 - PPE - Personal Protective Equipment
 - SHE - Safety, Health and Environment
- The following Definitions are applicable to this section:
 - **Contractor** within this context means main contractor, contractors, sub-contractors and self-employed persons.
 - **Coordinator for safety and health** means any person entrusted by ALMA project Supervisor to ensure SHE issues are considered during preparation or execution of the work.
 - **Project Supervisor** means any person responsible for the design and/or execution and/or supervision of the execution of a project, acting on behalf of ALMA.
 - **Self-employed person** means any person whose professional activity contributes to the completion of a project.
 - **Temporary or mobile construction sites** (hereafter referred to as *construction sites*) means any site at which building or civil engineering works are carried out. Examples include excavation, earthworks, construction, assembly and disassembly, conversion or fitting-out, alterations, renovation, repairs, dismantling, demolition, maintenance (painting and cleaning), drainage, etc.

PRIOR NOTICE

- In order to assure SHE coordination, each contractor must provide prior notification to ALMA contract management on all constructions sites on which:
 - work is scheduled to last longer than 30 working days and on which more than 20 workers are occupied simultaneously, or
 - the volume of work is scheduled to exceed 500 person-days.



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- The Prior Notice must include the following information:
 - Date of the notice
 - Exact location and address of the construction site
 - Type of construction project
 - Project Supervisor(s) (name(s) and address(es))
 - Safety and health coordinators(s) during the project preparation and execution stages (name(s) and address(es))
 - Date planned for start of work on the construction site
 - Planned duration of work on the construction site
 - Estimated maximum number of workers on the construction site
 - Planned number of contractors and self-employed persons on the construction site
 - Details of contractors and subcontractors already chosen

SAFETY AND HEALTH PLAN

- Each contractor is required to develop a Safety and Health Plan for each construction project under their control. The Safety and Health Plan must cover, at least, the following information:
 - Identification of the construction site
 - General organizational structure
 - Responsibilities of workers
 - Definition of the work, including signaling, routes, circulation, equipment use and control, material handling and storage, utilities, waste disposal, control and access to construction site
 - Identification of equipment and materials to be used
 - Risk assessment (identification of hazards and related control measures), in particular of those affecting workers from different contractors
 - Minimum requirements for health and safety
 - Management of information and communication among all contractors in SSHE matters
 - Emergency procedures, including evacuation
 - Communication system for accident reporting
 - Accommodation areas, sanitary installations, etc.

4) Responsibilities

ALMA PROJECT SUPERVISORS

The ALMA Project Supervisors are responsible to:

- Appoint in writing, one or more coordinator(s) for SSHE matters for any construction site on which more than one contractor is present.
- The main contractor may be appointed as the contractor coordinator for construction SSHE matters, if agreed.
- Ensure that prior to setting up of a construction site a safety and health plan is drawn up.

ALMA SAFETY OFFICE

The ALMA Safety Office is responsible to ensure the following:

- Prepare a work coordination plan.
- Request a meeting with every contractor before construction starts to initiate safe work coordination activities.



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- Review the contractor's protective equipment plan and protective measures used to assure employee safety.

CONTRACTOR SAFETY COORDINATOR

The contractor appointed SSHE coordinator(s) during project must:

- Coordinate implementation of the SHE provisions;
- Ensure that a safety and health plan is developed prior to construction;
- Coordinate implementation of safety preventions.
- Make adjustments required to the safety and health plan to take account of the progress of the work and any changes which have occurred.
- Cooperate with contractors, including successive contractors on the same site.
- Check that the working procedures are being implemented correctly;
- Take steps necessary to ensure that only authorized persons are allowed onto the construction site.
- Integrate preventive measures and work methods to improve the protection of workers and integrate into all the work activities at all hierarchical levels;
- Consult with workers on planning and introduction of new technologies with respect to consequences of the choice of equipment, the work conditions and environment for the safety and health of workers;
- Ensure that only workers who have received adequate instruction may access areas where there is serious and specific danger.
- Where several Contractors share a work place, all affected Contractors must cooperate with SSHE and occupational hygiene provisions.
- Coordinate actions in SSHE matters, and inform one another and their respective workers of the risks.

INDIVIDUALS

Each person must:

- Properly use machinery, apparatus, tools, dangerous substances, transport equipment and other means of production.
- Properly use the personal protective equipment supplied and after use, return it to its proper place.
- Refrain from disconnecting, changing or removing safety devices and use such safety devices correctly.
- Immediately inform the employer (contractor) of any work situation that represents a serious and immediate danger to safety and health and of any shortcomings in the protection arrangements.
- Cooperate with the employer (contractor) to protect the safety and health of workers.



14. Construction Safety

14-2 Holography Tower Access Requirements

- 1) **Purpose** – This procedure establishes the rules and regulations applicable for ascending the holography tower.
- 2) **Scope** – This program applies to the authorized staff when accessing the tower
 - Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.

3) Rules/Requirements

CLIMBING REQUIREMENT

- Only Team Leaders can require climbing and works on the Holography Tower. The work needs to be scheduled at least with one hour in anticipation and no improvised or sudden climbing will be required.
- The Team Leader will have to evaluate worker physical status; any sign of fatigue or sickness **MUST** forbid climbing the tower.
- The Team leader also must consider weather conditions, time of the day and work duration when requires a climbing.
- A second person to watch the work on the tower must be assigned

CLIMBING AUTHORIZATION

- A person is authorized to climb the tower only if all the following conditions are achieved:
 - A climbing / work instruction was received from the Team Leader
 - Health status was checked at the polyclinic
 - Person feels in good shape to make the climbing
 - The wind speed is less than 40 km/h (11.11 m/s). Get the information from the weather station <http://weather.aiv.alma.cl/>
 - The weather is not rainy or with possibilities of rain or electric storm
 - There is sunlight and the estimated work end time is not after the sunset. Sunset time depends on summer/winter season.
 - Night climbing is not allowed.
 - Do not climb after 16:30 in winter and 17:30 in summer.
 - All the safety equipment is available and in possession of the worker
 - A second person is assigned to watch the climbing
 - Team Leader authorizes the climbing
 - Safety Officer authorizes the climbing

SAFETY EQUIPMENT

- The following safety equipment **MUST** be in possession of the worker before start the climbing:
 - Harness + 2 safety tails
 - Slider for life-cable



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- Hardhat
- Safety shoes
- Oxygen
- Water
- Sun glasses
- Radio
- Gloves

CLIMBING THE TOWER

- A second assigned person must watch the climbing and working. MUST have a radio on channel 6 and must be able to talk with the climber all the time he/she is on the tower.
- Any person entering to the tower zone MUST use Hardhat, gloves and safety shoes.
- Before starting to climb notify to Safety Officer on radio channel 1.
- Keep on radio channel 1 for emergency.
- Attach slider to harness and to the life-cable - Never remove from the cable until the climb ends.
- The slider shall have a counter clockwise twist to have a safe and easy climb.
- Start to climb on normal pace. Control the effort and rest when start to feel tired to prevent become exhausted or dizzy.
- Rest as long is needed, drink water regularly. If feel dizzy use oxygen.
- If dizziness persists stop the climbing and return to the base.
- Any abnormal situation must be notified by radio.
- Upon arrival to the top attach the hook of the safety tails to the tower and detach the slider from the cable.
- Rest and drink water. Use oxygen whenever necessary.
- Give notice on the radio upon arrival to the top.
- While working on the top: NEVER detach the hooks of the safety tails. No exception is considered.
- The safety tails hooks can only be detached once the slider has been attached to the live-wire and is beginning to descend.
- Keep all tools and materials well organized and put away in order to avoid them falling down onto the ground.
- Immediately stop the work if wind starts to blow, and put tools, materials and pieces at a safe place and wait until the wind calms, if wind persists end the activities, pack the tools and materials and start the descending.
- When about to descend, sit on the gate of the top to attach the slider onto the live-wire.
- When descending, follow the same steps applied when climbing. Notify the watcher when beginning the descent.
- When the tower climb has ended, go back to the tower base and notify to Safety Officer.

WORKING ON THE TOP: ROPE MANEUVERS

- If the tools, materials and/or parts are too big or heavy to be carried up, then an elevator will have to be implemented by using the Tower Lifting arm and ropes.
- For lifting rope manoeuvres 2 people are required at the base of the tower. If the load is too heavy additional people have to be assigned.
- Two (2) ropes are stored in the Holography base enclosure; a thick rope and a thin rope.
- The thick rope has to be used for lifting the load and the thin rope is to guide the load in its way to the top, thus avoiding colliding with the tower.



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- Everyone participating in the rope manoeuvre must use safety gloves.
- Only one person will be assigned to guide the load with the thin rope.
- The rest of the people will help lift the load.
- The load has to be packed and correctly strapped with the ropes. A Safety Officer **MUST** check this before starting to lift.
- Once the lifting has started, **NEVER** leave the ropes unattended until the load has been safely removed on top of the tower.
- Follow the same indications as previously mentioned when a load needs to be taken down to the base.

PROTECTIVE EQUIPMENT



4) Responsibilities

MANAGEMENT

Managers and Supervisors are responsible to:

- Ensure employees are instructed in the holography tower requirements.
- Ensure employees comply with ALMA requirements.

SAFETY OFFICE

The ALMA Safety Office is responsible to:

- Ensure that all safety equipments are available.
- Ensure adequate height rescue capabilities are at hand
- Annually inspect the tower ladder, life line and fall protection is in place and functional.

INDIVIDUALS

All employees are required to:

- Comply with the safety requirement
- Report any defective climbing systems including fall protection as soon as noted.
- Must visually inspect climbing systems each time they use it.
- If the climbing systems are defective, the individuals must not use it, but tag it out of service.