



Hand auger set for heterogeneous soils

Manual



0111SO



0111SZ

Meet the difference

Contents

On these operating instructions.....	3
Introduction.....	3
1. Description.....	3
1.1 Edelman auger.....	3
1.2 Riverside auger.....	4
1.3 Auger for stony soil	4
1.4 Spiral auger	4
1.5 Piston sampler.....	5
1.6 Gouge auger	5
1.7 Accessories	5
2. Technical specifications.....	6
3. Safety	6
4. Preparing for use	7
5. Use of the augers.....	8
5.1 General	8
5.2 Edelman auger.....	9
5.3 Riverside auger and stony soil auger	9
5.4 Spiral auger	10
5.5 Piston sampler.....	10
5.6 Gouge auger	11
5.7 Accessories	11
6. Applications	11
7. Problems and solutions.....	12
8. Maintenance	13
Appendix: Rust on augers and gouges.....	14

On these operating instructions



If the text follows a mark (as shown on the left), this means that an important instruction follows.



If the text follows a mark (as shown on the left), this means that an important warning follows relating to danger to the user or damage to the apparatus. The user is always responsible for its own personal protection.

Text

Italic indicated text indicates that the text concerned appears in writing on the display (or must be typed).

Introduction

The hand auger set for heterogeneous soils consists of a number of types of augers held in a transport case. An auger consists of a bottom part with auger body to which a handle and optional extension rods can be attached. This manual is written for the set with bayonet connection, but it also applies for the set with conical screwthread connection. Contrary to the single type auger this set is suitable for almost any type of soil. It is lightweight and easy to manipulate by a single person.

The hand auger set for heterogeneous soils is suitable for manual augering and sampling in a wide variety of soil types for the purpose of general soil research (profiles, geology and mineralogy) and sampling in environmental research. Depending on the water table, structure and type of soil, augering can be done up to a depth of 5 m. Augers are available for any type of soil above or below the water table, and may be selected to adjust to the situation at hand. It is possible to switch augers in the process (see 5. The use of augers).

1. Description

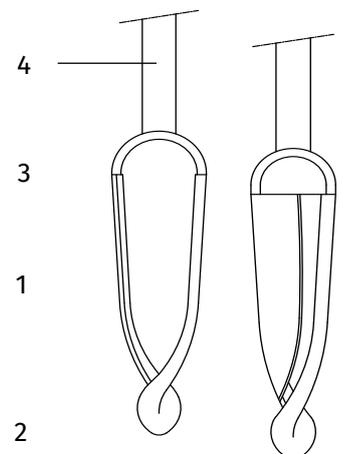
1.1 Edelman auger

The main drilling section of the Edelman auger is conical in shape and consists of two blades (1) that run into a point at the lower end (2) and at the top end are joined with the use of a bracket (3) to the lower piece (4) (see figure on page 3). The two blades sit alongside each other in the auger point and can be likened to two spoons. During the drilling process the auger point twists into the ground and draws the soil from the bottom of the auger hole into the body of the auger. The auger blades perform the job of scooping up and holding together the soil sample in the auger body in a way that also allows it to be emptied with ease.

Nearly all Edelman augers in the set have the same diameter (measured diagonally between the blades at the widest point of the main auger section). The various types of Edelman auger differ from each other in blade width and the way the auger point is shaped. There are four different types:

- clay type
- combination type
- sand type
- coarse sand type

Edelman auger, clay type. As wet clay soils are generally strongly cohesive, the blades of this type of auger do not need to be very large. On account of the narrow blades this auger encounters little resistance from the soil. This means that drilling can be carried out with a minimum of force and effort while the resultant sample is hardly disturbed. Wider blades would cause additional friction and the soil would be difficult to empty out.



Edelman auger combination type (left) and coarse sand type (right).

Edelman auger, combination type. The blades of the combination type Edelman auger are slightly wider and more rounded than those of the clay type. This allows soils with poor cohesion to be held together quite well while the cohesive soils can be emptied out quite easily. The auger point is longer than that of the clay type which means the auger rotates more easily in harder soil.

Edelman auger, sand type. This type of Edelman auger is suitable for soils with poor cohesion such as sandy soil. The longer, twisted auger point ensures that the auger cuts into the soil readily. The blades of the sand type are wider than those of the combination type, giving the auger a wider surface area for holding on to the soil.

Edelman auger, coarse sand type. This type of Edelman auger was developed from the sand type but has wider blades. This has produced an auger that is much more closed in (see figure) and can hold in soils with little or no cohesion such as soils containing very coarse or dry sand.

1.2 Riverside auger

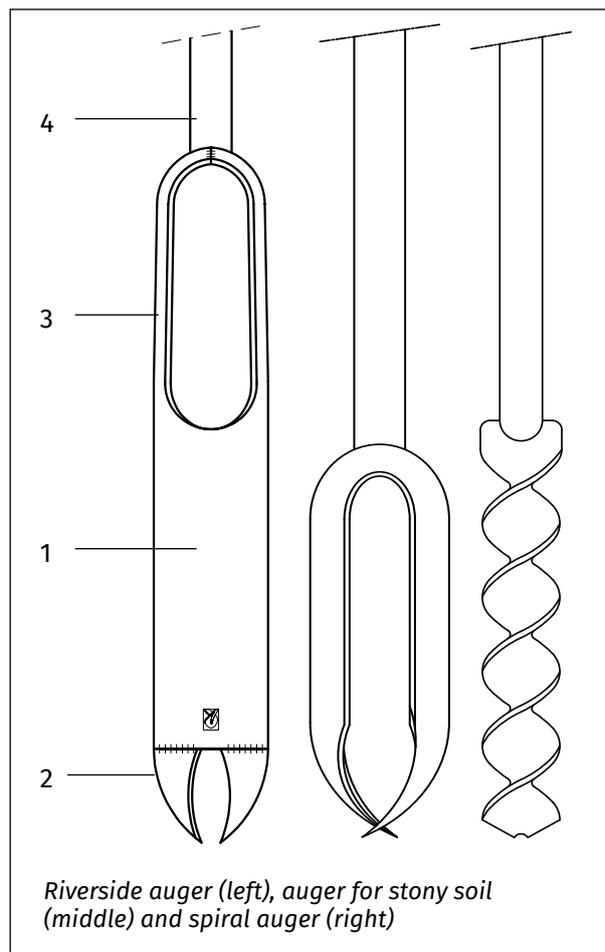
Where soils are very hard or dry the concentric auger point of the Edelman auger can no longer turn in the soil and the Riverside auger needs to be used (see figure). The body of the auger consists of an open tube (1) with two spoon-shaped auger blades at the bottom end (2). A bracket (3) fastens the open tube to the lower piece (4). The points of the auger blades which go down at an angle loosen the soil by scraping it and pushing it evenly into the tube. The auger blades project out a little beyond the tube which means that the auger encounters a minimum of resistance from the soil.

1.3 Auger for stony soil

The auger for stony soil is heavier and more robust than the other auger types. The auger has slightly protruding angled points that curve in towards each other (see figure). They form a more or less enclosed auger body but don't actually come in contact with each other. This creates a certain flexibility. The points cut downwards during the augering process. Stones that are encountered are wedged in between the auger blades, while the slightly finer soil (coarse sand with fine gravel) also stays in the auger.

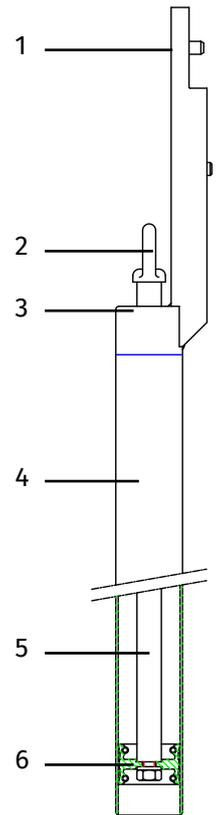
1.4 Spiral auger

The spiral auger (diam. 4 cm) (see figure) is the alternative option when other augers in the case of extremely hard, resistant soils are no longer able to penetrate the soil. This narrow spiral auger pushes the stones aside during augering while its specially shaped point digs a hole. Because of its straight design there is a great deal of resistance from friction while pulling out the auger.



1.5 Piston sampler

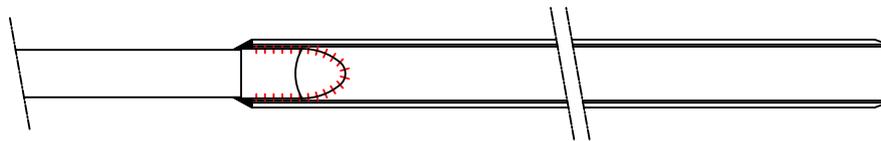
The piston sampler (see figure) is constructed from a thin-walled, 4 cm diameter, stainless steel tube (4). The bottom end is open, whereas the top has a lid (3) through which a stainless steel piston rod (5) can be moved, and outflow openings. The bottom end of the piston rod holds a piston (6), and to its top-end a wire eye (2) is attached. The top-end of the tube is equipped with a bayonet connection (1) welded on its outside to permit free passage of the piston rod. Due to the eccentricity of the sampler one has to reckon with a maximum of 6 cm when working with auger holes. The maximum length of the sample is 75 cm.



Piston sampler

1.6 Gouge auger

The auger body of the gouge auger is almost completely semi-cylindrical and has cutting edges that are equidistant running from the top to the bottom. The top part of the auger body is attached to the lower piece. It has a smaller diameter than the above augers. The maximum length of the sample is 50 cm.

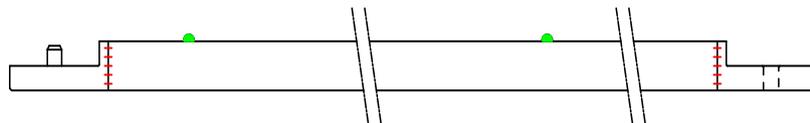


Gouge auger body

1.7 Accessories

Extension rods and coupling sleeves.

The extension rods are 1 m in length. Since the top piece, extension rods and lower pieces are fitted with bayonet couplings, the auger can be any desired length. Coupling sleeves are cylindrical sleeves that lock the coupling in place.

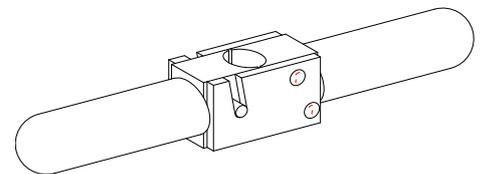


Extension rod (left) and coupling sleeve (right)



The Push/Pull Handle.

The push/pull handle has two parts that can be fitted around a rod. Once pressure is exercised on the two bars of the handle its construction ensures a firm hold on the rod.



Utility probe.

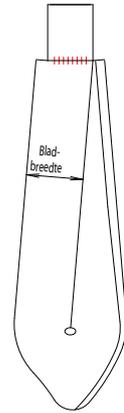
The fiberglass utility probe is 105 cm in length and ends in a cone with a diameter of 19 mm. The probe is well insulated and can therefore be safely used to test the augering spot for cables and various types of underground pipes.

2. Technical specifications

The most important dimensions of the various types of augers are set out in the table below. The diameters are measured across the widest point between the auger blades!

The auger bodies are manufactured from iron-manganese steel (not stainless steel, but non-toxic). As is appropriate for environmental research, all the auger bodies are unvarnished.

Auger type	Diameter (mm)	Blade width (mm)
Edelman auger clay type	70	30
Edelman auger combination type	70	35
Edelman auger sand type	70	40
Edelman auger coarse sand type	70	75
Riverside auger	70	-
Auger for stony soil	70	-
Spiral auger	40	-
Gouge auger	30	-
Piston sampler	Tube 40 Total ca 60	-



3. Safety



Before commencing with the drilling ascertain whether there are (power) cables or pipes running through the ground (make inquiries). Use the probe to carry out a safe inspection of the augering location. If cables or pipes are present, choose another location.



Always hold on to the auger by its synthetic handgrip during the drilling process. This ensures insulation if a power cable should be encountered with the auger.



Take hold of a coupling sleeve by its middle. This prevents the skin from catching under a coupling sleeve while components are being added or removed from the auger.



If an auger is longer than 4 m, divide it up into smaller sections. This prevents damage to the auger rods and reduces the risk of injury if an auger were to fall over. This applies when the auger is being lowered as well as when it is being pulled up.



Do not bang on the auger or force it. Banging can lead to serious damage such as tears in the steel or broken couplings.



Wear strong protective gloves when emptying the gouge auger with the spatula. This prevents cuts to the fingers.



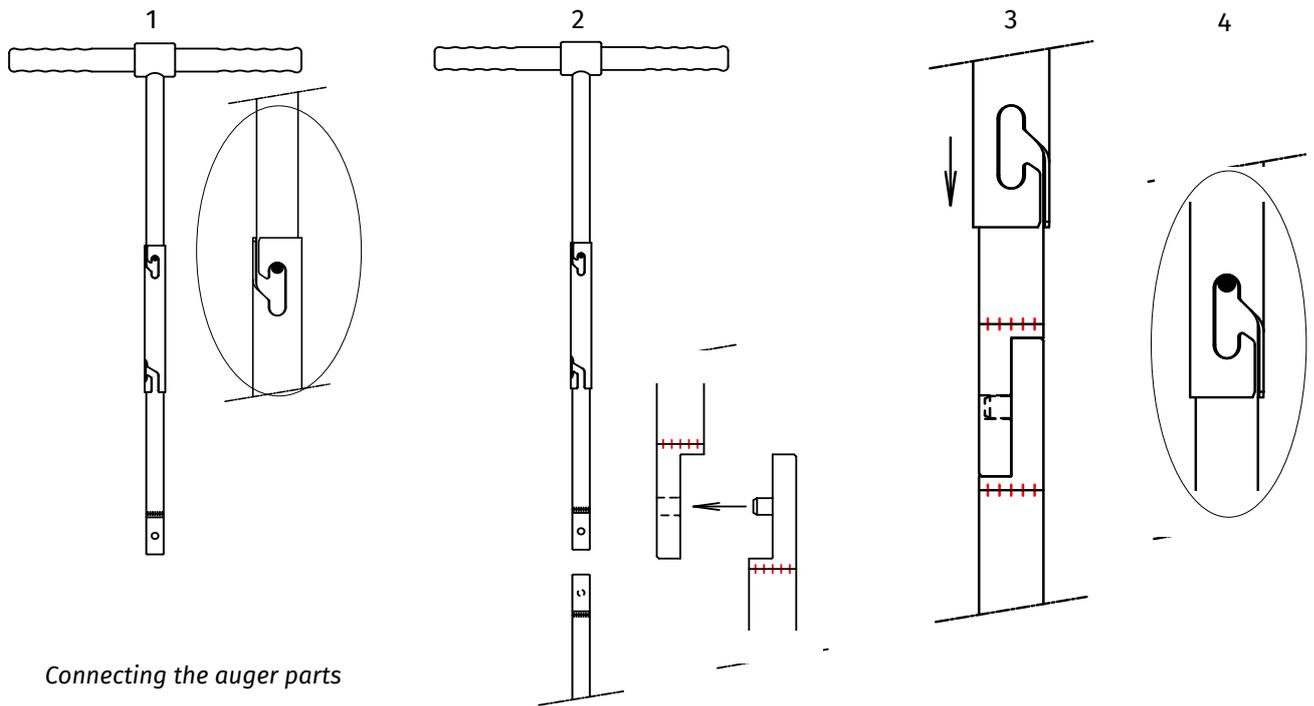
After drilling make sure that the auger hole is properly filled up again with drilled material or with special bentonite plugs. This ensures that persons or animals will not step into the auger hole and be injured.



Take special care during thunder. The possibility of being hit by lightning in the open field is much greater, especially when holding a metal auger.

4. Preparing for use

1. When using the auger for the first time, loosen the coupling sleeves from the extension rods and the upper part.
2. Screw the synthetic handle into the upper part.
3. Select the appropriate auger (see 6. Application). The Edelman combination type auger often proves to be the best choice.
4. Connect the auger parts (see figure).
 - 4.1 Hold the coupling sleeve in the middle and slide it onto the upper part until it clicks on the nipple (step 1). The sleeve is locked when it cannot be rotated.



- 4.2 Join the upper and bottom part (step 2).
- 4.3 To lock the connection, unscrew the sleeve from the upper part, and slide it across the connection (step 3) and click it onto the nipple (step 4). Check the lock. Notice it will have a slight play.



Hold the coupling sleeve in the middle, this will prevent you from catching the skin of your hands between the parts while (dis)connecting them.

When using a set with conical screw thread connections the extension rods are screwed together. Use the two open ended spanners for a hand tight connection.



Clean screw threads ensure easy tightening and loosening.

5. Use of the augers

5.1 General

Each type of auger has its specific application. However, the instructions below apply to all augers.



Prior to augering use the utility probe to check for cables, tubes and pipes. If necessary, select another spot to auger.



While augering hold the auger by its synthetic handle. It is fully insulated should you hit an electricity cable.

- The auger should always be rotated in a clockwise direction.
- Augering is done in a vertical position.
- Over 1,20 m extension rods should be used:
 1. Place the auger flat on the ground near the borehole.
 2. Slide the sleeve off the bottom part, and lock it onto the upper part.
 3. Detach the upper and bottom part.
 4. Select an extension rod and a sleeve. Lock the sleeve over the bayonet at the bottom end of the extension rod (the open end).
 5. Attach the upper and bottom part to the extension rod



Always check the coupling sleeves. Well-attached sleeves will prevent jamming or loss of parts when augering.

- An auger over 4 m should be inserted and hoisted in parts:
 1. Insert the auger in the borehole and place the bottom part on end for approximately 50 cm. Grip the auger firmly!
 2. To attach: connect the two parts, and slide the sleeve of the upper part across the connection and lock it onto the bottom part.To detach: slide the sleeve upward and lock it onto the upper part. Unclamp the upper and bottom part.



Augers over 4 m should be handled in parts. This will prevent damage to the rods and reduce the risk of being hit by augers tipping over. This applies to inserting and hoisting the auger.

- The auger's depth is indicated by marks. Small nipples on the bottom part indicate 50 cm from the bottom end of the auger. The piston sampler has no marking and the gouge auger has a small nipple at 75 cm. The upper part has a larger nipple indicating a depth of 1 m, except for the piston sampler and gouge auger, however, where it indicates a depth of 1.35 and 1.25 m respectively. Additional meters depend on the number of extension rods.
- To obtain an undisturbed sample rotate the auger clockwise without pushing, this will cause the sample to detach from the soil.
- To withdraw the auger after sampling, pull it upward while turning it (not when using the Riverside auger or the auger for stony soils). Keep your back straight and your knees bent to prevent injuries. Wear gloves for a full grip on the rods.
- Place the samples in a logical order of augering to allow examination.
- Should you encounter various types of soils, switch to other types of augers (see 6. Application).



Do not force, or pound on, the auger. This may cause serious damage, such as cracks or snapped joints.



After augering fill up the borehole with soil or special bentonite plugs. This will prevent humans or animals to trip into the hole and incur injuries, and restores impermeable soil layers.



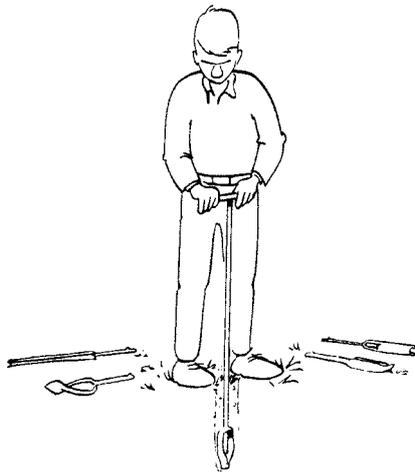
Be cautious during a thunderstorm. Lightning strokes often occur in the open field, in particular when one holds metal objects.

- ❑ Clean the parts of the auger by rinsing them after use. This will prevent jamming of the sleeves or the piston sampler to leak (see 8. Maintenance).

5.2 Edelman auger

Hold the auger by the handles and place it on the soil (see figure). Applying light pressure turn the auger to the right into the soil. After about $2\frac{1}{4}$ complete rotations (of 360°) the auger will have penetrated the soil by 10 cm (rotations can be counted with the aid of the halt knob). The auger will be filled with lightly stirred-up soil right up to the bracket. Depending on the type of soil, fewer or more turns may be required to reach the desired result.

Turn the full auger off and pull it up with gentle twists. Place the auger on an angle on the surface of the ground (see figure) for emptying out cohesive soil. Lightly press and turn the auger by 180° on the ground. The material is loosened and can be emptied out of the auger using your hands or by giving it a light tap on the ground. Material that is not very cohesive comes out virtually unaided. The samples can now be examined.



Augering (left), emptying (middle) and studying (right)



Avoid:

- ❑ Overfilling the auger. This causes excess material being spread against the wall of the augered hole, causing it to become narrower and making subsequent drilling more difficult. It also makes emptying out the soil very difficult. Where the drilling extends to below groundwater level, an overfilled auger can encounter strong suction which makes pulling out the auger more difficult and can also lead to the loss of the sample.
- ❑ Loss of sample material. Pull the full auger up with gentle turns and therefore not upright.

5.3 Riverside auger and stony soil auger

Turn the auger into the ground with some pressure. The material is stirred up regularly and forced into the auger. The soil stays in the auger because it becomes slightly compacted. Pull the full auger up in an upright position (without turning therefore!). Tap the auger lightly on the ground which will cause the soil to drop out. If the soil is cohesive the Riverside auger is difficult to empty and it is therefore better to use another type of auger (Edelman auger).

5.4 Spiral auger

Turn the auger into the ground with some pressure. The auger body will push any stones it encounters out of the way. Use gentle twists to pull up the auger. Because of the shape of this auger it can encounter considerable resistance in certain types of soil. The discharged material is strongly stirred. The spiral auger is often used for drilling through a hard layer or for pre-drilling a small hole before drilling with another type of auger.

5.5 Piston sampler

1. Attach a polyester cord to the piston sampler's wire eye and let the (extended) auger down to the bottom of the augered hole. The piston rod should remain in the lowest position. By shaking the piston rod it will fall to its lowest position.
2. Pull the cord attached to the wire eye of the piston rod and an underpressure will be created below the piston.
3. Push the tube steadily down (see figure) while keeping the cord (and the piston) stationary, i.e. at a constant distance to the sample material.



Pressing down the tube may cause resistance. Small pulling movements of the cord will cause an increase of the underpressure, thus reducing resistance and disturbance of the sample.

4. When the tube has been filled, push once more and pull it out of the auger hole.

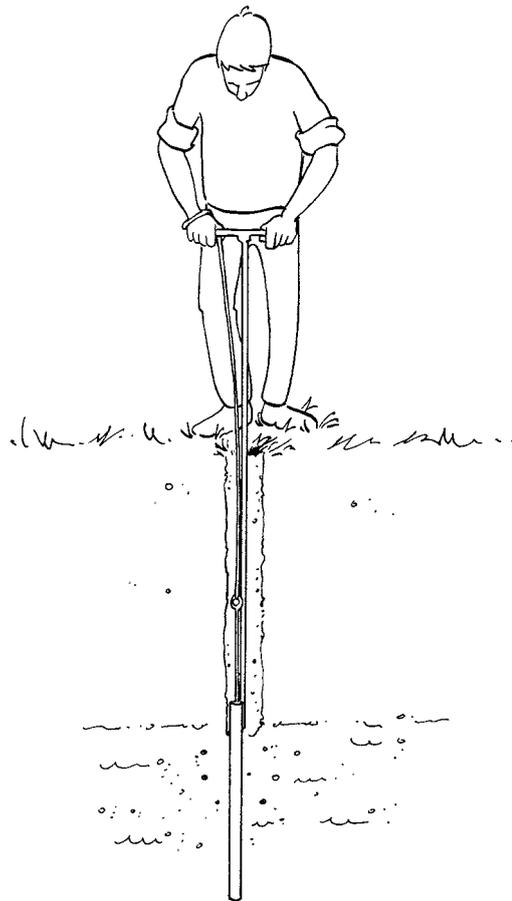


To keep the sample in the tube, the piston should remain in the highest position by keeping the cord taut (if necessary, tie the cord to the handle). Keep the piston rod parallel with the auger rod to prevent the piston to leak, and consequently loss of sample.

5. Place the sampler horizontally on the surface and push the sample out of the tube with the piston. Shaking the tube will facilitate this process. The sample will have a 75 cm undisturbed profile.

Remarks:

- In the case of cohesive soils it is necessary to auger a hole up to a moderately cohesive layer under the water table using another type of auger. Thin and cohesive strata (such as clay or loam up to a maximum of several centimetres) within a moderately cohesive layer may cause clogging of the tube. This impedes pressing the tube into the soil. It is recommended to note the depth of the cohesive layer. Pushing out the sample may cause it to flow as a result of increased water pressure behind the cohesive layer, thus disturbing the sample.
- The piston sampler should be used to sample one auger hole at a time. After sampling the auger hole may cave in and cannot be augered further.
- If the difference in height between the water level in the auger hole and the surface is too large, the sample may flow out of the tube. Filling the auger hole with water can prevent this.



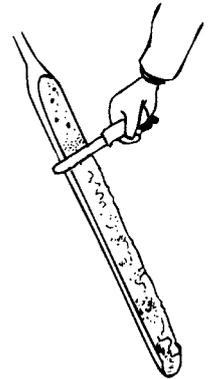
5.6 Gouge auger

Push the gouge auger into the ground without turning. Cut a sample of no more than 50 cm in length. If the gouge auger encounters strong resistance, this can be resolved by turning the auger off during the process. Then continue to push it down.

Turn the full gouge auger off and pull it up with gentle twists.

Use the curved spatula to cut the cylindrical column of soil off up to the rim of the gouge (see figure). The soil left behind provides a virtually undisturbed layer profile. If desired a mark can be applied every 10 cm with the use of the spatula and using the measurement markings on the outside of the gouge auger as a guide.

Use tough protective gloves when emptying out the gouge auger. Use the spatula (curved side up) to push the sample out.



When using extension rods during deeper gouge drilling sessions, keep attaching them to the top end of the auger, directly under the upper piece. The rods may have a slight bend caused through use and this will therefore influence the bore hole. When dividing off or reconnecting the rods it is important to keep to the original sequence.

5.7 Accessories

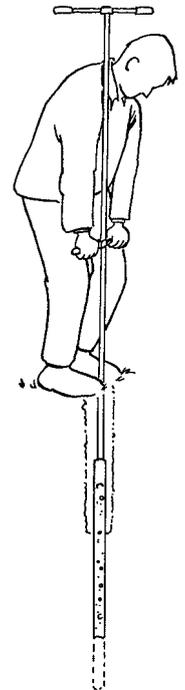
Push/pull handle.

The push/pull handle is ideal for insertion or withdrawal of the auger without straining your back (see figure). It is clamped around the extension rods at any desired height.

Two persons may also use the push/pull handle. To that purpose clamp the handle perpendicularly to the direction of the auger's top handle. Face the other person holding the bars of the push/pull handle with your right hand and holding the bars of the top handle with your left hand exerting up-or downward pressure.

Sounding device.

The sounding device is used to determine the ground water level in the auger hole. Drop it into the auger hole until it hits the water surface with a 'plopping' sound. The depth is crucial in determining the choice of auger. Note that, depending on the type of soil, it may take some time for the water in the auger hole to level with the water table.



6. Applications

The auger set for heterogeneous soils is suitable for drilling in almost every type of soil (except for solid stone or very stony ground). There is a specific type of auger best suited to every type of soil. With heterogeneous soils different types of augers can be used at different times. The auger set can be used to carry out drilling to a depth of 5 m depending on the depth of the groundwater, the structure of the soil and the nature of the material for drilling.

The Edelman auger is suitable for many different types of soil. In homogeneous type of soil there will always be one of the four types that will be suitable. Where the type of soil is unknown or of a mixed type, the combination type is the preferred choice. For hard or stony soils the Riverside auger, the auger for stony soil and the spiral auger provide the answer. The gouge auger is suitable for soft, cohesive soils both above and below groundwater level.

The table provides an overview of the ways in which the various types of augers can be used.

Auger type	Application
Hand auger set	Soil research in almost any type of soil
Edelman clay type	Marshy or clay soils above the water table
Edelman combination type	Universal: clay soils below the water table
Edelman sand type	Sandy soils above the water table
Edelman coarse sand type	Coarse sand soils above the water table
Riverside auger	Hard, rigid soils, such as dry clay soils; fine stony soils
Stony soil auger	Stony soils, gravely soils containing small stones
Spiral auger	Very hard, rigid soils such as iron pans, chalk and lime profiles. Particularly suitable to drill through, or to pre-auger in combination with other types of augers
Gouge auger	Soft, cohesive soils such as clay, loam and peaty soil
Piston sampler	Sandy soils below the water table or in open water.

7. Problems and solutions

- The coupling sleeve has seized on the auger as a result of dirt (soil particles) caught between the coupling sleeve and the auger rod (s). Pour clean water in one direction between the coupling sleeve and the rod. This will flush out any dirty particles. Pick the spatula up by its point and tap the synthetic back edge of it on the coupling sleeve. Coarser sand grains are loosened this way thus allowing the coupling sleeve to turn freely again. During freezing conditions ice can cause the coupling sleeve to seize.
- Augering is strenuous. This may be caused by a faulty match of auger and type of soil (see 6. Application), or incorrect augering (see 5. The use of augers).
- Loss of sample during augering. This may be caused by a faulty match of auger and type of soil (see 6. Application), or incorrect augering (see 5. The use of augers).
- The piston sampler leaks, leading to loss of sample. Slide the piston rod up and down parallel with the auger rod to prevent the piston to dislocate. Non-parallel movements can damage the piston permanently. Grains of sands may cause damage and leakage to the piston. Damaged pistons should be replaced (see 8. Maintenance).
- Loss of sample material. The difference in height between the water level in the auger hole and the surface is too large. Fill the auger hole with water.
- Make sure not to lose the coupling sleeves. Count them after augering. Carry them attached to an extension rod or to the upper part. Always check whether the sleeves are locked. Two spare sleeves are provided.
- Make sure to withdraw every single part of the auger. Always check whether the sleeves are locked.
- The sounding device does not produce a 'plopping' sound when passing the water table. Move it quickly up and down to increase its downward speed. Make a rough estimation of the depth of the water table in the tube and increase accuracy upon every examination.

8. Maintenance

- ❑ Keep materials clean during use by rinsing accumulated dirt off with water. Note: Do not aim the jet of a high pressure cleaner on the ratchet. Dirt can get in the mechanism.
- ❑ Clean the augers with water from the tap after use. Remove the coupling sleeves from the rods and the handle to ensure that the insides are less likely to oxidise and become roughened because of water that has been left behind (causing them to seize more quickly). Allow everything to dry thoroughly. When an auger body is not used for longer periods, it is advisable to coat it with Vaseline to prevent excessive rust from forming (not for the piston sampler).
- ❑ The piston of the piston sampler can be removed for cleaning. Hold the wire eye and turn the nut on the piston using a (ring) spanner 13. Push the piston rod to remove the piston (slant it slightly) from the tube. Clean the piston, position it in the tube, insert the piston rod, place the spring washer and tighten the nut.
- ❑ The auger bodies do not require sharpening. During normal use they continue to become sharper. Any rust that appears is normally not harmful and will disappear when the equipment is used.

Nothing in this publication may be reproduced and/or made public by means of print, photocopy, microfilm or any other means without previous written permission from Eijkelkamp Soil & Water. Technical data can be amended without prior notification. Eijkelkamp Soil & Water is not responsible for (personal) damage due to (improper) use of the product. Eijkelkamp Soil & Water is interested in your reactions and remarks about its products and operating instructions.

Appendix: Rust on augers and gouges

These augers and gouges are made of high tensile-strength forgeable iron-manganese steel. Both iron and manganese are non-toxic metals, abundant in the earth's crust on which we live. Natural concentrations are very high. During storage and transport some rust may develop on the bare metal surface. During first use this rust will scour off quickly. You may also scour with some wet sand prior to first use. The auger or gouge is then ready for sampling of soil on all metals like zinc, cadmium, chromium, copper and even iron and manganese!

Question 1: How do I clean and maintain my augers / gouges?

In practice augers keep themselves clean (and sharp) by the high friction of soil particles rubbing the augers surface. Augers or gouges used in acid, saline or alkaline soil are prone to oxidation and should be rinsed with pH neutral water after use. After a drilling in an oil-polluted borehole you may clean the auger with a brush in a bucket with water with neutral baby-shampoo added. Spraying our detergent 20.05.29 is very effective too and will also mobilize trace-metals, even the zinc plating from the extension rods! Use this detergent with care or limit the use to stainless steel or plastic tools only. Isopropylalcohol on a tissue is fine for rapid on-site cleaning. Acetone is more effective and will even remove tars from metals. Dismantle coupling sleeves and other loose parts prior to cleaning to allow rapid and complete drying after the final water rinse. Store in a well ventilated area free from dust and, for plastic materials, smells.

Question 2: Why did we not prevent the development of natural rust?

A paint will blister off quickly and will pollute samples with a variety of organic pollutants during a prolonged period, necessitating a difficult and cumbersome cleaning procedure prior to first use.

A zinc plating is very soft. The zinc will be scratched off in a few dozens of drillings resulting in measurable quantities of zinc in your soil samples and influencing your measurements during a prolonged period. After a few days or weeks the zinc has completely disappeared and is not effective anymore.

A wax or grease is easy to put on, but fairly hard to remove and, again, risky. Greases, oils and waxes will influence a gas chromatogram (GC) made from soil samples taken with such an auger or gouge. In addition the layer is sticky and it is unavoidable that it will spread all over in carrying bag or case, extension rods, gloves and consequently soil samples. This should be avoided at all times.

Question 3: The extension rods and upper part are zinc plated. Does this zinc plating contaminate the soil sample?

No, since there is no intense scouring contact between soil sample and the rods there is no influence.

Question 4: Do stainless steel soil samplers (coring tubes and rings) contaminate soil samples?

Stainless steel is an alloy of high percentages of mainly chrome, iron and nickel. Alloys have characteristics that are different from the characteristics of a simple "mix" of these metals! Stainless steel is so chemically stable that no loose oxides are formed. It is also hard; scouring with soil will not lead to detectable levels of iron, chromium or nickel concentrations in soil.

Question 5: Does the chromium plated gouge Model P (04.03) contaminate a soil sample?

This gouge is plated with a pure thick layer of nice shining chromium. Chromium is an extremely hard metal and will only and partly be rubbed off in years of use! Although there is very little chance that these quantities will contaminate a sample with Chromium we would not recommend this gouge as first choice for soil analysis on chromium.