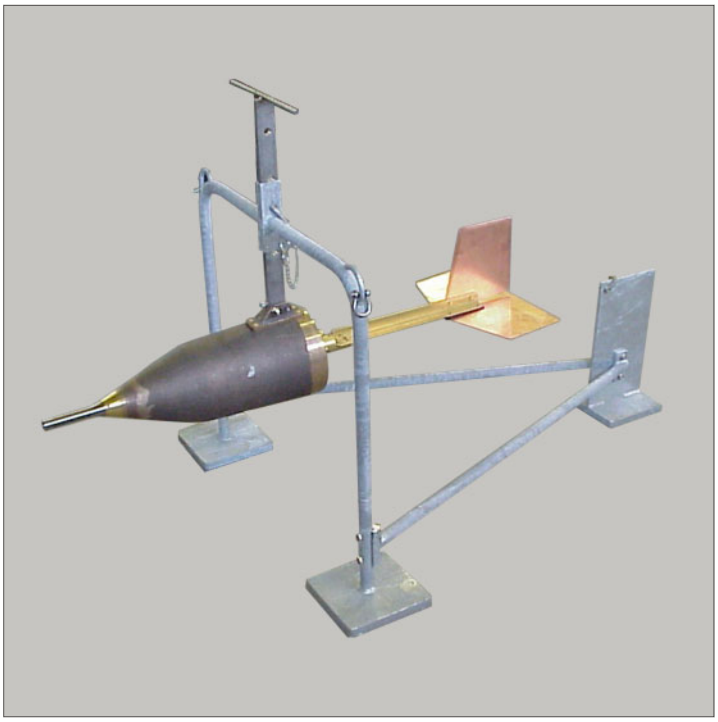
OPERATING INSTRUCTIONS

04.31 SUSPENDED LOAD SAMPLER DELFT BOTTLE TYPE



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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.**

1. General Information

The suspended load sampler, Delft bottle type, is used to measure suspended sediment transport in rivers and other water courses, from the surface down to 0.1 m above the river bottom.

The sediment containing water flows through a bottle shaped sampler. The shape of the sampling body induces a low pressure at the rear face in such a way, that the water enters the nozzle of the sampler with almost the same velocity as the undisturbed flow.

The sharp decrease of the velocity in the wide sampling chamber causes the sediment material to settle there. Because of the flow-through principle a large volume of water is sampled.

The sampler can be used in two ways (see also figure 4 on page 6):

❐ Suspended on a cable for all depths from the surface to 0.5 m above the bottom. A tail fin keeps the nozzle in up-stream direction.
❐ Standing in a frame on the bottom for distances of 10, 20, 30, 40 and 50 cm from the bottom. The inclination of the body requires the use of bent nozzles.

In both cases the same bronze sampling body is used. It is divided into three chambers; in the central one protudes a diffusor cone as an extension of the nozzle.

For use with the sampling body there are four nozzles, two straight and two bent ones. For measuring in wate r with moderate and high velocities the small one is to be used, the internal diameter is 1.55 cm, cross section 1.9 cm^2. For measuring in small velocities the greater nozzles with an internal diameter of 2.2 cm, cross section 3.8 cm^2, may be used.

The set comprises a sampler, the frame, a number of nozzles, measuring glasses, tools, spare parts and a wooden transport case.

<u>Characteristics.</u>
Suspended sampling body with nozzle and tail fin, length 1. 165 m, max. diameter 0. 195 m, weight 20 kg, min. required clearance between davit and railing 1.00 m.
Sampling body in frame overall length 1.55 m, height of the frame 0.85 m, width of the frame 0.9 m, weight 66 kg, min. clearance between davit and railing 1.5 m exclusive pulley or depth counter height.

Weight complete instrument with box but excluding frame 42 kg.
Weight frame 50 kg.
Measuring , range: Velocities up to 2.5 m/sec., grainsize exceeding 50 µm (0.05 mm)

<u>Limitation</u>
1. Handling requires a davit with depth counter and winch due to the weight of the instrument.
2. Working out procedure requires simultaneous measurement of velocities for application of the calibration coefficients.

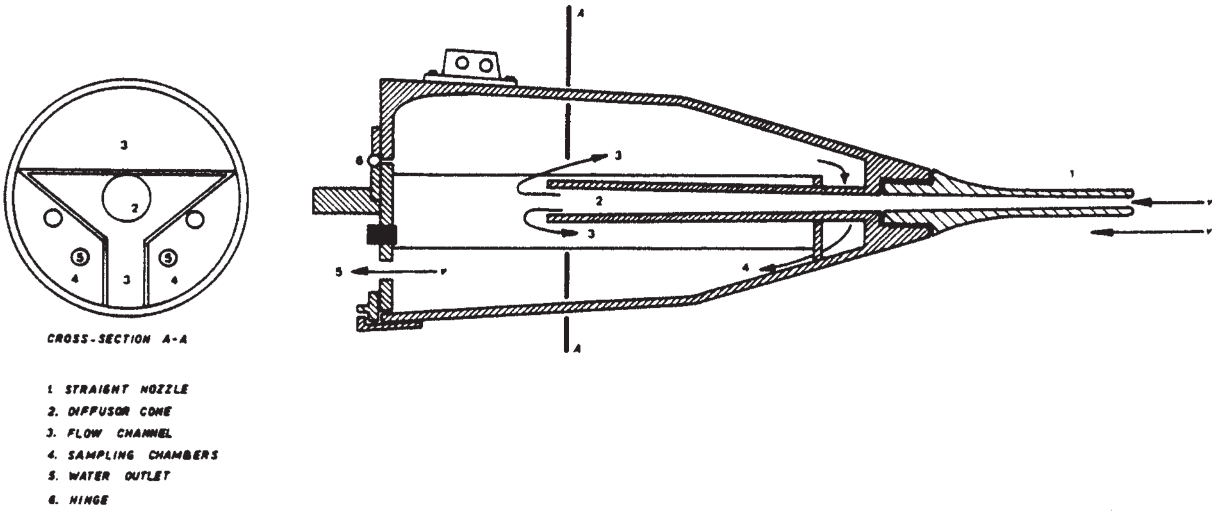

Figure 1 *Longitudinal section of the sampler*

2. Directions for use

As mentioned before, the Delft Bottle can be used in two ways. Suspended on a cable and standing on the bottom in a frame. For both ways the same brass sampling body is used.

For use on the cable the short steel bar must be fitted with the countersunk screw in the bronze top piece (see figure 2).

Thereafter suspend the sampler from the davit. Screw the correct nozzle on the front side of the bottle, attach the tail piece on the rear side and fix this well with the knurled screw.

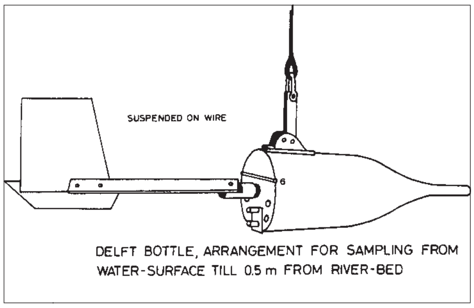

Figure 2 *Sampler suspended on a cable*

For use in the frame fit the brass body with the countersunk screw to the large stainless steel bar, set the body in the desired position and secure it in this position with the chained pin. For measurements 10, 20 or 30 cm from the bottom use a bended nozzle, for 40 or 50 cm a straight one (see figure 4 on page 6).

Big nozzle: Only to be used in case of small and moderate velocities (V= max. 1 m/ sec). None of the four openings in the lid should be closed.

Small Nozzle: Can be used in case of velocities up to 2,5 m/sec. The lower two openings in the lid should be closed with a rubber stopper

2.1 Operational advices

Start measuring with the small nozzle. Although the sand catch is smaller than with the big one, the accuracy is better due to the smaller correction factor and due to the fact that losses during hoisting up may be neglected.
In most cases a measuring period of 10-15 minutes gives a sufficient catch.
If the sand catch proves to be too small with the small nozzle and doubling of the measuring times is not possible (tidal waters) the big nozzle may be applied in case of velocities smaller than 1 m/sec.
After expiration of the measuring time the sampler must be hoisted up.
The best hoisting up velocity is about 10-20 cm/sec. Faster hoisting up causes loss of sediment.

2.2 Launching, for a measurement

- ❒ Lower the sampler into the water surface.
- ❒ Stop as soon as the sampler has been fully submerged; the sampler will incline backward due to air content: Air will escape from the nozzle and small opening on top of the rear side.
- ❒ Air venting can be accelerated by lifting the tailpiece by means of a hook.
- ❒ Wait for the sampler to reach a horizontal position.
- ❒ Adjust wire-counter to zero.
- ❒ Lower the sampler quickly till the measuring depth or bottom has been reached.
- ❒ Start the stopwatch.

2.3 After expiration of measuring time

- ❒ Stop the stopwatch
- ❒ Hoist the instrument up; not faster than 20 cm/second. As soon as the sampler emerges it will slightly incline forward, thus preventing loss of sand through openings in the lid.
- ❒ Manoeuvre the rear side of the sampler above the funnel.
- ❒ Open the lid with tailpiece as lever.
- ❒ Empty the contents of the chambers in the funnel.
- ❒ Squirt the chambers by means of a deck wash.
- ❒ Remove the sampler and make it ready for another measurement; take care that the lid is well closed.
- ❒ Let the sand catch settle in the measuring glass at the bottom of the funnel.
- ❒ Detach glass from funnel and read the caught volume.

2.3.1 The funnel

☞ **Mount the funnel in or out board in such a manner that the sampler can be emptied above it when it is suspended on the davit.**

The measuring glass can be easily set on and taken off from the funnel when during this operation the glass is turned a little around its axis.

3. Sediment transport computing procedure

3.1 Required data

- ❒ Total depth.
- ❒ Velocity distribution in the vertical (measure with a current meter).
- ❒ Sampling depth (wire counter).
- ❒ Measuring time (stopwatch).
- ❒ Sediment catch (sampler measuring glass).
- ❒ Average grain size.

3.2 Working out

Measurements are carried out mostly in measuring verticals which are chosen at well known intervals in a cross section of a water course.
For each vertical one measuring form should be used (see figure 5 on page 7).
Besides general information, sand catch, sampling depth, flow velocity and measuring time are noted down on this form.
The average grain size can be determined:
- ❒ by comparing with a standard sample ruler (instantaneous but rough).
- ❒ by means of drying and sieving (accurate and slow).

Knowing both the average grain size and the flow velocity the correction factor with which the sand catch must be multiplied can be determined from the graphs in figure 3.

This correction factor is the ratio of the loss coefficient and the hydraulic coefficient.

The loss coefficient is the ratio of the total sand volume that enters the nozzle and the part that settles down in the sampler. The loss coefficient increases with increasing flow velocity and with decreasing grain size.

The hydraulic coefficient is the ratio of the discharge through the nozzle and the discharge through the same imaginary orifice after removal of the instrument.

Subsequently all sand captures are corrected to one unit measuring time.
When a measuring vertical contains sufficient measuring points the sand transport through the vertical can be calculated by integration.
Knowing the sand transport in the verticals of a cross section the total sand transport through the cross section can be calculated in the same way.

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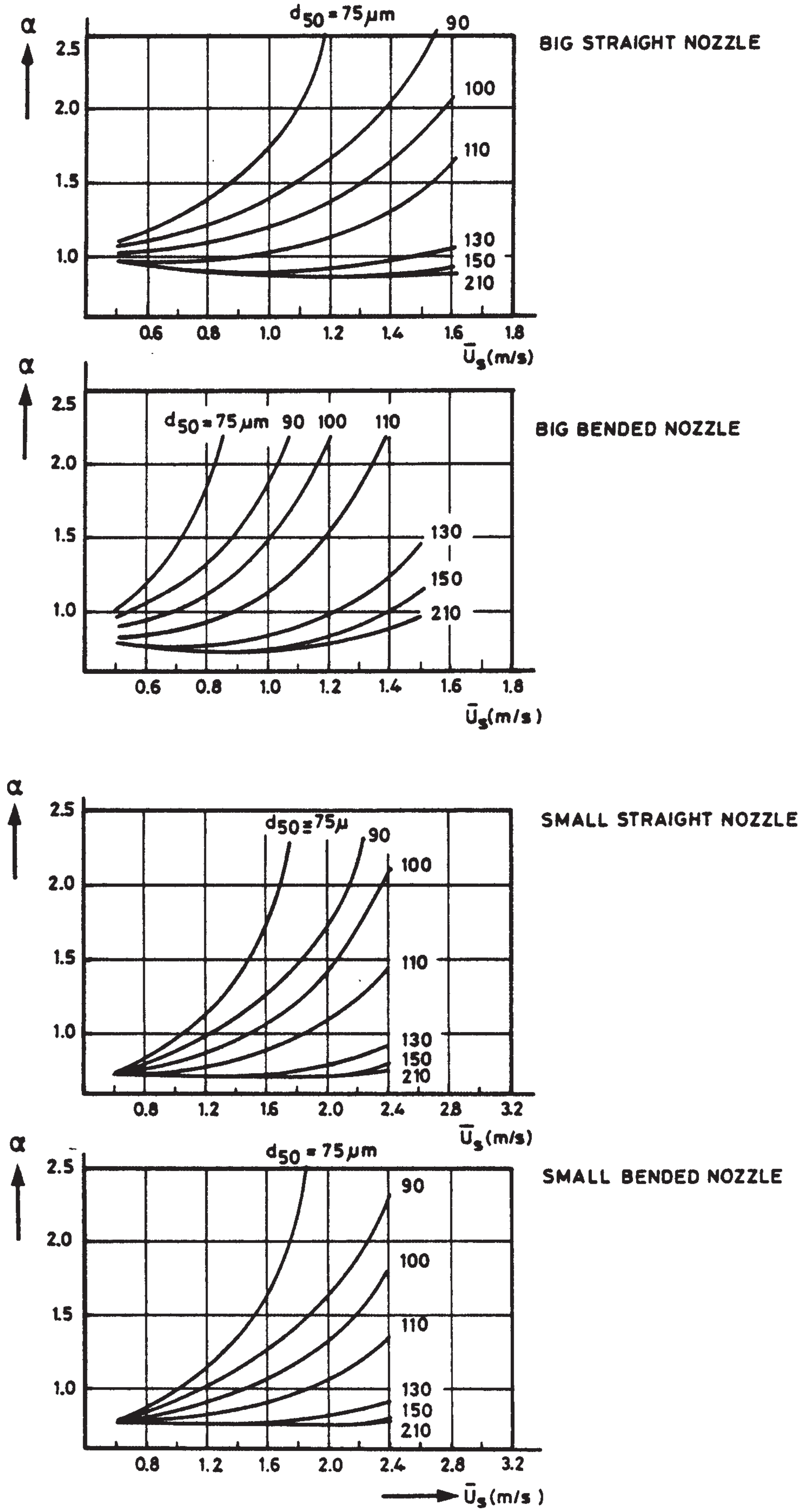

Figure 3 Graphs correction factors Delft bottle type sampler

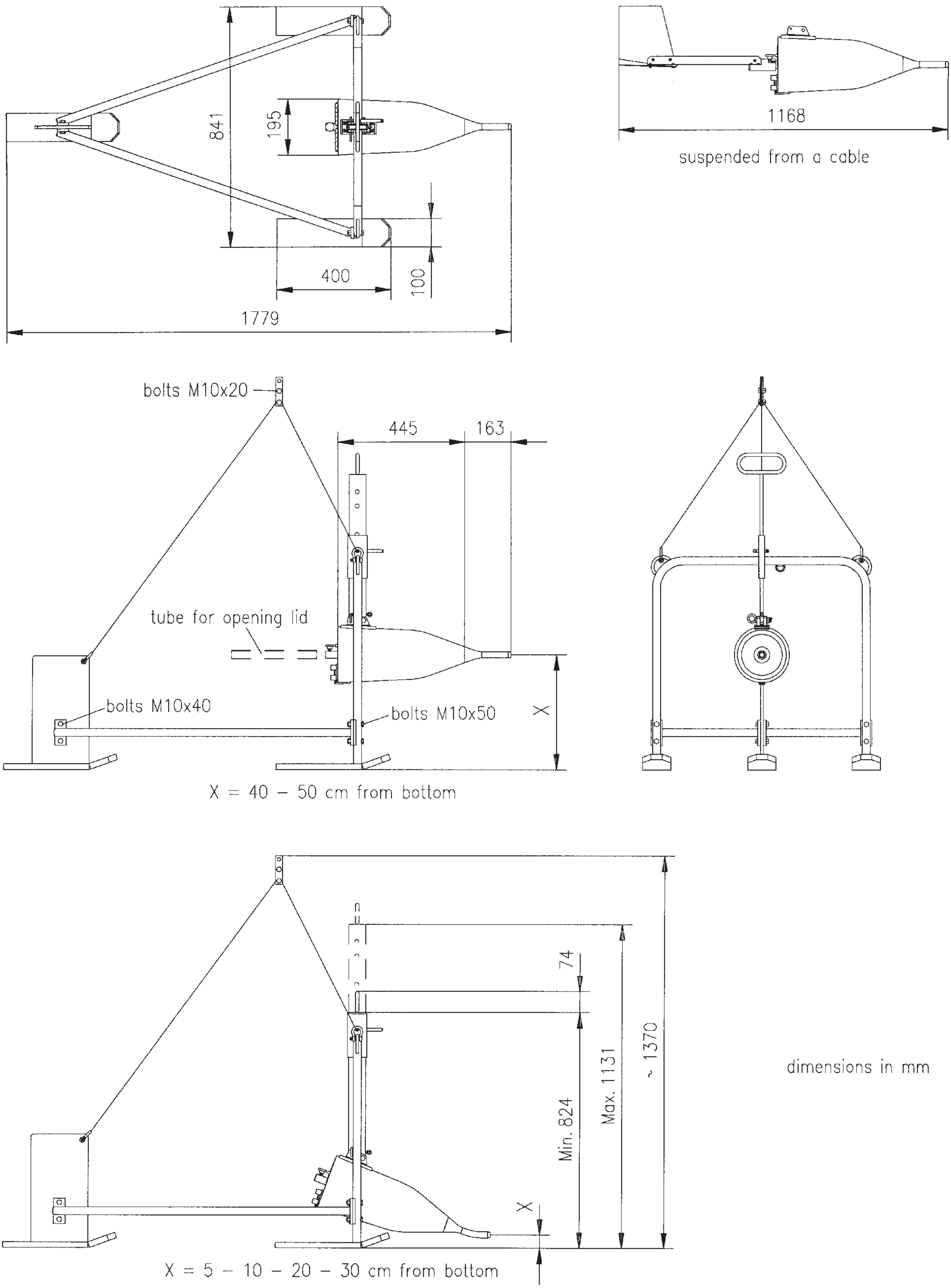

Figure 4 Suspended load sampler Delft bottle type

Measuring Sheet Delft Bottle - Delft Hydraulics Laboratory

Location =	Weather =		Nozzle type =
Date =	Wave Height =	m	Nozzle area = m^2
Survey vessel =	Wind speed =	m/s	
Observer =	Water temperature =	°C	

Local time	Sampling time			Height above bed	Height under water	Water depth	Flow velocity				Sand sample				Correc-tion factor	Sand transport
	lowering	sampling	raising				sampl. period	direc-tion			No.	volume	weight	D_{50}		
(hours)	(min)	(min)	(min)	(m)	(m)	(m)	(min)		(rev/s)	(m/s)		(cm^3)	(kg)	(μm)		(kg/ m^2s)

Figure 5 *Example of measuring form suspended load sampler Delft bottle type*

Technical data can be amended without prior notification.

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