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02280

MANUAL ON HAZARDS

EXPERIMENTAL PRODUCTION PLANT
FOR ASBESTOS PROCESSING
COCHABAMBA, BOLIVIA

SNC CONTRACT NO. 3250-0002

SURVEYER, NENNIGER & CHÊNEVERT INC.
CONSULTANTS
MONTRÉAL

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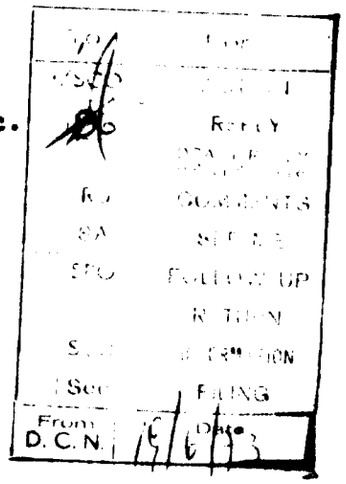

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CHAPTER 1

1.0 INTRODUCTION

On 5 March 1970, the United Nations Industrial Development Organization awarded a contract to Surveyer, Nenniger & Chênevert Inc. to assist the Government of Bolivia in the implementation of an experimental production plant for asbestos processing in Cochabamba. The contract was revised on 8 August 1972 and the work to be performed by SNC was divided into four phases:

Phase I: Evaluation of Asbestos Mineral Ore.

Phase II: Preparation of an Economic Study and Selection of Process.

Phase III: Design of Process and Design of Processing Plant.

Phase IV: Supply of Process Equipment, Erection of Process and Laboratory Equipment and Start-up of Plant.

Phase IV also includes the preparation of a manual detailing the hazards related to the handling and processing of asbestos.

This manual describes the various hazards generally encountered during the operation of such an experimental plant and includes recommendations for safety precautions and preventive protection. The manual deals with industrial hazards commonly associated with the processing of minerals and with health hazards more specifically related to prolonged exposure to asbestos fibres.

The handling and processing of asbestos ores is not a hazardous operation for the welfare of workers and the environmental conservation when performed through plants properly designed, where sound technology is applied, up-to-date equipment is used and maintained and efficient dust control and safety programs are enforced.

CHAPTER 2

2.0 INDUSTRIAL HAZARDS AND SAFETY PRECAUTIONS

2.1 Causes of Accidents

The main causes of industrial accidents are: inexperience, distraction, forgetfulness, laziness, fatigue, disobedience, showing off, improper attitude and misunderstanding. It has been proven that the main cause of accidents which occur to workers is the human factor.

Evidently there are also other causes of accidents: lack of protective equipment, inadequate protection, dangerous tools, substances or equipment, faulty engineering or design, untidiness, poor housekeeping, inadequate lighting, inadequate ventilation and improper clothing.

2.2 Protective Equipment

A substantial proportion of industrial injuries are caused by failure to have or to use personal protective equipment. Machines or operations designed to confine hazards and eliminate accidents are a more basic treatment of the problem than the use of personal protective equipment. Therefore, even with the best design, some conditions can be met only by the use of such protection. Accidents may and will happen because of human or mechanical failures. The use of personal protective equipment, if it will not prevent the accident, will guard from injury, or at least minimize the damage.

2.2.1 Head Protection

Protective hats are needed on jobs where workmen's heads are endangered by falling objects and where workers may bump their heads against overhead structures or protruding objects. Such dangers exist in an asbestos plant and all workmen should wear a protective hat which should be non-combustible, or at least should burn at a fairly low rate, be water resistant and electrically non-conductive. The cradle and sweatband should be readily detachable and replaceable due to deterioration from exposure to perspiration and for sanitary reasons, especially when the hat may be used by more than one man.

2.2.2 Eye Protection

The chief causes of eye injury in the asbestos industry are: dust, flying objects set in motion by hand tools, abrasive wheels, injurious light or heat rays and splashing metal. Safety glasses with side shields should be worn by all workers in the areas where sledge-hammers are being used. Cup goggles should be worn by workmen while grinding and working with a chisel. Filter lens goggles should be worn by welders and those working in their vicinity. All other workmen should wear protective glasses.

2.2.3 Finger and Hand Protection

The most vital and frequently used tool in the asbestos industry, and in all industry, is the human hand. The fingers and hands are exposed to cuts, scratches, bruises and burns. However, use of proper protective equipment can prevent injuries.

The hands of electricians and of workmen who handle sharp-edged or rough material should be protected with good quality work gloves.

Electricians should wear rubber gloves and other workmen should be provided with leather gloves to wear when their hands are expoeed to injuries.

It must be remembered that gloves should not be worn where they might become caught in revolving parts.

2.2.4 Foot Protection

Safety shoes are needed in the asbestos industry, as in most other industries. Where there is a possibility of heavy objects falling on or rolling over the toes of workers, safety shoes equipped with steel toe protection should be worn.

The toe box must support a static load of at least 1135 kilos and sustain the impact of a 22.7 kilo weight dropped from a height of 30 centimeters.

All workmen should wear safety shoes.

2.3 Clothing

A number of industrial injuries are caueed by wearing improper clothing.

Work clothing should be clean and in good repair, and should protect against minor injuries, such as burns and scratches. Good fit is essential. Loose clothing and rolled sleeves are hazardous.

Trousers that are too long must be shortened to proper length, and preferably be without cuffs.

Rings, jewelry, wristwatches and watch chains must not be worn.

A necktie must not be worn as it can easily get caught in moving machine parts.

Clothing soaked in oil or flammable solvent is easily ignited and can also cause skin irritations.

2.4 General Precautions

Running, distracting, throwing things, horseplay and scuffling are very dangerous and must be avoided.

Hands soiled with paint, lead, or any poisonous substance must be washed before eating.

Intoxicating liquor must not be permitted on the plant premises at any time.

Compressed air must be used only for those jobs for which it is intended and must never be blown against anyone as it might enter the body and kill. Clothes must never be cleaned with it.

Protruding nails, staples or steel strapping must be removed, cut off or hammered down.

Do not stand under any suspended load.

Jumping from an elevation such as a table, bench or platform, can result in serious injury and must be avoided.

2.5 Housekeeping

Poor housekeeping can cause many injuries. The work area must be kept clean throughout, and oily waste, rubbish or paper must be placed in the containers provided for that purpose. When there are boards with projecting nails, nails must either be removed or turned down, or boards put where they can do no harm. Loose nails must be picked up. Material must be piled properly and not block aisles, exits, power panels or valves. When a slippery substance is spilled on the floor, it must be wiped up immediately.

2.6 Lifting

Lifting heavy objects is very dangerous. Strain and sprains are often caused by improper methods of lifting. Heavy objects can be moved more safely, with greater precision and often more quickly, by the use of levers, rollers, jacks, etc., than by hand. In case it is necessary to lift the work to be done by hand, sufficient hold to avoid straining should be obtained. In lifting or moving heavy objects, the strength should be applied evenly and gradually. A secure position should be maintained to prevent slipping. The proper way to lift and avoid straining is to bend the knees, keep the body erect, take a deep breath and hold it until the load is up in a comfortable position, keep the mouth open, push upward evenly and gradually with the leg muscles.

It must be remembered that materials being liftsd may slip out of the hands and the feet must be protected as much as possible by keeping them out of the way.

2.7 Ladders

Before using a ladder, one must ensure that it has safety feet in good condition and is free of cracks, broken rungs, split side-rails or other defects.

A ladder should be firmly set before climbing it. If necessary, it must be blocked at the bottom and lashed at the top, or have another worker hold the ladder.

A worker must not overreach or lean sideways while working from a ladder as the ladder may slip or the worker lose his balance. Tools left on top of stepladders or platform ladders are liable to fall and injure someone in the vicinity. They must be kept in a box securely lashed to the ladder.

One must face the ladder when going up and down and keep one hand frse for support. It is unwise to carry any heavy or bulky object while ascending or descending a ladder. A rope must be used to raise or lower it.

2.8 Storage

Material should be stored in a safe and careful manner. Undercutting of piles, lopsided piles and piles without a solid and level foundation, must be avoided.

Piles must be kept straight; they present a better appearance and will not fall. Heavy articles should not be placed where there is any danger of their falling or being knocked down.

Sharp and pointed articles should be stored in such a manner that there is no danger of persons coming in contact with them.

Material storage racks and floor space should not be overloaded.

Avoid storing stock on top of lockers, cabinets, racks, etc., as it may injure someone or damage property.

Bags of material should be piled so that the layers cross each other at right angles.

As far as possible, only boxes of the same size should be piled on top of other boxes already piled.

In piling, one tier of bags, boxes, etc., must not depend on the next tier for support. The one who takes them down may move the support tier first.

Passageways to fire fighting equipment, electrical switches and fuse panels should not be obstructed.

Never throw a box or package upon a high pile as the whole pile may fall over.

Gloves should be used when handling rough surfaced materials, wire bound boxes and bundles.

2.9 Hand Tools

Hand tools cause a large portion of accidental injuries. Their mishandling, neglecting to keep them in proper condition, and leaving them in dangerous places are frequent causes of accidents.

Unshielded tools should never be carried in pockets. Sharp edged or sharp pointed tools should have the points or edges covered when being carried.

Tools with rough, splintered or badly worn handles should not be used, as they are apt to cause injury. All small tools should be inspected at least once each month and any defective ones should be replaced. When tools are put in a toolbox or drawer, they should be placed with points and cutting edges down, to prevent injury when reaching for them. In using knives and other cutting tools, always cut away from the body; they could slip and one may be cut.

Tools with mushroomed or broken heads must not be used, but be replaced or repaired.

2.9.1 Chisels

Chisels should be properly tempered and cup goggles should be worn when using a hammer and chisel. Care must be taken to protect fellow workers from flying chips.

2.9.2 Files

All files should be provided with handles and should never be used as a center punch, cold chisel or as a pry. They are brittle, apt to break, and someone else may be hurt by flying pieces.

2.9.3 Hammers

Faces of hammers must always be kept in good condition, otherwise, a chip may fly and cause an injury. Hammers with cracked, burred or badly worn heads or handles should not be used. A machinist's

hammer must not be used to drive nails nor a carpenter's hammer for machining work. Steel or cast iron hammers should not be used on tempered tools, but rather soft metal or rawhide mallets.

2.9.4 Pliers

Plier handles must be grasped at the ends, not near the hinge where one may pinch his hand. When snipping end of wire, wire and cutters must be held so that cut ends will be directed toward the floor away from the face.

2.9.5 Wrenches

When using a wrench, it must fit the nut and be suited for the job. Wrenches should not be used as hammers as this practice is unsafe. A wrench must be applied so that the jaws are not spread.

2.9.6 Screwdrivers

Screwdrivers are responsible for many injuries. A screwdriver must not be used as a chisel nor in such a position that if it slips, it strikes the face or body of the worker.

Long screwdrivers must not be carried in pockets as the projecting blades may cause a serious injury. A dull screwdriver or one with a rounded blade frequently causes injury and must not be used. Screwdrivers should not be used for any purpose other than to drive screws or remove them. Holding a screwdriver in one hand and the material to be worked on in the other must be avoided; if it should slip, one is apt to be injured; it is better to place the work on a bench or in a vise.

2.10 Solvents

Solvents are mostly used in the asbestos industry to clean and degrease metals. They may be toxic or flammable, or both.

The skin becomes dry after extended contact with solvents. Inflammation, discharge and even chronic eczema may keep a person away from work for extended periods. Solvent vapors also cause irritations to the eyes, nose, pharynx, trachea and bronchial tubes. One of the main characteristics of numerous solvents is their paralyzing action on the central nervous system. A high concentration very quickly provokes a state of drunkenness followed by loss of consciousness. Death may follow through paralysis of respiratory centres.

All solvents will affect the human system to a degree. Perchloroethylene and trichloroethylene are flammable. Solvents must be kept in closed containers, stored in a separate, well ventilated, fire-proof room and their use should be minimal.

In no case must solvents be poured into drains, water systems, or simply left to be absorbed into the ground. Places should be set aside for burning them.

2.11 Electricity

Every person should know how to protect himself from electrical shock. No voltage should be considered low; it has the ability to electrocute. Deaths have been recorded due to contact with circuits of less than 50 volts. It should always be assumed that any circuit has a current capacity great enough to cause injury

or death, regardless of its voltage. Accidental shocks can cause painful burns, dangerous falls and are sometimes fatal.

Safety from electrical shock depends on knowledge of a few fundamentals. Shock occurs when an electrical current flows through the body. The amount of shock that can be recieved is, in large measure, affected by the person's physical condition and by how good the contact is. When the hands are damp, for example, the contact is more dangerous, because water is a good conductor.

The chief body protection against electrical flow is the resistance offered by the skin. However, this resistance varies according to conditions. For example, skin resistance is low when it is moist or wet and is lowered after electrical contact, thus allowing more current to flow.

Shock from electrical current does not always result in immediate death. Very often, a victim grasping a low-voltage conductor is unable to let it go, due to loss of muscular control. The shock is thus prolonged and its effects are intensified.

When attempting to free someone from a live electrical circuit, open the circuit first, if possible, or remove the victim immediately from the circuit. The victim should never be touched with bare hands. Insulate yourself by wrapping several thicknesses of dry cloth or newspaper around your hands, or remove the victim from the circuit with a rope, wooden pole, leather belt, or the like.

Current will pass through the body by the easiest path. For example, if a man grasps the ends of a broken uninsulated wire in each hand, the electricity will go through one arm, across the

chest, and out the other arm. If he should grasp a wire in one hand while standing in a puddle, or a steel deck, wet ground, or when his body contacts any good conductor of electricity, the current will pass through his hand and arm, then through and out of the body at the point where it is grounded.

It is sensible then, when working with electrical wires, fixtures, or appliances, to avoid contacting grounded objects. In other words, protect yourself so that the current cannot pass through your body, if, for some reason, the circuit should become alive permitting the electricity to be uncontrolled.

Serious accidents can occur when skin resistance at the place of contact is low, even at low voltages. In general, locations or conditions which make low voltages particularly hazardous are when a person is in direct contact with grounded surfaces, wet or damp locations, and high temperatures (causing perspiration).

In many instances of electrical shock, a victim can be saved by prompt application of artificial respiration. Persons engaged in elsctrical work should be able to use an approved method of resuscitation. In addition, it is important for linemen to know ths pole tap method of giving artificial respiration.

It is recommended that the following specific safety rules be observed:

a) All portable electric tools should be grounded, prefersbly at the plug by a three-wire conductor.

b) Portable electrical equipment should be turned in periodically to the maintenance department for inspection.

c) Tested rubber gloves and boots should be worn to insulate the operator whenever ungrounded electrical equipment is operated in wet places.

d) Only weather-proof type sockets for extension cords, shop lights, and other lighting equipment should be used in wet or misty locations.

e) Cords and other conductors for electrical equipment should not be wrapped around or allowed to come in contact with water pipes, steel fixtures, or metallic equipment.

f) Use electricity resistant fuse pullers when changing cartridge fuses.

g) Many accidents involving electricity can be attributed to deterioration of electrical equipment and wiring rather than faulty initial construction or installation. Often industrial users of electricity install electrical equipment and give it no further thought until it breaks down because of mechanical failure, overheating, loosening of parts or other reasons. Therefore, it is advisable to have all electrical tools, equipment, and wiring inspected regularly by a qualified electrician.

2.12 Welding and Cutting

When engaged in welding or cutting operations, welders and helpers should always wear goggles and be sure that the colored lenses are of the proper shade for the work being done. They should also wear fire resistant gloves and aprons.

When welding and cutting are done where there is a possibility of sparks showering other workmen, a substantial screen should be

used below or around welding operations.

A fire extinguisher or pails filled with water should be kept close to welding or cutting operations.

2.12.1 Cylinders

All cylinders must be used and stored in an upright position only.

Cylinders must be stored away from open flame, radiators or other sources of heat.

Cylinders containing oxygen must not be stored near other cylinders containing gas or near oil, grease or other combustible materials.

Cylinders must be located so that they will not be knocked over or damaged by falling objects, passing vehicles or persons.

The cylinder valve key or wrench must stay in place on the valve spindle while the cylinder is in use.

Before moving a cylinder, its valve must be closed.

Regulators or reducing valves must be tightly connected with a gas tight connection.

Cylinder valves should never be lubricated.

All valves must be opened by hand.

Cylinders should be used in the order they are received from the supplier. When empty, their valves should be closed and the cylinders marked with a tag or sign indicating that they are empty.

Clothing, gloves or any other foreign objects should not be hung on cylinders, valves, etc.

2.12.2 Hoses and Hose Connections

Oxygen hose should be a different color from fuel or gas line hose.

Hoses must be located so that they will be protected from damage

by moving objects and will not create a tripping hazard.

Hoses must be carefully examined at frequent intervals for leaks, worn places and loose connections.

Hose connections should never be lubricated.

2.12.3 Torches

Torches must be lighted by means of friction lighters, pilot flames or similar sources of ignition, not with matches.

When torches are changed or when welding is stopped longer than 5 minutes, all cylinder valves should be closed. Momentary stoppage is controlled by means of the torch valves.

2.13 Electric Arc Welding

Helmets or hand shields should be provided with both proper shade filter lenses and a clear protective cover glass.

The recommended shades of filter lenses are:

Amperage	Shade
Below 30	No. 6-7
30 to 75	8
75 to 200	10
200 to 400	12
over 400	14

Helmets and hand shield should be checked frequently. Protective colored goggles with side shields should be worn to protect against harmful rays when an arc is struck, and for protection against flying chips. The lenses should be No. 2 or 3 shade.

When arc welding operations are performed in an area that is not enclosed or isolated, workers or other persons within 75 feet of the arc should wear appropriate goggles.

All confined spaces should be ventilated when welding operations

are performed within them. When impracticable to provide such ventilation, supplied-air respirators should be used.

In confined spaces where the means of exit is a manhole or other small opening, means should be provided, such as a safety belt, for quickly removing workers in an emergency, and an attendant should be stationed outside the exit at all times while work is in progress.

2.14 Conveyors

No attempt should be made to oil, grease, clean, adjust or repair a conveyor, or clean a choked conveyor until the driving motor has been stopped and the control switch disconnected, tagged and locked.

All workmen should know the locations of controls and stops and not hesitate to stop a conveyor when necessary.

Conveyors should not be put in motion until a check is made to be certain that all is clear, that fellow workers are not making repairs, adjustments, lubricating or cleaning, and that all safety guards are in place.

One must not step over or climb upon any conveyor.

Good housekeeping should be maintained, especially at loading and discharge points, and around conveyors. Spilled liquid, oil, grease, etc., must be promptly wiped up.

2.14.1 Belt Conveyors

Placing hands on moving parts must be avoided and guarded against for broken or rough sections of belt.

2.14.2 Bucket Elevators

Opening inspection doors while the conveyor is moving must be avoided.

2.14.3 Screw Conveyors

The principal hazard of screw conveyors is in hands or feet being caught in the screw. Therefore, screw conveyors should not be operated if trough covers are not in place.

2.15 Process Equipment

No attempt should be made to oil, grease, clean, adjust (except the speed of the impact crusher and the feed rates of the feeders) or repair any process equipment, or clean choked process equipment until the driving motor has been stopped and the control switch disconnected, tagged and locked.

All workmen should know the locations of controls and stops and not hesitate to stop process equipment when necessary.

Process equipment should not be put in motion until a check is made to be certain that all is clear, that there are no fellow workers around, and that all safety guards are in place.

Good housekeeping should be maintained around process equipment and spilled liquid, oil, grease, etc., must be promptly wiped up.

2.16 Fire

Fire can cause severe damage and efforts must be made to prevent it.

One must learn the locations and proper use of the fire extinguishers.

Good housekeeping must be maintained. It can prevent many fires.

Paesages to reach extinguishers should not be obstructed.

Solvents, oils, gasoline, thinners and other flammable liquids, and grease must be kept in a separate well ventilated fire-proof room. Under no condition should they be poured into draine, water systems or simply absorbed into the ground. Places should be set aside for burning them.

A fire extinguisher or pails filled with water should be kept cloee to welding or cutting operations.

Gas cylinders used in welding and cutting operations must be ueed and stored in an upright position only and must be stored away from open flames, radiators, or other sources of heat.

Cylinders containing oxygen must not be stored near other cylinders containing gas, or near solvents, oils, grease, gasoline, thinners, or other combustible materials.

Gas and oxygen cylinder valves and connections should never be lubricated.

Workmen must not wear oil-soaked clothing which could catch fire.

CHAPTER 3

3.0 FIRST AID

3.1 General Provisions

The first aid attendant shall:

a) Wash his hands thoroughly before attempting to give first aid, such as touching a wound or a dressing, and so on.

b) Refer the case to a physician whenever the wound requires:

  a) suturing

  b) an incision

  c) injectable medication

  d) any other type of medical attention that may be given only by physician, such as removing a foreign body lodged in the eye, palpate a dislocation, and so on.

c) Apply to any deep chest wound a dressing of adequate size and thickness, cover with a pressure pad and firmly secure so as to prevent air from being sucked into the wound.

d) Call a physician whenever fainting results from a wound or a blow to the head, even though loss of consciousness may last only a few seconds.

e) Place an unconscious casualty on his side rather than in the supine position.

f) Apply artificial respiration and continue same until the casualty resumes breathing, or unless death is pronounced by a physician, or "rigor mortis" is obvious.

g) In the event of fractures, stop all bleeding and immobilize the injured part before attempting to move the casualty.

h) Avoid flexing a casualty who has sustained a severe back injury.

i) In major burn cases, never remove the clothing that may adhere to the skin; never apply petroleum jelly, burn ointment or any other greasy medication; call a physician immediately.

3.2 Use of Antiseptics

Antiseptics must be used judiciously. Only those currently used in hospitals or doctors' offices are recommended.

3.3 First Aid Kit

The contente listed hereafter are the minimum. They shall be checked at regular intervals.

a) 1 first aid manual

b) Instruments

1 pair bandage scissors
1 pair tweezers (100 mm)
24 safety pins (assorted sizes)
20 tongue depressors (individually wrapped)
1 package of 50 cotton-tipped applicators
1 tourniquet

c) Medications

12 ampoules (crushable) aromatic spirits of ammonia
6 ounces recognized antiseptic (without iodine)
1 tube burn ointment (without tannic acid), or petroleum jelly
1 bar soap (containing hexachlorophene or some other similar product)
1 bottle castor oil with eye dropper, for eye care

d) Dressings

6 packages of sterile absorbent cotton
50 adhesive bandages (individually wrapped)
1 roll adhesive tape, (25 mm wide)
3 triangular bandages

25 gauze squares, 50 mm x 50 mm, individually wrapped
25 gauze squares, 75 mm x 75 mm, individually wrapped
25 gauze squares, 100 mm x 100 mm, individually wrapped
6 rolls sterile gauze, 25 mm wide
6 rolls sterile gauze, 50 mm wide
6 rolls sterile gauze, 75 mm wide
2 packages of cotton batting for padding
6 splints, various sizes
4 eye shields (celluloid or fibre)

3.4 Stretcher

Provide and maintain one stretcher and two blankets for the proper handling and moving of injured employees.

CHAPTER 4

4.0 SAFETY

It is a common practice to use frequency and severity rating of injuries to measure safety progress in a department or in a plant.

4.1 Frequency Rating of Injuries

The frequency rating of injuries is the amount of lost time for injuries for each million man-hours worked by employees.
As an example, supposing for the period being calculated, a department or plant has worked 250,000 man-hours. During this period of time, 5 employees had been injured seriously enough to warrant time lost from work over and above the day on which they received the injury. The frequency rating would then be

$$F = \frac{5 \times 1,000,000}{250,000} = 20$$

A simpler explanation of frequency rating is to relate the constant 1,000,000 man-hours as the equivalent of 500 men working a 40-hour week for 50 weeks during the work year. Therefore, a frequency rating of 20 relates to 20 lost time injuries for each 500 employees, or 4 lost time injuries for each 100 employees, or 2 lost time injuries for each 50 employees, etc.

4.2 Severity Rating of Injuries

The severity rating of injuries is the number of days lost, or charged for from work for each million man-hours worked by employees. As an example, if for the lost time injuries of above example, the total time lost from work by the 5 employees totalled 20 days, the severity rating would be

$$S = \frac{20 \times 1{,}000{,}000}{250{,}000} = 80$$

In addition, there are special time charges which must be applied when working out the severity rating if the injury results in permanent disability. These charges vary with the degree of lost time to the individual. Where a time charge is applied, the actual number of days lost is not counted. A table of scheduled charges is given in section 4.3.

Referring back to our severity rating example, if all conditions remain the same, but one of the 5 men who was injured lost one finger completely and was off work 10 days, then we deduct these 10 days from the original 20 days, and add 400 days (time charge). The severity rating would be

$$S = \frac{(10 \quad 400) \times 1{,}000{,}000}{250{,}000} = 1640$$

4.3 Special Time Charges for Permanent Injuries

Permanent Injuries	Time Charge Days
Fatality	6000
Both eyes (loss of sight) in one accident	6000
One eye and one hand, or one arm, or one leg, or one foot	6000
Any two of the following not on the same limb: hand arm, foot, or leg	6000
Dismemberment of one leg above knee, or one arm above elbow	4500
Dismemberment of one arm above wrist and at or below elbow	3600
Dismemberment of one leg above ankle and at or below knee	3600
Both ears (loss of hearing) in one accident	3000
One foot	2400
One eye (loss of sight) whether or not there is sight in the other eye	1800
One ear (loss of hearing) whether or not there is hearing in the other ear	600

Permanent Injuries	Time Charges Days
Thumb, 1st phalange	300
1st and 2nd phalanges	600
total dismemberment	900
Index finger,	
1st phalange	100
1st and 2nd phalanges	200
1st, 2nd and 3rd phalanges	400
total dismemberment	600
Middle finger,	
1st phalange	75
1st and 2nd phalanges	150
1st, 2nd and 3rd phalanges	300
total dismemberment	500
Ring finger,	
1st phalange	60
1st and 2nd phalanges	120
1st, 2nd and 3rd phalanges	240
total dismemberment	450
Little finger,	
1st phalange	50
1st and 2nd phalanges	100
1st, 2nd and 3rd phalanges	200
total dismemberment	400
Large toe,	
1st phalange	150
1st and 2nd phalanges	300
total dismemberment	600
Each other toe,	
1st phalange	35
1st and 2nd phalanges	75
1st, 2nd and 3rd phalanges	150
total dismemberment	350

CHAPTER 5

5.0 HEALTH HAZARDS

5.1 Biological Manifestations

During the last decade, many institutions around the world have carried out extensive scientific research on the effects of asbestos on human health. The diseases believed to be related to exposure to asbestos fibres are: mesothelioma, bronchogenic cancer, asbestosis and pleural plaques.

5.1.1 Mesothelioma

This is a cancer of the lining of the lung, stomach or intestine. Most of mesothelioma cases related to exposure to asbestos involve workers in the fields of insulation or manufacturing rather than miners and millers. A study made in New York and New Jersey, U.S.A. by Dr. T.J. Selikoff of Mount Sinai Hospital School of Medicine reported that from 380 insulation workers who handled asbestos, 22 suffered mesothelioma. Another study made in Quebec Canada by Dr. J.C. McDonald of McGill University on 2,413 Quebec asbestos mine and mill workers reported only 3 cases of mesothelioma, which is about the normal rate of any population group. From the medical evidence available, it is believed that mesothelioma is related, in some way, to asbestos fibres, but it is still undetermined if the type of fibre, the level of exposure, the period of exposure and the associated inhalation of metal dust and fumes have a direct cause-effect relationship between asbestos and mesothelioma.

5.1.2 Cancer

Bronchogenic cancer is cancer of the lungs. Medical evidence available suggests that lengthy exposure to extremely high concentrations of asbestos fibres is related to lung cancer, but there is disagreement on the extent of the asbestos role. The study, conducted by Dr. J.C. McDonald of McGill University, reported a lower lung cancer rate among the 2,413 Quebec asbestos workers than the average rate for the Province of Quebec during the same period, except for a 5% group which was exposed to extreme conditions. Findings indicated a higher incidence of lung cancer among asbestos workers who smoke than among non-smokers. Dr. P. Pelnar of the Institute of Occupational and Environmental Health suggests that lung cancer can be attributed to asbestos only if the patient has symptoms of asbestosis.

5.1.3 Fibrosis

Pulmonary fibrosis is commonly called asbestosis. Medical evidence available today suggests that prolonged exposure to extremely high airborne concentrations of asbestos fibres is related to asbestosis. Workers who worked for 20 to 30 years in asbestos mines and mills where there was no dust control and exposed to concentrations as high as 100 million dust particles per cubic foot of air suffered a high rate of asbestosis.

5.1.4 Pleura Plaques

Pleura plaques is the term applied to the thickening of the pleura and, at times, this thickening has the appearance of plaques, some of which may be calcified. This phenomenon is said to be related to past exposure to asbestos fibres. However, there is no medical evidence today that asbestos develops pleural plaques; on the other hand, unless the thickening of the pleura is extensive, the effects on pulmonary function are minimal or absent.

5.2 Concentration of Asbestos Fibres

Studies undertaken by various organizations around the world have demonstrated that the occupational diseases attributed to asbestos can be minimized when the concentrations of airborne asbestos fibres are maintained at a low level. However, controversies exist on:

a) a specific level below which exposure is safe against any specific adverse biological manifestations;

b) the relative toxicity of the various kinds of asbestos, i.e., actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite;

c) the relative hazard related to the various sectors of the asbestos industry, i.e., mining, milling, manufacturing, processing and insulation.

When the evidence tends to show that crocidolite is more harmful than chrysotile, it is still not sufficiently substantiated to establish, at this moment, separate standards for variaties of asbestos.

The current practice of some countries involved in asbestos is as follows:

5.2.1 England

In England, the Asbestos Research Council gives the following interpretation to the various asbestos dust concentrations using the Membrane Filter Method and counting fibres with a Phase Contrast Binocular Microscope at 430X.

Asbestos Dust Concentration Fibres/CC	Interpretation
Less than 2	The provision of the Regulation is not expected to apply.
From 2 to 12	The extent of improvement will be dependent upon duration of exposure when deciding what measures are necessary to comply with the Regulation. From 4 fibres/CC and over: Employees will be advised to try to improve the situation.

Asbestos Dust Concentration Fibres/CC	Interpretation
Above 12	Protective clothing and approved respiratory protective equipment must be worn.

NOTE: It is important to bear in mind that, of necessity, the standards are provisional and may have to be reviewed from time to time. The above figures apply to chrysotile, amosite and anthophyllite, but for crocidolite, in general, respiratory protection will be required unless the dust concentration is considerably below the minimum level indicated above, that is, less than 2 fibres/CC, for fibres larger than 5 microns in length.

5.2.2 United States

In the United States of America, the Department of Labour, Occupational Safety and Health Administration, has issued the following standards, while the determination of airborne concentrations of asbestos fibres shall be made by the Membrane Filter Method at 400-450X with Phase Contrast Illumination for all varieties of asbestos, including crocidolite and chrysotile as well.

a) Effective July 7, 1972. The 8-hour time-weighted average airborne concentrations of asbestos fibres to which an employee may be exposed shall not exceed 5 fibres, longer than 5 micrometers, per cubic centimeter of air. Concentrations above

5 fibres, but not to exceed 10 fibres, would be permitted up to 15 minutes in an hour, but for not more than 5 hours in any one 8-hour day.

b) Effective July 1, 1976. The 8-hour time-weighted average airborne concentrations of asbestos fibres to which any employee may be exposed shall not exceed 2 fibres, longer than 5 micrometers, per cubic centimeter of air. Peak concentrations should not exceed 10 fibres/CC, with no time restriction.

5.2.3 Canada

In Canada, the Quebec Asbestos Mining Association, which compriees all asbestos producers in the Province of Quebec, has agreed to a maximum acceptable concentration of 5 MPPCF (million particles per cubic foot) based on the Midget Impinger Method, as a standard practice. By this method, counts are recorded for asbestos fibres and particles of rock dust. However, the next legislation in this province may change the permissible concentration, the type of particles to be counted and the method to be used for determining these concentrations.

5.3 Method of Measurement

The Membrane Filter Method is applicable for the determination of atmospheric concentrations of asbestos fibres. This method is suited for sampling in both asbestos textile operations and mixed dust operations containing asbestos fibres. The procedure is

particularly valuable in mixed dust areas, since asbestos fibres alone are counted without interference from granular dusts.

5.3.1 Equipment

Basically, the membrane filter sampling equipment consists of a suction pump unit and a filter holder assembly. The suction pump unit is the MSA Monitaire Sampler. This instrument will sample for 7 hours and provide a constant sample flow rate that can be adjusted between zero and ten cubic feet per hour. Pump battery is recharged overnight.

The filter holder assembly is the Aerosol Analysis Monitor containing a Millipore membrane filter, type AA, 37 mm diameter, 0.8 micron pore size. The filters are supported on thick pads with aid in controlling the distribution of air through the filter. Tubing of suitable length is connected to the inlet side of the pump and to the filter holder assembly. The pump is turned on and adjusted to the appropriate gauge setting. This gauge reading should be maintained throughout the sampling period.

5.3.2 Sampling

Established sampling stations should be taken with the Monitaire Sampler attached to the operator's belt and the filter holder clipped to the operator's clothing. Where this is not possible and in general room samples, the filter holder assembly may be attached to a suitable stand or holder in the worker's "breathing zone". The sampling time should be gauged to obtain sufficient material on the filter for satisfactory counting under the

microscops. Excessive dust deposits should be avoided, since no dilution is possible.

5.3.3 Sample Counting

a) Preparation of Mounting Solution

The mounting eolution used in this method is a 1:1 mixture of dimsthyl phthalate and diethyl oxalate. This solution may be used when the sample is to be counted within 24 hours after preparation. If samples are to stand for longer periods of time, an alternats solution may be prepared by dissolving 0.05 grams of membrane filtar material per millimetar of solution. For example, in a 100 cc solution, 50 cc dimsthyl phthalate are mixed with 50 cc of diethyl oxalate. Fivs grams of sampling filter materials are weighed and dissolved in the 100 cc solution. The purpose of the dissolved material is to provide a solution with as high a viscosity as possible without being difficult to handle. The highly viscous solution delays the migration of particlss outward from the center of the mount. The samples will remain stabls with no apparent loss in concentration for approximately 30 days.

b) Mounting Sample

To count fibres on a filter, it must bs mounted and rendsred transparent in prsparing a eample for microscopic examination. A drop of mounting solution is placed in the centar of a frashly cleaned standard microscope slide (25 mm x 75 mm)

using a pipet. A wedge-shaped piece about 1 cm x 2 cm is excised from the filter paper using a scalpel and forceps. This piece is placed, dust eide up, on the drop of mounting solution. A No. 1-1/2 coverslip, carefully cleaned with lens tiseue, is placed over the filter wedge. Apply slight pressure on the coverslip to achieve contact between it and the mounting solution. The eample may be analyzed es soon as the mount is transperent. The clearing of the filter requiree about 15 minutes.

c) Sample Counting

Counting of the fibres retained on the filter surfece ehall be performed with a research-quality binoculer microscope equipped with phase contrast accessories. Counting shall be carried out et 400 to 450X magnification with one of the eyepieces containing a Paterson Globe end Circle reticule to define the counting field and assist in judging lengthe of fibres. Any particle having a length to width ration of 3:1 or greater is considered a fibre. All other particles are considered as background and should not be counted. The following steps will be taken:

1) Adjust the 400X phase contrest microscope (e 40X phase contrast objective and 10X eyepieces) for optimum illumination and focus.

2) Scan several fields of review to essure that fibre distribution is random (a 10X phase contraet objective and 10X eyepieces may also be used for this scanning).

3) Count the number of fibres 5 microns in length end greater in 20 fields of view selected at random.

4) Record results and calculate the number of fibres per cubic centimeter of air.

5) Label the mounted slides.

d) Computation of Results

In the following calculations, let

A = Effective Filtration Area in mm^2. (855 mm^2 for the Aerosol Monitor)

a = Area of any field of view in mm^2.

N = Number of fibres counted in "n" fields.

n = Number of fields of view counted (normally 20).

V = Volume of air in cc's.

Then the concentration (C) in fibres/CC is given by:

$$C = \frac{A \times N}{a \times n \times V \times 1000}$$

Example:

A = Area of membrane sample = 855 mm^2

a = Area of field view = 0.005 mm^2

N = Number of fibres counted = 200

n = Number of fields observed = 20

v = Sampling rate = 2 lpm

t = Sampling time = 90 minutes (not necessarily)

Calculation

$$C = \frac{855}{0.005} \times \frac{200}{20} \times \frac{1}{2000 \times 90}$$

$$= 170{,}000 \times 10 \times \frac{1}{180{,}000}$$

$$= 9.4 \text{ fibres/cc}$$

5.3.4 Reliability

For those who will be performing dust sampling and counting, they will find the technique much easier to understand if they realize at the beginning that there is no absolute or precise method of determining the total number of particles in a given sample of air. Most of the sampling methods do not collect all of the particles and if they did, all of the particles could not be counted and differentiated by any method known up to now. In making fibre counts, the most important consideration is that the method should yield results that can be duplicated and compared with those obtained by other technicians under similar conditions. It should give the same results for different operators sampling the same concentrations so that the conditions as found can be compared with similar conditions where observations over a longer period of time have permitted an evaluation of the hazards involved by continuation of engineering and medical studies.

5.4 Dust Monitoring Program

5.4.1 Method of measurement

All determinations of airborne concentrations of asbestos fibres shall be made by the Membrane Filter Method (see section 5.5).

5.4.2 Equipment

The equipment supplied to perform the dust monitoring by the membrane filter method is described hereafter:

One - MSA Monitaire Sampler with diaphragm pump of 0 to 10 cubic feet per hour capacity and battery unit that will run the sampler continuously for seven hours at a constant flow rate which can be adjusted.

One - MSA Battery Charger designed for the pump battery with a 16-hour rate for overnight and a 64-hour rate for weekend charging.

90 - Millipore Aerosol Analysis Monitors, type AA white, gridded filter for particle counting, No. MAWG 037 A0.

100 - Millipore Membrane Filters, type AA white, gridded, 0.8 micron pore size, 37 mm diameter, No. AAWG 037 00.

One - Millipore Aerosol Adapter, No. XX62 0000 04.

One - Bausch & Lomb Phase Contrast Microscope, model No. BBT 252, binocular, ungraduated mechanical stage, turret, zoom with flat field phase, three objectives and phase hi-intensity base illuminator with continuously variable

zoom magnification, wide field 10X eyepieces paired, quadruple revolving rotosphere nosspiece with one each Achromatic phase contrast objectives

10X FF- 16 mm E.F.L. - 0.25 N.A. - 5.4 mm WD

20X FF- 8 mm E.F.L. - 0.50 N.A. - 0.65 mm WD

40X FF- 4 mm E.F.L. - 0.65 N.A. - 0.40 mm WD

less the 100X FF - 1.8 mm E.F.L. - 1.25 N.A. oil immersion objective, rack and pinion substage.

One - Paterson Globe and Circle Reticule, standard 21 mm diameter, 1.5 mm thickness.

One Gross - Micro Slides, 75 by 25 mm, pre-cleaned, frosted end.

One Ounce - Cover Glasses, square, No. 1-1/2, size 22 mm.

One Gallon - Diemethyl Phthalate

One Quart - Diethyl Oxalate.

One - Dissecting Set

400 - Pasteur Disposal Pipets.

Six - Balsam Bottles

48 Books - Lens Paper

5.5 Preventive Protection

Because of the long period of time which elapses between the onset of exposure to asbestos fibres and the adverse biological manifestations, it is important to initiate and improve programs which are conceived to protect persons and invironment against asbestos fibres and prevent the rejuvenation of related diseases. These probrams should be based on the following means of protection:

5.5.1 Dust Control

A dust control program can be achieved by securing the generation of fibres first and by preventing the dispersion of released fibres into the ambient air of the work places. This program shall include dust monitoring within the breathing zone of the employees and areas of work environment, complying with specific standards and performed at regular intervals.

5.5.2 Medical Examination

An appropriate medical examination on a periodic basis for every employee exposed to airborne concentrations of asbestos fibres shall be performed by a physician with expertise in diagnosis of asbestos-related diseases. It is recommended that this medical examination take place at the beginning and termination of employement and once a year during exposure.

5.5.3 General Practice

Rotation of employees on different jobs where dust concentrations reach various levels, protective equipment and good housekeeping shall be enforced throughout the plant to increase protection.

5.5.4 Records

The maintenance of records detailing dust control, monitoring, medical examinations and pertinent programs has many merits and shall not be underestimated.

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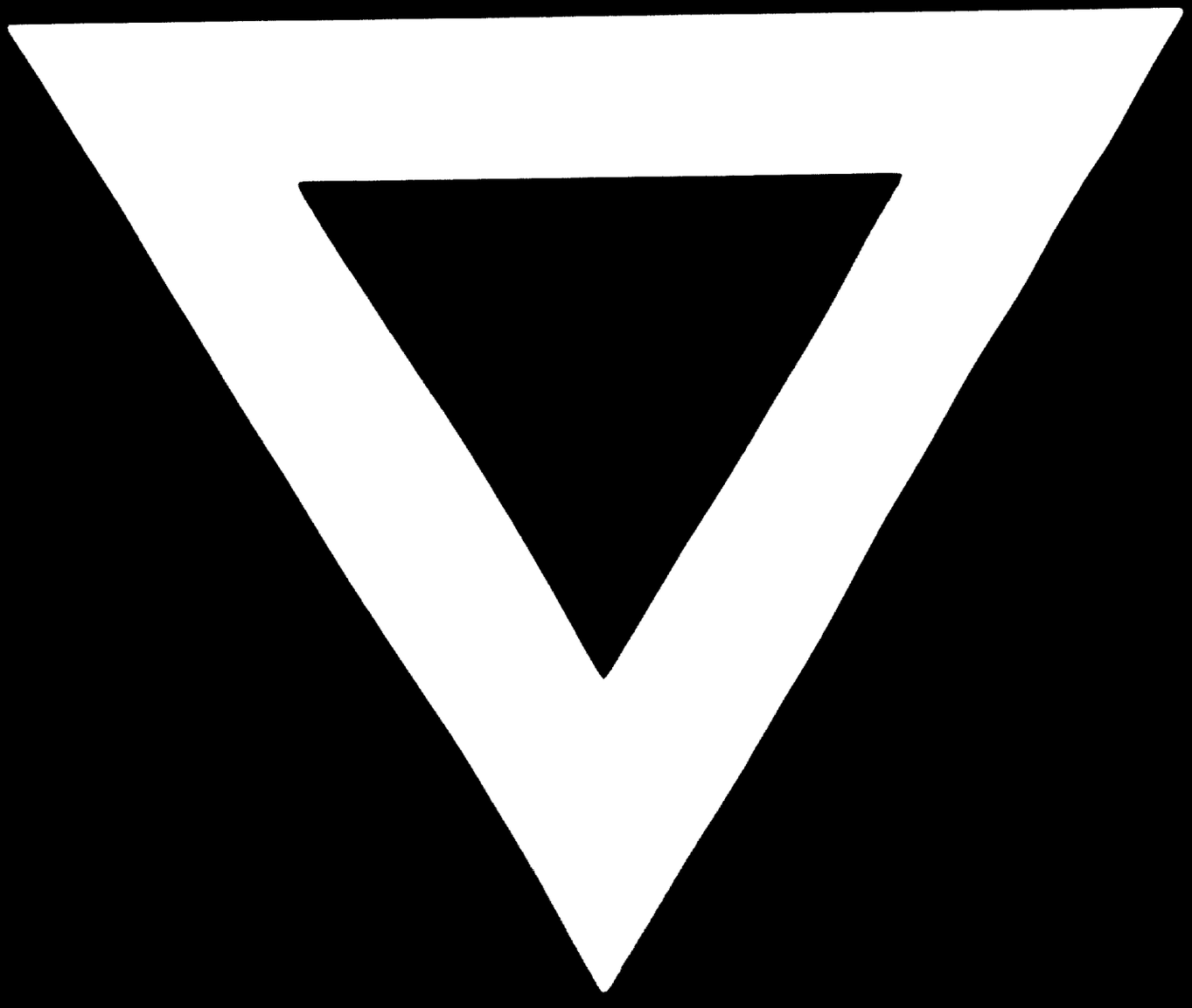

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