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DOCUMENTS FOR WORK ABOVE 5.500 MASL

CERRO CHAJNANTOR, SAN PEDRO DE ATACAMA

GENERAL MANAGER: Jim Blair

SIGNATURE_____

INSTRUCTIVE CCAT-004

REST AREA RECOVERY ROOM AT 5,500 MASL

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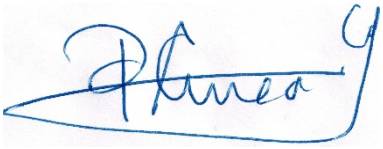
 Signature	 Signature	 Signature

1. Objective

To have an adequate rest area for the physiological recovery of workers who are affected by fatigue, temperature, or who have indications of acute mountain sickness or hypobaria. In this way, one of the requirements demanded in the Technical Guide on Occupational Exposure to Chronic Intermittent Hypobaria due to High Altitude, published by the Ministry of Health for work above 5,500 masl, is fulfilled.

2. Scope

This instruction must be known and complied with by all the personnel that directly or indirectly participate in the CCAT Project who carry out work at or above 5,500 masl.

3. Responsibilities

CCAT Management, through its Risk Prevention Management program, is responsible for having a rest area with hypoxia mitigation measures that includes providing supplementary oxygenation and acceptable conditions of temperature, humidity, and noise habitability. The CCAT Project will make use of and implement the Recovery Room at its summit site location on Cerro Chajnantor.

Field supervisors should identify workers who are showing signs of fatigue or discomfort from exposure to geographic altitude, and will be directed to the rest area or Recovery Room.

4. Definitions

Extreme altitude: at or over 5,500 masl.

Rest Areas/Recovery Room: A modular, transportable, enclosed structure, fitted out with two rooms, where there are at least four (4) comfortable seats, connected to an oxygen supply, for the care of a minimum of four (4) workers simultaneously. It is not a polyclinic and does not have a paramedic or nurse in attendance.

Rest areas are adequate enclosures for the physiological recovery of the worker, which considers mitigation measures such as oxygenation and compliance with habitability standards.

Standards of Habitability: are the conditions of temperature of comfort between 17 and 22 degrees Celsius, and humidification between 40 and 70% inside the Recovery Room. Noise must be less than 30 dB and a light level less than 5 Lux.

Physiological recovery: includes reduction of signs of fatigue, physical discomfort from temperature, increasing symptoms of acute mountain sickness such as headache and/or abdominal discomfort, associated with work in hypobaria at 5,500 meters above sea level, by the recovery effect of rest in a temperature conditioned room with additional oxygenation of 2 - 3 liters/minute for 20 minutes or more.

5. Procedure

Workers who perceive signs of fatigue, physical discomfort from temperature, increasing symptoms of acute mountain sickness (headache, abdominal discomfort) may come forward spontaneously and freely to the Recovery Room. In such cases, every worker should be accompanied by another person, preferably a safety officer or supervisor.

Field supervisors must bring to the Recovery Room workers who consider themselves to be affected or estimated to be in conditions of physical fatigue unfavorable for the execution of their tasks.

Once the fatigued worker arrives in the Recovery Room, he or she will lie down and the saturation will be measured by pulse oximeter to ensure that the values are equal to or greater than 85%. The Acute Mountain Sickness questionnaire score (see attached annex) and the fatigue level will be evaluated using the Borg Scale score (see attached annex). If after 20 minutes at rest with oxygen supply of 2 - 3 liters per minute there is persistence of acute mountain sickness symptoms of 4 or more points and the oxygen saturation level remains below 85%, the person should begin the immediate descent to below 3,000 masl and proceed to the ALMA-AOS polyclinic for evaluation and the determination of follow-on actions.

The Recovery Room will always be constantly monitored for correct habitability, as well as for the maintenance of necessary supplies for the correct recovery of affected people.

This Recovery Room can also be used as a shelter in critical environmental conditions, wind - chill extremes and/or water - snow storms.

6. Conditions of Habitability and Oxygen in recovery room

The CCAT Recovery Room will be located inside the CCAT summit area near the top of Cerro Chajnantor, at approximately an altitude of 5,597 masl. It will comply with the following parameters according to point 11 of the Hypobaria Technical Guide (HIC) of the Ministry of Health, DS28.

6.1 Humidification between 40 and 70%.

The room will have humidification between 40% - 70%, according to the HIC Technical Guide, utilizing humidifiers that will be installed and operated continuously (when the site is manned), consuming approximately 2 liters of water daily.

6.2 Comfort temperature between 17 and 22 ºC.

The room will have a temperature control system which will maintain an ambient temperature of approximately 17 to 22 ºC.

6.3 Noise Level Less than 30 dB(A).

The noise level shall not exceed 30dB when the door to the facility is closed, with permanent monitoring.

6.4 Lighting

The recovery room will have general artificial lighting and sectorized to illuminate a zone, allowing a person to rest in comfort.

6.5 Constant monitoring of recovery room habitability

For this point, the data of the variables indicated shall be monitored and recorded periodically.

6.6 Oxygen Supply

Oxygen will be supplied by means of two 6 m3 cylinders, with regulator, flowmeter, and humidifying vessel. Also 6 units of disposable individual masks. The filling pressure will be checked daily and when it is between 500 and 1,000 psi, a change is made for a full one. There will always be two full cylinders available. Cylinder changes will be programmed when the pressure is between 500 and 1,000 psi (approximately every 7 days).

7. References

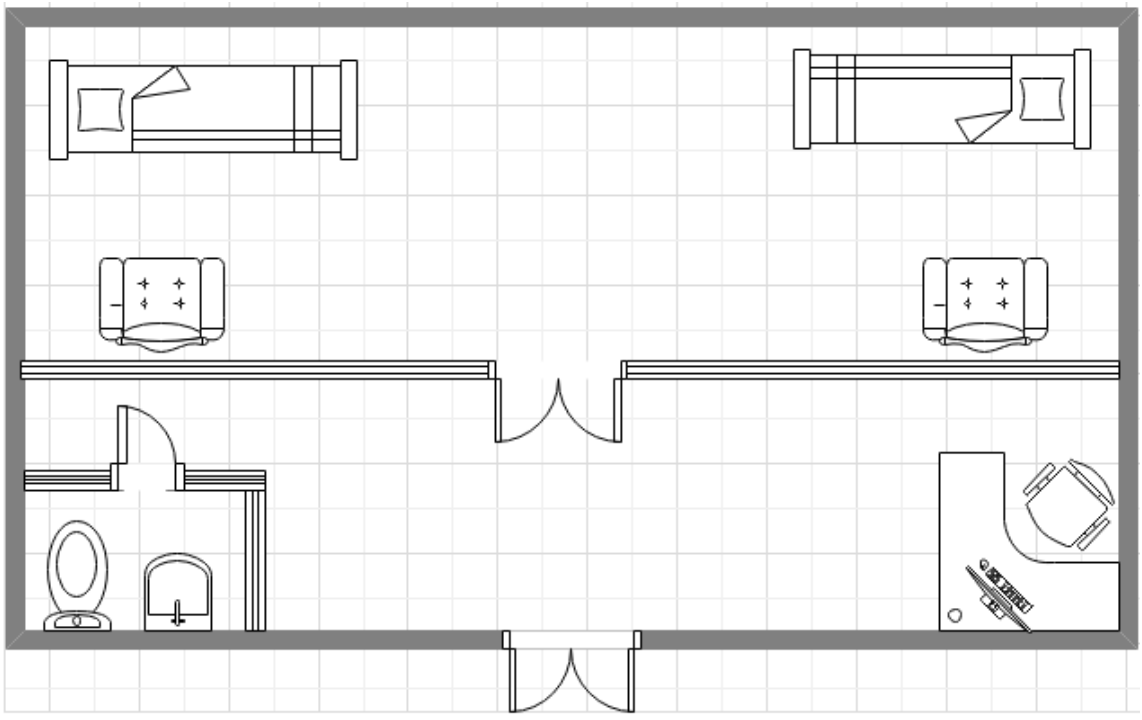
Technical Guide on Occupational Exposure to Chronic Intermittent Hypobaria due to High Altitude, Sanitary authorization for work over 5,500 meters above sea level, Point 11.

https://www.minsal.cl/sites/default/files/guia hipobarica altitud.pdf

Observation: The main objective of the recovery room is to reduce fatigue through control of the vital signs and condition referred by the worker.
Therefore, it is not a procedure room for health care or procedures, since it does not have the corresponding permits to function as a first aid room, therefore, it will not have the corresponding authorization from the competent authority.

8. Annexes,

Annex 1: Plan of the Recovery Room



Annex 2: Recovery Room Registration

RECOVERY ROOM REGISTRATION									
Date	**Complete name**	**Symptoms**	**Oximetry**		**Hour**		**Oxygen Cylinder Level**		**Supervisor Signature**
			check -in	**check-out**	**check -in**	**check-out**	**Start**	**End**	

Annex 3: Temperature and Humidity Recording

Temperature and humidity recording					
Date	**Hour**	**Temperature**	**Humidity**	**Name of Responsible**	**Signature**

Annex 4: Reference Values of Vital Signs at Extreme Geographic Altitude

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1. Objective

Ensure that workers exposed to high and extreme altitudes, meaning altitudes above 3,000 and 5,500 masl respectively, are found with clinical signs adequate to safe exposure to hypobaria, to prevent diseases of geographical altitude and risky work fatigue, or to avoid complications in emergency situations and rescues.

The vital signs measured above 3,000 meters above sea level allow medical personnel to evaluate the tolerance to geographic height of a non-acclimatized person, as well as an acclimatized person, in the field work place, to include the starting of days in meeting rooms (on-site installation), the effect of preventive oxygen provided to each worker or to control workers who mitigate hypobaria in a recovery room at high altitude, or in situations of rescues and emergencies.

2. Vital Signs

The vital signs to measure are: pulse, oxygen saturation, blood pressure, and also the results of the Acute Mountain Sickness questionnaire, called the Lake Louise questionnaire. In addition, respiratory rate and auxiliary temperature are important vital signs to monitor as well.

For this purpose, the techniques of basic nursing procedures must be complied with.

3. Scope

Health professionals and paramedics

4. Basic Nursing Equipment

- Stethoscope
- Sphygmomanometer, mercury manometer
- Saturometer, digital pulse oximeter
- Thermometer
- Clock with seconds indication
- Lake Louise questionnaire
- Recording system (sheet, form, or computer file)
- Tank with cotton swabs
- Waste bin
- Two portable folding seats for field controls: for worker and paramedic.
- Preventive oxygen for personal use 1-2 lts/min.

5. Conditions of site where vital signs are controlled

- Worker seated, or in dorsal decubitus on a stable surface, protected from the wind
- Basic nursing equipment, as indicated in point 4
- Open registration system
- Washing hands with soap and water, or with alcohol gel, before preparing any equipment and before and after caring for a worker or wearing clean vinyl or other gloves.
- Health professional using oxygen per nostril of 1-2 liters / min.

6. Reference values of vital signs at extreme geographical altitude

6.1 Heart Rate - pulse at 5,500 meters above seated or in dorsal decubitus, 50 to 100 beats per minute

6.2 Blood Pressure, at 5500 m.a.s.l. in the seated position, with oxygen 3 lts/min, the reference values for normal blood pressure will be: systolic less than 120 and diastolic less than 50 mmHg. The risk level will be between 121-138 systolic and 81-88 mmHg diastolic. High blood pressure will be in systolic greater than 140 and diastolic greater than 90 mmHg. If the blood pressure is elevated, you should remain at rest for 20 minutes and repeat the measurement. If the diastolic pressure remains above 100 mmHg, a drop of 1,000 me-tres should be indicated, for recovery and normalization. If he does not respond, he should be referred to medical control at his mutuality.

6.3 Oxygen saturation, oximetry in a seated position.

- Without additional oxygen, saturation above 90% is recommended. Below 90% requires additional permanent oxygen as indicated in the Hypobaria technical guide, page 17 and 20
- With an additional 1-3 l/min of oxygen, the saturation should remain between 90% or more during rest and work.
- If no saturation above 90% is achieved, it is indicated to descend to the ALMA Observatory polyclinic and increase the flow to 3-4 litres per minute during the transfer.

6.4 Breathing rate in sitting or in dorsal position, 12 to 19 breaths per minute, with additional oxygen 1 - 2 lts/min. Over 19 breaths (tachypnea) requires 5 minutes rest and then reassessment. If the person does not have a lower frequency of breaths, oxygen supply should be increased up to 4 lts/min. If the person still does not respond, consider lowering 500 to 1,000 meters and control. If tachypnea persists, transport to the ALMA-AOS polyclinic for reassessment and follow-on control, as needed.

6.5 Axillary and buccal temperature is 36 to 37º Celsius. Above 37º indicate rest, abundant oral hydration, partly undress in temperature conditioned enclosure and control in 10 minutes. If temperature above 37º persists, transport to the ALMA-AOS polyclinic for reassessment and follow-on control, as needed.

6.6 Acute Mountain Sickness (AMS), Lake Louise Questionnaire. With a score of 4 or higher, AMS is diagnosed. A score over 7 indicates severe AMS points and the person must be transported to lower altitude (below 3,000 masl). DS28 Technical Guide Questionnaire page 24

Symptoms	Intensity		
	Mild	Moderated	Disabling
Headache	1	2	3
Decreased appetite, nausea or vomiting	1	2	3
Fatigue, weakness	1	2	3
Dizziness, vertigo	1	2	3
Difficulty sleeping	1	2	Doesn't sleep
Score			

7. Complementary Evaluations

7.1 Control of vital signs in Recovery Room of fatigued worker: During work it is required to maintain oxygen saturation greater than or equal to 90%. In the presence of fatigue or symptoms of acute mountain sickness, the worker must enter the temperature conditioned recovery room and remain at rest, maintaining a supply of 2-3 lts/min for 20 minutes. Then the saturation should be controlled as greater than or equal to 90%, and then observed for 10 more minutes to verify a stabilization of the saturation above 85-90%. If it does not recover, because it does not achieve saturation greater than or equal to 90%, descent to the ALMA-AOS polyclinic in indicated, and increase the oxygen flow to 3-4 lts/min during transfer.

- Monitor heart rate, blood pressure, Lake Louise score, and verify perceived reduction in worker fatigue.
- Record the signs of each control.

7.2 Perception of Fatigue. The perception of fatigue can be controlled by the Borg index of scale 0 - 10. A person is considered fatigued if they perceive a muscular - corporal physical effort of level 6 and more.

Borg Scale		
Perception of the degree of physical muscle and body effort in the activity		
Level Indicator	**Value**	**Denomination**
	0	Nothing at all
	0.5	Very, very weak (almost absent)
	1	Very weak
	2	Weak
	3	Moderate
	4	Moderate +
	5	Strong
	6	Strong +
	7	Very strong+
	8	Very, very strong
	9	Extremely strong
	10	Maximum
In three levels it would be: Low to Not heavy: 0 to 3; Medium to Medium-heavy: 4.5; High - Heavy: 6 to 10		

7.3 Control of oximetry and heart rate of field worker, rescue, emergencies. In order to standardize these measurements, the worker is evaluated sitting on the folding seat, or lying on rescue boards. The geographical attitude, where the exposed worker is located, should be recorded.

In workers, working at 5,500 meters above sea level, with continuous oxygen 1-2 lts/min, the expected saturation is greater than or equal to 90%. If the figures are lower, the worker should be kept in a seated position, observing a flow of 2 lts/min of oxygen and saturation greater than or equal to 90%. If the worker does not achieve this concentration they should go to the Recovery Room, and be checked as described in 7.1.

The worker's heart rate should be less than 105 beats per minute to prevent and control the risk of fatigue.

Heart rate with risk of heavy work and fatigue, according to age, at 5,500-5,600 masl

Age	Heart Rate, Heavy Duty Limits
50-59	100-150
40-49	105-110
30-39	110-115
20-29	115-120

If there are signs of intolerance to hypobaria, headache, nausea, apply the Lake Louise questionnaire. If the score is 4 or higher, the worker should be taken to the Recovery Room for 20 minutes and re-evaluated. If recovery is not achieved, the worker should be descended with oxygen at 2 lts./min, below 3,000 meters above sea level and/or the ALMA-AOS polyclinic for evaluation.

In emergency and rescue situations, blood pressure should be measured in the field to assess the risk of hypotension (associated with trauma, severe bleeding) or hypertension (associated with hypoxic and/or traumatic stress). In both conditions, the worker should be transported to the Recovery Room while preparing the evacuation to the ALMA-AOS polyclinic.

7.4 Controls over 5,500 masl, Hypoxia Tolerance Test. Ataxia, blood pressure.

In the certificate of labor evaluation of Health for work at or above 5,500 masl, submitted by the doctor of the mutuality, of workers apt for this exposure, recommendations and indications are included.

The recommendations refer to monitoring on the ground for signs of ataxia of oxygen deprivation and blood pressure responses, in addition to oxygen use. Such recommendations are described in the "Conclusion" in the following way by way of example:

> *Mrs .., is considered an APT person for ascent to altitudes of 5,500 meters above sea level.*
> *However, given the elevation in her systolic blood pressure, signs of mild ataxia and a greater degree of deoxygenation greater than 12%, she must be kept under control during operation at altitude as well as the use of oxygen during stay at altitudes of 5,500 masl.*
> *However, mild ataxia and lethargy alterations were observed.*
> *Altitude control and the use of oxygen are recommended.*
> *However, given the elevation in your blood pressure, it must be kept under control during operation at altitude as well as the use of oxygen during permanence at altitudes of 5,500 msnm.*

Ataxia control. Two signs will be evaluated once in the Recovery Room, the Romberg Test and observations of ataxic gait. Both tests will be performed under the effect of oxygen at 2 lts/min. in compliance with the occupational exposure standard for extreme altitude.

- **Romberg test.** Order the person to stand, feet together, arms on both sides of the body, and close the eyes for one minute.
    - The ability to remain in that position without unbalance or falling over is observed as a negative Romberg.
    - A Positive Romberg observation exists if there is presence of oscillation or swaying of the trunk in any sense, or change of position of the feet by imbalance, or tendency to fall; and opening of the eyes to avoid the imbalance.

If the test is positive, the person should not be exposed to extreme altitude and should be referred for medical re-evaluation by their mutual insurance.

Ataxic gait: the person is instructed to walk on a straight line 6 to 8 steps, and to turn back, looking forward, without tilting the head. The gait is ataxic when there is deviation of the trajectory, increase of the base of sustentation separating the feet or instability of the trunk. If there is the presence of ataxic gait, the person should not be exposed to extreme altitude, and should be referred for medical re-evaluation by their mutual insurance.

Control of oxygen saturation and blood pressure. Proceed as indicated in points 6.2 and 6.3. These controls must be recorded on the care record sheet of the Recovery Room, with mention of hypoxia test observation control.