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**DOCUMENTS FOR WORK ABOVE 5.500 MASL  
CERRO CHAJNANTOR, SAN PEDRO DE ATACAMA**

**GENERAL MANAGER: Jim Blair**

**SIGNATURE \_\_\_\_\_**


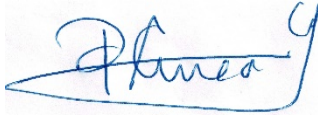

**INSTRUCTIVE CCAT-003**


**IDENTIFICATION OF WORKPLACES WITH HIGH PHYSICAL AND ERGONOMIC  
LOAD AT EXTREME ALTITUDES**

	<b>OCCUPATIONAL SAFETY MANAGEMENT SYSTEM CCAT</b>	Date: April 2020
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October 2019	April 2020	April 2020
		
Signature	Signature	Signature

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## 1. Objective

Identification of workplaces located above 5,500 meters of geographical altitude that have high physical and ergonomic load, and to establish plans for mitigation and control of occupational risks. In this way, one of the requirements demanded in the Technical Guide on Occupational Exposure to Chronic Intermittent Hypobarism due to High Altitude, published by the Ministry of Health for works 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:** Provide physical and organizational resources for the management of job evaluation, and facilitate the implementation of risk control plans and mitigation of high physical loads. This responsibility is shared with each **Contract Administrator** of contractor/subcontractor companies that execute work for the CCAT Project at or over 5,500 masl.
- **Risk Prevention Official for CCAT and contractor/subcontractor companies:** Responsible for evaluating the physical and ergonomic load of workplaces according to the established procedure for identifying workplaces with high physical load and requiring mitigation or prevention measures. Also responsible for educating workers in physically demanding workplaces and their supervisors on occupational hazard and fatigue mitigation measures.
- **Field supervisors for CCAT and contractor/subcontractor companies:** ensure that workers in workplaces with high physical loads comply with occupational risk mitigation and preventive measures.
- **Workers:** collaborate in the evaluation of the physical load of their job. Workers in identified positions of high physical load must comply with the mitigation measures indicated in these instructions.

## 4. Definitions

**Extreme altitude:** at or above 5,500 masl.

**Physical workload:** set of physical requirements (biomechanical and bioenergetic) to which the worker is subjected during the working day.



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**Workload Levels:** according to the Ministry of Labor's Technical Guide for Heavy Duty Evaluation, three levels of workload are recognized. Positions with level 3, High, are those that must be identified in order to intervene with risk control and mitigation measures.

### Perception of Physical Effort according to Borg Scale

Level	Description	Qualification	Action Level
1 (Low)	No risk of premature aging or health disorders	Light duty	No corrective action is required, although review is suggested if working conditions change significantly
2 (Medium)	Medium risk of premature aging or health disorders	Semi-heavy duty	Alert level. It is advisable to examine the work carefully. Requires corrective action.
3 (High)	High risk of premature aging or health disorders	Heavy duty	It requires implementing corrective actions in the short term.

### Borg Scale of Effort Perception physical, muscular and corporal activity

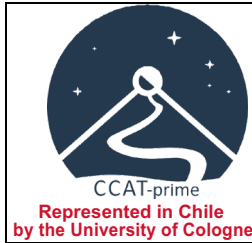
Nivel Indicador	Valor	Denominación	% Contracción Voluntaria Máxima.
	0	Nada en absoluto	0% MCV
	0,5	Muy, muy débil (Casi ausente)	
	1	Muy débil	10%
	2	Débil	20%
	3	Moderado	30%
	4	Moderado +	40%
	5	Fuerte	50%
	6	Fuerte +	60%
	7	Muy Fuerte	70%
	8	Muy, muy Fuerte	80%
	9	Extremadamente Fuerte	90%
	10	Máximo	100% Máx MCV

The perception is graduated in 3 Levels:

Low physical exertion: 0-3 points, not heavy

Medium physical exertion: 4.5 points, semi-heavy

High physical exertion: 6-10 points, heavy



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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		

**Methods of observation:** systematic observation by a trained observer to record the characteristics of the job requirements in predefined templates to determine the risk present in the tasks, with respect to different physical factors at work.

**Direct measurement method:** use of sensors placed directly on the subjects to measure exposure variables, parameters at work, such as articular kinematic analysis, dynamometry, heart rate, oxygen consumption and electromyography activity, among others. In the case of CCAT, the direct measurement of the heart rate will be used to estimate the cardiovascular load, as regulated in the Heavy-Duty Technical Guide of the Ministry of Labor.

Direct Measurement Method	
Heart Rate Monitoring to Evaluate Cardiovascular Load	Cardiovascular Load Estimates Oxygen Consumption  $\% \text{ CL} = \frac{(\text{CL work} - \text{CL rest})}{(\text{CL max} - \text{CL rest})} \times 100$

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		In 8 hours, 40% should not be exceeded; and in 12 hours, over 30% is heavy work, with indication of mitigation and prevention measures.

**High Physical Load Mitigation Measures:** include workplace interventions to reduce the level of load to which the worker is exposed, whether interspersed with light work, oxygenated breaks, or distributing work between two people, or mechanizing tasks.

## 5. PROCEDURE

In order to identify the work points (WP) with high physical load and to define mitigation measures, four stages will be followed:

- 1.- General Description of the Physical Requirements of the WP.
- 2.- Qualitative Preliminary Qualification of WP and selection of critical WP.
- 3.- Evaluation of WP with high physical load by percentage of the Direct Measurement of Cardiovascular Load (%CL).
- 4.- Mitigation measures of heavy workplaces with %CL over 30%.

### 5.1 General Description of Physical Requirements of the WP (Annex 1)


The general description of the physical requirement of all the jobs of this task comprises:

- a. WP identification
  - I. Identification of the WP
  - II. Working hours
  - III. Exposure to environmental agents
  - IV. Abnormal atmospheric pressures
- b. WP Characterization
  - I. Physical requirement evaluated by Borg Scale (Perception of Physical Effort) and Qualitative Physical Load Level (low, medium, heavy).
  - II. Description of the Manual Tools Used
  - III. Physical Working Posture, Maintained Posture
  - IV. Manual Handling of Loads
  - V. Specific Body Movements, Repetitive Movement

### 5.2 Qualitative Preliminary Qualification of WPs (Annex 2)

WPs are described by the Borg Perception Scale and the Load Levels of the Postural, Maintained Posture, Manual Load Handling, Walking >75% of the Day, and Repetitive Movement requirements.


WPs with levels 3 in Borg Perception and Load Level will be chosen for evaluation for direct measurement of cardiovascular load.

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**5.3 Evaluation of high physical load by Direct Heart Rate Measurement Methods** The percentage of Cardiovascular Load (%CL) will be estimated by monitoring the heart rate during the working day of WP workers identified as having a high physical load. In this way, those with a %CL greater than 30% to indicate mitigation measures will be known.

**5.4 Mitigation measures for high physical loads.**

The interventions to consider are to insert light work, oxygenated breaks, distribute the work between two people, or mechanize all or part of the tasks. This decision must be documented in a report and approved by CCAT's Head Risk Prevention Official and appropriate official at each contractor/subcontractor company.

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## 6.0 REFERENCES

- Technical Guide on Occupational Exposure to Chronic Intermittent Hypobarica, Sanitary authorization for work over 5,500 meters above sea level, page 20.

[https://www.minsal.cl/sites/default/files/guia\\_hipobarica\\_altitud.pdf](https://www.minsal.cl/sites/default/files/guia_hipobarica_altitud.pdf)

- Technical Guide for the evaluation of heavy work. Ministry of Labor Cardiovascular load pages 362 – 364.

[https://www.spensiones.cl/portal/institucional/594/articles-12791\\_guia\\_tecnica\\_evaluacion.pdf](https://www.spensiones.cl/portal/institucional/594/articles-12791_guia_tecnica_evaluacion.pdf)


- Technical Guide for the risk evaluation in manual loads handling. Ministry of Labour, Borg scale, page 88.

<https://www.previsionsocial.gob.cl/sps/download/biblioteca/seguridad-y-salud-en-el-trabajo/guia-manejo-cargas/guia-tecnica-manejo-manual-de-carga.pdf>

- Heavy Duty Qualification Requirement Form. National Ergonomics Commission. See Instruction manual at:

[http://www-safp.cl/portal/institucional/594/w3-propertyvalue-10161\\_html](http://www-safp.cl/portal/institucional/594/w3-propertyvalue-10161_html)



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## 7.0. Annexes

### Annex 1. GENERAL DESCRIPTION OF PHYSICAL JOB REQUIREMENT

#### IDENTIFICATION OF THE WORK CENTER

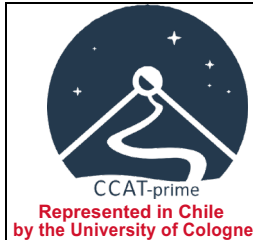
Name / Designation as described in the organizational structure.

Work area. Job.

#### WORK SCHEDULE

Shift Time		Characterization			
Fixed Shift		Entry Time		Departure Time	
		Day	Afternoon	Night	
Rotary Shift	Address, sequence or shift cycle				
D: Day N: Night A: Afternoon F: Free		N° of Days		Entry Time	Departure Time
	Day				
	Afternoon				
	Night				
	Free				

Hours of work per day		Working Hours Weekly	
Week work days/break days		Year: working days / rest days	
Average Time to Move Home - Work (over 2 hours)	Describe from: Calama Antofagasta Iquique Arica Copiapo La Serena Santiago Other		



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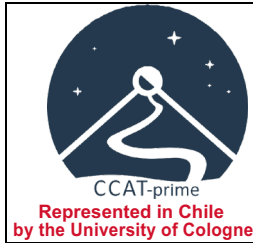
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<b>EXPOSURE TO ENVIRONMENTAL AGENTS</b>		
(Mark with an x the box that approximates the degree of exposure you have of the agents you identify below. Also indicate how long of your workday you are exposed to it and briefly describe what the exposure situation is like and if you have any protective devices.)		
Noise Exposure	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High	
	Exposure time. Hrs. or minutes/day.	
	Describe, Source of noise, protective measures	
Exposure to Vibrations (hand/body)	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High	
	Exposure time. Hrs. Or minutes/days	
	Describe, Sources and forms of protection	
Exposure to Brightness	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High	
	Exposure time. Hrs.	Light Natulal
		Light Artificial
	Describe Level: good, excessive, low. Protection used.	
Exposure to Solar radiation (direct UV)	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High	
	Exposure time. Hrs.	
	Describe means of protection	

<b>Air Quality</b>	
Ventilation	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High
Dust Floating in the air	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High
Chemicals, Gases, Steams	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High
Biological agents	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High
Describe means of protection	Exposure time hrs.

<b>Thermal Environment</b>	
Ventilation	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High
Humidity	Very Low <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Very High
Temperature	Very cold <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> A lot of heat
Describe means of protection	Exposure time hrs.



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Describe means of protection	Difference Summer / Winter	

ABNORMAL ATMOSPHERIC PRESSURE		
Height	Description	
Work Site over 3.000 masl		
Immersion (underwater)		

### CHARACTERISATION OF THE WORK PLACE (WP)

#### PHYSICAL DEMAND


You must proceed according to general aspects of Perception of Physical Effort by Borg scale and load level of the following aspects of the Workplace:

- Description of the manual tools.
- Physical Working Posture, Maintained Posture
- Manual Loads Handling.
- Specific Movement of the Body. Repetitive movements.

The Borg Scale from 0-10 is applied to assess the perception of physical muscle exertion.

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
<b>In three levels it would be: Low to Not heavy: 0 to 3; Medium to Medium-heavy: 4.5; High - Heavy: 6 to 10</b>		



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### **Physical Working Posture. Maintained posture.**

Next, indicate parts of the body and in each one, mark with an X only that which coincides with what is done daily or habitually (not sporadically), and it may happen that more than one is marked by the working conditions. At the side of each X, describe the reasons for assuming this posture and the exposure time as a percentage of the workday.

It is important that, for each part of the body, the sum is not greater than 100%. Also estimate the perception of physical exertion according to the Borg 0-10 scale.

At the end, identify which of the aforementioned postures are maintained for more than 30 minutes (especially those that alter the normal posture).

POSTURE (mark with an x only if the situation is met. If yes, describe the time applied and the reasons for the action. The sum of the totals should not exceed 100%).					
Requirement on		Reasons (reach tools, enter data, measure levels)	Percentage of exposure time in the day	Borg scale 0 to 10	Load Level 1-2-3
Legs	Standing				
	Sitting				
	Crouching / Squatting				
	Kneeling				
		Total (must not exceed 100%)	100%		
Column	Straight				
	Inclined				
	Rotated				
		Total (must not exceed 100%)	100%		
Neck	Straight				
	Downwards				
	Upwardly				
	Rotated				
		Total (must not exceed 100%)	100%		
Arms	Below the shoulders and within the body axis				
	Over the shoulders				
	Outside the body axis				
		Total (must not exceed 100%)	100%		
Fixed posture maintained for more than 30 minutes					

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### Manual handling of loads


Next, cargo handling actions will be indicated, in which only those that coincide with what is carried out daily and habitually (not sporadically) should be marked with an X. More than one may be marked due to the working conditions. At the side of each X, describe the type of load being carried, the weight of that load and the number of actions that it must do per hour.

It is important to consider the direct weight that the worker must carry, not the total load if he or she does not carry it that way or if he or she uses mechanical assistance to do so (e.g.: a 100 kg obese patient. It is not supported by a human being, except with mechanical assistance or with the collaboration of the patient himself; likewise, loading using a key, the load is the co-link/chain and not the direct load).

MANUAL LOADING HANDLING (Mark with an X only if the proposed action is fulfilled. If effective, describe the type of load, the effective weight and the exposure time. Do not fill if you use mechanical equipment for your action).					
Action	Type of load, object, tool, equipment, dimensions. Type of grip.	Loading weight (Kg)	N° Actions/hour	Borg scale 0 to 10	Load Level 1-2-3
Raise					
Transport					
Push					
Drag					
Loading/supporting					
How high your body takes the load (cm)	At the beginning:	How high your body leaves the load (cm)	At the end:		
Distance traveled (mts)	Meters: (from - to):				

### Specific Body Movements. Repetitive movement.

It is required to point out some movements that are exposed next. Only in case it is fulfilled, mark with an X and at the side describe the situation and the reasons for the fulfillment of the indicated.

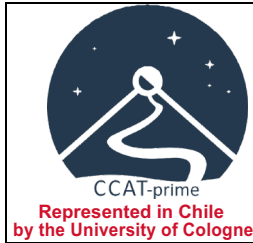
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MOVEMENT: (Mark with an X if it fits the above situations. If so, briefly describe the reasons for this situation and the related actions to be taken)			
Situation	Description	Borg scale 0 to 10	Load Level 1-2-3
You must move / walk more than 75% of the day.			
Work causes a lot of sweating.			
Repeat the same movements at least 3 times a minute.	Type:		
Repeat the same movements throughout the day.	How many times a day?		

## **Annex 2. PRELIMINARY QUALITY CLASSIFICATION ACCORDING TO PHYSIOLOGICAL REQUIREMENTS**

In the general description of the workstations, we have arrived at the quantitative estimates of the postural loads, by maintained posture, manual handling of the load and repetitive movements, by means of a Borg scale on three levels (0-4=Low, 5-6=Medium, 7-8-9-10=Heavy) and load level 1-2-3.

This information completes the table of physical requirements per workstation.



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PHYSICAL DEMANDS	WORKING PLACES															
	1		2		3		4		5		6		7		8	
	Borg	Load	Borg	Load	Borg	Load	Borg	Load	Borg	Load	Borg	Load	Borg	Load	Borg	Load
<b>POSTURAL</b>																
Legs																
Column																
Arms																
<b>POSITION HELD</b>																
<b>MANUAL LOAD HANDLING</b>																
Raise																
Transport																
Push																
Drag																
Loads / holds																
Mobilize																
Meters travelled																
<b>MOVEMENT</b>																
<b>WALK less 75% DAY</b>																
Causes sweating																
<b>REPETITIVE MOTION</b>																

The workstations will be ordered according to items with level 3 in Borg and Loads.

The workstations with the highest number of items in level 3 will be analyzed with additional methods to evaluate the risk of heavy work/fatigue/accidentability and classified as PDT "con high physical load and ergonómica" (Hypobaric Technical Guide, page 20).

Cardiovascular load estimates oxygen consumption by monitoring resting and working heart rate and the subject's maximum heart rate (HR).

$$CC = (\text{Working HR} - \text{Resting HR}) / (\text{Maximum HR} - \text{Resting HR}) \times 100$$

Heavy work is considered %CC over 30% in a 12-hour shift and over 40% in an 8-hour shift.





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**Anexo 3. CONSTRUCTION MANAGER WORK DESCRIPTION.**

DESCRIPCIÓN GENERAL DE EXIGENCIA FÍSICA DE PUESTO DE TRABAJO	
<b>IDENTIFICACIÓN DEL PUESTO DE TRABAJO</b>	
Nombre / Denominación como esta descrito en la estructura organizacional.	<b>Pedro Correa Krumenacker,</b>
Descripción del puesto de trabajo.	<b>Gerente de Construcción</b>
Describa las tareas del puesto de trabajo	<ol style="list-style-type: none"> <li>1. Coordinación de la ejecución de las obras</li> <li>2. Controlar avances y presupuestos de la construcción los proyectos de la empresa además de recursos, personal y materiales necesarios.</li> <li>3. Realizar evaluación de proveedores de servicios relacionados a la construcción</li> <li>4. Control, aprobación de avances y control de calidad de obras según normas y exigencias</li> <li>5. Control de presupuestos, facturas y estados de pagos</li> <li>6. Validar factibilidad constructiva en la implementación de soluciones no previstas en el proyecto</li> <li>7. Liderar el desarrollo de las obras según lo planificado y gestionar a los equipos de construcción</li> <li>8. Mantener un estatus de las obras actualizado y preciso</li> <li>9. Evaluar el alcance contractual del trabajo a realizar según lo planificado</li> <li>10. Gestionar riesgos y establecer planes de contingencia según desviaciones de la obra</li> <li>11. Asegurar el control documental según especificaciones contractuales</li> <li>12. Presentar informe de su gestión respecto a las obras al Gerente General</li> </ol>
Área de trabajo, Faena	Proyecto construcción Observatorio CCAT

HORARIO DE TRABAJO					
Tiempo de Turno		Caracterización			
Turno Fijo		Hora de Ingreso		Hora Salida	
		Día	Tarde	Noche	
Turno Rotativo	X	Dirección, secuencia o ciclo de turno			
D: Día N: Noche T: Tarde L: Libre		N° de Días		Hora Ingreso	Hora Salida
	Día	X		08:30	17:00



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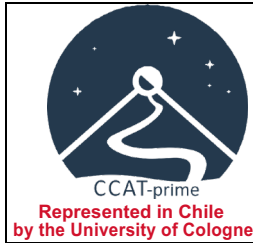
	Tarde			
	Noche			
	Libres			
Horas de trabajo diario	8 hora	Horas de trabajo Semanal	40 horas semanales	
Semana días de trabajo/días de descanso	5/2	Año: días de trabajo / días de descanso	240 días / 129 días	
Tiempo Promedio de Traslado Hogar - Trabajo (mayor de 2 horas)	N/A	Describa desde: Calama Antofagasta Iquique Arica Copiapó La Serena Santiago Otros		

#### EXPOSICIÓN A AGENTES AMBIENTALES

(Marque con una x el casillero que se acerca el grado de exposición que tiene de los agentes que identifica a continuación. Señale además cuánto tiempo de su jornada se expone a ello y describa brevemente cómo es la situación de exposición y si dispone de elementos protectores)

	Muy Baja	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Muy Alta
Exposición de Ruido	Tiempo de exposición. Hrs. minutos/ día.	15 min. / 3 veces a la semana					
	Describa, Fuente de ruido, medidas de protección	Maquinaria Pesada					
Exposición a Vibraciones (mano/cuerpo)	Muy Baja	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Muy Alta
	Tiempo de exposición. Hrs. O minutos/días	N/A					
	Describa, Fuentes y formas de protección	N/A					
Exposición a Luminosidad	Muy Baja	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Muy Alta
	Tiempo de exposición. Hrs.	Luz Natural	4 horas				
		Luz Artificial	3 horas				
	Describa Nivel: buena, excesiva, baja. Protección utilizada.	Buena. Pantallas protectoras para luminarias, uso luz día.					





# OCCUPATIONAL SAFETY MANAGEMENT SYSTEM CCAT

Date:  
April 2020

## IDENTIFICATION OF WORKPLACES WITH HIGH PHYSICAL AND ERGONOMIC LOADS AT EXTREME ALTITUDES

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**POSTURAS** (marque con una x solo si se cumple la situación planteada. En caso efectivo, describa el tiempo aplicado y los mo ejecutar esa acción.

La suma de los totales no debe superar a 100%)

Exigencias Sobre		Motivos (alcanzar herramientas, ingresar datos, medir niveles)	Porcentaje de tiempo de exposición en la jornada	Escala de Borg 0-10	Nivel de Carga 1-2-3	
Piernas	De pie	X	Recorrido de las áreas de trabajo.	30%	2	1
	Sentado	X	Trabajo administrativo en oficina.	60%	2	1
	Agachado /Encucilladas		N/A			
	Arrodillado		N/A			
Total (no debe ser superior a 100%)			80%			
Columna	Columna Recta	X	Trabajo administrativo en oficina.	60%	2	1
	Columna Inclinada		N/A			
	Columna Rotada		N/A			
Total (no debe ser superior a 100%)			60%			
Cuello	Cuello Derecho	X	Trabajo administrativo en oficina.	60%		
	Cuello Gacia Abajo		N/A			
	Cuello Hacia Arriba		N/A			
	Cuello Rotado		N/A			
Total (no debe ser superior a 100%)			60%			

Postura fija mantenida por mas de 30 min.	¿Cuál?				
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**MANEJO MANUAL DE CARGA** (marque con una x solo si se cumple la situación planteada. En caso efectivo, describa el tipo peso y el tiempo de exposición. No llenar si utiliza equipo mecanizado para su acción)

Acción	Tipo de carga, objeto, herramienta, equipo, dimensiones, Tipo de agarre	Peso de carga Kg	N° de acciones / hora	Escala de Borg 0-10	Nivel de carga 1-2-3
Levanta	N/A				
Transporta	N/A				
Empuja	N/A				
Arrastra	N/A				

