ROYAL Eijkelkamp
Meet the difference

Hand-operated bailer boring auger set

Manual

Meet the difference

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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-operated bailer boring set for heterogeneous soils allows manual augering in almost any type of soil, above and below the water table. The set consists of various sets of augers, synthetic casing tubes and fittings, bailers and various accessories. The augers have an upper part with handle, bottom part with auger body, and one or several extension rods. The set can be handled by a single person and consists of several smaller parts, enhancing mobility in less accessible areas. Since the set contains no parts filled with oil or petrol it can be used in nature reserves.
Upon erosion of rock soils are formed and transported by natural processes to be deposited elsewhere. Soils consist of minerals, organic material and cavities filled with air and/or water. The minerals may vary in size of clay and loam (<63 μm) and sand (63 μm – 2 mm), to gravel (2 - 63 mm and stones (>63 mm).
Soil in its natural position may consist of various types of soils (stratified or heterogeneous soil). Differences in texture or soil-forming processes lead to stratification. Soils type will vary from clay, loam, sand to stony soil, depending on its loam and sand content. Peaty soil mostly consists of organic material.
Cohesive soils, for instance, are wet clay, loam and peaty soil. Sand and stony soils are moderately cohesive.
The hand-operated bailer boring set for heterogeneous soils is used in exploratory augering and sampling, and is very suitable for installing well pipes. The set permits augering up to a depth of 7 m. It contains augers for any type of soil above and below the groundwater table. Augers may be switched during augering in heterogeneous soils without restraint.
Bailer boring demands pre-augering to a moderately cohesive layer below the water table. To prevent the auger hole from silting up, synthetic casing tubes are used. The bailer removes the soil under the casing tubes thereby allowing augering at a desired depth. Augering inside the casing tubes may be carried out as well.

1. Description

The standard hand-operated bailer set for augering to 7 m is a complete set containing various types of augers to auger to the water table, augers to obtain moderately disturbed samples, synthetic casing tubes with thread protectors, casing tubes clamps, bailers with steel and synthetic valves and accessories. The bailer boring set is held in two transport cases.

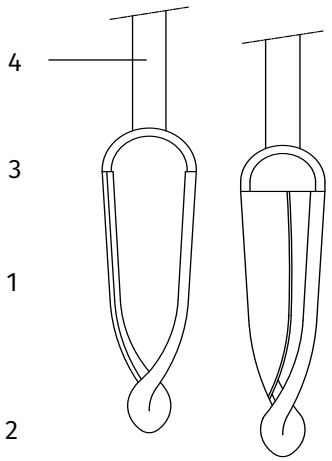
1.1 Auger types for pre-augering

Augers for the purpose of pre-augering have a 10-cm diameter (measured diagonally between the blades). Four Edelman type augers, the Riverside auger, a stony soil auger and a gouge auger (diameter 4 cm) are available.

Edelman auger.
The Edelman auger body (see figure, next page) is conical in shape and consists of two blades (1) joined in a bit (2). The top of the blades is welded to a bracket (3), which is connected to the auger rod (4). The blades are vaulted and when entering the soil the sample is dug up and evenly guided into the inside of the auger body. The vaulting of the blades not only promotes digging up but also ensures a firm grip of the sample while permitting easy emptying of the auger body. The various Edelman augers vary in blade breadth (see 2. Technical specifications) and shape of bit, viz.:

a. Clay type
b. Combination type
c. Sand type
d. Coarse sand type

a. The Edelman auger, clay type. Clay soils can be very cohesive; therefore, the blades of the clay type can be rather narrow. Consequently, the blades meet with little resistance.
b. The Edelman auger, combination type. The blades of this type are slightly broader and rounder than those of the clay type, permitting a good hold of moderately cohesive soils, while cohesive soils can easily be removed. The bit is elongated allowing easy augering in stiffer soil.
c. The Edelman auger, sand type. This type of Edelman auger is suitable for moderately cohesive soils, such as sandy soils. The elongated, twisted bit ensures easy entering. The blades of the sand type are broader than those of the combination type, allowing a good hold of the soil.
d. The Edelman auger, coarse sand type. This auger is based on the sand type but the blades have extra wings thus forming an almost closed auger that will firmly keep hold of loose material such as coarse sand or very sandy soils.



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

Riverside auger.

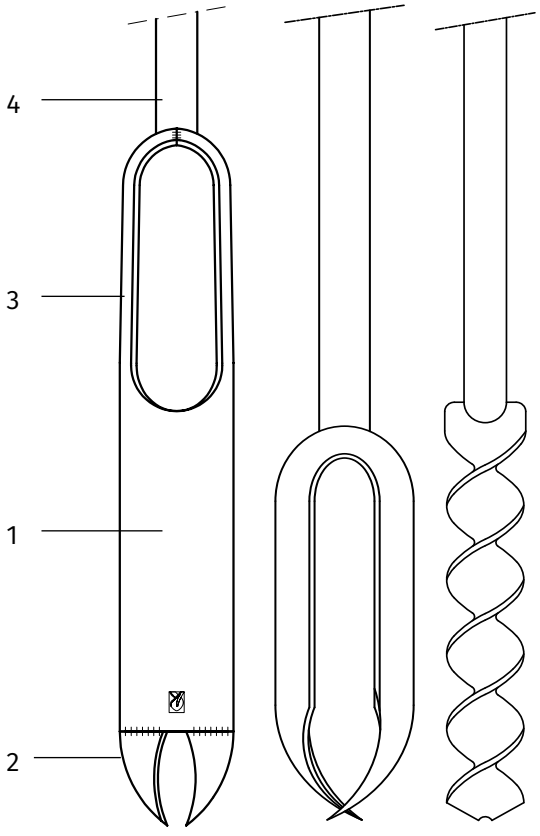
Dry and coarse soils do not permit the use of the Edelman auger with its centric bit. Therefore, the Riverside auger is being used (see figure). The auger body has an open tube (1) with two beak-like bits at its base (2) and a bow bracket (3) at its top, which connects to the auger rod. The extremities of the bits are skewed and scrape the soil, pressing the sample evenly into the tube. The diameter of the auger bits slightly exceeds the tube's diameter so as to reduce friction between soil and tube to a minimum.

Auger for stony soil.

The auger for stony soil is heavier and more rigid than the other types of augers. It has outwardly forged auger ends, forming an almost closed auger body. At the top end and in the middle the blades are connected but do not touch at the bottom, rendering certain flexibility. The slanted bits cut downward thus gripping and holding the stones and other less coarse soil material between the blades.

Spiral auger.

Where other augers cannot cope with hard and rigid soils, the spiral auger (see figure, previous page) is ideal. Its narrow spiral with its negative end (the centre is whetted away, and the two ends are bent) easily digs into the soil pushing stones aside. Its straight design causes friction when hoisting the auger.



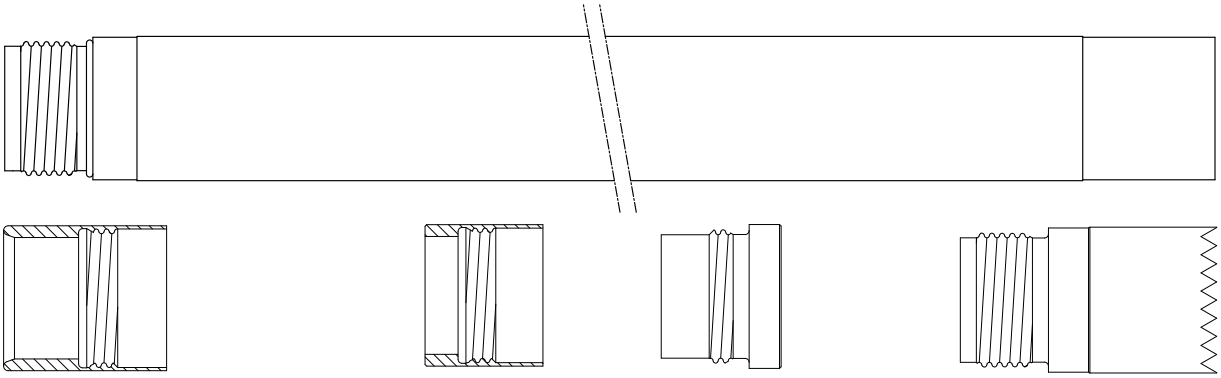
Riverside auger (left), auger for stony soil (middle) and spiral auger (right)

1.2 Casing tubes, clamps, platforms and accessories

The hand-operated bailing boring set contains casing tubes with thread protectors, a casing shoe, a casing head, and two casing tube clamps. In addition, it holds two casing tubes platforms, and a funnel for filter sand.

The casing tubes measure 1 m and are manufactured from heavy-duty, lightweight synthetic material. Their surface is smooth and the diameter is a fraction smaller than that of the pre-augered borehole, so as to reduce friction. Both sockets are glued on, and have a left-hand, coarse, round screw thread; the top end has outside screw thread, the bottom end has inside screw thread. The thread closes in 2¼ turns; a synthetic O-ring seals it for fine sand and enhances unscrewing the tubes. The thread protectors on the inside and outside threads prevent damage to the tubes' edges during transport.

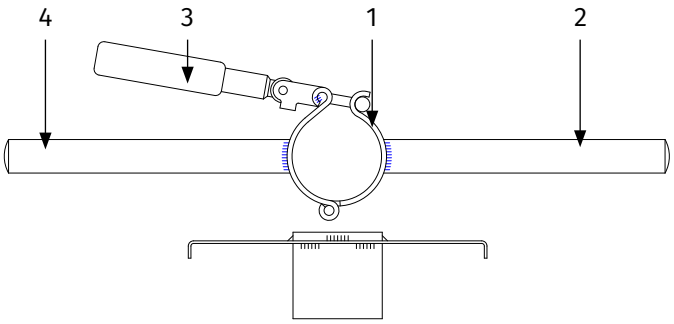
A steel 10-cm casing shoe protects the down end of the bottom casing tube. The slightly receding slotted notches facilitate placing the tubes into the soil. A steel casing head protects the outside thread of the upper casing tube during bailing and augering.



A casing tube (above) and (below left to right) a casing head two thread protectors and a casing shoe

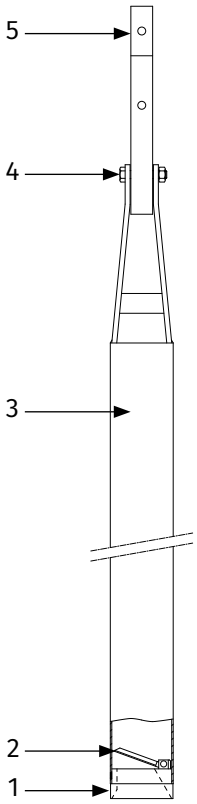
The two halves (1) of the casing tube clamp fit over the tube and are connected by a hinge (see figure). Two grips (2) are attached to the halves and are held when turning the tube into the soil or when withdrawing it. An adjustable quick fastener (3) tightens the clamp around the tube to a pre-adjusted value.

The casing tube platform is used to ensure an ergonomic operating position during bailer boring at greater depth. The platform is a stable, steel table with a hole fitting over the casing tube. The platform can be attached to a clamp to carry the weight of one person.



Casing tube clamp (above) and casing tube platform (below)

1.3 Bailer



Bailer

The bailer (see figure) consists of a stainless steel cylinder (2) with a bailer head at the bottom (1). In the bailer head a stainless steel or synthetic valve is mounted that can only open into the bailer tube. The stainless steel valve responds with more precision during bailing than the synthetic valve, which is more flexible to fine gravel. The valve has a 45º opening. The bailer's diameter is 63 mm which allows some play in the tube.

The top end of the bailer has a bayonet connection (5), to which extension rods can be attached. This bayonet connection can hinge (4), allowing withdrawal of the bailer without disconnecting the extension rods.

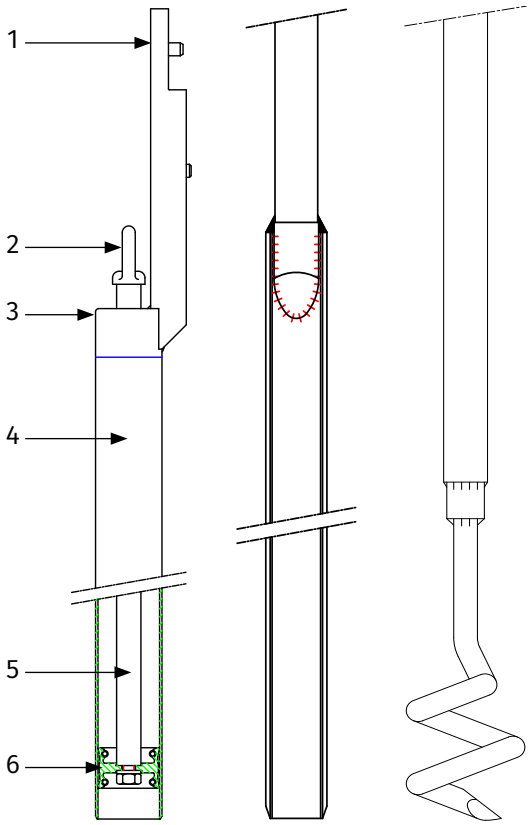
1.4 Augers for augering in casing tubes

The types of augers to be used for augering in casing tubes are similar to those used for pre-augering (see paragraph 1.1); the only difference being the diameter, which is 7 as opposed to 10 cm. Additional types are the stone catcher, the piston sampler and the gouge auger. These types are also used in manual augering in heterogeneous soils without bailing.

Stone catcher.
The stone catcher is a metal spiral with a slanted, whetted tip. When augering, stones or small rocks are caught in the spiral and hoisted from the borehole.

Piston sampler.
The piston sampler (see figure) is constructed from a thin-walled, stainless steel tube (4); its operational length is 75 cm. The bottom end is open, whereas the top has a lit (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). To its top end a wire eye (2) is attached, with a polyester cord. The bottom part 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, allowing the piston to pass comfortably through the casing tubes or a borehole.

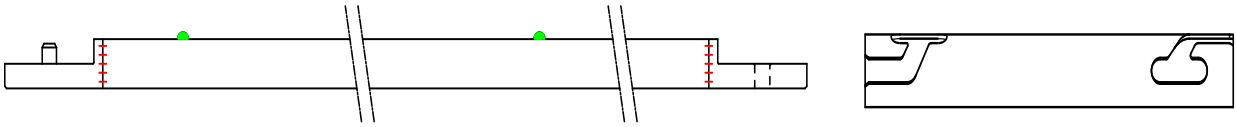
Gouge auger.
The body of a gouge auger is half-cylindrical, with parallel cutting edges running from top to bottom. The auger body is attached to the bottom part at its top end. Its diameter is smaller than that of other augers. The maximum sample size is 50 cm.



Piston sampler (left), gouge auger (middle) and stone catcher (right)

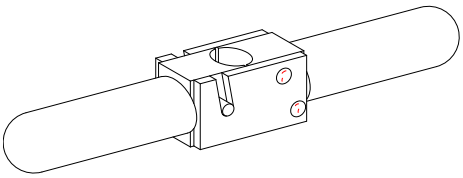
1.5 Accessories

Upper part, extension rods and coupling sleeves.
The upper parts measure 60 and 100 cm and have a detachable, synthetic grip. The extension rods measure 1 m. Since the upper part, the extension rods and bottom parts have bayonet connections, the auger can be adjusted to any length. Coupling sleeves are cylindrical and lock the connections.



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.

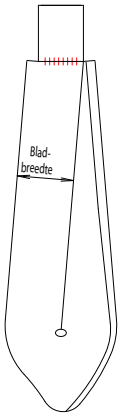


Utility Probe.
The fibreglass utility probe measures 105 cm, and has a 19-mm cone diameter. It is insulated allowing safe checking of the substratum for cables, tubes and pipes.

2. Technical specifications

Various important dimensions of different types of augers are listed in the table below.
Diameters have been established by diagonally measuring the widest point between the blades.

Auger type	Diameter (mm)	Blade width (mm)
Edelman auger clay type	70, 100	30, 40
Edelman auger combination type	70, 100	35, 50
Edelman auger sand type	70, 100	40, 60
Edelman auger coarse sand type	70, 100	75, 105
Riverside auger	70, 100	-
Auger for stony soil	70, 100	-
Spiral auger	40	-
Gouge auger	30	-
Piston sampler	Tube 40 Total ca 60	-
Bailer	63	-



The auger bodies are manufactured from (non-toxic, not stainless steel) iron-manganese steel. The piston sampler is made of stainless steel. All auger bodies are unpainted for the purpose of environmental research.

The casing tube is made from plastic (ABS) which has the following properties: smooth surface, shockproof, durable (not sensitive to UV rays and cold) and non-toxic. The tubes measure 1 m and have a 90 x 76 mm diameter.

3. Safety instructions

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.

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.

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.

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 a metal auger.

Release or tighten the quick fastener of the casing tube clamp only when not attached to a tube. This will prevent damage to the clamp.

4. Assembling an auger

Assemble the auger by linking the upper and bottom part, if necessary use extension rods:

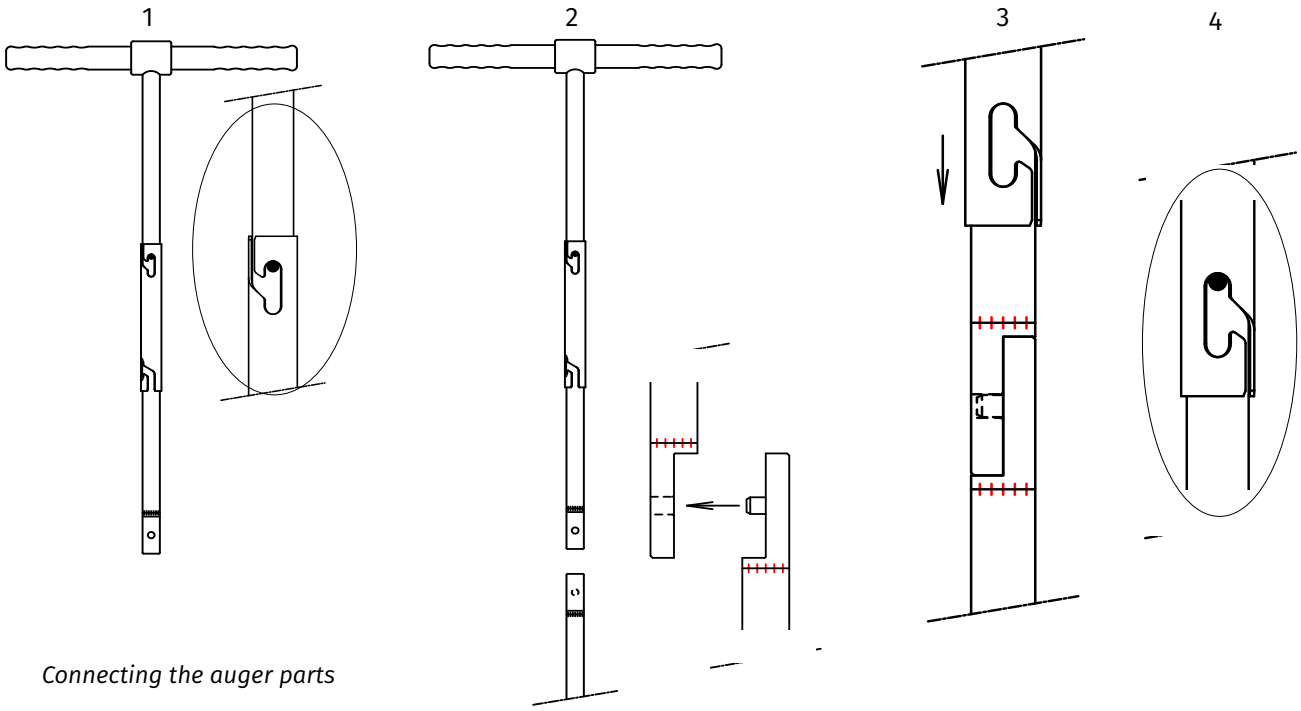
1. Detach the coupling sleeves from the extension rods and the upper part.
2. Screw the handle into the upper part.
3. Select the appropriate auger (see 6. Applications). The Edelman combination type auger often proves to be the best choice.
4. Connect the auger parts (see figure, next page).

   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.



Connecting the auger parts

5. Usage

5.1 General

The items listed below describe the process of bailer boring:
1. Pre-augering (10 cm diameter) down to the moderately cohesive soil under the water table.
2. Placement of the casing tubes.
3. Bailing to remove the soil under the casing tubes to sink the casing.
4. Sampling of slightly disturbed soil, using narrow-bladed augers (7 cm diameter), the piston sampler and gouge auger under and from within the casing.
5. Hoisting and cleaning of the casing tubes.

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.

❒ Hold the auger vertical while drilling.

Rotate the auger clockwise.

❒ When augering 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. Unclamp 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.

Handling the auger in parts will prevent it from bending, and reduce the risk of being hit by augers falling over.

❒ Cut off the sample: turn the auger a full circle without pressing down.
❒ Keep your back straight and your knees bent to prevent injuries when hoisting auger with sample. Wear gloves for a full grip on the rods.
❒ Types of soils may vary, necessitating the use of different augers.

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

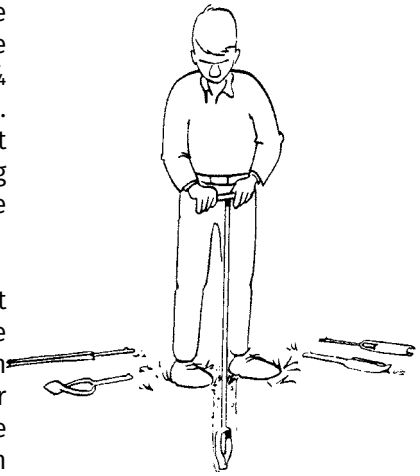
After augering fill up the borehole with soil or special bentonite plugs. This will prevent humans or animals to trip into the hole and incur injuries, and restores impermeable soil layers.

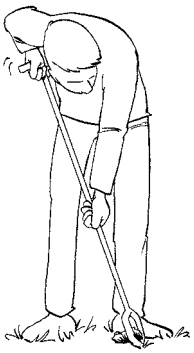
Be cautious during a thunderstorm. Lightning strokes often occur in the open field, in particular when one holds a metal auger.

❒ 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 Pre-augering

<u>Edelman auger (all types).</u>
Hold the auger by its handle and rest it on the ground (see figure, left). Rotate it clockwise while gently pushing it into the soil. Upon 2¼ rotations, the auger should have dug 10 cm. The auger body will be filled up to its bracket with slightly disturbed soil material. Depending on the type of soil additional rotations may be necessary.





Withdraw the auger after sampling; hoist it while gently rotating the auger. To release the cohesive material hold the auger askew on the surface (see figure, right), rotate the auger 180° while pressing it into the ground. The sample should detach itself and can be taken out by hand or by lightly tapping the auger. Moderately cohesive material will detach itself immediately. Now, examination is possible.

Caution:

- ❒ Do not overfill the auger body. Superfluous material will coat the auger hole, which hinders pulling out subsequent soil layers. When augering under the water table an overfilled auger acts like a plunger, which hampers hoisting the auger and results in loss of sample material.
- ❒ Prevent loss of sample material. Hoist the auger with sample while lightly rotating it, do not pull it straight out.

Riverside auger and auger for stony soil.
Screw and press the auger into the soil. The soil will be fed evenly into the body. Pull out the auger without rotating it. Tap it gently on the surface and the sample will detach itself. In cohesive soils it is difficult to empty the Riverside auger, consequently another type (the Edelman auger) is recommended.

Spiral auger.
Screw and press the auger into the soil. The auger body will push stones aside. Hoist the auger lightly rotating it. In certain types of soils its design may cause considerable friction. The sample will often be disturbed. The spiral auger is often used to penetrate hard layers or to pre-auger before other type of augers can be used.

5.3 Placement and removal of the casing tubes

The casing tubes are placed before and during the bailing process. They are removed again upon finishing the bailing work.

Placement of the casing tubes.

1. Remove the thread protectors from the tubes. Moisten the threads.

☞ **Always keep the screw threads clean and wet when working.**

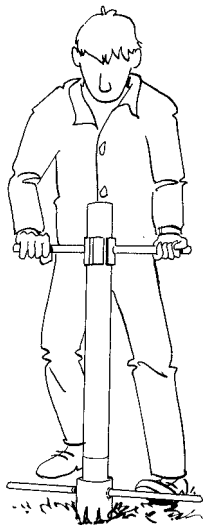
2. Screw the casing shoe onto the bottom tube.

3. Connect a desired number of tubes in pairs (thereby obtaining several sets of casing tubes).

4. Prior to placing a set of tubes, attach the casing tube clamp at a position of 50 cm below the top of the casing tubes.

☞ **Always attach the casing tube clamp to a tube to prevent loosing it by dropping into the borehole.**

⚠ **Release or tighten the quick fastener of the casing tube clamp only when not attached to a tube. This will prevent damage to the clamp.**



5. Place the first casing tubes set, gently rotating it counter-clockwise, in the borehole. The borehole being slightly larger the tube's diameter, no friction will occur. With the casing tube clamp in place, it will stand out approx. 50 cm.

☞ **Always rotate the casing tubes counter-clockwise.**

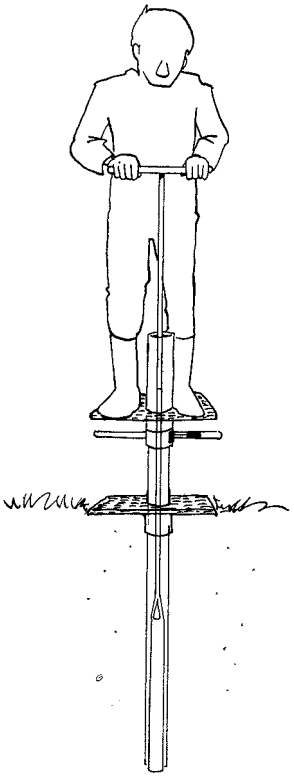
6. If necessary, attach the next set of casing (including a second casing tube clamp) to the first set (see figure). Remove the lower casing tube clamp which will cause the casing to drop to the level of the upper clamp. Repeat these actions until the casing shoe hits the bottom of the borehole.

7. Attach the casing head to the tube standing out.

☞ **Always attach a steel casing head to the upper tube to protect the tube's edges during bailing and augering.**

8. Sink the casing tubes, using the bailer to remove the soil under the casing (see paragraph 5.4).

When augering at greater depth the casing will no longer drop automatically; the pressure of the borehole's walls prevents this. At this stage it is necessary to press down the casing tubes and rotate them at the same time.



To minimise manual labour, two casing tubes platform are used to ensure an ergonomic operating position (see figure). Its design ensures safe usage and no damage can be done to the casing tube.

1. Place the first platform over the casing tube in the borehole (remove the clamp). This will stabilise the casing tubes when augering at greater depth and prevents loose soil material to flow between the borehole's walls and the tubes.
2. Attach a second platform to the casing tube clamp at a position of about 40 cm above the surface level.
3. Mount the platform, the casing tube will sink by the weight of the operator.

☞ **Make sure the casing tube clamp does not slip. Do not step on the handle, but use the platform to exercise weight on the casing.**

9. If necessary, extend the casing by attaching additional tubes (follow step 5 and 6, do not forget to remove the casing head.

Removing the casing tubes.

☞ **Do not postpone removal of the casing tube. As a result of friction it may jam, impeding removal. If placing was strenuous, timely removal is recommended.**

1. Remove the upper platform from the clamp

2. Withdraw the casing, using the casing tube clamp. Gently turn it counter-clockwise until the next tube stands out well above the surface level.

3. Wedge the casing with your foot against the edge of the borehole or against the lower platform to prevent the casing from dropping into the borehole. Attach the second clamp to the tube standing out above the surface level.

4. Use the clamps to unscrew the tubes. Repeat this action until all tubes have been hoisted.

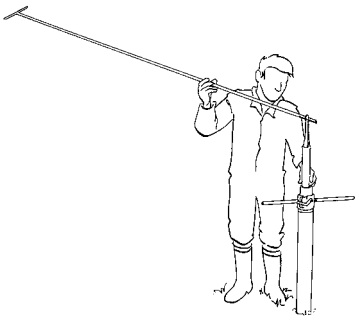
5. Rinse the threads and the tubes, using the steel brushes. Re-attach the thread protectors to prevent damage during transport.

5.4 Bailer boring

Bailing rests on the principle of up-and-down movements of the bailer, stirring the water in the borehole, thereby suspending the soil material. As the valve opens on downward movements and closes when the bailer is hoisted, the suspended soil material is trapped in the bailer.

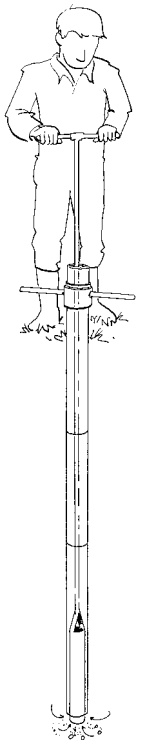
1. Upon placement of the casing tubes on the bottom of the borehole, and attachment of the casing tube clamps and the platforms, the bailer can be positioned into place (see figure). As a rule, use the bailer with the steel valve. Use the synthetic valve bailer in the case of coarse sand or fine gravel. It is preferable to use the long upper part to ensure a comfortable operating position in the case that the tube stands out way above the surface level.

2. Pour water into the borehole to allow bailing.



The water level in the borehole seemingly tends to drop as a result of the fact that during bailing the volume of water being bailed out is greater than the volume of water that flows back into the borehole. This leads to increasing groundwater pressure on the borehole, impeding the bailing process. This can be prevented by regularly pouring water into the casing tubes. This volume depends on the situation. Bailing is still possible even if the groundwater drops by 1 m. In areas with strong seepage it may be necessary to overfill the tubes to create counter-pressure.

☞ **For proper performance of the bailer, fill the tubes well with water. Do not spill water along the tube, since the flushing of sand around the casing tube can wedge it very tightly in the soil.**



3. Move the bailer up and down quickly and make sure to gently hit the bottom of the borehole (see figure on the left). This will cause the bailer to catch suspended soil material, removing the soil under the bailer head. Excess water in the bailer will flow out at the top of the bailer. Successful bailing, and silting up depend on the compactness of the soil and the groundwater pressure.

☞ **Make sure that the bailer does not snap at its hinge. Only lightly touch the ground while bailing.**

By pressing down the casing tubes while bailing, the borehole will not silt up. If necessary, use the casing tube platforms (see paragraph 5.3).

☞ **The top end of a coupling sleeve on an extension rod should be level with the top end of the screw thread of the socket of the upper tube (not level with the top end of the casing head!).**

4. Hoist the full bailer (it is a matter of experience to able to judge whether the bailer is full). The hinges allow emptying of the bailer without changing the position of the extension rods (see figure on the right).

5. If necessary, take soil samples every now and then, using augers to auger in the tubes.

6. Repeat this process until a desired depth has been reached.

When a cohesive layer is situated below the moderately cohesive soil type, bailing will not yield results. The following is recommended:

6.1 Screw the casing shoe slightly into the cohesive layer.
6.2 Empty the tube, using the bailer.
6.3 Use a gouge auger to examine the thickness of the cohesive layer. Use the Edelman auger (7-cm diameter) if the layer is not too thick.
6.4 Use the piston sampler to examine whether the moderately cohesive layer runs deeper and whether bailing can be continued.
6.5 Depending on the cohesive layer's thickness:

❒ Cohesive layers under 40 cm (depending on circumstances): press down and rotate the casing tubes below the cohesive layer. Cohesive soil material will flush around the casing tube (the borehole is smaller than the tube) and cause friction.

❒ Cohesive layers over 40 cm (depending on circumstances): Increasing frictions impedes further sinking of the tubes. In that case, stop bailer augering and use augers to auger in the tubes.

Remarks:
- ❒ Caving in of the borehole will cause the bailer's position to be too high up upon the first bailer boring.
- ❒ Make sure to check the quality of the water poured into the tubes (in the case of environmental research)
- ❒ The maximal augering depth depends, among other things, on the friction that the casing incurs caused by the pressure of the moderately cohesive soil. Manual bailing, as a rule, is possible to a depth of 5 m below the groundwater level. Other factors are an impermeable gravel layer or a thick cohesive layer.
- ❒ In stony soils, do not rotate the casing tubes during bailing. Gravel setting between the bailer and the wall of the casing tube may wedge the bailer.
- ❒ Filter sand is often poured into the casing tube upon placement of observation pipes. Use the funnel to prevent the sand from flushing around the casing tube and cause additional friction.
- ❒ Soil material running into the tube hampers the process: bailing becomes more strenuous (the soil material cannot dissolve), and an observation pipe may get wedged in the tube when the casing tubes are hoisted.
- ❒ If frequent, deeper augering is necessary, larger casing tubes in combination with a tripod, a hand winch and a cable bailer are available from Royal Eijkelkamp.

5.5 Augering in tubes

For sampling the bailer is less suitable: the samples are fully disturbed and, to a certain extent, mixed. To obtain soil samples from below the casing tubes for examination, augering in the tubes during and after bailing may take place. Operation of the Edelman auger, the Riverside auger, and the stony soil auger has been described in paragraph 5.2. See the figure for augering in the casing tubes.

Stone catcher.
The use of the stone catcher is recommended when encountering stones during augering. Depending on the shape and dimensions, the stone catcher grips the stones. Upon removal of the stones, augering may continue, using other types of augers. The stone catcher also proves to be useful in hoisting loose objects that were dropped into the borehole.

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 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.

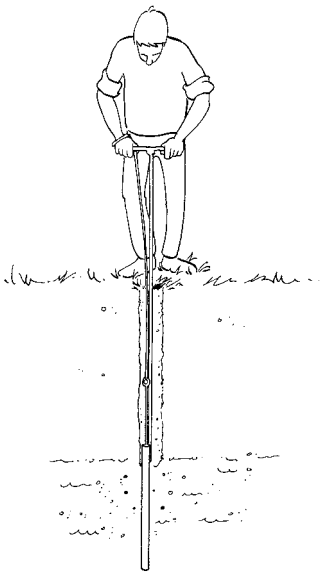
4. When the tube has been filled, push once more and pull it out of the auger hole.

☞ **To keep the sample in the tube, the piston should remain in the highest position by keeping the cord taut (eventually, 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.

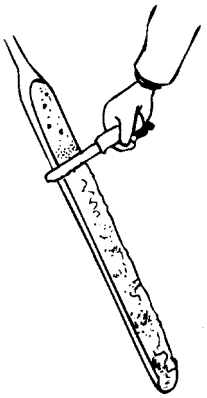
Remarks:

- ❒ In the case of cohesive soils it is necessary to auger a hole 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 the process of 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.



Gouge auger.
Push the gouge auger vertically into the soil without rotating it. Take a sample of maximally 50 cm. Should you encounter resistance, cut off the sample and press again.

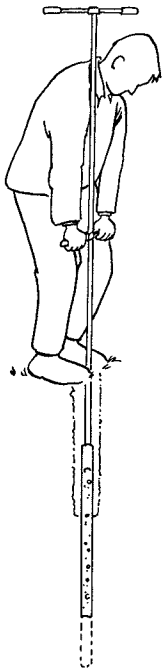
Cut off the sample by rotating the auger without pressing down and hoist it gently. Use a bent spatula to cut off protruding soil along the cutting edges (see figure), this will provide an almost undisturbed profile. If necessary, the sample can be marked every 10 cm. using the calibration on the outside of the gouge auger. Wear sturdy gloves emptying the gouge auger. Push out the sample using the rounded side of the spatula.



☞ **When augering at greater depth, attach extension rods to the upper end of the gouge auger, directly below the upper part. The rods tend to bend, following the line of the auger hole. Follow the same order when (dis) connecting the rods.**

5.6 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 hand-operated bailer boring set for heterogeneous soils allows manual augering and sampling in almost any type of soil, above and below the water table (not in solid rock or in stony and gravelly soil). The set permits augering by a single person to a depth of 7 m.
The hand-operated bailer boring set is utilised in:

- ❒ Profile research in exploratory augering and sampling.
- ❒ Installation of well pipes.
- ❒ Deep sampling in or below moderately cohesive strata below the groundwater table.
- ❒ Sampling in shallow, open water from a stable position (a boat or a platform).

There are specific augers for any type of soil (see table below). Augers of a similar diameter can be switched without restraint. The Edelman auger can be used in various types of soil. In homogeneous soil one of the four types will suffice. In unidentified or mixed soil types the combination auger will be preferred. In hard or stony soils the Riverside auger or stony soil auger or spiral auger will be useful. The piston sampler is suitable in sandy soils under the water table, giving an undisturbed profile. The gouge auger also provides an undisturbed profile and is suitable for soft, cohesive soils, above and below the water table. The stone catcher is utilised to hoist stones from a borehole.

Casing tubes to support the borehole are used for augering at greater depth in moderately cohesive soils below the groundwater table. Augers are used to pre-auger (10-cm diameter), and bailers remove the soil under the casing tubes, thereby causing the casing to sink. Augers, such as the piston sampler, can be used to auger in the tubes to sample deeper strata.

The table below provides an overview of the applications of the hand-operated bailer boring set.

Auger type	Application
Auger type diameter 7 cm	Soil research, if necessary in the tubes; pre-augering, prior to using a 10-cm auger type.
Auger type diameter 10 cm	Pre-augering to a moderately cohesive layer below the groundwater table, prior to placement of casing tubes.
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
Stone catcher	Removing stones from the borehole.
Gouge auger	Soft, cohesive soils such as clay, loam and peaty soil or a combination of soils under the casing tubes (optional); checking the thickness of the cohesive layer below the moderately cohesive layer under the casing tubes.
Piston sampler	Sandy soils below the water table or in open water, often under the casing tubes
Bailer	Removing moderately cohesive soil material from below the groundwater table, under the casing tubes; bailing of leaking observation pipes.

7. Troubleshooting

7.1 Augering

- ❒ Soil particles between the augering rod and the coupling sleeve have caused the sleeve to jam. Pour clean water in one direction in the sleeve, this will flush out the particles. Use the synthetic backside of the spatula to tap the sleeve, coarse particles will become come loose thereby allowing the sleeve to slide. In winter conditions, icing up may cause the sleeve to jam.

- ❒ Augering is strenuous. This may be caused by a faulty match of auger and type of soil (see 6. Applications), or incorrect augering (see 5. Usage).

- ❒ Loss of sample during augering. This may be caused by a faulty match of auger and type of soil (see 6. Applications), or incorrect augering (see 5. Usage).

- ❒ 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 eventually 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 an upper part. Always check whether the sleeves are locked. Two spare sleeves are provided.

- ❒ 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.

7.2 Bailer boring

- ❒ The bailer leaks, resulting from a badly closing valve caused by fine gravel sitting between the valve and the tube’ wall. Using a synthetic valve may remedy this situation. If leaking persists, discontinue augering this type of soil. Replace the valve if it is damaged (see 8. Maintenance)

- ❒ Bailing is strenuous as a result of soil material down in the casing tube clogging between the tube and the bailer (gravel may even cause it to jam). Hoist the bailer and the casing to a point it no longer contains soil. Continue bailing.

- ❒ When pressing and rotating the casing tubes meets with too much resistance, coupled with an uncomfortable working position, opt for usage of the casing tube platform.

- ❒ The tubes are difficult to unscrew when the threads are dirty. Rinse them prior to, and during bailing (see 8. Maintenance)

- ❒ Marshy ground around the borehole may easily get pressed against the casing, causing pollution and additional friction. To stabilise the area around the casing, attach a casing tube platform. This will also provide a stable place to stand on.

- ❒ The length of the casing causes it to become unstable, thereby damaging the threads. Use both casing tube platforms; place one on the ground, attach the other one to the casing tube. The most stable position for the upper platform is at 40 cm above the ground surface.

❒ Thick cohesive soil or increasing pressure occurring at greater depth (pressure of the soil below the groundwater table) may cause the casing to jam. Cease bailing and quickly remove the casing tubes. Always turn counter-clockwise to prevent disconnecting the tubes (left-hand thread!)

❒ Stiff soils may impede hoisting of the casing tubes; in that case, a jack with lever may be used (available from Royal Eijkelkamp)

❒ It may occur (exceptional!) that a socket with thread breaks off. Contact Royal Eijkelkamp to determine the appropriate type of glue.

8. Maintenance

❒ It is recommended to keep the equipment in good condition by rinsing it during use. Flush out any dirt from the piston sampler by moving the piston rod up and down under water.

❒ Clean the augers and the tubes with tap water after use. Take off the coupling sleeves from the rods and the upper parts, clean and dry them well to keep the insides smooth and prevent oxidation (rough inner surfaces of the sleeve may cause it to jam). To avoid excessive oxidation when storing the auger body, apply Vaseline (not for the piston sampler and bailer).

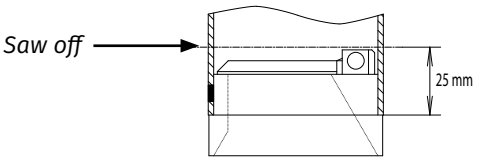
❒ Attach thread protectors during transport. Make sure the threads have been well-dried before attaching the thread protectors. For longer storage, apply Vaseline to prevent oxidation, and ensure easy (un)screwing.

❒ The auger bodies need no whetting, use keeps them sharp-edged. Under normal conditions oxidation is not detrimental and will vanish upon use.

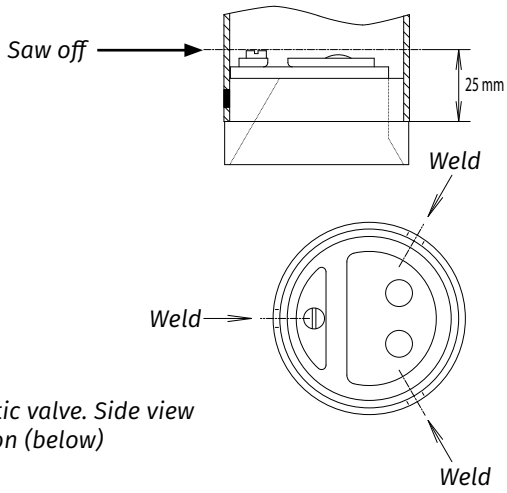
❒ The piston of the piston sampler can be removed for cleaning. Hold the wire eye and turn the nut on the piston using a (ring) spanner 13. Push the piston rod to remove the piston (slant it slightly) from the tube. Clean the piston, position it in the tube, insert the piston rod, place the spring washer and tighten the nut.

❒ Replacement of the valve (see figures):

a. Shorten the tube by 25 mm at its bottom end, mount a new bailer shoe and weld it on. Bailer shoe with synthetic valve: weld the bailer shoe as indicated in the figure. Make sure it is set in the proper position. Push up the synthetic valve using a small tube. Cool down with water after every weld.
or
b. Drill out the weld styles using a drill (Ø 10 mm). Remove the bailer shoe, place a new shoe and weld the drill holes. Bailer shoe with synthetic valve: weld the bailer shoe as indicated in the figure. Make sure it is set in the proper position. Push up the synthetic valve using a small tube. Cool down with water after every weld.



Bailer shoe with steel valve (side view)



Bailer shoe with synthetic valve. Side view (above) and cross section (below)