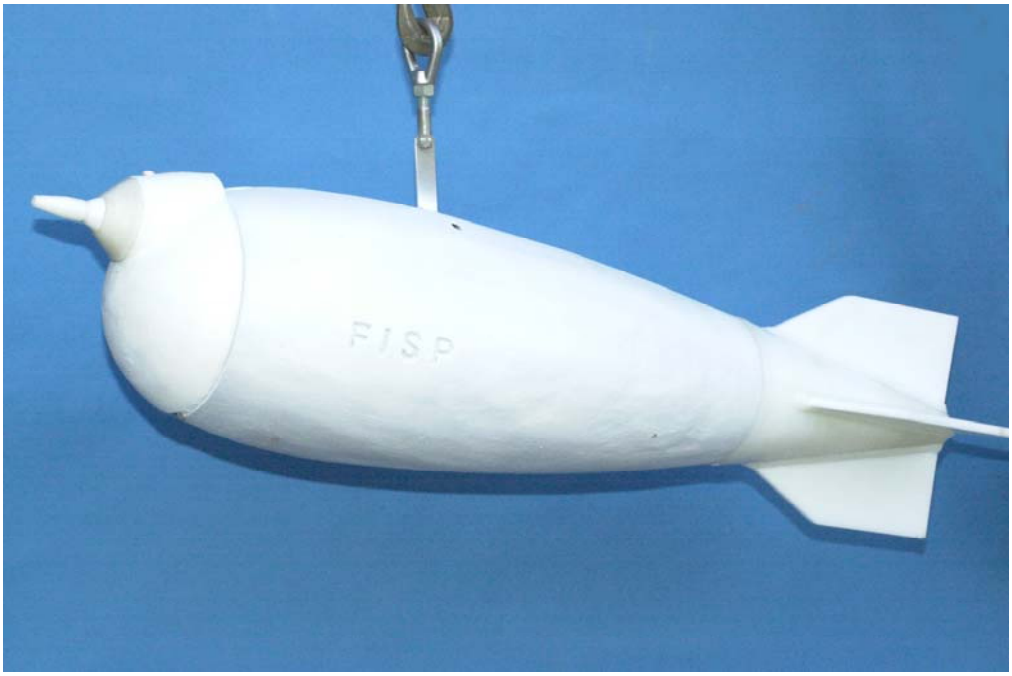
OPERATING INSTRUCTIONS FOR THE US D-99 DEPTH-INTEGRATING COLLAPSIBLE-BAG SUSPENDED-SEDIMENT SAMPLER



Published by

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Operating Instructions for the US D-99 Depth-Integrating Collapsible-Bag Suspended-Sediment Sampler Characteristics

Description: The US D-99 is a collapsible-bag sampler capable of collecting up to a 6-liter sample. It is 41 inches long, weighs 285 pounds, and has a hollow cavity inside the sampler body. It is fabricated from a bronze casting with a High Density Polyethylene (HDPE) tail. Figure 1 is a schematic of the sampler. All metal parts are plastic coated with commercially available "PlastiDip." (The use of brand names is this document is for identification purposes only and does not constitute endorsement by the United States Government.) The sampler employs a hinged head that holds the nozzle holder with nozzle in place. The bag is attached to the nozzle holder with hook and loop type strap.

Sampling container: The sampler employs a 3 or 6-liter bag as the sample container. The perfluoroalkoxy (PFA) and plastic (polyethylene) bags were used during development and testing of the US D-99 sampler.

Sampler function: When the sampler is submerged with the nozzle pointed into the flow, the water sediment mixture flows through the nozzle into the bag at a rate that is the same or nearly the same as the ambient stream velocity.

Operating Parameters

Velocity: The US D-99 sampler will collect acceptable flow-weighted samples in streams with velocities from 2 to 15 feet per second (ft/sec). An acceptable velocity range is one at which a representative flow-weighted sample is collected at a sampler inflow efficiency between 90% and 110%. Inflow efficiency is defined as the ratio of the sample velocity in the nozzle to the ambient stream velocity. An inflow efficiency of 100% is referred to as isokinetic. Based on data collected during inflow efficiency test, it is recommended that the 3-liter bag be used with all samples collected in the velocity range of 2up to 3.5 ft/sec. For samples collected from 3.5-ft/ sec. and up to 15 ft/sec the 6-liter bag should be used. Extreme care should be used at stream velocities above 10 ft/sec.

Depth: At a maximum transit rate of 0.4 times the mean stream velocity, the US D-99 sampler is capable of sampling to a depth of 78 ft with a 5/16-in diameter nozzle, 120 ft with a 1/4-in diameter nozzle, and 220 ft with a 3/16 in diameter nozzle using a 6-liter bag. The sampler is capable of sampling to a depth of 37 ft with the 5/16-in diameter nozzle and 60 ft with the 1/4-in diameter nozzle using the 3-liter bag. The 3/16-in diameter nozzle is not recommended for use with the 3-liter bag

Unsampled zone: The unsampled zone is defined as the distance between the centerline of the nozzle and the bottom of the sampler when resting on the streambed. The US D-99 can sample to within 8 inches of the streambed.

Transit rate: The transit rate is the speed of lowering and raising the sampler in the sampling vertical. The US D-99 is not subject to the same transit rate limitations as rigid bottle samplers. The minimum transit rate is one at which the sample volume does not exceed 6 liters. Table 1 gives the sampling time for the 3 different diameter nozzles at varying stream velocities. The minimum transit rate can be calculated using the sampling time from the table and the total distance to be transited. For example, if the total sampling time is 60 sec, the minimum transit rate should be such that it takes 30 sec to descend from the surface to the bottom, and 30 sec to ascend from the bottom back to the surface. If the stream is 30 ft deep, then the transit rate would be 1 ft/sec.

The maximum transit rate is 0.4 times the mean stream velocity, which is due to the apparent approach angle of the nozzle as it moves vertically in the stream. The transit rate should never exceed 0.4 times the mean stream velocity.

Operating Instructions

The sampler is supplied with a set of plastic and tetrafluoroethylene (TFE) nozzles and nozzle holders. The nozzle holders are stamped "TFE" and "P" to denote the material. The nozzles are also stamped to denote the material and the diameter. In addition, the plastic nozzles have a blue ring for quick identification. The plastic parts should NOT be used when an acid rinse is used in the sampling/cleaning protocol. Only TFE parts should be used when employing an acid rinse.

The US D-99 is simple to use when the following steps are followed:

1. Select the appropriate nozzle and screw it into the nozzle holder.
   Place the nozzle holder in the center of the bag opening as shown in figure 2.

2. "Gather" the open end of the bag around the rear of the nozzle holder between the 2 lugs. Secure the bag by cinching it down between the 2 rear lugs with the hook and loop strap as shown in figure 3.

3. Lay the bag and nozzle holder combination on a flat surface. The top of the shipping box makes an excellent work platform. Fold the bag in half, lengthwise, as shown in figure 4. Starting at the rear of the bag, use one hand to hold the bag, and the other hand to flatten and push all the air out of the bag.

4. Slide the bag into the sampler cavity and nozzle holder into the head as shown in figure 5 and rotate it 180 degrees. It will only go in the nose insert one way. A small 1/16-in diameter air exhaust hole in the nozzle holder should be pointed up and not covered by the bag. Index marks on the nozzle holder and head insert insure proper alignment of the exhaust hole.

5. Once the sample is collected, remove the nozzle holder, and remove the bag containing the sample (figure 6).

Two elements in the instructions are critical to insure isokinetic sampling. (1) As much air as possible must be removed from the bag. (2) The 1/16-inch diameter "pressure equalization hole" should be pointed up, not covered by the bag, and free from any debris. This is extremely important for slow stream velocities in the 2 to 3 ft/sec range. Caution should be used when clearing the hole to insure that it is not enlarged or distorted.

Questions and comments regarding sampler operation should be addressed to:

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Table 1—Sample collection time

VELOCITY FT/SEC	VOLUME IN ML	3/16" NOZZLE TIME IN SECONDS	1/4" NOZZLE TIME IN SECONDS	5/16" NOZZLE TIME IN SECONDS
2.0	3000	N/R *	156	99
2.2	3000	N/R	141	90
2.4	3000	N/R	130	83
2.6	3000	N/R	120	76
2.8	3000	N/R	111	71
3.0	3000	N/R	104	66
3.2	3000	N/R	97	62
3.4	3000	N/R	91	58
3.4	6000	325	185	117
3.6	6000	307	174	111
3.8	6000	291	165	105
4.0	6000	276	157	99
4.2	6000	263	149	95
4.4	6000	251	143	90
4.6	6000	240	136	86
4.8	6000	230	131	83
5.0	6000	221	126	80
5.2	6000	212	121	77
5.4	6000	205	116	74
5.6	6000	197	112	71
5.8	6000	190	108	69
6.0	6000	184	105	66
6.2	6000	178	101	64
6.4	6000	173	98	62
6.6	6000	167	95	60
6.8	6000	162	92	59
7.0	6000	158	90	57
7.2	6000	153	87	55
7.4	6000	149	85	54
7.6	6000	145	83	52
7.8	6000	142	80	51
8.0	6000	138	78	50
8.2	6000	135	77	49
8.4	6000	132	75	47
8.6	6000	128	73	46
8.8	6000	126	71	45
9.0	6000	123	70	44
9.2	6000	120	68	43
9.4	6000	118	67	42
9.6	6000	115	65	41

*Not Recommended

Table 1—Sample collection time

VELOCITY FT/SEC	VOLUME IN ML	3/16" NOZZLE TIME IN SECONDS	1/4" NOZZLE TIME IN SECONDS	5/16" NOZZLE TIME IN SECONDS
9.8	6000	113	64	41
10.0	6000	110	63	40
10.2	6000	108	62	39
10.4	6000	106	60	38
10.6	6000	104	59	38
10.8	6000	102	58	37
11.0	6000	100	57	36
11.2	6000	99	56	36
11.4	6000	97	55	35
11.6	6000	95	54	34
11.8	6000	94	53	34
12.0	6000	92	52	33
12.2	6000	91	51	33
12.4	6000	89	51	32
12.6	6000	88	50	32
12.8	6000	86	49	31
13.0	6000	85	48	31
13.2	6000	84	48	30
13.4	6000	82	47	30
13.6	6000	81	46	29
13.8	6000	80	45	29
14.0	6000	79	45	28
14.2	6000	78	44	28
14.4	6000	77	44	28
14.6	6000	76	43	27
14.8	6000	75	42	27
15.0	6000	74	42	27

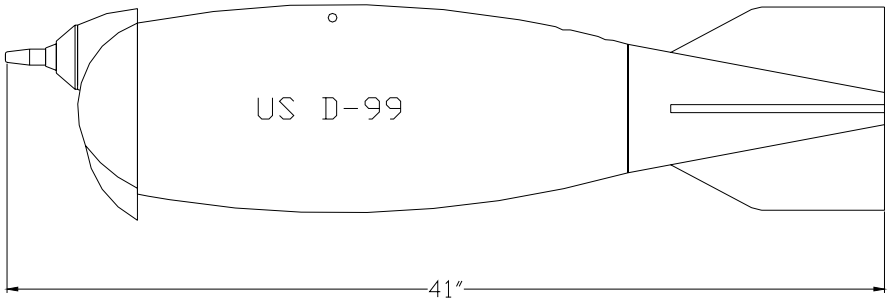

Figure 1 - schematic of US D-99 Sampler

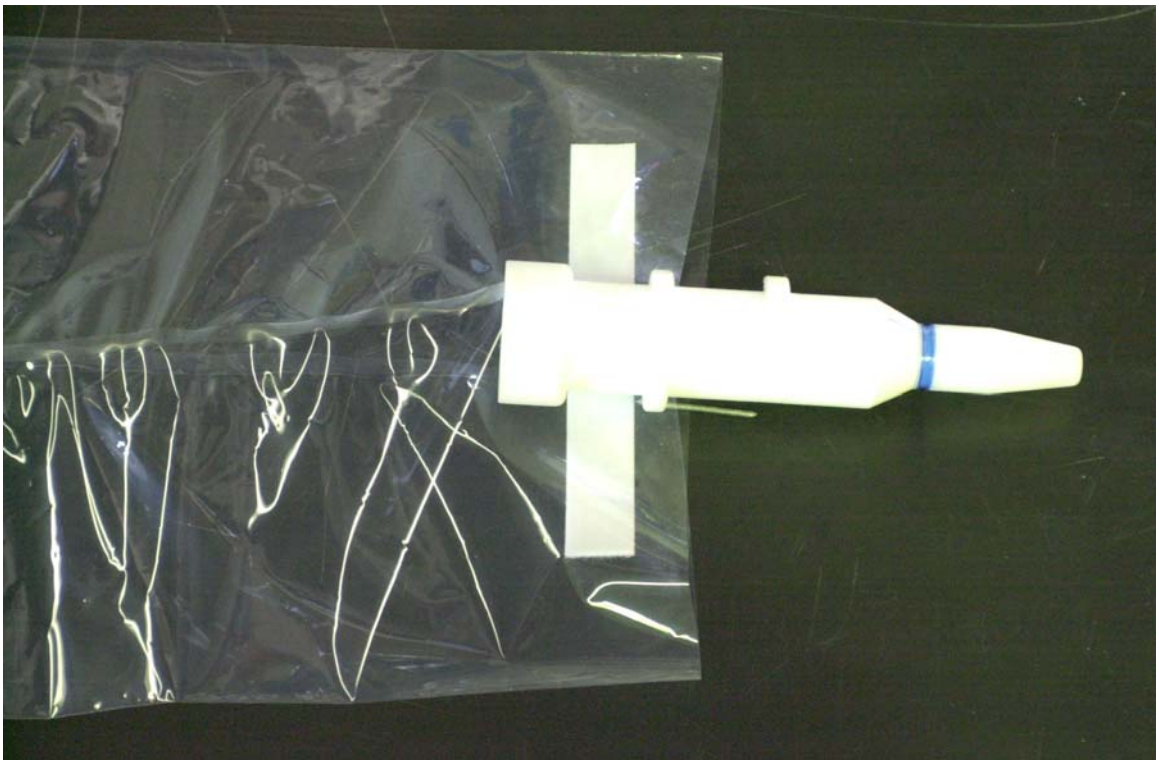

Figure 2 - place nozzle holder in center of bag opening

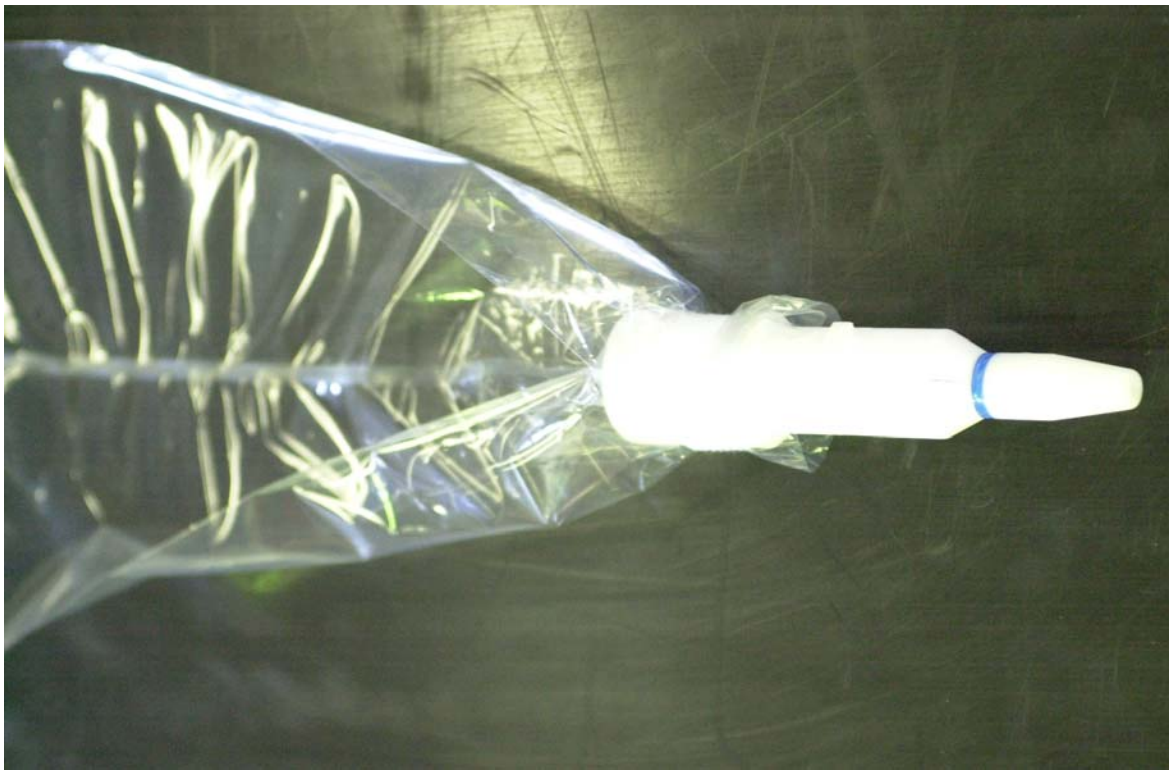

Figure 3 - gather bag between 2 rear lugs

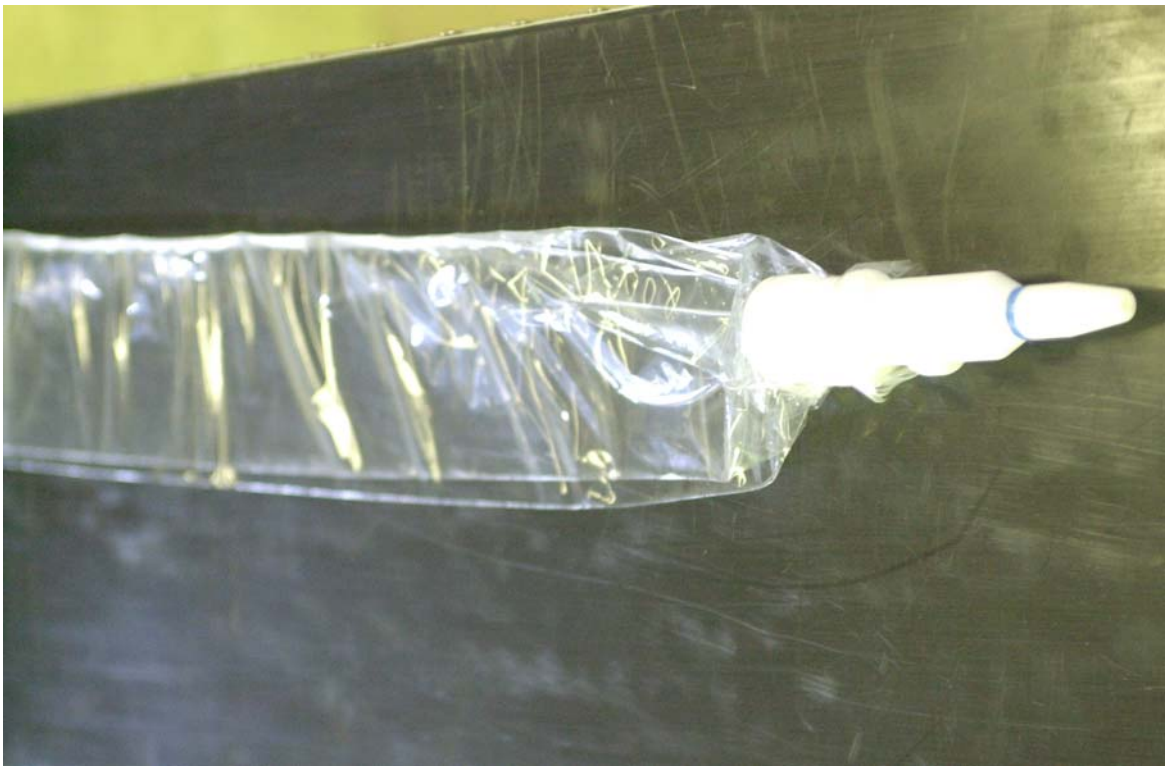

Figure 4 - fold bag lengthwise and push air out

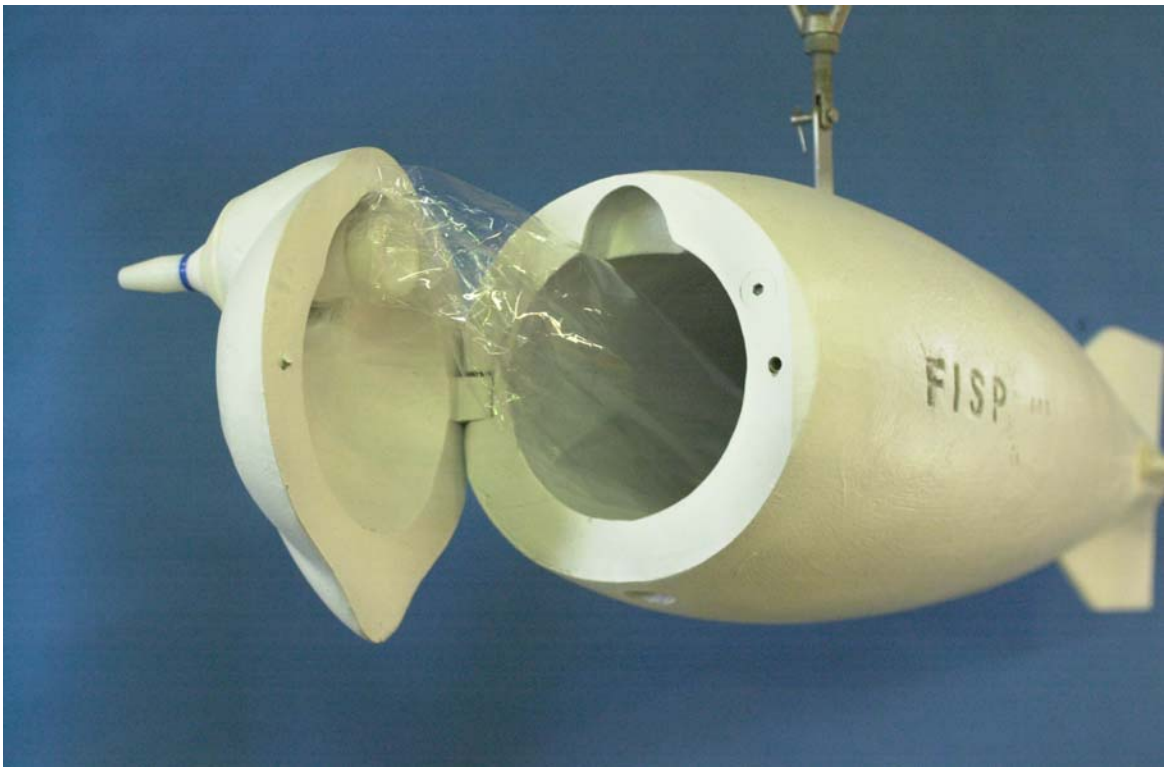

Figure 5 - insert nozzle holder in nose and bag in sampler cavity

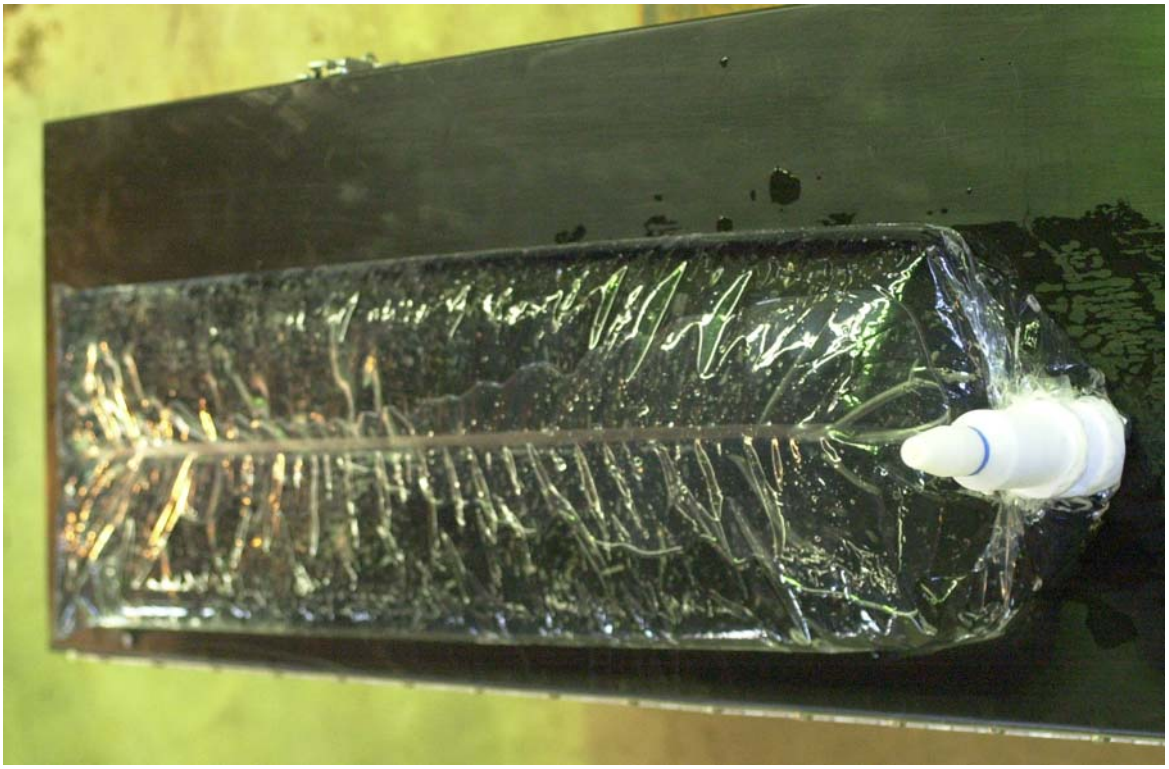

Figure 6 - remove bag from sampler