OPERATING INSTRUCTIONS

Portable Rock Shear Box

77-1040

ELE International Chartmoor Road, Chartwell Business Park Leighton Buzzard, Bedfordshire, LU7 4WG England phone: +44 (0) 1525 249200 fax: +44 (0) 1525 249249 email: ele@eleint.co.uk http://www.ele.com ELE International, a division of Hach Lange Ltd.	***Distributor:***	**ELE International** Soiltest Product Division PO Box 389, 5600 Lindbergh Drive Loveland, CO 80539 USA phone: +1 (970) 663 9780 fax: +1 (970) 663 9781 email: soiltest@eleusa.com http://www.eleusa.com

Contents

Portable Rock Shear Box

1 General

NOTICE
ELE International is not responsible for any damage due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment. Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Messages meaning:

ATTENTION	This warning refers to all procedures which must be carefully followed to avoid any damage to the machine.
DANGER	This warning refers to all procedures which could present some risks for the operator if not carefully followed.

1.1 Identification

Manufacturer Identification : See the cover page.
Machine Identification **:** See the plate on the machine for complete identification data together with electrical features.

1.2 Applications

This equipment has been developed for the determination of joints and other discontinuities that could be present in rock masses surrounding underground excavations, beneath foundations and within slopes. The equipment also gives information about the shear strength of rocks.

The appliance works on rock samples using simple physical tests, avoiding, where possible, long and sophisticated laboratory studies.

The appliance is fully portable and can therefore be moved easily and hand operated in the field. This avoids the necessity for packing, storage and transport of samples, and hence reduces the possibility of sample disturbance due to drying or handling.

The appliance allows testing of cubic or core samples up to 125 mm (5") by casting them into rapid-setting plaster, concrete or epoxy mortar.

This appliance must only be used for the purpose for which it has been manufactured. Any other use of the machine is not permitted.

ATTENTION	The instructions given in this operating manual are for the correct use of the appliance. To carry out the test in the correct manner, the user must refer to the specific standards in force for the test itself.

1.3 Structure and operation of the machine

The equipment is made up of three basic parts (see Appendix A):

- **The frame (see Appendix B)**: normal load is applied to the specimen using a hydraulic ram **B1** located in the upper housing; it acts against the cross bar **B2** fixed in the lower housing by flexible steel cables. The machine is able to shear the sample, using two lateral hydraulic rams **B3**, located in the lower housing and opposite to each other. The rams work on a pair of yokes **B4** which are attached to opposite ends of the upper housing using flexible steel cables. The shear displacement is measured by a dial gauge indicator **B6.** This is located using a mounting block attached to the lower housing and acts against the screw **B5** in the upper housing **B7.**

- **The hand operated hydraulic pumps (see Appendix C):** two pumps allow the working of the hydraulic rams **B1** and **B3.** The pumps are coupled to the rams via quick fit hydraulic connections **C4.** Both pumps are equipped with load gauges **C1** which are calibrated and have load peak indicators. The lever **C2** allows the working of the pump. Oil can be sent into the hydraulic circuit or returned back into the reservoir of the pump by using the outlet valve **C3.**

- **The moulds for sample casting (see Appendix D):** The equipment is supplied complete with 2 mould assemblies for the specimen preparation. They comprise of a pair of aluminium formers **D1** and two side Perspex plates **D2** held together with fixing screws **D3.** A clamp (see picture 1 of Appendix D) enables the sample to be located and, by the use of adjustable screws **D4,** it can be held in position during the application of mortar. Cast supporting bolts **D5** are located through the sloped surfaces of the mould to secure cast sample during the preparation.

For further information please contact ELE International.

2 Safety Information

2.1 General safety standards

- **The use, lifting, installation, maintenance and scrapping of the machine should be carried out only by qualified staff.**
- The operator of the machine must be carefully instructed in relation to both its operation, to avoid any misuse, and to the safety devices which the machine could eventually be equipped with. The safety devices must always be kept assembled and checked daily.
- ELE International offers training and assumes no liability for any damage due to misuse of the machine by unskilled staff.
- ELE International recommends that the operating manual instructions are carefully followed, together with the procedures and safety standards relating to the safety devices and general rules of the work environment.
- Verify the accordance of the machine to the standards in force in the country where the machine is to be installed.
- The operating manual must be carefully read by the operators and maintenance engineers and should always be kept near the machine for reference.
- Any tampering or modifications to the machine (electric, mechanical, etc.) that have not been approved in writing by ELE International must be considered as not permitted and will therefore not accept liability for any damage caused.

- The removal or tampering of the safety devices will be an infringement to the EEC Safety Standards and ELE International assumes no liability for any damage caused.
- The machine must be installed in areas safe from fire and explosions.
- ELE International recommends that only original spare parts and accessories are used, and assumes no liability if this instruction is not followed.
- Ensure that dangerous situations are avoided during operation of the machine; stop the machine immediately should it not work properly and ask ELE International's service department for advice.

ELE International assumes no liability for any damage to people, material or animals caused by the non-compliance of the above instructions.

2.2 Dangerous parts and residual risks

The dangerous place is the space inside and around the machine where the operator could suffer injury.

During some procedures the operator could face some risks of danger. The risks can be eliminated by carefully following the procedures in this manual and using suitable safety devices.

General information:

- Before starting the machine, ensure that all the components are in good working condition and check there are no defective or damaged parts. If necessary, repair or replace any damaged parts.
- During test execution it may happen that the sample breaks down suddenly (particularly for samples with a very high strength) instead of step by step. This could cause an unexpected displacement of the upper housing **B7** according to the shear direction. **To avoid any problem to the operator, do not touch any moving part of the equipment during the test execution and always wear suitable protective clothing (reinforced gloves and glasses).**
- **Under particular conditions, the lever could quickly turn back. Always stay by the pump sides, out of its reach.**
- Use **only flexible hoses** in perfect condition and with a security standard 4:1 since the elevated pressure could cause breaking. Use only fittings with security springs against deformation with load released**.**

During operation:

- The pumps have a tank without ventilation. When the tank is subjected to an extremely high pressure, it may break down, wounding the operator or damaging the equipment itself. **NEVER TRY TO FILL THE TANK OVER ITS CAPACITY.**
- Do not kink, twist, or sharply bend the hose.
- Avoid big impacts to the hose.
- **NEVER ADD an extension to the working lever. An extension may cause incorrect working of the appliance.**
- Do not expose the appliance to fire, extreme temperatures or weld splatter.
- Avoid corrosive substances coming into contact with the appliance.
- During lifting, take care that the machine is conveniently held and secured and that it cannot slide.
- **Do not carry the appliance by the three rams B1 and B3 or by the cross-bars B2 and B4.**

- Do not subject the rolls to impacts or any kind of stress.
- Do not stand in a direct line with the application of force. Do not approach the machine when a force is applied to the sample.
- **Always wear suitable protective clothing when working with hydraulic equipment.**

RISK OR DANGER	PROTECTION DEVICES
Crushing injury	Reinforced gloves
Projection from machine parts	Glasses
Oil loss from the hydraulic circuit	Glasses, gloves
Fluid ejection at high pressure (ex. discharge valves)	Glasses, gloves, overalls

DANGER	Never wear large clothes, ties, watches, chains, etc. which may become entangled in the moving parts of the machine**.**

DANGER	Never wash the equipment using water sprays**.**

ELE International assumes no liability for any damage to people and material due to a lack of observance of the instructions and the use of the safety devices.

2.3 Noise

The appliance does not emit any noise.

ATTENTION	Even though the appliance does not emit any noise, the operator could face risks related to other factors, for example the environment, the presence of other appliances installed near to the machine, etc.

3 Installation

DANGER	Read Section 2.3 ‘Dangerous parts and residual risks’ before proceeding.

3.1 Lifting

The instructions given in this section must be complied with during the transport of the appliance in the following situations :

- Lifting and storing
- Initial installation
- Further installations
- To avoid damage, the gauges should be removed from the pumps **C1**, the extensometers and the dial gauge indicators. **B6** should also be removed during transportation and put in the special case.
- To avoid losing screws the moulds should be transported fully assembled.

- During transportation, make sure the appliance is sufficiently held at the lifting point and that it cannot slide.
- **Never lift the appliance by the rams B1 and B3 or by the cross-bars B2 and B4.**
- **During pump transportation carry them by the working lever. Never carry the pumps by their flexible hose or you may damage both.**

- Avoid any impact, particularly to the most fragile parts such as the rams **B1** and **B3**, and the gauges **C1.**

ATTENTION	Pay attention to avoid impacts and turnovers.

ATTENTION	Protect the machine from the atmospheric agents. Water and humidity could cause oxidisation, resulting in serious damage.

3.2 Unpacking

After removing the packaging, check that no parts of the machine are damaged. In case of doubt, **DO NOT USE THE MACHINE** and refer to ELE International.

DANGER	The materials used for the package (plastic, polystyrene, screws, nails, wood etc.) must be kept away from children. They must be disposed of in a proper collection centre.

ATTENTION	Before throwing away the packaging, check that any accessories, manuals, documents and spare parts have been removed.

3.3 Installation

- The machine must be placed in an environment suitable for its purpose (in a laboratory protected by the atmospheric agents). The installation must be carried out by a skilled operator.

ALLOWED TEMPERATURE: from -10°C to +80°C
ALLOWED HUMIDITY: from 30% to 95%
MAX. HEIGHT OVER SEA LEVEL: 1000 m

- The machine must be installed with access to each side in order to easily carry out maintenance.
- **Never carry the appliance by the rams B1 and B3 or by the cross-bars B2 and B4.**
- **Never carry hydraulic pumps by their flexible hose.**
- No authorised people and no dangerous objects must be near the machine.
- The hydraulic pumps may only be operated in a vertical or horizontal position and with the end of the hose downwards, otherwise the pump will suck up air and therefore won't reach the required pressure.
- Make sure that the appliance is conveniently supported by a solid and clear surface in order to avoid sliding.
- Avoid any shock to the appliance, particularly to its most fragile parts, such as the rams **B1** and **B3**, and the gauges **C1.**

4 Machine Features

4.1 Dimensions and mass

Length	770 mm
Width	235 mm
Height	615 mm
Mass	46 kg

4.2 Calibration

The machine is controlled and calibrated by ELE International using sampling tools which are periodically certified by a National Standards body. A copy of the Calibration Certificate is delivered with this literature.

The gauges for pressure measurement should normally work without any maintenance, however the calibration of every gauge should be checked periodically. This procedure can be carried out by using a dead weight pressure tester or any similar instrument which could induce a known hydraulic pressure in the gauge. The value obtained by the gauge should then be compared with the one corresponding to the given pressure (to get this result multiply the pressure for the area of the piston cross section).

In case the gauge is out of range, damaged, out of calibration, or doesn't return to zero at pressure release, we recommend its replacement.

WARNING	Laws now in force may require the calibration to be checked after every machine lifting. Once the machine is installed and ready to work, official institutions must check the calibration before this can be used for official tests. Please refer to your relevant national standard.

5 Operator Interface

5.1 Specification (Appendix B – Frame)

Description of parts referred to in Appendix B.

B1	Upper Hydraulic Ram	Allows a nominal load to be applied to the sample using the upper housing of the shear box **B7**.
B2	Upper Cross Bar	Allows the upper ram **B1** to be operated on the specimen by a flexible hose.
B3	Lower Hydraulic Rams	Allows shearing of the specimen in the intended direction.
B4	Lower Bars	Using the flexible steel rope they allow the lateral ram **B3** to act on the specimen.
B5	Mounting Block	Allows the dial gauge indicator to read the shear displacement.
B6	Dial Gauge Indicator	Reads the shear displacement.
B7	Upper Housing of the Shear Box	Allows the upper ram **B1** a homogeneous distribution of the nominal load to the specimen.
B8	Lower Housing of the Shear Box	Allows the specimen location.

5.2 Description of parts for Hydraulic Hand Pumps (Appendix C)

C1	Load Gauge	Allows determination of the load applied to the hydraulic pump. The connection between the gauge and the pumps is made using quick fit connections **C4**.
C2	Operating Lever	Allows pressure to come into the hydraulic system.
C3	Relief Valve	Opens or closes the hydraulic system of the pump.
C4	Quick Fit Connections	Connect the hydraulic pumps to the rams **B1** and **B2**.
C5	Cap of the Oil Tank	Used for topping up or replacement of pump oil.
C6	Pin	Used for the normal maintenance of the hydraulic pumps.
C7	Piston Pin	Used for the normal maintenance of the hydraulic pumps.
C8	Ram Head	Used for the normal maintenance of the hydraulic pumps.

5.3 Description of parts for Specimen Moulds (Appendix D)

D1	Aluminium Formers	Allows the specimen preparation by epoxy mortar, then the specimen can be located in the shear box (**B7** and **B8**).
D2	Perspex Side Plates	Holds together the aluminium formers **D1** during casting.
D3	Fixing Screws	Holds the Perspex side plates **D2** together with the aluminium formers.
D4	Clamp Regulating Screws	Allows the clamp to block the specimen so that it can easily be located inside the aluminium formers **D1**.
D5	Supporting Bolts	Prevents the specimens slipping from the walls of the aluminium formers **D1** during casting.

6 Use

DANGER	Read Section 2.3 ‘Dangerous parts and residual risks’ before proceeding.

6.1 Working position

The operator should stay as far as possible from the frame, taking care to always be by the side of the pump, out of reach of the lever.

6.2 Basic set up procedures

After the installation of the appliance, prepare it for the test execution by following these instructions:

a) Assemble the load gauges **C1** to the two hand pumps using the quick fit connections.
b) The pumps should be located at a safe distance from the frame to avoid any obstacles during the test execution.
c) Connect one of the hydraulic pumps to the upper ram **B1** using the special flexible hose.

6.3 Specimen preparation

The recommended procedure for preparing jointed or intact samples for testing is as follows:

a) If necessary, trim the sample so that it will fit freely into one of the mould assemblies with its intended plane of shear aligned along the interface of the two aluminium formers **D1**. Direct shear tests will often yield different results for different shear directions, therefore it is important **to ensure that the sample is orientated so that it can be sheared in the intended direction when located into the shear box.** Ideally the intended plane of shear should be greater than 2500 mm2 and, if possible, of square or rectangular shape.
b) Determine the contact area of the joint faces to be tested, or the cross-section area of the intended plane to be sheared. It may be useful at this stage to also record the profile of the joint surfaces to be sheared. This can be done using a carpenter's profile gauge or similar device which allows the profile to be recorded and traced onto paper.
c) If a jointed sample is to be tested, wire the two halves of the sample together using copper or annealed steel wires so that the faces of the joint match together.
d) Assemble the lower aluminium former to the two Perspex side plates **D2** using fixing screws, and locate the cast supporting bolts **D5** so that they protrude inwards through the sloped surfaces of the former.
e) Apply a suitable release agent to the inner surface of the assembly (petroleum jelly, i.e. Vaseline, is generally used).
f) Using the sample locating clamp, put the sample into the mould assembly (see Figure 1 of Appendix D).
g) Put the sample locating clamp into the lower mould assembly and ensure that the intended plane of shear is horizontal (see Figure 2, Appendix **D**). Once in position, the clamp will remain on the top of the aluminium former, and the intended plane of shear should be central and symmetrical within the mould.
h) Remove the specimen with the clamp attached and prepare sufficient casting medium to fill the lower half of the mould assembly when the sample is replaced. Crystacal plaster or dental plaster is usually adequate as casting medium, but if the sample is particularly strong, or if high normal and shear loads are anticipated, then cement or epoxy mortar may be used.
i) Pour the wet casting medium into the mould and replace the sample so that its lower half is immersed into the wet mix. Ensure that the casting medium is adequately compacted and that its level reaches the top of the aluminium former, taking care not to contaminate the sample at the intended plane of shear. If necessary, the mould could be vibrated to ensure adequate compaction of the casting medium and removal of entrained air.
j) When the casting medium has set, undo the fixing screws **D3** and remove the Perspex side plates **D2** from the aluminium former and the casting. The cast sample should remain in the former. The bonding material should set sufficiently hard to ensure that the cast supporting bolts **D5** do not break out of the casting when the mould is turned upside down.
k) Remove the sample locating clamp from the sample, since it is useless to leave it longer and becomes difficult to remove it later.
l) Clean the Perspex side plates **D2** and assemble them to the remaining aluminium former using the fixing screws.
m) Apply release agent to the inner surface of this assembly.
n) Prepare sufficient casting medium to fill this half of the mould assembly when the sample is located.

o) Pour this wet mix into the mould assembly, then slide the former with the bonded specimen between the two Perspex side plates and onto the second half of the mould assembly. The fixing screws **D3** may be loosened slightly to allow easy passage of the upper mould and sample between the Perspex side plates **D2**.
p) If necessary, small amounts of wet casting medium can be added or removed so that the mix is at the same level with the top of the lower former. This may be done through the gap between the two formers or through the inspection slots in the Perspex side plates **D2**, using a palette knife. Utmost care should be taken to avoid contamination of the sample at the intended plane of shear. Furthermore, the casting medium should be adequately compacted. If necessary, the mould could be vibrated to ensure a better compaction of the casting medium and removal of entrained air.
q) When the upper former and the sample are correctly seated and aligned with the lower former, use all the eight fixing screws to tighten the mould assembly together to ensure accurate alignment and dimensions required.
r) After the casting medium has set, undo the eight fixing screws and remove the Perspex side plates **D2**. Remove the cast supporting bolts **D5** from the casting and the former and remove the castings and sample from both formers.
s) Allow the casts enough time to cure. This will depend on the casting medium used, but overnight is usually sufficient time.
t) It is recommended that any wires holding the two cast halves of the jointed sample are NOT cut at this stage but are left intact until the sample is installed in the shear box ready for testing.
u) Clean all components of the mould assembly so they are ready for the next sample.

ATTENTION	In order to obtain the most accurate results, ensure maximum care is given during specimen preparation to avoid any risks of contamination on the intended shear surface.

6.4 Specimen positioning

Once the specimens are ready for testing (see Section 6.3 ‘Specimen preparation’), locate them in the lower part **B8** of the appliance, and then put the upper housing **B7** over the specimen. Ensure that the two housings are perfectly aligned and that the intended shear direction is the same as the side rolls (see Figure 3, Appendix D).

6.5 Preparation of appliance for testing

Follow these instructions to prepare the appliance correctly for test execution:

a) Locate the specimens as described above.
b) Move the upper yoke **B2** over the upper hydraulic ram **B1.**
c) Close the pump valve **C3** turning it counter clockwise (as shown in Figure 3, Appendix C) and operate the hand pump using lever **C2** to expand the ram **B1** just sufficiently to hold the shear box housings (steel rope and yoke) in position without applying any significant or excessive normal load to the sample. **See notes at the end of the paragraph.**
d) Connect the remaining hand pump to one of the lateral hydraulic rams **B3** using the flexible hose and quick fit connector, bearing in mind the orientation of the sample in the shear box and the intended direction of shear.
e) Locate the corresponding yoke into this lateral ram **B3** previously connected to the pump.

f) Close the pump valve **C3** turning it clockwise (as shown in Figure 2, Appendix C) and operate the hand pump using lever **C2** to expand the ram **B1** sufficiently to hold the shear box housings (steel rope and yoke) in position, without applying any significant shear load to the sample. **See notes at the end of the paragraph**
g) Locate the shear-displacement dial gauge indicator **B6** into position bearing in mind the intended direction of shear and ensuring that the indicator will operate as necessary when shearing commences.
h) If not already done, use a pair of electrician's side cutters, tip snips or similar tool to cut any wires holding the jointed sample.

The appliance is now ready to be used on the specimens.

ATTENTION	Close the pump valve only by hand. The use of tools may cause damage to the pump valve and consequently to the pump itself.

6.6 Testing

Before using this machine, check it is in perfect working condition by visually examining every part of the appliance. **If you find any defective or suspect equipment, repair or replace it immediately**.

In case of problems during this test cycle refer to Section 8 Diagnosis.

If the instructions given in this manual are unable to solve the problem, please contact ELE's Service Department.

6.7 Operation

DANGER	Carefully read and understand all the instructions given in this manual prior to operation.

The machine can be used in many different ways depending on the kind of test you want to perform.

Outlined below is a standard procedure which allows an operator with limited experience to carry out a test. An experienced operator will be able to optimise the machine's performance depending upon the requirements of the customer.

a) Prepare and locate a specimen as described in Section 6.3 'Specimen preparation' and Section 6.4 'Specimen positioning'.
b) Prepare the appliance as described in Section 6.5 Preparation of appliance for testing.
c) In order to create the same environmental conditions of the site the specimen has been taken from, apply an adequate load to the specimen by the ram **B1**.

ATTENTION	The load applied to the specimen is not a fixed load; it changes depending on the material to be tested, the type of test required, and the characteristics and environmental conditions of the site the specimen has been taken from. The operator will decide the right load for the test.

d) Apply a normal shear load to the sample using the hand pump previously connected to one of the lateral rams **B3**. Check the dial gauge indicator to ensure sufficient accuracy of displacement during the shear**.** Slightly correct the normal shear load to maintain the original value.

e) Record the normal shear load and the maximum peak reached by the shear strength.
f) Continue shearing until this value has been overcome. In this way you are able to achieve an average value of the residual strength. If necessary, change shear direction. Record also the shear displacement corresponding to the residual shear strength. The required displacement for residual strength determination depends on the rock characteristics. A displacement of 10 mm is generally sufficient. In order to preserve near axial symmetry of normal loading, the joint should not be sheared more than approximately 10 mm from its initial position.
g) Repeat the procedure with a series of normal loads, recording the peak values and the residual strength ones (we recommend starting with the greatest normal load and then decrease).
h) Using the measured area of the sample as well as the recorded shear loads, estimate the maximum stress values in order to draw the graph showing the maximum stress applied and the residual shear strength under a normal load.

ATTENTION	If cohesion values are to be determined, the ram friction and the mass of the upper housing should be taken into account to reduce the risk of mistakes.

6.8 End of the working cycle

At the end of the working cycle, and every time the use of the appliance is interrupted, ensure you bleed the hydraulic system by turning the valve **C3** on the pump counter clockwise (in the opposite direction to that shown in Figure 3, Appendix **C**).

If the hydraulic pumps have to be disconnected from the frame, we recommend the use of the special metal dust caps for flexible hoses and quick fit connections.

7 Maintenance

WARNING	See Section 2.3 ‘Dangerous parts and residual risks’ before proceeding.

WARNING	Only original spare parts can be used. ELE International will assume no liability if non-original spare parts are used.

7.1 Routine maintenance

In order to maintain the efficiency of the machine, periodically clean and oil all non-painted parts.

Avoid the use of solvents, which will damage the painted parts and those made from synthetic materials.

The appliance should work without need of regular maintenance. The only exception is a periodic topping up with hydraulic fluid. This operation is carried out through the feeding opening **C5** located in the pump body. For further information see Sections 7.2 Periodic inspections and 7.3 Periodic operation.

7.2 Periodic inspection

OPERATION	**OIL LEVEL IN THE HYDRAULIC HAND PUMPS**
PROCEDURE	Check that the oil level in the pumps is always optimal. If necessary, add oil (see Section 7.3 'Periodic operation').
PRECAUTION	Use only Enerpac hydraulic fluid.
FREQUENCY	**MONTHLY**

ATTENTION	All high-pressure hydraulic equipment should be thoroughly examined and proof-tested by an expert engineer at least once a year - more frequently for heavy use.

7.3 Periodic operation

OPERATION	**CLEANING OF DIAL GAUGE**
PROCEDURE	The dial gauge indicator must be kept clean and dry. Periodic inspection is recommended to ensure the dial gauge indicator is working properly and gives correct readings.
FREQUENCY	**DAILY**

OPERATION	**CLEANING OF THE OIL SYSTEM**
PROCEDURE	Make every effort to avoid dirt and dust entering the pump, as this could result in failure of the pump, ram or valve. When the pump is not connected we recommend the use of special metal dust caps.
FREQUENCY	**DAILY**

OPERATION	**OIL ADDITION**
PROCEDURE	Remove the oil tank stopper **C5**. Fill the tank only until you reach the level on the pump. If necessary, re-check the oil level after removing air (see **AIR REMOVAL** below). Replace the oil tank stopper **C5**. Non-vented hand pumps require air in the reservoir to function properly. If the reservoir is completely full, a vacuum will form preventing oil from flowing out of the pump.
PRECAUTIONS	The pumps do not use a ventilated tank. Consequently, the tank could break if subject to high pressure and could cause damage to people or things. **Never try to fill the tank over its capacity. To avoid this possibility, add oil only with the piston completely down.**
FREQUENCY	**MONTHLY**

OPERATION	**AIR REMOVAL**
PROCEDURE	a) Position pump at a higher elevation than the cylinder. b) Position the cylinder with the plunger end down (up if using pull cylinder). c) Operate the pump to fully extend the cylinder (retract if using pull cylinder). d) Open release valve **C3** to retract cylinder (extend if a pull cylinder). This will force the trapped air to move up to the pump reservoir. e) Repeat the above steps as necessary. f) Add oil if necessary. g) Return vent/fill cap to operating position.
FREQUENCY	**MONTHLY**

OPERATION	**OIL REPLACEMENT**
PROCEDURE	Undo the cap of tank **C5**. Bend the pump to drain all the old oil. Fill the tank only to the level on the dipstick. Close the tank using cap **C5.** Replace all the oil using Enerpac. A more frequent replacement is needed for dirty working conditions.
PRECAUTIONS	Discharge the old oil according to the laws in force.
FREQUNCY	**1 YEAR**

OPERATION	**PUMP**
PROCEDURE	To increase pump life and ensure optimal performance, regularly oil pin **C6,** the piston pin **C7** and the ram head **C8,** using grease for roller bearings (see Figure 3, Appendix **C).**
FREQUNCY	**MONTHLY**

7.4 Calibration

We recommend carrying out periodic calibration control of all gauges by local accredited bodies.

If one of the gauges is out of range, damaged or does not reset (return to zero) as the pressure is released, or if it is out of calibration, replace it immediately. Spare gauges are available from ELE International.

7.5 Special maintenance

For any special maintenance operation (repairs, replacements or any other operation not described in this manual), please contact ELE International.

8 Diagnosis

Below are some common problems that may occur during use of the machine.

WARNING	All maintenance, checking, control and repairing operations of each part of the machine must be carried out by skilled operators.

PROBLEM	POSSIBLE CAUSE	CURE
One of the rams stay still or moves step by step	Wear or tear of the ram or pump gasket.	Replace the gasket.
	Low oil level in the pumps.	Add oil as described in Section 7.3 'Periodic operations'.
	Relief valve **C3** is open.	Close the valve.
	Connection to the hydraulic system of the pumps is loose.	Ensure all connections are completely tightened.
	Excessive load.	Never try to apply a load bigger than the maximum nominal load.
	Presence of dirt between cylinder and ram.	Contact ELE Service Department.
	Piston seizure.	Verify possible damage to the ram/cylinder. Contact ELE Service Department.
One of the rams moves but is unable to keep pressure.	Leak in one of the hydraulic connections to the pumps.	Ensure all connections are completely tightened and there are no leaks.
	Cylinder gaskets do not work properly.	Find the leakage and contact ELE Service Department for repair.
	Internal leak in the pump.	Contact ELE Service Department.
One of the rams doesn't return, return slowly or more slowly than it normally does.	Relief valve **C3** is closed.	Open the valve.
	Too much oil in the pump tanks.	Drain the excess oil to the marked level. See Section 7.3 'Periodic operation - Oil Addition'.
	Connection to the hydraulic system of the pumps is loose.	Verify that all the connections are tightened.
	Internal diameter of the flexible hose is too small.	Replace it with a larger diameter flexible hose.
	Presence of dirt between cylinder and ram.	Contact ELE Service Department.

ATTENTION	Contact ELE Service Department for any other problem not listed above or if the problem persists following the operator's intervention.

9 Disposal

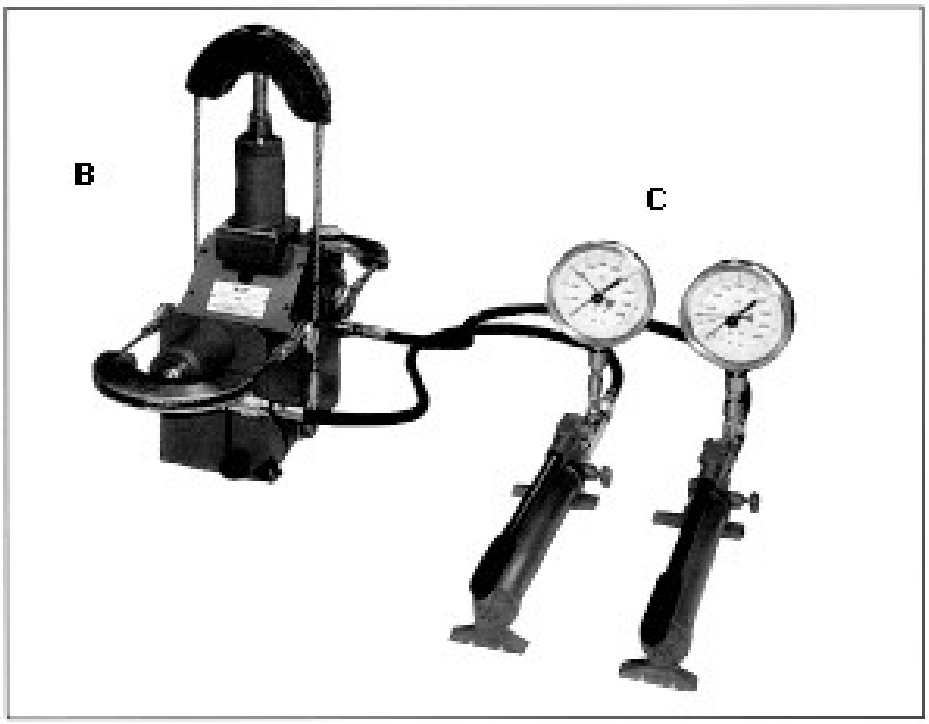
9.1 Non-use of machine

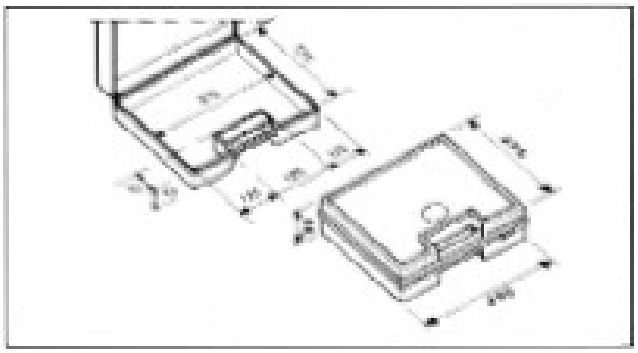
If the machine is not to be used for a long time, the electrical supply must be disconnected.
Execute all the maintenance operations.
Oil the parts that are not coated and cover the machine to prevent accumulation of dust.

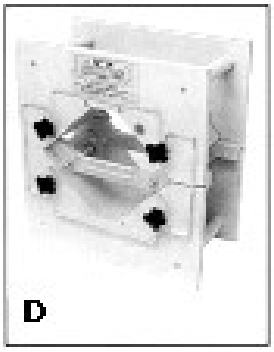
9.2 Disposal

This equipment contains oil which must be disposed of responsibly in accordance with local environmental standards.

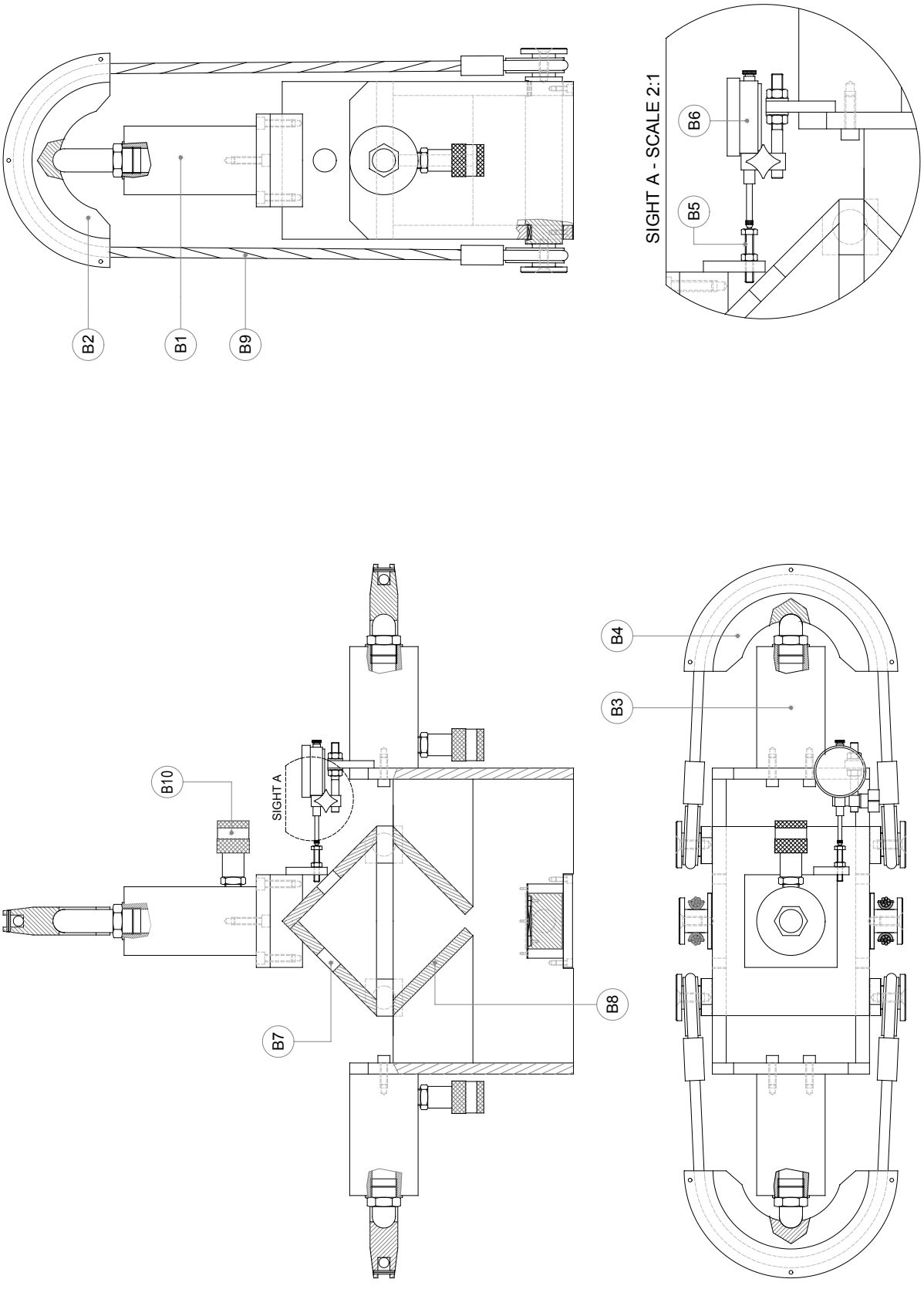
APPENDIX A : General View







APPENDIX B : Appliance



APPENDIX C : Hydraulic Hand Pumps

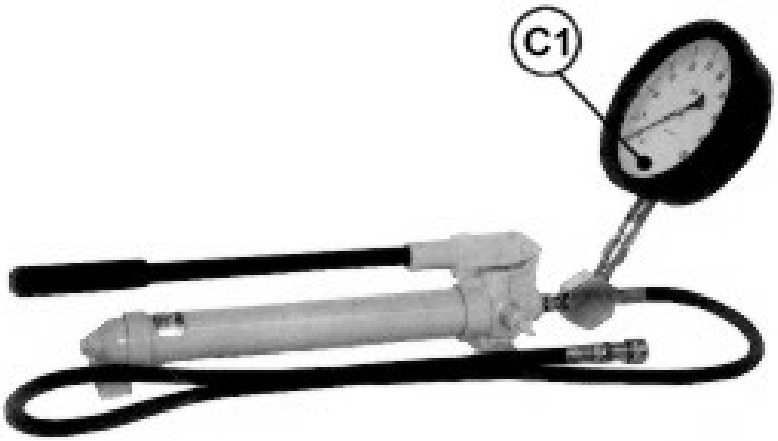


Figure 1

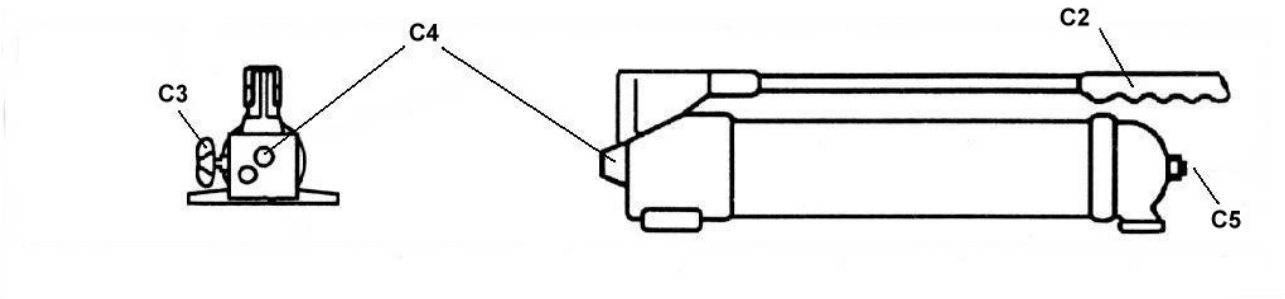
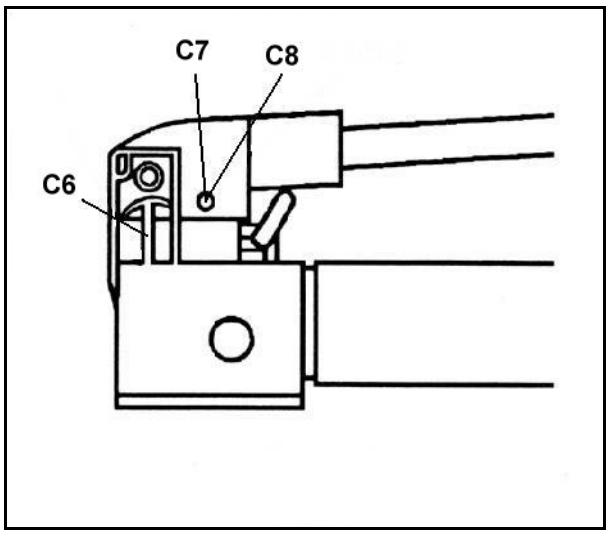
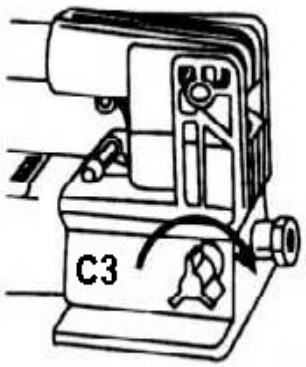


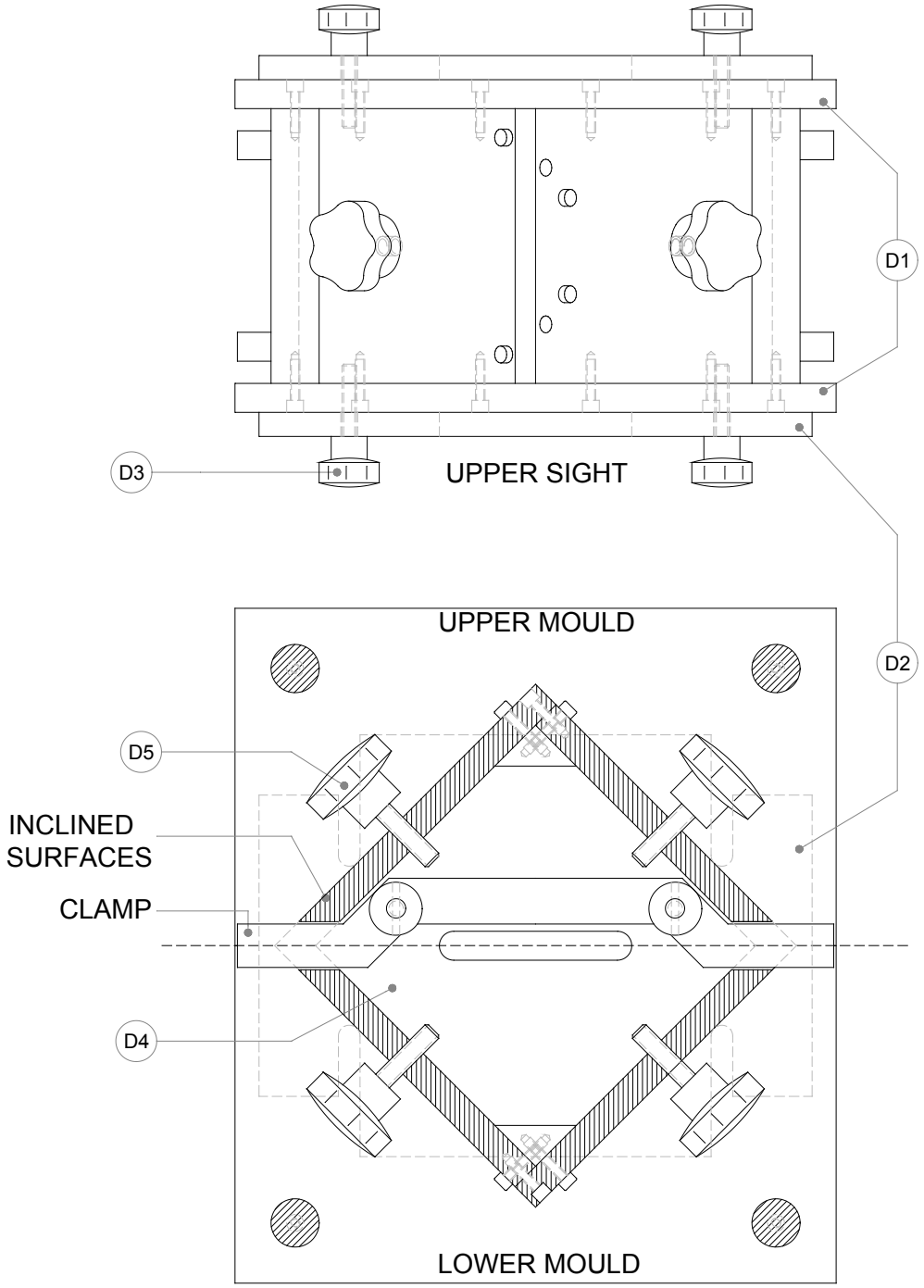
Figure 2

Figure 3





APPENDIX D : Specimen Moulds



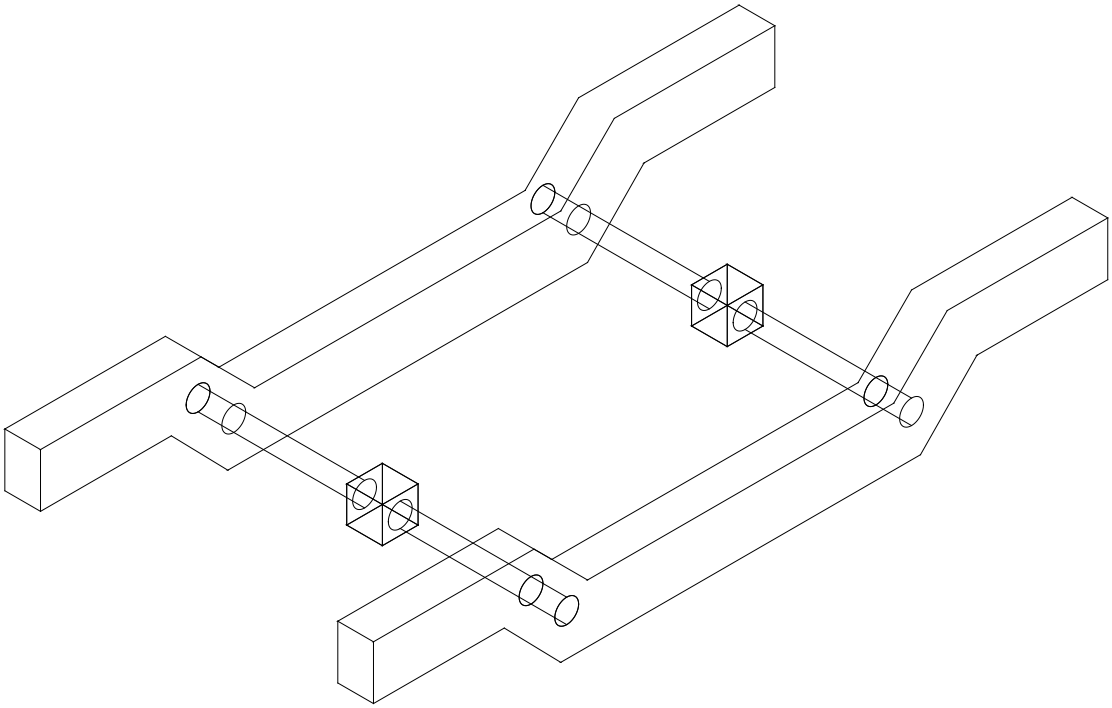


Figure 4 : Clamp for Specimen

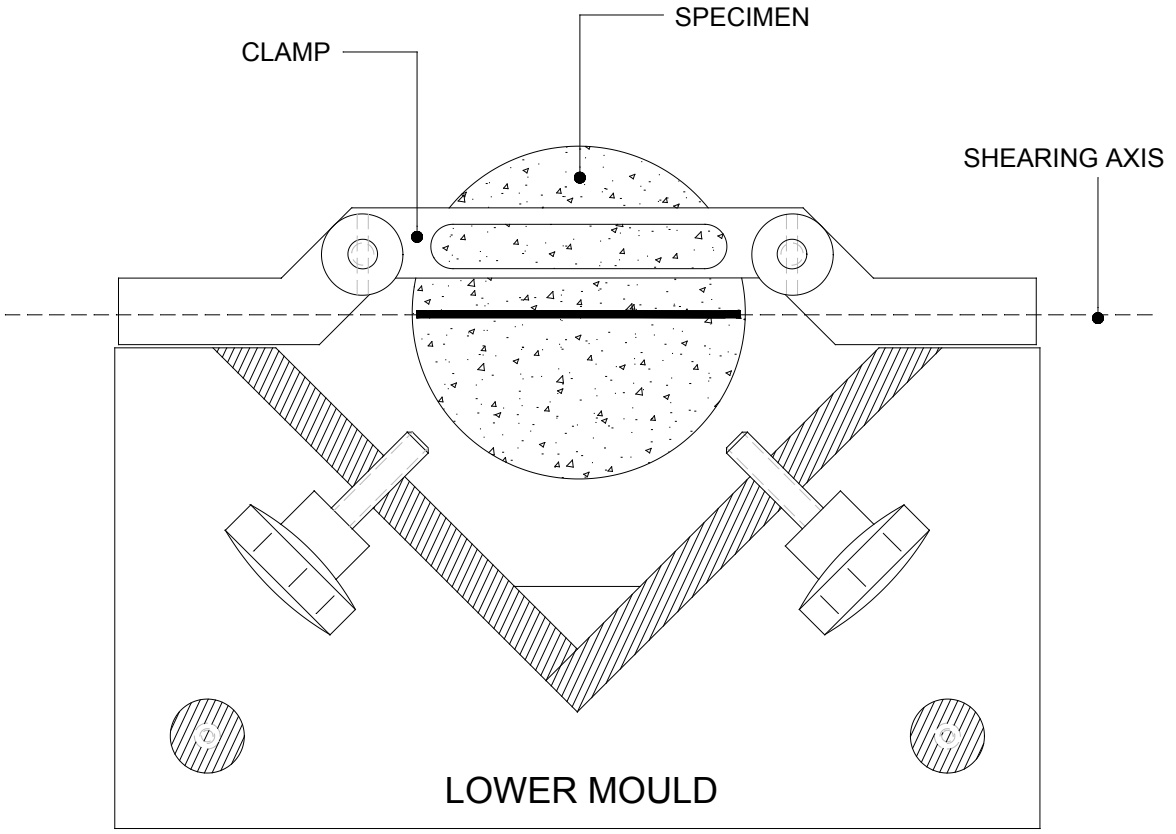


Figure 2 : Preparation of the Specimen

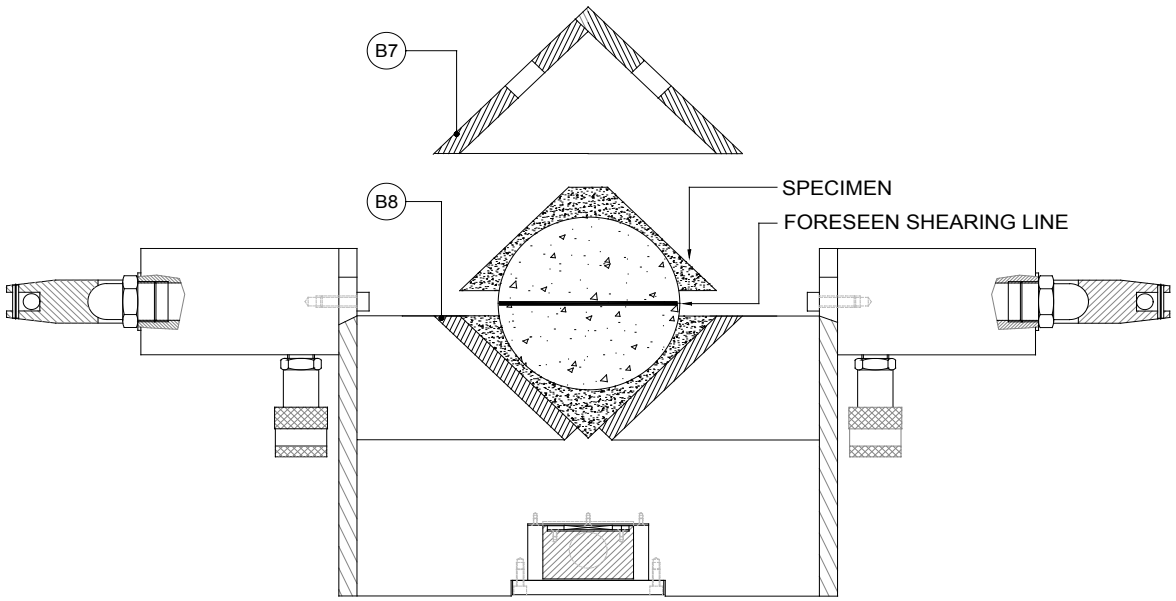


Figure 3 : Positioning of the Specimen