SA-77
Liquid Accumulator

- **Flow Meter Not Required**
- **Environmentally Friendly**
- **Anti-Spill Interlock**
- **Two Moving Parts**
- **Extremely Low Maintenance Cost**
- **Single and Multi-Stroke Versions Available**

The Premium Liquid Sampler

Meeting the needs of Industry
One Sample at a Time
Oil and Gas; Water Treatment; Waste Treatment and More

Ph: 1-800-667-7993

SA-77 Liquid Sampler: Drawings and Parts List
Ph: 1-800-667-7993

Specifications:

Materials: All wetted parts are 316 SST, Delrin, Viton (&/or Aflas).

Operating Pressure: Standard Max: 750 psi (5171 kPag)
High Pressure Option: 1440 psi (9928 kPag)

Receivers: 1.8 L HDPE or 1.8 L Glass

Operating Temperature: Standard Max: 200 F (93 C)
High Temp Option: 350 F (175 C)

Operating Signals: Pneumatically Powered
Single Stroke: Level Control Output: 3-15 psi or 6-30 psi
Multi Stroke: Fixed Supply of 5 to 20 psi or Level Controller Output

Mounting: Standard: 2" Pipe Mount or Wall Mount

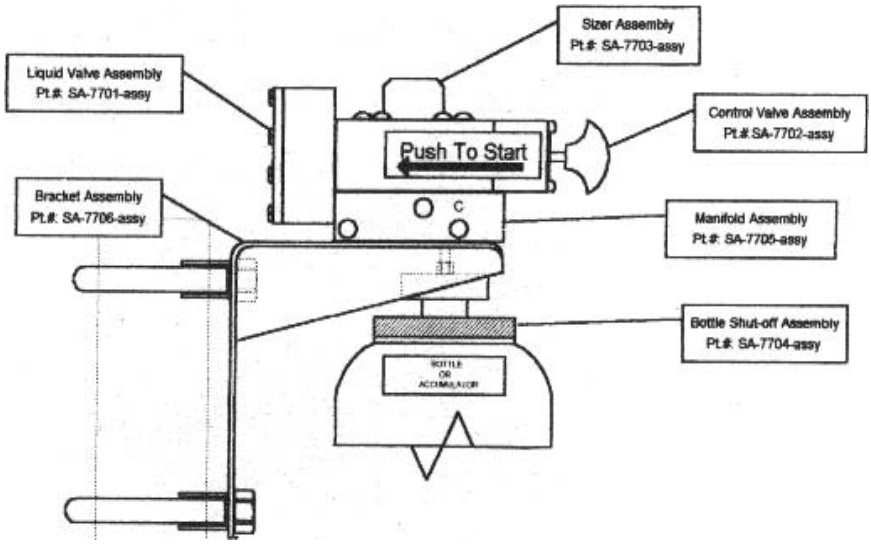
Dimensions: 9.25" x 8.00" approximately (without receiver)

Sample Size: 0.65 - 5.75 cc per cycle

Weight: 7 lbs; or 18 lbs shipped.

Single Stroke **Multi-Stroke**

Installation:



Mounting

- Using the 2 pipe clamps (supplied) mount on a 2" vertical or horizontal pipe.
- Or use lag screws (not supplied) to mount to wall.

Supply or Signal Connection (on the left side of the Manifold Assembly)

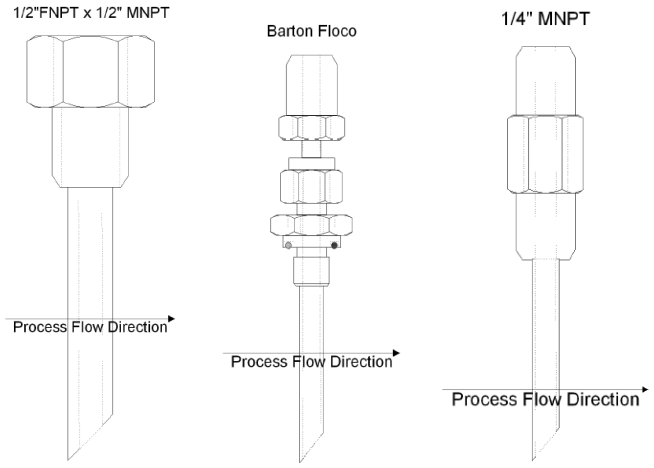
- For the Multi-Stroke models connect a clean instrument supply of 5 to 20 psi to the 1/8" NPT port on the Accumulator's manifold marked "C" or "Control". (Supply may also come from the level controllers output)
- For the Single-Stroke models connect the "C" or "Control Signal" port to the separator level controller's output.

Process or Sample In Connection (on the right side of the Manifold Assembly)

- For both models tube your connection for the process to be sampled to the 1/8" NPT port on the Accumulator marked "S" or "Sample In".

Sample Probe Installation (Industry Best Practice Sharing)

- Probe weld-o-lets should be placed on the side of the pipe at center, so the probe quill sits in the horizontal plane.
- If the choice is available mount in vertical piping flowing upwards.
- Always pull the sample from between the associated meter and the level control valve.
- Mount Sampler as close as possible to sample point, keeping sample tubing as level and short as possible.
- Install a low cracking pressure check valve in the sample line at the probe block valve. When the sample line has a slope in it this check valve will prevents sample stratification which allows oil or water to rise or fall back into the dump/meter leg causing an error in water cut value.
- Use full port valves in the sample line, not restrictive needle valves.
- Use ¼" tubing to keep sample line volume low.



Bore through and custom probes are also available.

Operation:

Run / Stop (*See General Overview Drawing this page- Control Valve)*

- To start the Accumulator push the knob in. To stop the Accumulator pull the knob out. Note: when the Accumulator's jar is full, pressure from the sample line will push this knob out and stop the Accumulator.

Sample Size Adjustment (*See General Overview Drawing on this page)*

- The Accumulator can be adjusted to change the size of sample taken in each stroke. To increase the size of the sample per cycle, adjust the Sizer Assembly out.

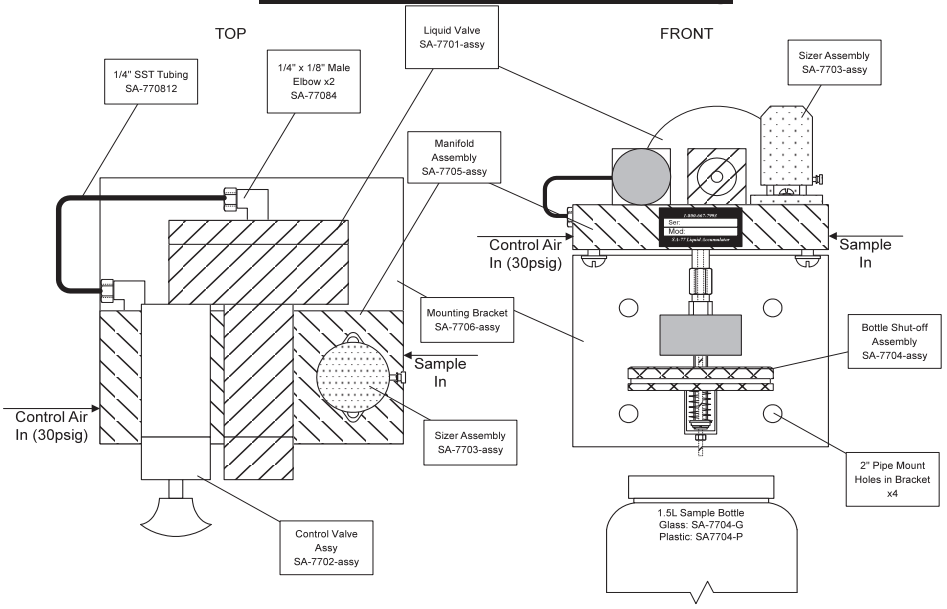
Cycle Time Adjustment - Multi-Stroke Series Only (*See drawing & parts reference on page 10; item 2)*

- To adjust the time period of the Accumulator's cycle use the metering valve that feeds supply pressure to the volume bottle and the oscillating relay. Opening this valve will speed up (shorten) the cycle time.

Bottle Shut-off Adjustment *(See drawing & parts reference on page 9; items 5, 8 & 9)*

- Loosen Lock Nut (item 8) and adjust the Valve Stem (item 9) in relation to Cage Housing (item 5) until proper shut-off occurs. *The more stem sticking out past the lock nut the less sample required to shut off the assembly.*

General Overview Drawing



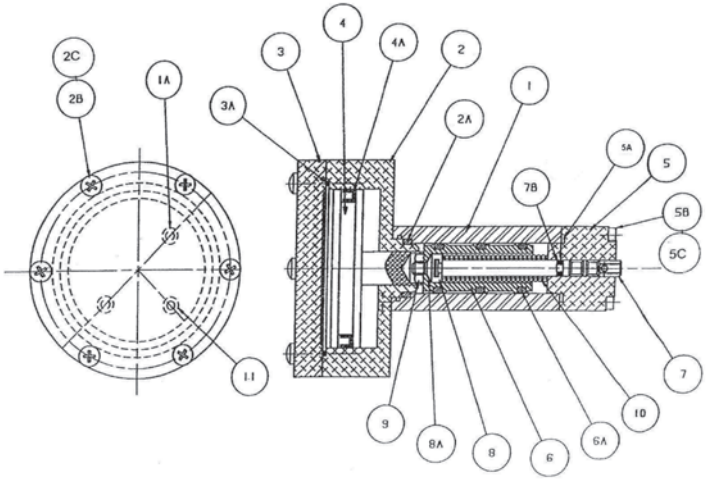
SA-77 Liquid Sampler: Drawings and Parts List

Ph: 1-800-667-7993

SA-77 Liquid Valve Assembly Part Number: SA-7701ASSY

Item	Description	Material	Part No.	Qty.
1	Valve Block -Liquid Valve	SST	SA-77011	1
1A	Screw 6-32 x 318”	SST	SA-77011A	2
2	Liquid Valve Piston Chamber	Anodized Al.	SA-77012	1
2A	0-ring Piston Chamber to Body	Nitrile/Aflas	SA-77012A	1
2B	Screw 8-32 x 3/4”	SST	SA-77012B	6
2C	# 8 Lock Washer	SST	SA-77012C	6
3	Liquid Valve Piston Cover	Anodized Al.	SA-77013	1
3A	0-ring-Liquid Valve Piston Cover	Viton/Aflas	SA-77013A	1
4	Liquid Valve Actuator Piston	Anodized Al.	SA-77014	1
4A	Liquid Valve Piston U-cup	Viton	SA-77014A	1
5	End Block	SST	SA-77005	1
5A	End Block Seal 0-ring	Viton/Aflas	SA-77005A	1
5B	End Block Mtg. Screw 6-32 x 1”	SST	SA-77005B	2
5C	End Block Mtg. Lock Washer	SST	SA-77005C	2
6	Valve Spool	Delrin	SA-77006	1
6a	0-ring Seal , Spool Assembly	Viton/Aflas	SA-77006A	3
7	Valve Spindle	SST	SA-77007	1
7B	Seal for Valve Spindle, O-ring	Viton/Aflas	SA-77007B	1
8	Spindle Retainer	SST	SA-77008	1
8A	Seal for Retainer, O-ring	Viton/Aflas	SA-7708A	1
9	Spindle Retainer Lock Nut	SST	SA-77009	1
10	Liquid Valve Return Spring	Spring Metal	SA-770110	1

Liquid Valve Assembly Drawing



SA-77 Liquid Sampler: Drawings and Parts List

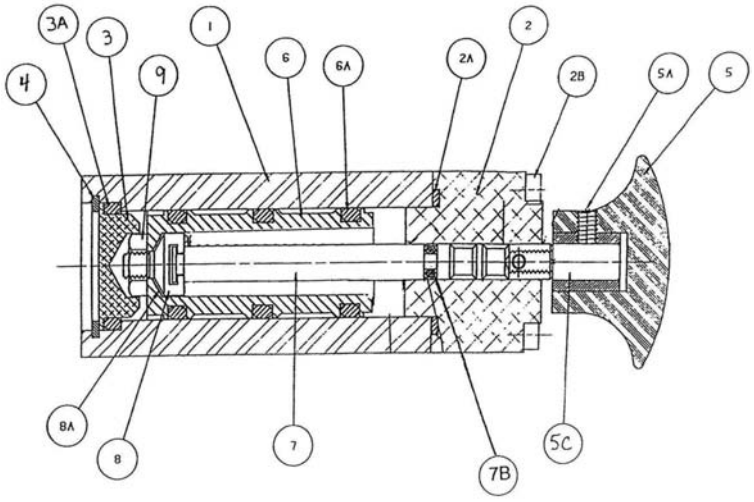
Ph: 1-800-667-7993

SA-77 Control Valve Assembly Part Number: SA-7702ASSY

Item	Description	Material	Part No.	Qty.
	Valve Block(Control)			
I	Start/Stop	SST	SA-77021	1
2	End Block - 316 Sst	SST	SA-77005	1
2A	End Block Seal	Viton/Aflas	SA-77005A	1
2B	End Block Mtg.Screw 6-32x1"	SST	SA-77005B	2
2C	End Block Mtg. Lock Washer	SST	SA-77005C	2
3	End Plug	SST	SA-77023	1
3A	End Plug Seal	Viton/Aflas	SA-77023A	1
4	Snap Ring For End Plug	SST	SA-77024	1
5	Knob, Start/Stop 117-32	Polyethylene	SA-77025	1
5C	Control Valve Knob Adapter	SST	SA-77025C	1
6	Valve Spool -Delrin	Delrin	SA-77006	1
6A	O-Ring Seal, Spool Assy	Viton/Aflas	SA-77006A	3
7	Valve Spindle	SST	SA-77007	1
7B	Seal For Valve Spindle	Viton/Aflas	SA-77007B	1
8	Spindle Retainer	SST	SA-77008	1
8A	Seal For Retainer	Viton/Aflas	SA-77O08A	1
9	Spindle Retainer	SST	SA-77009	1
	Label Push To Start	Vinyl Sticker	SA-77027	1

Due to new revisions item 5A is no longer used. Item 5 is threaded to receive item 5c which is now threaded on both ends.

Control Valve Assembly Drawing



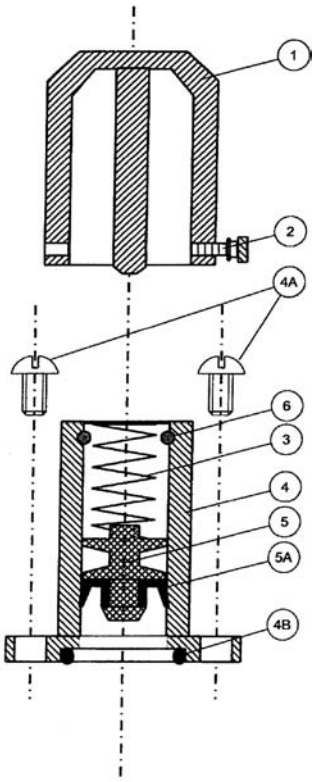
SA-77 Liquid Sampler: Drawings and Parts List

Ph: 1-800-667-7993

SA-77 Sizer Assembly Part Number: SA-7703ASSY

Item	Description	Material	Part No.	QTY.
I	Sizer Adjusting Cap	SST	SA-77031	1
2	Sizer Cap Thumb Screw	Brass	SA-77032	1
3	Sizer Piston Spring	SST	SA-77033	1
4	Sizer Body	SST	SA-77034	1
4A	Sizer Mtg Screw Hex Socket	SST	SA-77034A	2
4B	Sizer Mounting Seal Oring	Viton	SA-77034B	1
5	Sizer Piston	Brass	SA-77035	1
5A	Sizer Piston U-Cup Seal	Buna	SA-77035A	1
6	Sizer Piston Retainer Ring	SST	SA-77036	1

Sizer Assembly Drawing



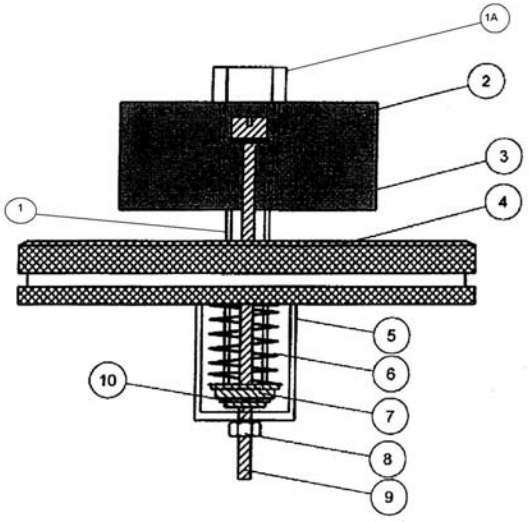
SA-77 Liquid Sampler: Drawings and Parts List

Ph: 1-800-667-7993

Weight Actuated Shutoff-Plastic Assembly Part Number: SA-7704ASSY

Item	Description	Material	Part #	Qty.
1	Valve Body	SST	SA-77041	1
1A	Valve Body Bushing;3/8-1/4	SST	SA-77041A	1
2	Stem Seal Oring	Viton	SA-77043A	1
3	Rain Cap Guard	Polyurethane	SA-77042	1
4	Lid Aluminum-Bottle Holder	Anodized Al.	SA-77044	1
5	Cage Housing	Cast SST	SA-77045	1
6	Spring	SST	SA-77046	1
7	Support Bushing	SST	SA-77047	1
8	Adjusting Lock Nut	SST	SA-77048	1
9	Valve Stem	SST	SA-77043	1
10	Retaining Ring, C-clip	SST	SA-77049	1
Not Shown:				
	Plastic Sample Receiver Jar	Plastic	SA-7704PJAR	
	Glass Sample Receiver Jar	Glass	SA-7704GJAR	

Weight Actuated Shutoff Drawing



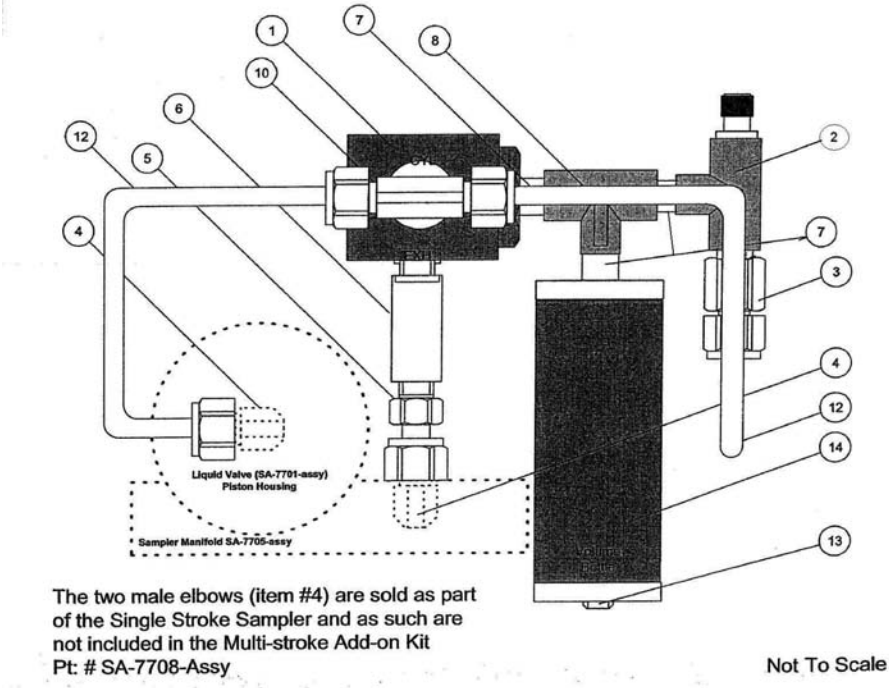
SA-77 Liquid Sampler: Drawings and Parts List

Ph: 1-800-667-7993

SA-77 Oscillator Assembly Part Number: SA-7708ASSY

Item	Description	Part No.	Qty
1	Humphrey Relay Valve	SA-77081	1
2	1/8"P Adjustable Flow Check Valve	SA-77082	1
3	1/4"TX1/8"P Female Connector	SA-77083A	1
4	1/4"T x1/8"P Male Elbow	SA-77084	2
5	1/4" Male Tube Adapter	SA-77085	1
6	Restrictor M/F for Osc. Inlet	SA-77086	1
7	1/8" Close Nipple	SA-77087	3
8	1/8" Female Pipe Tee	SA-77088	1
10	1/4"T x 1/4"P Male Branch Tee	SA-770810	1
12	1/4" SST Tubing	SA-770812	~1ft
13	1/8" Pipe CTRSK Hex Head Plug	SA-770813	1
14	Volume Bottle	SA-7708VB	1

SA-77 Oscillator Assembly

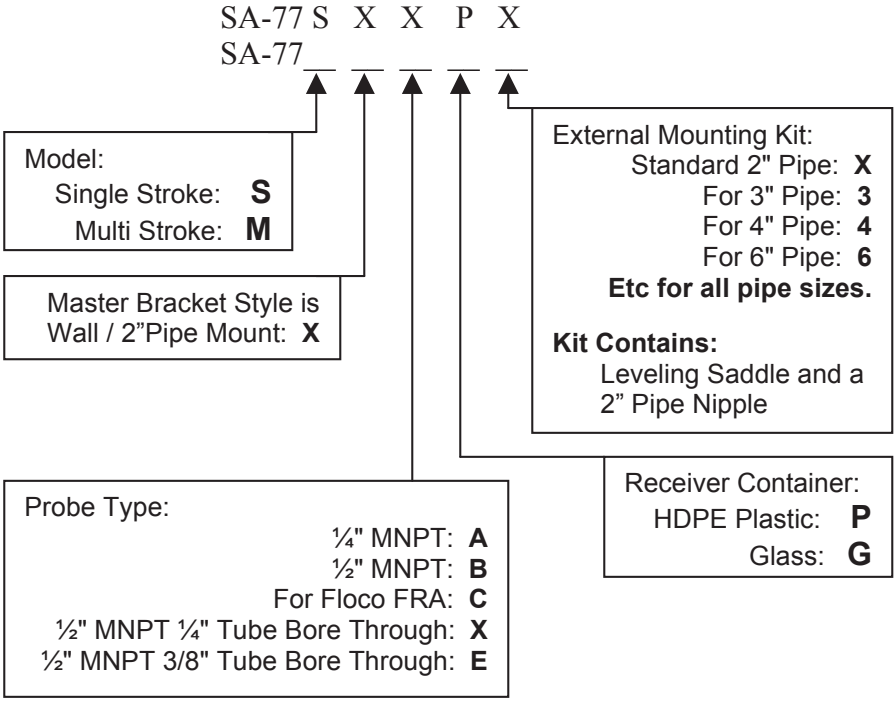


The two male elbows (item #4) are sold as part of the Single Stroke Sampler and as such are not included in the Multi-stroke Add-on Kit Pt: # SA-7708-Assy

Not To Scale

Ordering Information

Example: SA-77SXAPX



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- ☐ Custom Made Requirements

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We are the Manufacturer or Exclusive Canadian Importer of many of these products. Those not exclusive to us have featured purchasing arrangements that allow us to offer our customers the best possible pricing.

Volume Equivalents

Note: Use Multiplier at Convergence of Row and Column	Cubic Deci-meters (Liters)	Cubic Inches	Cubic Feet	U.S. Quart	U.S. Gallon	Imperial Gallon	U.S. Barrel (Petro–leum)
Cubic Decimeters (Liters)	1	61.0234	0.03531	1.05668	0.264178	0.220083	0.00629
Cubic Inches	0.01639	1	5.787×10^{-4}	0.01732	0.004329	0.003606	0.000103
Cubic Feet	28.317	1728	1	29.9221	7.48055	6.22888	0.1781
U.S. Quart	0.94636	57.75	0.03342	1	0.25	0.2082	0.00595
U.S. Gallon	3.78543	231	0.13368	4	1	0.833	0.02381
Imperial Gallon	4.54374	277.274	0.16054	4.80128	1.20032	1	0.02877
U.S. Barrel (Petroleum)	158.98	9702	5.6146	168	42	34.973	1

1 cubic meter = 1,000,000 cubic centimeters.
1 liter = 1000 milliliters = 1000 cubic centimeters.

Volume Rate Equivalents

Note: Use Multiplier at Convergence of Row and Column	Liters Per Minute	Cubic Meters Per Hour	Cubic Feet Per Hour	Liters Per Hour	U.S. Gallon Per Minute.	U.S. Barrel Per Day
Liters Per Minute	1	0.06	2.1189	60	0.264178	9.057
Cubic Meters Per Hour	16.667	1	35.314	1000	4.403	151
Cubic Feet Per Hour	0.4719	0.028317	1	28.317	0.1247	4.2746
Liters Per Hour	0.016667	0.001	0.035314	1	0.004403	0.151
U.S. Gallon Per Minute	3.785	0.2273	8.0208	227.3	1	34.28
U.S. Barrel Per Day	0.1104	0.006624	0.23394	6.624	0.02917	1

Water-Cut (BS&W) Procedure

Obtaining accurate water-cut (BS&W) percentage during well proration testing is an important aspect of oil well measurement and accounting because it directly affects the oil volume determination. However, it is one that is frequently overlooked. In some cases, well test liquids are easily separated using standard procedures, such as adding a small amount of demulsifier and spinning the sample in a centrifuge, as discussed later in this section. Other situations (such as very high water cuts or tight emulsions) require additional effort to achieve accurate results. Due to varying BS&W ranges, water-cut procedures have been divided into three categories, which are described on the following pages. Note that these procedures are not considered enforceable EUB (ERCB) regulations but are recommended for well test applications in their own Audit Handbook Directive 46.

For further reference, BS&W determination is discussed in more detail in the API MPMS, Chapter 10, Section 4: Determination of Sediment and Water in Crude Oil by the Centrifuge Method (Field Procedure).

See the following pages for each of the three procedures:

- **For 0% to 10% BS&W**
- **For 10% to 80% BS&W**
- **For 80% to 100% BS&W**

Water-Cut (BS&W) Procedures (cont.)

For 0% to 10% BS&W

1. Obtain a representative sample of liquid (minimum 500 ml). Sample should be taken as close to the test meter as possible.

2. Shake the sample inside the container vigorously to ensure a good mix prior to pouring into centrifuge tubes.

3. Fill each of two centrifuge tubes with the sample; to the 50 ml mark in 100 ml tubes or to the 100 ml mark in 200 ml tubes (read the top of the meniscus)

4. Add solvent (toluene, varsol, etc.) to bring the level in the tubes to 100 ml or 200 ml respectively (solvent should be water saturated at 60°C).

5. Add demulsifier as required. Stopper the tubes and shake vigorously to ensure a good mix. Heat the samples to 60°C or treater operating temperature before spinning.

6. Place the sample tubes in the centrifuge on opposite sides to create a balanced condition. Spin for at least 5 minutes.

7. Compare the results from each tube. If the two results are not the same, return the tubes to the centrifuge and spin again for at least 5 minutes (do not shake the tubes at this stage). Repeat this operation, and if the samples still do not match after two more spins, discard this sample and take another one.

8. Read & record the volume of water and sediment in the bottom of each tube.
   a. For 100 ml tubes, read to the nearest 0.05 ml from the 0 to 1 ml graduations and to the nearest 0.1 ml above the 1 ml graduation mark.
   b. For 200 ml tubes, read to the nearest 0.05 ml from the 0 to 3 ml graduations, to the nearest 0.25 ml between the 3 and 5 ml graduations, and to the nearest 0.5 ml above the 5 ml graduation mark.

9. For 100 ml tubes, water cut is determined by adding the results of both tubes together.

10. When using 200 ml tubes, water cut is determined by reading the results directly from one tube.

See example on next page

Example 1

100 ml centrifuge tube	200 ml centrifuge tube
Reading from each tubes = 0.50 ml	Reading from each tube = 1.00 ml
Water cut = (0.50 + 0.50) / 100 = 1.0 %	Water cut = 1.00 / 100 = 1.0 %

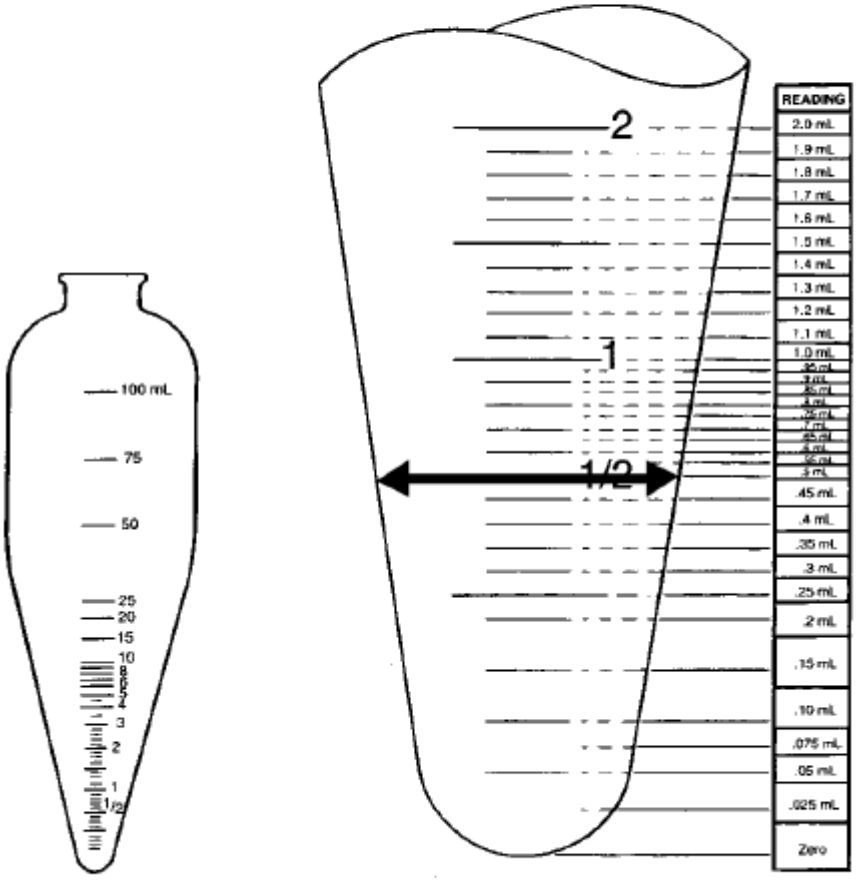

Figure 1. Reading a 100 ml centrifuge tube

Water-Cut (BS&W) Procedures (cont.)

For 10% to 80% BS&W

1. Obtain the maximum representative sample of liquid feasible (between 800 and 1000 ml).

2. Transfer the entire sample into an adequately sized graduated cylinder. (Mason jars will not provide adequate results.)

3. Place the graduated cylinder into a heat bath at approximately 60°C (or as close to treater temperature as possible) until the sample temperature and free water fallout have stabilized. A clear oil/water interface should be visible.

4. Read and record the total volume, volume of free water, and volume of oil in the graduated cylinder.
    a. Calculate the free water percentage as follows:

Percentage of free water =
Volume of free water / Total volume x 100%

5. Using a burette filler, draw 100 ml from the oil portion in the graduated cylinder and fill each of two centrifuge tubes exactly to the 50 ml mark. Add heated solvent to bring the level in the tubes to exactly the 100 ml mark. Add demulsifier as required.

6. Follow the procedure outlined for spinning samples of 0% to 10% water cut.

7. Once the centrifuge has stopped, read and record the volume of water and sediment in the bottom of each tube. The combined results will be the water cut of the emulsion.
    a. Calculate the percentage of water remaining as follows:

Percentage of water remaining =
Total oil volume in cylinder x Water cut of oil / Total volume

Calculate the total water-cut percentage as follows:

Total water-cut percentage =
Percentage of free water + Percentage of water Remaining

See example 2 on next page

Example 2
1000 ml graduated cylinder

Percentage of free water = 600 ml / 900 ml x 100% = **66.7%**

Percentage of water remaining = 300 ml / 900 ml x 10%* = **0.33%**

* Water cut of oil portion determined by spinning samples

Water-cut percentage = 66.7% + 0.33%= **67.03%**

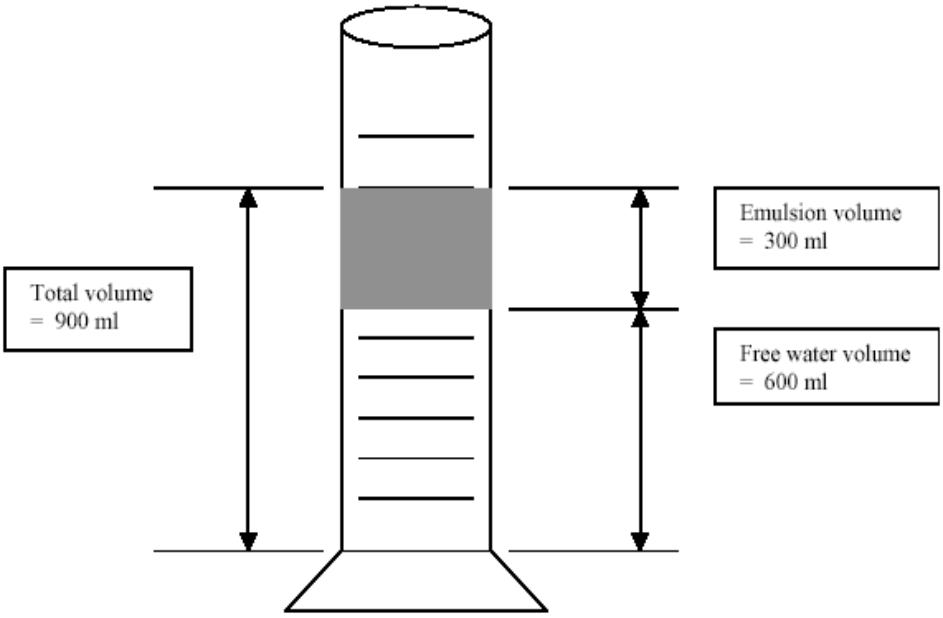

Figure 3. Water cut = 10% to 80%

Water-Cut (BS&W) Procedures (cont.)

For 80% to 100% BS&W

1. Obtain the maximum representative sample of liquid feasible (between 800 and 1000 ml).

2. Transfer the entire sample into an adequately sized graduated cylinder. (Mason jars will not provide adequate results.) For very high water-cut wells, it may be necessary to wash out the inside of the sample container with a measured volume of solvent to ensure that all of the oil is removed. If this is done, it is necessary to account for the additional amount of solvent added when calculating water cut.

3. Place the graduated cylinder into a heat bath at approximately 60°C (or as close to treater temperature as possible) until the sample temperature and free water fallout have stabilized. A clear oil/water interface should be visible.

4. Read and record the total volume and volume of free water in the graduated cylinder.

Calculate the water-cut percentage as follows:

Water-cut percentage =
Volume of free water / Total volume x 100%

If solvent is added to the sample at any stage of this procedure, it must be accounted for in the calculation as follows:

Water-cut percentage =
Volume of free water / (Total volume-Volume of solvent)x 100%

The oil portion of the samples does not have to be spun due to the limited amount of the oil portion of the sample available.

Recommended Rates and Pressure Drops for Liquid Meters

When evaluating fluid measurement systems, it is important to first determine if the control or dump valve is a snap-acting type valve. By having snap-acting control, as well as having a properly designed separator system, the meter will immediately get up into the recommended operating range of approximately 30% to 70% of the meter capacity.

Each meter manufacturer guarantees a specific accuracy range for a given meter provided that the recommended flow rates and pressure drops are adhered to. The following two tables and chart list several meters currently in service for oilfield production measurement. The manufacturer's recommended flow rates and pressure drops are indicated. If the meter is not on the list, record the meter type, size, model, and serial number and call the manufacturer or local representative for that information.

Table 1. Positive Displacement Meters

Type	Size (inches)	Flow rate (m^3/day)	Oil and water pressure drop (psi) Min - Max	Condensate pressure drop Min – Max	Flow rate (L/10 sec) Min - Max
	1 ½ – 2	133.5 – 686	.02 – 2.5	Not recommended	15 – 79.5
AO Smith	2 ½ – 3	305 - 1525	.02 – 4.5		35.5 – 176.5
Mock & Floco					
500#	1 – 2	32 – 326	1.0– 15.0	3 – 15	3.7 – 38.0
500 – 2500#	3	49 – 490	.5 – 6.0	3 – 15	5.6 – 56.0
2500 – 5000#	1	32 – 326	1.5 – 15.0	3 – 15	3.7 – 38.0
2500#	2	32 - 326	1.0 – 15.0	3 - 15	3.7 – 38.0
Flotrac	1 – 306	23 – 476	2.5 – 50.0	2.5 – 50.0	2.6 – 55.0
	1 - 380	8 - 81	1.5 – 45.0	1.5 – 45.0	1.0 – 9.0
Brooks (Red)	1 – 793	26 – 286	1.0 – 20.0	3 – 15	3.0 - 33
(Black)	1 – 792	7.9 - 108	1.0 – 5.0	1 – 15	.1 – 13
Neptune	5/8	11 – 109	Not available	Not recommended	1 – 12
	¾	16 – 164			2 – 18
	1	27 – 271			3 – 31
	1 ½	55 – 545			6 – 63
	2	87 - 872			10 – 100

Table 2. Turbines

METER TYPE	METER SIZE	AVERAGE K-FACTOR (pulses/gal)	AVERAGE K-FACTOR (pulses/m^3)	FLOW RATE (GPM) Min	FLOW RATE (GPM) Max	FLOW RATE (BPD) Min	FLOW RATE (BPD) Max	FLOW RATE (LPM) Min	FLOW RATE (LPM) Max	FLOW RATE (m^3 PD) Min	FLOW RATE (m^3 PD) Max
Blancett	3/8"	15364	4059169	0.3	3.00	10.3	102.9	1.14	11.36	1.5	16.4
	1/2"	11145	2944509	0.75	7.50	25.7	257.1	2.84	28.39	4.1	40.9
	3/4"	3033	801309	2.0	15.0	68.6	514.3	7.57	56.73	10.9	81.8
	7/8"	3047	805007	3.0	30.	102.9	1328.6	11.36	113.55	16.4	163.5
	1"	847.04	223788	5.0	50.0	171	1714	18.93	189.25	27.3	272.5
	1-1/2" & 2"	318.42	84027	15	180	514	5171	57	681	81.8	981.1
	2"	46.23	12214	40	400	1371	13714	151	1514	218.0	2180.2
	3"	51.46	13596	60	600	2057	20581	227	2271	327.0	3270.2
	4"	30.13	7960	100	1200	3429	41143	379	4542	545.0	6540.5
	6"	7371	1947	200	2500	6857	85714	757	9463	1090.1	13626.0
	8"	3014	796	250	3500	8571	120000	946	13248	1362.6	19076.5
	10"	1643	434	500	5000	17143	171429	1893	18925	2725.2	27252.1
Cliff Mock	1"	860.02	227218	5.0	50.0	171	1714	18.93	189.25	27.3	272.5
	1-1/2"	325.01	85867	15	180	514	6171	57	681	81.8	981.1
	2"	53.00	14003	40	400	1371	13714	151	1514	218.0	2180.2
	3"	56.00	14796	50	600	2057	20571	227	2271	327.0	3270.2
	4"	29.00	7662	600	1200	3429	41143	379	4542	545.0	5540.5
Daniels	3/4"	940.42	248458	3.9	28.8	132.1	987.6	14.58	109.03	21.0	157.0
	1"	570.25	150660	6.0	60.0	206	2057	22.71	227.08	32.7	327.0
	1-1/2"	140.05	37000	14.9	129.9	510	4454	56	492	81.0	708.0
	2"	115.05	30396	25.0	224.8	656	7706	94	851	136.0	1225.0
Halliburton	3/8"	20001	5234137	0.30	3.00	10.3	102.9	1.14	11.36	1.6	16.4
	1/2"	13000	3434689	0.75	7.50	25.7	257.1	2.84	28.39	4.1	40.9
	3/4"	3000	792621	2.0	15.0	68.6	514.3	7.57	56.78	10.9	81.8
	7/8"	1601	423000	3.0	30.0	102.9	1028.6	11.36	113.55	16.4	153.5
	1"	920.02	243070	5.0	50.0	171	1714	18.93	169.25	27.3	272.5
	1-1/2"	330.01	87177	15	180	514	6171	57	681	81.8	981.1
	2"	55.00	14531	40	400	1371	13714	151	1514	218.0	2180.2
	3"	57.00	15060	60	600	2057	20571	227	2271	327.0	3270.2
	4"	29.00	7662	100	1200	3429	41143	379	4542	545.0	6540.5
	6"	7.37	1947	200	2500	6857	85714	757	9463	1090.1	13526.0
	8"	3.01	796	350	3500	12000	120000	1325	13248	1907.6	19076.5
Hydril	1/2"	12000	3170482	0.72	7.28	25	250	2.71	27.57	3.9	39.7
	3/4"	3200	845462	2.0	15.0	66	515	7.50	56.81	10.8	81.8
	1"	860.03	253639	5.0	49.5	170	1698	18.75	187.50	27.0	270.0
	1-1/2"	320.01	84546	15.0	174.8	515	5995	58.81	661.80	81.8	953
	2"	213.01	56276	37.8	378.9	1296	12990	143.06	1434.02	206	2065
ITT Barton	3/4"	2885	762255	2.5	30.0	36	1030	9.51	113.68	13.7	163.7
	1"	1048	276948	6.0	75.1	205	2575	22.64	284.3	32.6	409.4
	1-1/2"	419	110779	15.0	180.3	515	6182	56.87	682.50	81.9	982.8
	2"	138	36399	25.0	300.5	659	10302	94.79	1137.29	135.5	1637.7
	3"	41	10814	55.1	561.1	1868	22666	208.47	2502.21	300.2	3603.2
Natco	3/4" LF	4548	1201512	1.32	13.12	45	450	5.00	49.65	7.2	71.5
	3/4"	1875	495388	3.21	23.04	110	790	12.15	87.22	17.5	125.6
	1"	938	247826	6.4	63.9	220	2190	24.31	241.74	35	348.1
	1-1/2"	345	91088	17.5	175.0	600	6001	56.25	662.50	95.4	954
	2"	180	47557	33.0	289.9	1131	9939	127.86	1097.22	179.8	1580
Tejas/ Camco	3/4"	2101	555066	2.92	29.17	100	1000	11.04	11.42	15.9	159
	1"	700	185022	8.8	87.5	300	2999	35.12	331.04	47.7	476.7
	1-1/2"	350	92511	17.4	174.8	598	5995	55.97	661.80	95	953
	2"	220	58149	29.2	291.5	1000	9996	110.35	1103.47	58.9	1589

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