

# BACKHOE LOADER AND LOADER SHOVEL LABORABLE RISK PREVENTION MANUAL



# INDEX

## MODULE I BACKHOE LOADER

- Objectives
- General Characteristics
- Risks and Preventive Measures in the Backhoe Loader
  - Dangerous Circumstances
  - Consequences
  - Preventive Measure
- Personal Protection
- Affected Legislation

## MODULE II LOADER SHOVEL

- Objectives
- General Characteristics
- Loader Accidents and Preventive Measures
  - Dangerous Circumstances
  - Consequences
  - Preventive Measures
- Personal Protection
- Affected Legislation

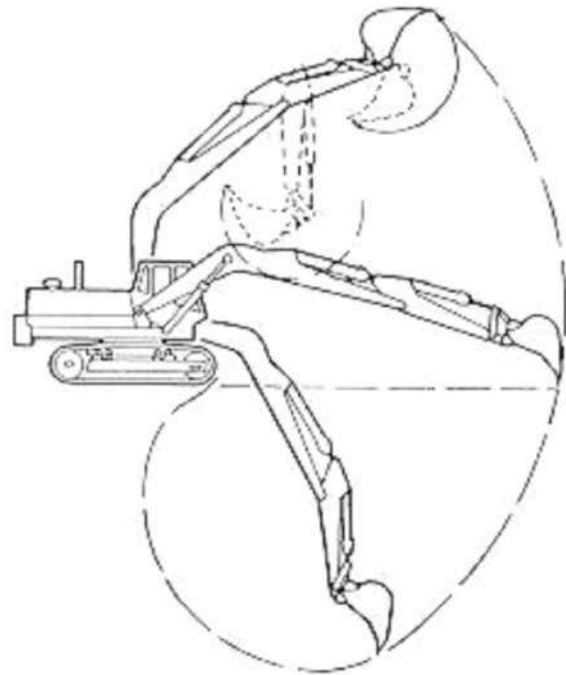
## **MODULE III**

### **ERGONOMICS AND CONSTRUCTION: WORK IN TRENCHES**

- Introduction
- Description of Tasks:
  - Small trenches (branches and breakdowns). Undertake works.
  - Medium trenches. Canalization Works
  - Big ditches. Canalization Works
- Main Risks
- Preventive Measures



**BACKHOE LOADER**



## **MODULO I**

### **BACKHOE LOADER**

#### **Objectives**

The purpose of this manual is to make the **specific risks of the backhoe loader known** so that they can be taken into account by the driver as well as maintenance personnel.

#### **General characteristics**

The backhoe loader is basically used to open trenches for pipes, cables, drains, etc.

Another very frequent field of application is the excavation of foundations for buildings, as well as the excavation of ramps in plots when the excavation of the same has been done with loader shovel.

There are basically **two types** of backhoe:

- With chassis on **tyres**
- With chassis on **chains**

In the tire backhoe loader, the undercarriage is composed of rubber wheels. The movement command bodies, steering and braking controls are located in the driver's cab. Stability during work is ensured by wheel-independent stabilisers.



On chain backhoes, the chassis is supported by two parallel chains. As with tyres, the controls are located in the driver's cab.



## RISKS AND PREVENTIVE MEASURES ON THE BACKHOE

The different functions performed with the backhoe, as well as its risks and preventive measures, will be analysed in detail below.

**Dangerous Circumstances:** Reckless handling of the backhoe.

**Consequences:** Overrun and overturning.

**Preventive measures:**

- ➡ Know the possibilities and limits of the machine and in particular the space required for manoeuvring.
- ➡ Balize the evolution zone of the same one when the space is reduced.
- ➡ Monitor the position, the function and the operating direction of each of the controls, signalling devices and safety devices.
- ➡ Adjust the seat to the driver's comfort, height and weight.

**Dangerous Circumstances:** Ignorance of the place of work.

**Consequences:** Collision with other vehicles.

**Preventive measures:**

- ➡ Know the traffic plan of the worksite and be informed every day of the work that may constitute a risk: open trenches, laying of cables, etc.
- ➡ Find out the height of the machine while driving and working, as well as the areas of limited height or narrow.
- ➡ With the rubber wheeled running gear, drive cautiously at a slow speed in areas of dust, mud or frozen ground.

**Dangerous Circumstances:** Circulation on the road and on the construction site.

**Consequences:** Collisions with other vehicles, overturning.

**Preventive measures:**

- ➡ When driving on the road, the boom stabilisers and the turning area will be blocked with the mechanisms provided for this purpose.
- ➡ When driving backwards be very attentive or better be guided.
- ➡ Keep distances to ditches, slopes and any alteration of the terrain that can enable the machine to overturn.
- ➡ Never start work without stabilisers if the machine is made of tyres.

**Dangerous Circumstances:** Perform work without proper knowledge of the machine.

**Consequences:** Strikes.

**Preventive measures:**

- ➡ Loading into trucks will be carried out with caution. When it is not practical to try with two posts and a horizontal bar.
- ➡ Place bucket equipment on the ground, even for short stops.

**Dangerous Circumstances:** Working on steep slopes.

**Consequences:** Overturning.

**Preventive measures:**

- ➡ Orient the arm towards the bottom, touching almost the ground.
- ➡ If the backhoe is a tracked excavator, make sure that it is properly braked.
- ➡ Always work facing the slope when extracting material.



### **Dangerous Circumstances: In demolition**

**Consequences:** Fall of objects.

**Preventive measures:** Do not knock down elements that are higher than the machine with the spoon extended.

### **Dangerous Circumstances: Electrical hazards.**

**Consequences:** Electrocutation.

**Preventive measures:**

- ▶ When driving next to an overhead power line it is necessary to take into account the sinuosity of the road, potholes and other irregularities when calculating distances.
- ▶ For lines of less than 66,000 V, the distance from the machine must be at least 3 m and 5 m.

### **Dangerous Circumstances: When leaving the machine.**

**Consequences:** accident.

**Preventive Measures:** Do not leave the excavator without resting the equipment on the ground, stop the engine and apply the brake. Keep the ignition key on top.

### **Dangerous Circumstances: Transport of the machine.**

**Consequences:** Shocks to other vehicles.

**Preventive measures:** Immobilize the area that turns with the device provided by the manufacturer.

## **REMEMBER!!**

### **PREVENTIVE MEASURES**

#### **Overturning cabin**

It should primarily protect the driver from entrapment in the event of a rollover. For this reason, and in order to avoid damage from knocks, it should be complemented with the use of a safety belt that keeps the driver fixed to the seat, in the style of those installed in cars. It should also protect against the fall or collapse of earth and materials, such as walls, trees, etc., so the exclusive use of a portico is not a fully satisfactory solution. The ideal cabin is the one that protects against the inhalation of dust produced even by the work of the same machine and that is frequently introduced in the eyes, against the deafness produced by the noise of the machine and against the thermal stress or insolation in summer.

#### **Anatomical seat**

Basically, its function is to alleviate the probable back injuries of the driver and the physical fatigue of the same.

#### **Arrangement of controls and commands**

It should be verified that they are perfectly accessible, that they are located in the zone of maximum action and that their movement corresponds to the usual stereotypes. Both the effort to be made on flywheels, levers, etc., as well as their possible regressions, are aspects that should also be checked in each machine and after each repair or reform.

## **PERSONAL PROTECTIVE EQUIPMENT**

### **Head protection helmet**

Normally the driver's seat is protected with a cabin, but it is essential to wear a helmet when leaving it to drive around the construction site. The safety helmet will be approved (MT-1).

### **Non-slip safety boots**

Safety footwear is important because of the conditions in which you usually work on the job (mud, water, oil, grease, etc.).

### **Protection of the ears**

When the noise level exceeds the established safety margin and, in any case, when it exceeds 80 dB, the use of approved headphones or earplugs (MT-2) shall be compulsory.

### **Work clothes**

Do not wear loose work clothing that can be caught by moving parts. Eventually, when weather conditions make it advisable and the operator's platform lacks a cab, the driver must have clothing to protect him from the rain.

### **Gloves**

The driver should wear suitable gloves for possible conservation emergencies during work.

## Sight protection

In addition, where there is no cab, the driver should wear safety goggles in order to protect himself from the projection of particles in excavation operations. If the goggles are of the universal type, they will be approved (MT-16).

## Antivibrating abdominal belt

In order to be protected from the effects of vibrations. This belt can have the dual purpose of preventing the driver from being thrown out of the tractor.

## Breathing apparatus protection

When working with powdery soil, masks should be used (MT-8).

## RELEVANT LEGISLATION

General Ordinance on Occupational Safety and Health  
(Articles 31, 65, 92, 124, 141, 142, 143, 145, 147, 148, 149 and 151).

Building, Glass and Ceramics Labour Ordinance  
(Articles 277, 278, 279, 281, 285, 289, 290, and 291).



## **LOADER BLADE**

## MODULE II

### LOADER BLADE

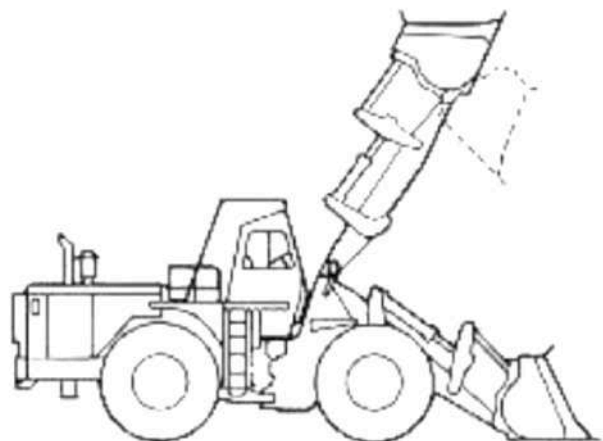
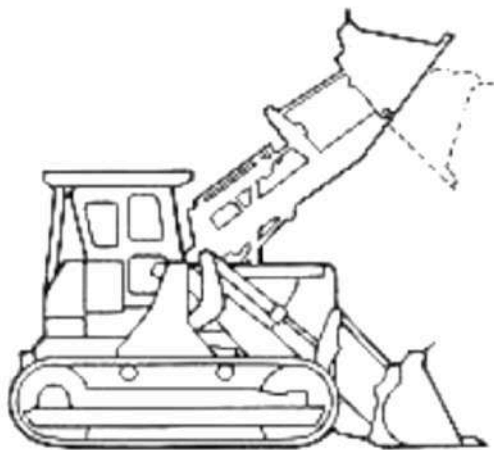
#### Objective

To make known the main risks and the most appropriate means of protection to avoid accidents occurring during the use of the shovel loader.

#### General Characteristics

Loaders are tractor-mounted shovels suitable for various jobs, but especially for earthworks.

The front loader, front loader, front loader or simply loader is the mechanical shovel consisting of a crawler tractor or tyres equipped with a bucket whose lifting movement is achieved by means of two articulated side arms.



## ACCIDENTS AND PREVENTIVE MEASURES ON THE LOADER

**Dangerous circumstances:** Absence or defective operation of optical or acoustic signals.

**Consequences:** accident.

**Preventive measures:** Incorporate horn and adequate lighting and keep it in good maintenance condition.

**Dangerous circumstances:** Poor visibility due to faulty lighting in night work, tunnels, etc.

**Consequences:** accident.

**Preventive measures:** Adequate lighting in the work area.

**Dangerous Circumstances:** Poor visibility due to excessive dust in the workplace, due to the same, produced by other vehicles, due to excessive speed.

**Consequences:** accident.

**Preventive measures:** The work area should be irrigated conveniently, so as to avoid dust, without producing mud.

**Dangerous circumstances:** Presence of people in the work area due to lack of delimitation and signposting of the area of operations.

**Consequences:** accident.

**Preventive measures:** Delimit the work area with fences or signs of the machines.

**Dangerous circumstances:** Use of the bucket for lifting people.

**Consequences:** accident.

**Preventive measures:** Prohibit personnel from getting on the spoon.

**Dangerous circumstances:** Transport of persons in the machine.

**Consequences:** accident.

**Preventive measures:** It is also forbidden for personnel to climb on the machine while it is running.

**Dangerous circumstances:** Abandonment of the machine or improper parking of the machine on slopes, with the engine running or without shims, etc.

**Consequences:** accident.

**Preventive measures:** Whenever the machine is left stationary, it is will leave the spoon touching the ground with wedges on.



**Dangerous circumstances:** Poor visibility due to the same causes mentioned in the table above.

**Consequences:** Overturning of the machine.

**Preventive measures:** The machine will be in perfect state of maintenance as far as illumination is concerned, likewise the work area will be illuminated.

**Dangerous Circumstances:** Faulty movement or work on steep slopes.

**Consequences:** Overturning of the machine.

**Preventive measures:** Do not work on slopes greater than 50%.

**Dangerous circumstances:** Land subsidence.

**Consequences:** Overturning of the machine.

**Preventive measures:** Examine the work area in detail.

**Dangerous circumstances:** Excessive approach to slopes, embankment edges, etc.

**Consequences:** Overturning of the machine.

**Preventive measures:** Shortening or beaconing of the slope area.

**Dangerous circumstances:** Faulty operation.

**Consequences:** Overturning of the machine.

**Preventive measures:** Before starting any work, analyse the manoeuvres to be carried out.

**Dangerous Circumstances:** Riding at excessive speed and/or on poorly maintained tracks (slippery, covered with water, etc.).

**Consequences:** Overturning of the machine.

**Preventive measures:** Speed limiters will be placed or drivers will be instructed to respect the indicated speed. On the tracks, if there is mud, it will be removed and if there is dust, it will be watered.

**Dangerous circumstances:** Excessive speed.

**Consequences:** Collision with other vehicles.

**Preventive Measures:** Limit speed by means of indicators or by instructing personnel.

**Dangerous circumstances:** Lack of visibility.

**Consequences:** Collision with other vehicles.

**Preventive measures:** If it is due to dust will be watered and if it is due to darkness will be illuminated by the machine itself or with auxiliary lighting.

**Dangerous circumstances:** Lack of signalling.

**Consequences:** Collision with other vehicles.

**Preventive measures:** Signposting the work area.

**Dangerous circumstances:** Improper working method (several machines in the same pit interfering with each other).

**Consequences:** Collision with other vehicles.

**Preventive measures:** Order traffic on site.

**Dangerous circumstances:** Direct contact with airlines.

**Consequences:** Electrocutation.

**Preventive Measures:** For lines of less than 86,000 V. the distance will be at least 3 m and 5 m.

**Dangerous circumstances:** Arc formation when working close to overhead lines without respecting safety distances.

**Consequences:** Electrocutation.

**Preventive Measures:** Maintain safety distances expressed above.

**Dangerous Circumstances:** Contact with buried electrical conduits.

**Consequences:** Electrocutation.

**Preventive Measures:** Examine the work area to discover the hazards. buried lines and maintain a safety distance of 0.50 m.

**Dangerous Circumstances:** Breakage of gas pipes.

**Consequences:** Explosion.

**Preventive measures:** Preliminary reconnaissance of the terrain and delimitation of the area.

**Dangerous circumstances:** Filling the fuel tank

**Consequences:** Fire

**Preventive Measures:** Do not smoke while refuelling.

**Dangerous circumstances:** Short circuit in the electrical system.

**Consequences:** Fire

**Preventive Measures:** Permanent revision of the electrical system.

**Dangerous circumstances:** Overturning of the machine.

**Consequences:** Trapping.

**Preventive measures:** Safety cabinet.

**Dangerous circumstances:** Landslides.

**Consequences:** Trapping.

**Preventive Measures:** Closed safety cabinet.

**Dangerous Circumstances:** Transmissions, Gears and Moving Elements Exposed.

**Consequences:** Trapping

**Preventive Measures:** All guards and safety covers must be in place.

**Dangerous circumstances:** Cleaning, greasing or regulating parts of the machine while it is in motion.

**Consequences:** Trapping

**Preventive Measures:** Do not perform any work on the machine while it is in motion.

**Dangerous circumstances:** Unexpected movements of the machine or its moving parts, especially during repair or maintenance.

**Consequences:** Trapping

**Preventive Measures:** Check all the safety elements of the machine before making any manipulation.

**Dangerous Circumstances:** Overload ladle.

**Consequences:** Projection of particles.

**Preventative measures:** The ladle will not fill above the top edge of the spoon.

**Dangerous circumstances:** Sudden movements with full ladle.

**Consequences:** Projection of particles.

**Preventive measures:** With a full ladle, the following will not be carried out abrupt movements.

**Dangerous circumstances:** Inadequate working methods.

**Consequences:** Projection of particles.

**Preventive measures:** Always work downwind.

**Dangerous circumstances:** Getting on or off the machine.

**Consequences:** People falling

**Preventive Measures:** Ladders, handles and machine surfaces must be free of obstacles, grease, etc.

**Dangerous circumstances:** Transporting people on the machine.

**Consequences:** People falling

**Preventive Measures:** Prohibition of the transport of persons.

**Dangerous circumstances:** The engine of the machine itself.

**Consequences:** Noise.

**Preventive Measures:** The engine and exhaust pipe will be maintained in good working order.

**Dangerous circumstances:** Other machines working in the vicinity.

**Consequences:** Noise.

**Preventive measures:** Try not to agglomerate too many machines in the same place of work.

**Dangerous circumstances:** Shock of the spoon with stony materials.

**Consequences:** Noise.

**Preventive measures:** Try not to drag the spoon on the rocks.

**Dangerous circumstances:** Insufficient damping.

**Consequences:** Vibrations leading to spinal or renal injuries.

**Preventive measures:** Keep the seat in good working order, as well as its height adjustment.

**Dangerous Circumstances:** Poor driver's seat design.

**Consequences:** Vibrations leading to spinal or renal injuries.

**Preventive Measures:** The seat will be anatomically designed.

**Dangerous Circumstances:** Inhalation of dust produced when handling different materials, especially in the dry and hot seasons of the year.

**Consequences:** Pneumoconiosis

**Preventive Measures:** The work area, if there is a lot of dust, will be watered continuously.



**Dangerous circumstances:** Working in the hot seasons of the year.

**Consequences:** Stress-thermal

**Preventive measures:** Use cabin and water road.

**Dangerous circumstances:** Excess of hours worked.

**Consequences:** Fatigue

**Preventive Measures:** Do not work in a row.

**Dangerous circumstances:** Ergonomically defective seats and controls.

**Consequences:** Fatigue

**Preventive Measures:** The driver's seat shall be designed to be comfortable: it shall be adjustable in height, backrest, etc.

## PREVENTATIVE MEASURES

### Overturning cabin

It should primarily protect the driver from entrapment in the event of a rollover (fig. B and D). To this end, and to avoid damage from knocks, it should be complemented by the use of a safety belt that keeps the driver fixed to the seat in the style of those installed in cars, which is also suitable against collisions.



A) CABIN



B) STRUCTURE WITH 4 ROOF STRUCTS



C) SOUNDPROOFED CABIN



D) STRUCTURE WITH 2 ROOF STRUCTS

It should also protect against falling or collapsing earths and materials, such as walls, trees, etc., so the exclusive use of a portico is not a fully satisfactory solution. The ideal cabin is the one that protects against the inhalation of dust produced even by the work of the same machine and that is introduced frequently in the eyes, against the deafness produced by the noise of the machine and against the thermal stress or insolation in summer (fig. A and C).

The greatest difficulty of this cab to protect the driver from dust, noise and climatic rigors lies in the harsh conditions in which the machine works and therefore the maintenance has to be very frequent and not being a fundamental element for the operation of the machine is not used.

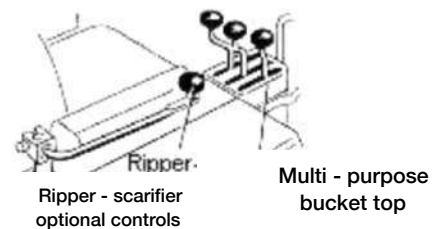
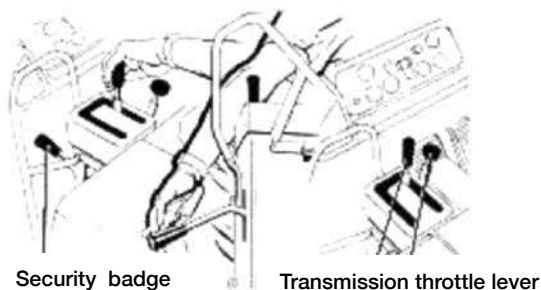
## Anatomical seat

Basically, its function is to alleviate the probable back injuries of the driver and the unnecessary physical fatigue of the same.

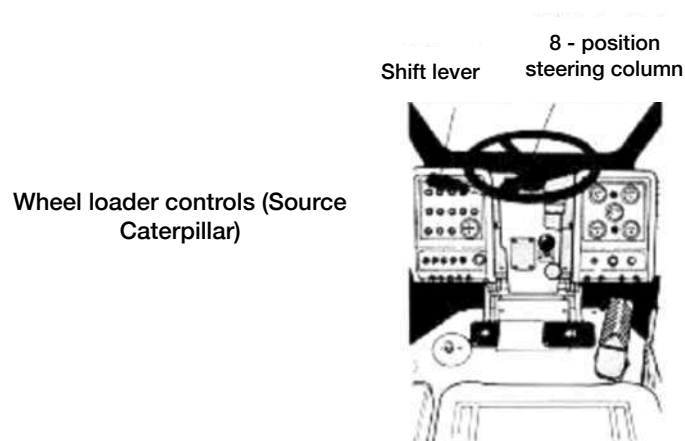


## Arrangement of controls and commands

It should be verified that they are perfectly accessible and that they are located in the zone of maximum action and that their movement corresponds to the usual stereotypes. Both the effort to be made on flywheels, levers, etc., as well as their possible regressions, are aspects that should also be checked in each machine and after each repair or reform.



Crawler loader controls (Source Caterpillar)



Wheel loader controls (Source Caterpillar)

## **PERSONAL SAFETY**

These machines must be equipped with a safety cabinet, suitably conditioned to eliminate or cushion hygienic problems, noise, dust, etc.

### **Head protection helmet**

Although the driving position must be protected by a roof, it is essential to use the helmet, which is required for use outside the machine.

### **Non-slip safety boots**

They are necessary because the ascent or descent has to be made on the machine in the working conditions (with mud, water, oil, grease, etc.). They are also suitable so that the manoeuvring pedals do not slip.

### **Gloves**

A set should be provided for possible conservation emergencies during work.

### **Antivibrating abdominal belt**

In order to be protected from the effects of vibrations on the abdominal viscera. This belt can serve the dual purpose of preventing the driver from being thrown out of the tractor.

## **Work clothes**

Machine operators, like all other machine operators, should not wear loose work clothes that can be caught by moving parts.

Eventually, when weather conditions make it advisable and the tractor lacks a cab, the driver should wear waterproof clothing.

## **Sight protection**

In addition, where there is no cab, the driver should wear safety goggles to protect himself from the projection of particles during excavation operations on hard ground.

## **Protection of the ears**

Where the noise level exceeds the established safety margin and in any case where it exceeds 80 dB, the use of headphones or earplugs shall be compulsory.

## **Breathing apparatus protection**

In work with dusty soil, masks should be used.

## **Safety Belts**

When there is a safety cabin, the use of safety belts is obligatory.

## **RELEVANT LEGISLATION**

General Ordinance on Health and Safety  
(Articles 31, 65, 124, Chapter XIII, Articles 141, 142, 143, 145, 147, 151).

Building, Glass and Ceramics Labour Ordinance  
(Articles 252, 277, 278, 279, 281, 285, 289, 290, 291).



**ERGONOMICS AND CONSTRUCTION:  
WORKING IN TRENCHES**

## **MODULE III**

# **ERGONOMICS AND CONSTRUCTION: WORKING IN TRENCHES**

### **INTRODUCTION**

Construction work normally involves significant physical activity, but in trench work the physical load is particularly high, and is aggravated by outdoor work involving often extreme thermo-hygrometric conditions. The type and high number of physical demands in this work help explain why injuries, musculoskeletal disorders and accidents due to over-exertion of occupational origin occupy an important place in this sector.

After carrying out an analysis of the accident rate in both 2006 and 2007, it can be seen that almost 50% of accidents are overstrains, due to the handling of loads and the postures adopted in excavation work and the laying of pipes in trenches.

In this manual, we analyze the risks in different work situations such as these:

- ➡ Work in large trenches
- ➡ Work in medium trenches
- ➡ Work in small trenches

The following section describes the tasks carried out in each of them as well as the main characteristics of each one.

### **DESCRIPTION OF TASKS**

The tasks to be carried out in trenches differ considerably according to the size of the trench, so we will study large, medium and small trenches separately.

## → BIG DITCHES. CANALIZATION WORKS

These are works for the execution of new pipes in the drinking water network with a diameter of more than 400 mm; this section also takes into account the installation of all its elements (valves, discharges, air inlets, etc.) as well as the installation of new connections on the installed pipe and the transfer of the existing ones. This process includes the connection of the new pipe as well as the necessary earthmoving, civil works and signalling services.

The average depth of the trenches is approximately three metres, which entails placing the shoring depending on the terrain.



**Working in large trenches**

The work begins with the manual opening of tastings to locate the services previously marked by the technician of the radio detector.

The works to be carried out in this type of trench are those of demolition with pneumatic hammer, cutting asphalt, manual excavation with spout and shovel, guide of machinery, manipulation of materials (pipe, pieces, valve, sacks), placement of signalling, placement of collective protections, assembly of pieces (screws), welding by thermofusion, filling and compacting, and paving.

The average duration of the works is approximately:

- ▶ Manual excavation of tasting and canalization: 2 hours.
- ▶ Machinery guide: 2 hours.
- ▶ Use of machinery (hammer, tyre, compressor...): 2 hours.
- ▶ Welding: 2 hours.



## → MEDIUM DITCHES. CHANNELING WORKS

These are works for the execution of new pipes for the drinking water network with a diameter of no more than 400 mm; this section includes the installation of all its elements (valves, discharges, air inlets, etc.) as well as the installation of new connections on the installed pipe and the transfer of the existing ones. This process includes the connection of the new pipe to the existing one, as well as the necessary earthworks, civil works and signalling services.

The brigades are usually made up of 4 workers who work an 8-hour day, usually from 8:00 a.m. to 5:00 p.m., with an hour's rest for lunch.

The approximate depth of the trenches is 1 metre with a width of 60 cm.

The work begins with the manual opening of tastings to locate the services previously marked by the technician of the radio detector.

The works to be carried out in this type of trench are those of demolition with pneumatic hammer, cutting asphalt, manual excavation with spout and shovel, guide of machinery, manipulation of materials (pipe, pieces, valve, bags), placement of signalling, placement of collective protections, assembly of pieces (screws), welding by thermofusion, filling and compacting, and paving.

The average duration of the works is approximately:

- ▶ Manual excavation of tastings: 2 hours.
- ▶ Machinery guide: 2 hours.
- ▶ Use of machinery (pneumatic hammer, compressor...): 2 hours.
- ▶ Welding: 2 hours.

## → SMALL TRENCHES (BRANCHES AND BREAKDOWNS). CONNECTION WORK

These are works for the construction of connections to the drinking water network; this section also includes the tasks performed to carry out the installation of branches, including civil works and the necessary assembly.

The brigades are usually made up of 3 workers who carry out their 8-hour working day, usually from 8 a.m. to 5 p.m., with an hour's rest for lunch.

The approximate depth of the trenches is 1 metre with a width of 60 cm.

The work begins with the manual opening of tastings to locate the services previously marked by the head of the brigade through the locator.

The work to be carried out in this type of trench is demolition with a pneumatic hammer, manual excavation with a spout and shovel, handling of materials not exceeding 4 m (pipes, parts, valves, bags), fibre cement work, placement of signs, placement of collective protections, assembly of parts (screws), filling and compacting and paving.

The duration of the work is approximately as follows:

- ▶ Manual excavation of tastings: 4 hours.
- ▶ Handling of parts not exceeding 4 m: 2 hours.
- ▶ Use of machinery (pneumatic hammer, compactor...): 2 hours

## **MAJOR RISKS**

The main risks found in this type of work are caused by of musculoskeletal disorders and can be classified in four sections that are those related to postures, to the manipulation of loads, to muscular overexertion and to the repetitiveness of movements.

Postures and movements: These include aspects related to standing posture, the position of the trunk and upper extremities, knee or squatting posture, the use of the upper extremities, etc.

Manual handling of loads: These refer to both the type of weight handled and the conditions under which the handling is carried out.

Repetitiveness and muscular efforts: This section covers muscular over-exertion and the repetitiveness of tasks in terms of cycle duration, repetition of movements, etc.

Environment: have also been taken into account, within the previous sections, the influence of the environment, climatic conditions, etc.

## POSTURE

Two of the main risk factors are, on the one hand, the extension or hyperextension of the upper extremities and, on the other hand, torsion, inclination, flexion and hypertension of the trunk.

The result is that, in both cases, the muscles have to do extra work in order to maintain posture and support the weight of the arms.

In many occasions the lack of space does not allow to adopt a comfortable position or adequate to carry out the task which leads to a decrease in the strength that can be performed; this results in these situations have an increase in muscle fatigue and greater biomechanical wear of both the spine and joints.

The tasks performed in the trenches themselves and the lack of space often mean that the worker has to adopt forced neck postures, i.e. extension, flexion, inclination and rotation of the neck that leads to an overload in the cervical and scapular areas.

Another of the forced postures that are usually adopted are those of knees and squats which leads to a significant overload of the lower extremities. In addition, this situation is aggravated by the friction of the lower extremities with the work surface, be it pavement or earth.

To all the previous aspects of postural load must be added having to manipulate tools or other types of weights which is an aggravating factor in the physical load of the worker.

## MANUAL HANDLING OF LOADS

Manual handling of all types of loads is common in this type of task:

Some are small, but are used continuously resulting in muscle and biomechanical fatigue which, after many hours of manipulation, can become very considerable.

Others are large, heavy and can cause back injuries (mainly at the dorsal lumbar level).

Both because of the weight of the load itself and the conditions under which it is handled: handling in forced postures, with the arms raised or extended, when there are sudden movements resulting from gusts of wind, unevenness in the ground, slippery pavement, falls, etc.

The risk of suffering a back lumbar injury depends on several factors, some associated with the load; others, to the demands of the activity, the work environment and personal characteristics as expressed in the annex to Royal Decree 487/1997 of 14 April, which establishes the Minimum Safety and Health Provisions relating to the manual handling of loads involving risks, in particular back lumbar, for workers and which are detailed below.

## Characteristics of the load

Manual handling of a load may present a risk, particularly lumbar dorsum, in the following cases:

- ➡ When the load is too heavy or too large.
- ➡ When it is bulky or difficult to secure.
- ➡ When it is in unstable equilibrium or its contents run the risk of being displaced.
- ➡ When it is placed in such a way that it must be held or manipulated at a distance from the trunk or with torsion or inclination of the trunk.
- ➡ When the load, due to its external appearance or consistency, may cause injury to the worker, particularly in the event of a blow.

## Physical effort required

Physical exertion may pose a risk, particularly lumbar dorsum, in the following cases:

- ➡ When it is too big.
- ➡ When it can only be done by a torsional movement or by a movement of bending of the trunk.
- ➡ When it may cause a sudden movement of the load.
- ➡ When performed while the body is in an unstable position.
- ➡ When it is a question of lifting or lowering the load with the need to modify the grip.

## Characteristics of the working environment

The characteristics of the working environment may increase the risk, particularly the lumbar dorsum, in the following cases:

- ➔ When the free space, especially vertical, is insufficient for the exercise of the activity in question.
- ➔ When the floor is irregular and, therefore, can give rise to tripping or is slippery for the footwear worn by the worker.
- ➔ When the situation or working environment does not allow the worker to manually handle loads at a safe height and in a correct posture.
- ➔ When the floor or the work surface present different levels that imply the manipulation of the load in different levels.
- ➔ When the floor or support point is unstable.
- ➔ When the temperature, humidity or air circulation are inadequate.
- ➔ When the lighting is not adequate.
- ➔ When there is exposure to vibrations.

## Activity requirements

The activity may involve risk, particularly the lumbar dorsum, when it involves one or more of the following requirements:

- ➔ Physical efforts that are too frequent or prolonged, particularly involving the spinal column.
- ➔ Insufficient period of physiological rest or recovery.
- ➔ Distances too large for lifting, lowering or transport.
- ➔ Rhythm imposed by a process that the worker cannot modulate.

## **Individual risk factors**

They are individual risk factors:

- ➔ Lack of physical fitness to perform the tasks in question.
- ➔ Inadequate clothing, footwear or other personal effects worn by the worker.
- ➔ Insufficient or unsuitable knowledge or training.
- ➔ The previous existence of dorsal lumbar pathology.

## **ABOUT FORCES**

This section groups together all those muscular efforts that are not related to posture or manual handling of loads.

The workplace: poor lighting conditions, heat, cold, humidity, wind gusts, uneven or slippery floors, narrow traffic routes, etc.

Work equipment: tools that are not ergonomic or too heavy, vibrations of the tools, means of protection that hinder movements or postures, etc.

Organisational factors: lack of rest time, poor planning of the work, lack of preventive culture, etc.



## **REPETITIVE TASKS**

Repetitive tasks are those in which the work cycles are less than half a minute or in which the same movements are repeated for more than half of the cycle.

Among the repetitive tasks that occur in trench work are the following:

- ▶ Demolition
- ▶ Manual Excavation
- ▶ Pipe installation
- ▶ Tornillería of screws
- ▶ Loading and unloading of diverse material
- ▶ Displacements by work

Repetitiveness is aggravated by poor grip, by grasping the different elements used with the tweezers, by forced hand or wrist postures (radial or ulnar deviation, hyperflexion or hyperextension), by the use of unsuitable gloves, and by vibrations produced by tools.

## **RISKS ASSOCIATED WITH TRENCH SIZE: LARGE TRENCHES**

### **POSTURE**

Forced postures are adopted mainly in the following tasks:

- ▶ When demolishing the sidewalk and manually excavating the service location tasting.
- ▶ To carry out the welding of the pipe the worker must be placed around the entire circumference including the bottom of the pipe.
- ▶ In the trench shoring process, operators often have to work with their arms over their shoulder.
- ▶ When replacing the sidewalk, workers must kneel or squat to place the tiles and spread the cement around the area of action.

### **CARGO HANDLING**

Loads have to be handled mainly in the following tasks:

- ▶ Laying of the pipe with the help of a truck crane inside the trench.
- ▶ Provision of material (cement bags, tiles, etc.) for the subsequent replacement of the pavement.

### **REPETITIVE WORK AND OVEREXERTION**

Repetitive movements or overexertions are carried out in almost all the operations of manual excavation of tastings, guide machinery, use of machinery (hammer, tyre, compressor...), welding and mainly of the following tasks:

- ▶ Work with the shovel and the spout in manual excavation of tastings.
- ▶ Process along the entire diameter of the pipe.

## **MEDIUM DITCHES**

### **POSTURE**

Forced postures are adopted mainly in the following tasks:

- ▶ When demolishing the sidewalk and manually excavating the service location tasting.
- ▶ The welding work is done with the thermofusion machine which requires the placement of the pipes and the plate in each joint.
- ▶ When replacing the sidewalk, the workers must be placed on their knees or squatting to lay the tiles and spread the cement over the area of action.

### **CARGO HANDLING**

Loads have to be handled mainly in the following tasks:

- ▶ Pipe laying between two or more operators inside the trench
- ▶ Contribution of material (cement bags, tiles, ....) for the subsequent replacement of the pavement.

### **REPETITIVE WORK AND OVEREXERTION**

Repetitive movements or overstrains are carried out in the tasks of manual excavation of tasting and channelling, handling of materials (pipes, parts, valves, sacks...) and welding work by thermofusion, use of machinery (pneumatic hammer, compacting machine...) and mainly in the following tasks:

- ▶ Work with the shovel and the spout in the manual excavation of tasting sessions.
- ▶ Placement of pipe inside the trench
- ▶ Demolition of sidewalk with pneumatic hammer.

## **SMALL DITCHES**

### **POSTURE**

Forced postures are adopted mainly in the following tasks:

- ▶ When demolishing the sidewalk and manually excavating the service location tasting.
- ▶ In the changes or installation of new branches it is required that the operator enters inside the existing box of the building being these of reduced sizes.
- ▶ When replacing the sidewalk, workers must kneel or squat to place the tiles and spread the cement around the area of action.

### **CARGO HANDLING**

Placement of the pieces inside the tasting.

Provision of material (cement bags, tiles, etc.) for the subsequent replacement of the pavement.

### **REPETITIVE WORK AND OVEREXERTION**

Repetitive movements or overstrains are carried out in the tasks of manual excavation of tastings and manipulation of pieces, use of machinery (pneumatic hammer, compacting machine...) and mainly in the following tasks:

- ▶ Placement of screws and small pieces.
- ▶ Works with the shovel and the spout in manual excavation of tasting.
- ▶ Demolition of steel pneumatic hammer with pneumatic hammer.

## **PREVENTATIVE MEASURES**

The following are the preventive measures that must be taken to avoid or minimise the risks of suffering a musculoskeletal injury related to postures, load manipulation, muscular over-exertion and repetitive movements.

## **POSTURE**

Avoid keeping your arms above shoulder height by placing a platform, preferably made of wood, which, when the worker climbs on it, lowers the working plane. This also minimizes neck hyperextensions.

When there is enough room, the legs should be flexed instead of the trunk. This is mainly applicable in medium and large trenches.

Avoid torsion of the trunk. To do this, you must pivot on your feet and turn your whole body; this is achieved through proper training. It is relevant to work in small trenches.

Place the tools on belts to avoid the forced trunk postures to be adopted when taking them from the ground or from surfaces above the head.

If you have to rest your knee on the floor, we recommend the use of knee pads that protect this part of the body from chafing and compression.

Use an excavator/ bobcat or other mechanical digging devices whenever possible. This is especially recommended in small trenches to avoid hyperflexion and overexertion of upper extremities when opening the trench.

## **CARGO HANDLING**

In the first place and as stated in article 2 of Royal Decree 487/1997 of 14 April, which establishes the Minimum Safety and Health Provisions relating to the manual handling of loads involving risks, particularly lumbar back, for workers "the employer must adopt the technical or organizational measures necessary to prevent the manual handling of loads, especially through the use of equipment for their mechanical handling, whether automatically or controlled by the worker". Where this is not possible, any type of mechanical or manual means should be provided to help handle the load with less effort or organizational measures should be taken.

The most effective organizational measures are the introduction of breaks and the alternation of load handling tasks with others that do not involve handling.

As mechanical means there are a variety of manipulators and specific tools for the handling of construction material.

Large manipulators are especially applicable when working in large trenches.

When handling weights greater than 3 kilos, the risks should be evaluated taking into consideration the factors indicated in the Annex to Royal Decree 487/ 1997 and their possible combined effects.

When the loads are very heavy or difficult to grasp (tubes, metal rods, beams, etc.) the task will be carried out between two people.

The weight reduction of the materials must be maximized, especially the bags and the transfer plates.

In order to handle bags, always use a trolley or trolley, move the loads between two people and avoid carrying several bags at once.

Adequate information must be given about the weight of the load, the centre of gravity or the heaviest side when a package is unevenly loaded.

Ensure adequate and accurate information and training on how to handle loads correctly, the risks arising from handling them and the consequences that may result.

## **REPETITIVE WORK AND OVEREXERTION**

The musculoskeletal consequences that a person may suffer from repetitive work can be minimized by rotating tasks.

Likewise, it is necessary to avoid tools that vibrate and those that force unnecessary overexertion.

Use certified anti-vibration gloves (ISO 19819) to cushion and minimize the transmission of vibrations produced by the tools to the upper extremity.

Individuals should be provided with gloves that conform to the anthropometric measurements of their hands.

Use shovels of different lengths, short or long, depending on the type of task; for example, use shorter shovels when digging in small trenches, with limited space. When the reach is larger, use long-handled shovels.

Avoid driving forklifts on very uneven surfaces, sandy, slippery or slippery ground, etc. Try to have plates or similar to smooth the terrain.

If you need to make a cut in any material or carry out some kind of force, make it, approximately, at the height of the hips.

## **GENERAL MEASURES**

To try to ensure that the space in which the worker has to move is sufficiently large in order to avoid the adoption of forced positions or the carrying out of unnecessary over-exertions. This is most relevant in the case of small ditches.

Provide workers with ergonomic tools that facilitate both their use and their grip and make them a good maintenance to prevent them from losing their properties.

Use of special tweezers to place the kerbstone pieces.

Wherever possible, use machinery both for trenching and for providing soil and sand.

Adapt to the maximum the tasks and environment to the capacities of the person.

It is advisable to warm up before the start of the working day by carrying out specific physical exercises. The support and advice of a physiotherapist is very useful.

To provide theoretical, practical and specific training in manual handling of loads as well as in postural hygiene.

Conduct adequate health surveillance and health promotion of workers.





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