

by

WESTERN SNOW CONFERENCE METRICATION COMMITTEE:

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The Western Snow Conference (WSC) Metrication Committee obtained 189 comparative measurements over a four-year period. The committee used a variety of snow samplers over a large geographic area in snowpacks with a wide range of depth, density, and water equivalent. The equipment was tested in the snowpacks of eastern Canada, western Canada, the Sierra Mountains in California, and the Rocky Mountains in Montana.

Test procedures and early results were reported in the 1980 Western Snow Conference Proceedings (Farnes, et al., 1980). These data show that the small-diameter (areas of 10 to 11.2 cm<sup>2</sup>) cutters with blunt teeth, such as the standard Federal or Leopold and Stevens snow samplers, overmeasure the snow water equivalent by 9 to 10 percent. Similar cutters that are sharpened to the inside edge and sharp cutters, such as the Bowman, McCall, and Rosen, overmeasure by 3 to 6 percent (Table I). Samplers with sharp cutters having area larger than 20 cm<sup>2</sup> overmeasure very little when compared with the Glacier sampler (cutter area of 81.9 cm<sup>2</sup>), which was used as the standard for these tests (Table II).

In the past two years, the committee focused on this problem of overmeasure. They concluded that a small-diameter metric snow sampler for deeper snowpacks in the west that does not overmeasure the water equivalent can be produced if the scales are adjusted to compensate for the overmeasure or if the cutter area is calibrated to actual scale weight. Because many snow surveyors use or may use scales other than the standard snow scales for weighing water equivalent, the metrication committee proposes a WSC metric snow sampler with cutter area of approximately 10.6 cm<sup>2</sup> and with scales that read in true weight, i.e., 1 gram weight equals 1 mm water equivalent. The committee also proposes that the cutter diameter be calibrated so the sampler does not overmeasure.

The large-diameter or ESC-30 metric snow sampler with a cutter area of 30 cm<sup>2</sup> for snow depths less than 1 m has no significant overmeasure.

The plans and specifications for both metric snow samplers as proposed by the metrication committee are included.

Conversion to metric units should be accomplished in three phases. First, apply a soft conversion to the data obtained with existing equipment. Second, modify existing equipment by changing the markings on the tube and scale to metric units and replacing the cutter on the standard Federal sampler with the new metric design. No change in cutter would be necessary for the MSC or Adirondack samplers. Third, replace modified equipment with newer metric samplers.

A final report on the metrication of manual snow sampling equipment will be printed and distributed in the fall of 1982. This report will contain more detailed presentation of data collection procedures, equipment design and implementation, data from other sources, data analysis, photographs, snow profiles at test pits, and metrication of all phases of snow surveying.

Those involved in conversion to metric units or those interested in the more complete data presentation should request this report from the Western Snow Conference.

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TABLE I  
OVERMEASUREMENT OF SNOW WATER EQUIVALENT AND CORRECTION FACTOR  
FOR  
VARIOUS SNOW SAMPLERS

TYPE	CUTTER AREA, cm <sup>2</sup>	OVERMEASUREMENT (Percent)	CORRECTION FACTOR <u>1/</u>
Glacier (used as Ground Truth)	81.9	0	1.00
Standard Federal	11.2	10.0	.91
Sharpened Federal	11.2	6.2	.94
1978 Metric (short)	10.0	7.6	.93
1978 Metric (long)	10.0	4.0	.96
1979 Metric	10.0	7.6	.93
1980 Metric	10.0	4.5	.96
1981 Metric	10.4	3.8	.96
ESC-30	30.0	-0.3	1.00
Aluminum Tubing	77.1	0.6	.99
ESC-50	50.0	-0.1	1.00
PVC Tubing	20.9	0.0	1.00
ESC-40	40.0	0.2	1.00
Broken-tooth Federal	11.2	12.1	.89
BUNG	11.2	4.7	.96
McCall	11.2	4.5	.96
Adirondack	35.7	-0.2	1.00
CRREL Tubes (Volume = 500 cm <sup>3</sup> )		7.1 <u>2/</u>	.93
Rosen	11.2	4.1	.96
Bowman	11.2	4.6	.96
Leopold and Stevens	11.2	8.2	.92
MSC	39.1	7.0	.93
Utah	11.2	5.6	.95

1/To obtain true SWE with various samplers, multiply measured SWE by the correction factor.

2/All tests in shallow snow in Alaska

BASED ON DATA OBTAINED BY METRICATION COMMITTEE AND OTHER STUDIES OF SNOW SAMPLER ACCURACY. COMPARISONS MADE WITH GLACIER SAMPLER WHEN DATA AVAILABLE; OTHERWISE, COMPARISONS MADE WITH STANDARD FEDERAL OR COMBINATION OF GLACIER AND STANDARD FEDERAL.

Table II Data obtained by the Metallization Committee of "Metal" --- All 1/8" in mm

Location	No.	Date	Glacier (Depth)	Glacier Density	Glacier Type	Standard Federal	Sharpened Federal	1979 Metric (Sharp)	1979 Metric (Blunt)	1980 Metric (Blunt)	1981 Metric (Blunt)	Broken Metric (Blunt)	Profile Gage	McCall	Adirondack	CRREL	Alum. Tubing	ESC 50 Fiberglass	ESC 50 Plastic	PVC Tubing	Utah	ESC 40	ESC 30	MSC
Maynard Creek S., MT	79-MT-1	1/30/79	99	28	102	37.7	17.2	35.1	30.0	33.7	38.4	37.1	---	---	67.4	50.9	94.1	79.6	79.5	51.6	37.7	71.8	91.7	70.5
Maynard Creek N., MT	79-MT-2	1/30/79	95	27.5	81.0	11.2	11.2	30.0	30.0	10.0	10.4	11.2	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
New World N., MT	79-MT-3	1/31/79	95	22	195	235	208	226	226	226	226	226	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
New World N., MT	79-MT-4	1/31/79	80	24	212	250	215	250	250	250	250	250	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
New World N., MT	79-MT-5	1/31/79	86	22	189	229	209	214	214	214	214	214	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Lower New World E., MT	79-MT-6	1/31/79	99	23	232	244	244	262	262	262	262	262	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Lower New World W., MT	79-MT-7	1/31/79	100	23	227	251	242	262	262	262	262	262	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Porcupine S., MT	79-MT-8	2/21/79	93	26	241	242	242	231	231	231	231	231	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Lower New World SE., MT	79-MT-9	2/21/79	115	29	400	460	459	462	462	462	462	462	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Lower New World SW., MT	79-MT-10	2/26/79	133	28	376	425	431	426	426	426	426	426	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Twenty-one Mile W., MT	79-MT-11	3/9/79	145	26	360	428	408	403	403	403	403	403	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Twenty-one Mile SE., MT	79-MT-12	3/9/79	141	26	360	414	392	406	406	406	406	406	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Star Lake NW., MT	79-MT-14	3/9/79	146	26	375	431	411	408	408	408	408	408	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Star Lake S., MT	79-MT-15	3/21/79	254	35	875	984	966	972	972	972	972	972	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Fisher Creek S., MT	79-MT-17	3/22/79	248	36	893	983	959	978	978	978	978	978	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Fisher Creek N., MT	79-MT-18	3/22/79	248	36	882	988	973	988	973	988	973	988	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Cooke Station W., MT	79-MT-19	3/22/79	186	33	616	678	693	692	693	692	693	692	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Cooke Station E., MT	79-MT-20	3/22/79	185	34	667	725	725	737	737	737	737	737	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
White Hill S., MT	79-MT-21	3/22/79	211	34	715	818	818	809	809	809	809	809	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
White Hill N., MT	79-MT-22	3/22/79	208	37	293	310	284	256	256	256	256	256	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Lick Creek N., MT	79-MT-23	4/26/79	61	35	281	296	285	263	263	263	263	263	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Shower Falls W., MT	79-MT-24	4/26/79	196	36	704	778	741	748	748	748	748	748	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Shower Falls E., MT	79-MT-25	4/27/79	195	34	671	757	731	733	733	733	733	733	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Clark Fork W., MT	79-MT-26	4/27/79	110	43	566	566	560	564	564	564	564	564	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Clark Fork E., MT	79-MT-27	5/15/79	113	47	531	523	523	523	523	523	523	523	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Fisher Creek W., MT	79-MT-28	5/15/79	109	41	482	482	482	482	482	482	482	482	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Fisher Creek S., MT	79-MT-29	5/15/79	109	42	892	988	974	989	989	989	989	989	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Cooke Station W., MT	79-MT-30	5/29/79	204	42	892	987	968	988	988	988	988	988	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Star Lake SW., MT	79-MT-31	5/29/79	204	42	850	943	903	928	903	928	903	928	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Star Lake SE., MT	79-MT-32	5/29/79	126	40	500	568	569	568	569	568	569	568	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
White Hill W., MT	79-MT-33	5/30/79	137	41	555	629	629	629	629	629	629	629	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
White Hill E., MT	79-MT-34	5/30/79	99	49	349	350	350	350	350	350	350	350	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Cooke Station W., MT	79-MT-35	5/30/79	99	49	349	350	350	350	350	350	350	350	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Cooke Station E., MT	79-MT-36	5/30/79	206	32	655	660	641	641	641	641	641	641	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Spaulding, CA	79-CA-1	3/15/79	211	34	713	761	721	734	721	734	721	734	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Spaulding, CA	79-CA-2	3/15/79	168	40	664	680	651	664	680	664	680	664	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Spaulding, CA	79-CA-3	3/15/79	146	45	651	653	676	685	685	685	685	685	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Spaulding, CA	79-CA-4	4/2/79	196	36	709	709	711	711	711	711	711	711	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Alpha, CA	79-CA-5	4/4/79	152	46	692	731	742	739	739	739	739	739	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Alpha, CA	79-CA-6	5/2/79	152	46	692	731	742	739	739	739	739	739	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Forbiden Plateau, BC	79-BC-1	2/9/79	153	26	390	413	402	394	394	394	394	394	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Whistler Mtn, BC	79-BC-2	2/20/79	133	23	307	335	319	314	314	314	314	314	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Blackwall Pk., BC	79-BC-3	2/21/79	169	26	442	487	467	489	489	489	489	489	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
New Copper Mtn., BC	79-BC-4	2/22/79	58	21	119	104	104	124	124	124	124	124	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Newcastle Ridge, BC	79-BC-5	3/9/79	319	38	126	139	136	139	139	139	139	139	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Whistler Mtn, BC	79-BC-6	3/13/79	313	33	505	555	532	545	545	545	545	545	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Whistler Mtn, BC	79-BC-7	3/13/79	313	33	505	555	532	545	545	545	545	545	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Blackwall Pk., BC	79-BC-8	3/14/79	327	37	100	96	96	88	88	88	88	88	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70.5
Blackwall Pk., BC	79-BC-9	4/19/79	332	45	1493	1630	1572	1612	1612	1612	1612	1612	---	---	35.7	20.4	77.1	49.3	49.3	49.3	37.7	71.8	91.7	70

Table II (Continued)

Location	No.	Date	Glacier Depth (cm)	Glacier Density	Glacier Standard Federal	Sharpened Federal	1978 Metric (short)	1979 Metric	1980 Metric	1981 Metric	Brook's Plat. Lustr. or Template	McCall	Astronack	CRREL	Alum Tubing	ESC 50 Fiberglass	ESC 50 Plastic	PVC Tubing	Utah	ESC 40	ESC 30	MSC			
																							95	96	97
Porcupine S. MT	80-MT-1	2/1/80	44	22	95	97	99	106	87	87															
Porcupine N. MT	80-MT-2	2/1/80	44	22	96	97	89	106	87	87															
Tepee Creek W. MT	80-MT-3	2/14/80	82	22	181	203	178	188	185	185															
Tepee Creek E. MT	80-MT-4	2/14/80	79	21	165	193	171	159	157	157															
New World W. MT	80-MT-5	2/26/80	104	24	248	276	276	263	262	262															
New World E. MT	80-MT-6	2/26/80	118	24	290	320	318	309	306	306															
New World Gulch E. MT	80-MT-7	2/26/80	115	24	273	311	303	284	288	288															
Bridger Bowl E. MT	80-MT-8	2/26/80	128	30	379	404	395	402	391	391															
Bridger Bowl W. MT	80-MT-9	2/26/80	120	28	337	367	378	375	375	375															
Sackajawa SC W. MT	80-MT-10	3/14/80	151	28	428	461	456	447	445	445															
Sackajawa SC E. MT	80-MT-11	3/14/80	128	24	316	342	329	347	328	328															
Sackajawa W. MT	80-MT-12	3/14/80	140	26	359	397	383	389	387	387															
Sackajawa E. MT	80-MT-13	3/14/80	147	33	489	530	503	521	507	507															
Hayward Cr. N. MT	80-MT-14	4/11/80	144	34	489	530	503	521	507	507															
Hayward Cr. S. MT	80-MT-15	4/11/80	144	34	489	530	503	521	507	507															
Battle Ridge S. MT	80-MT-16	4/11/80	84	32	272	271	269	258	256	256															
Battle Ridge N. MT	80-MT-17	4/11/80	86	32	272	271	269	258	256	256															
Battle Ridge E. MT	80-MT-18	4/11/80	86	32	272	271	269	258	256	256															
Star Lake W. MT	80-MT-19	4/22/80	219	39	846	966	938	852	836	836															
Star Lake N. MT	80-MT-20	4/22/80	219	39	846	966	938	852	836	836															
White Hill E. MT	80-MT-21	4/22/80	214	39	830	907	861	869	891	891															
White Hill W. MT	80-MT-22	4/22/80	162	38	618	673	641	668	682	682															
White Hill N. MT	80-MT-23	4/22/80	165	38	630	687	654	686	692	692															
NE Entrance E. MT	80-MT-24	4/22/80	55	37	202	194	183	182	183	183															
NE Entrance W. MT	80-MT-25	4/22/80	51	34	271	284	282	290	274	274															
Hyalite Creek W. MT	80-MT-26	4/22/80	84	33	278	306	300	300	286	286															
Hyalite Creek E. MT	80-MT-27	4/22/80	84	33	278	306	300	300	286	286															
Window Rock N. MT	80-MT-28	4/22/80	57	36	206	230	209	190	214	214															
Window Rock S. MT	80-MT-29	4/22/80	61	34	206	230	209	190	214	214															
Arch Falls W. MT	80-MT-30	4/22/80	92	35	322	350	340	325	320	320															
Arch Falls E. MT	80-MT-31	4/22/80	92	35	322	350	340	325	320	320															
Spaulding, CA	80-CA-1	1/4/80	98	39	315	327	314	221	217	217															
Spaulding, CA	80-CA-2	1/4/80	138	32	435	477	452	463	452	452															
Alpha, CA	80-CA-3	1/30/80	161	35	567	609	565	632	595	595															
Alpha, CA	80-CA-4	1/31/80	183	37	652	731	708	650	622	622															
Alpha, CA	80-CA-5	2/14/80	175	38	673	751	731	650	657	657															
Spaulding, CA	80-CA-6	2/27/80	95	33	353	353	353	253	242	242															
Alpha, CA	80-CA-7	3/13/80	252	35	957	1071	998	1001	1016	1046															
Alpha, CA	80-CA-8	3/13/80	278	39	1090	1168	1163	1152	1112	1086															
Alpha, CA	80-CA-9	3/26/80	235	40	950	1072	983	976	1016	968															
Alpha, CA	80-CA-10	3/27/80	269	42	1134	1225	1184	1185	1151	1151															
Alpha, CA	80-CA-11	5/1/80	172	46	792	914	892	830	830	830															
Blackwell, BC	80-BC-1	2/12/80	154	30	456	535	507	516	508	508															
Blackwell, BC	80-BC-2	2/12/80	156	29	454	493	477	478	471	471															
Blackwell, BC	80-BC-3	2/13/80	143	25	107	94	90	90	94	94															
New Copper, BC	80-BC-4	2/13/80	44	23	99	94	90	90	91	91															
Whistler, BC	80-BC-5	2/14/80	121	29	358	397	387	387	427	348															
Whistler, BC	80-BC-6	2/14/80	120	28	339	387	387	387	427	348															
Newcastle Ridge, BC	80-BC-7	2/15/80	231	30	868	1037	955	994	994	965															
Newcastle Ridge, BC	80-BC-8	2/20/80	224	30	868	1037	955	994	994	965															
Newcastle Ridge, BC	80-BC-9	2/20/80	224	30	868	1037	955	994	994	965															
Newcastle Ridge, BC	80-BC-10	2/20/80	145	31	456	518	518	508	495	508															
New Copper, BC	80-BC-11	2/23/80	38	28	106	96	97	97	97	97															
Whistler, BC	80-BC-12	3/2/80	125	33	410	449	444	438	445	445															
Blackwell, BC	80-BC-13	3/18/80	200	32	642	724	702	718	733	706															
Blackwell, BC	80-BC-14	3/19/80	200	32	642	724	702	718	733	706															
McBride, BC	80-BC-15	3/21/80	125	25	314	348	351	354	335	335															
McBride, BC	80-BC-16	3/21/80	125	25	314	348	351	354	335	335															
Whistler, BC	80-BC-17	3/25/80	125	30	373	412	397	394	388	388															
Whistler, BC	80-BC-18	3/25/80	125	32	403	397	373	358	368	368															
Alpha, CA	81-CA-1	2/4/81	109	24	253	279	267	275	269	273															
Alpha, CA	81-CA-2	3/1/81	98	34	333	304	291	283	278	280															
Alpha, CA	81-CA-3	3/1/81	99	37	363	409	376	378	378	369															
Alpha, CA	81-CA-4	3/18/81	90	39	355	373	358	357	351	378															
Alpha, CA	81-CA-5	4/2/81	157	37	576	582	568	568	568	568															
Alpha, CA	81-CA-6	4/16/81	96	43	409	451	444	441	415	420															



Table II (Continued)

Location	No.	Date	Climber Depth (cm)	Glacier Density	Glacier Standard Federal	Sharpened Federal <sup>1</sup>	1975 Metric (short)	1979 Metric (short)	1980 Metric	1981 Metric	Benken Tooth or Ped.	Pit or Template	Profile Gage	McCa: Adromack	Alum Tubing	ESC 50 Fiberglass	ESC 50 Plastic	PVC Tubing	Utah	ESC 40	ESC 30	MSC	
																							1979 Metric
Blackwall, BC	81-BC-1	2/26/81	165	26	485	461	450	452															
Newcastle Ridge, BC	81-BC-2	3/3/81	80	29	204	207	201	195															
Ottawa, ONT	81-ON-1	2/10/81	43	35	152	147	152	141															
New World W, MT	81-MT-1	1/29/81	43	20	89	97	92	96	91												94		
New World E, MT	81-MT-2	1/29/81	42	20	86	93	89	91	91												88		
Lower New World W, MT	81-MT-3	1/29/81	28	15	41	43	40	38	40												38		
Lower New World E, MT	81-MT-4	1/29/81	28	15	42	41	40	38	41												37		
Lick Creek E, MT	81-MT-5	3/12/81	83	28	245	248	245	242	249												220		
Lick Creek W, MT	81-MT-6	3/12/81	83	28	230	245	245	242	249												220		
Skyark Trail N, MT	81-MT-7	3/25/81	115	33	376	386	384	397	389												372		
Skyark Trail S, MT	81-MT-8	3/25/81	112	32	359	379	375	383	388												356		
Palace Butte NE, MT	81-MT-9	3/30/81	48	27	131	144	144	157	146												122		
Palace Butte W, MT	81-MT-10	3/30/81	47	27	127	141	141	153	142												119		
Palace Butte SW, MT	81-MT-11	3/30/81	52	28	163	163	152	158	155												127		
Lick Creek W, MT	81-MT-12	3/30/81	55	30	198	187	187	181	180												164		
Lick Creek E, MT	81-MT-13	3/30/81	52	30	167	187	164	181	178												164		
Lick Creek W, MT	81-MT-14	3/30/81	52	32	165	170	153	170	153												174		
Shower Falls W, MT	81-MT-15	3/31/81	179	24	432	471	458	425	430												428		
Shower Falls E, MT	81-MT-16	3/31/81	183	24	441	475	468	425	433												446		
Arch Falls N, MT	81-MT-17	3/31/81	117	26	301	304	314	282	288												285		
Arch Falls SE, MT	81-MT-18	4/8/81	110	27	303	303	326	311	304												302		
Pochonville, MT	81-MT-19	4/8/81	110	27	303	303	326	311	304												302		
Cooke City W, MT	81-MT-20	4/8/81	105	27	276	295	287	293	286												273		
Jardine E, MT	81-MT-21	4/9/81	53	25	135	135	130	137	138												132		
Jardine W, MT	81-MT-22	4/9/81	53	25	136	142	133	138	146												132		
Black Bear W, MT	81-MT-23	4/22/81	162	41	566	675	664	673	680												677		
Black Bear E, MT	81-MT-24	4/22/81	139	40	412	474	462	466	477												527		
Whiskey Creek W, MT	81-MT-25	4/23/81	36	36	132	149	141	137	144												126		
Whiskey Creek E, MT	81-MT-26	4/23/81	36	36	132	149	141	137	144												126		
Fisher Creek N, MT	81-MT-27	5/11/81	185	34	619	670	664	698	635												642		
Fisher Creek S, MT	81-MT-28	5/11/81	178	35	617	642	633	652	613												614		
Cooke Pass N, MT	81-MT-29	5/12/81	65	38	246	250	239	242	244												244		
Cooke Pass S, MT	81-MT-30	5/12/81	70	38	265	279	265	263	265												265		
Cooke Station E, MT	81-MT-31	5/12/81	109	32	348	385	385	390	384												362		
Cooke Station W, MT	81-MT-32	5/12/81	109	32	348	385	385	390	384												362		
Luther Marsh, ONT	82-ON-1	1/8/82	22	22	48	49	48	48	48												46.5		
Luther Marsh, ONT	82-ON-2	1/8/82	20	19	38	42	42	42	42												40		
Peterborough, ONT	82-ON-3	1/13/82	23	20	47	52	49	49	49												46		
Dorset, ONT	82-ON-4	1/22/82	48	22	104	114	114	112	112												106		
Dorset, ONT	82-ON-5	1/22/82	41	23	137	134	134	124	124												103		
Peterborough, ONT	82-ON-6	2/8/82	58	22	131	131	129	120	120												123		
Peterborough, ONT	82-ON-7	2/8/82	58	22	129	131	129	120	120												123		
Luther Marsh, ONT	82-ON-8	2/10/82	55	22	120	114	114	114	114												118		
Battle Ridge S, MT	82-MT-1	12/29/81	68	22	147	140	136	135	127												141		
Battle Ridge N, MT	82-MT-2	12/29/81	66	20	133	146	128	131	124												145		
Battle Ridge E, MT	82-MT-3	12/29/81	66	20	133	146	128	131	124												145		
Battle Ridge W, MT	82-MT-4	12/29/81	66	20	133	146	128	131	124												145		
Shower Falls N, MT	82-MT-5	1/26/82	171	19	65	63	64	55	59												65		
Shower Falls S, MT	82-MT-6	1/26/82	172	26	450	503	496	508	484												65		
Shower Falls E, MT	82-MT-7	3/29/82	269	28	744	805	788	815	830												445		
Shower Falls W, MT	82-MT-8	3/29/82	264	28	734	831	805	821	824												445		
Lick Creek N, MT	82-MT-9	3/30/82	115	29	302	317	316	316	322												322		
Lick Creek S, MT	82-MT-10	3/30/82	118	26	310	337	323	330	322												322		
Alpha, CA	82-CA-1	2/2/82	212	31	649	698	685	677	683												664		
Alpha, CA	82-CA-2	2/19/82	173	39	677	734	691	691	680												683		
Alpha, CA	82-CA-3	2/25/82	157	39	620	647	625	621	626												623		
Alpha, CA	82-CA-4	3/15/82	206	36	742	803	760	781	806												785		

## SPECIFICATIONS FOR WSC METRIC SNOW SAMPLER

### General

The WSC metric snow sampler shall conform with the attached drawing entitled "WSC Metric Snow Sampler."

### Tubes

The tubes shall be made from 44 mm (44.4 mm OD) 6061-T6, 18 STUBs gauge Alcoa or 17 ST Alcan aluminum or equivalent. Each tube section shall represent 75 cm snow depth. Markings are to be stamped on the tube every centimeter with zero measured from the cutter teeth. Numerals shall be stamped every fifth increment to represent depths of 5, 10, 15, 20, etc., through 75 for the first section and 80, 85, etc., for the second tube, etc.

All tubes will have baked-on silicone release agent Dow Corning 1-2531 resin or equivalent after they are assembled.

Slots on the snow tubes will be 3.4 mm X 8 cm on alternate sides of the stamped numerals and increments with no overlap. The first tube section will have a slot starting at increment 11 and extended to increment 19; the next slot will be on the opposite side of depth markings and extend from 19 to 27, etc., with the uppermost slot on the first tube extending from 59 to 67. The second tube will have 8-cm-long slots beginning at 79 and ending at 143. The third tube will begin at 154 and end at 218, etc.

### Cutter

The cutter shall be milled 4130 aircraft moly or cast 17-4 stainless alloy, heat treated and ground to 36.7 mm inside diameter. The cutter shall have 16 teeth with lands approximately 2 mm width and grooves approximately 5 mm width. The teeth shall have a slope angle of 7 degrees and shall be 30 mm in length. The inside lip that is ground to 36.7 mm shall extend 15 mm from the point of the teeth. All leading surfaces of the teeth will be sharpened to the inside.

### Couplings

The male and female couplings shall have a shrink fit on the tubing and have smooth surface inside the tube when screwed together. Threads are to be modified Acme with three threads per centimeter.

### Thread Protector

The thread protector will be similar to the male coupling except that it shall not be tapered. The outside section will be knurled. A hole will be drilled for the spanner wrench. It will be constructed so as to fit in the top of any tube section.

### Spanner Wrench

The spanner wrench will be constructed from light-weight steel stock and be bent so as to fit smoothly around the couplings and secure each tube section so any stuck or frozen threads can be released with moderate pressure. Two spanner wrenches are required for each sampler.



SPECIFICATIONS FOR METRIC WEIGHING SCALE  
FOR WSC METRIC SNOW SAMPLER

General

The weighing scale and cradle shall conform with attached drawing entitled "Metric Scale for WSC Metric Snow Sampler." It shall be constructed of 6061-T6 Alcoa aluminum or equivalent. The scale spring shall be a close-wound extension coil spring with an outside diameter of 19.8 mm. The spring material shall be self-tempering steel spring wire 1.63 mm in diameter. All stamped numerals and numbers will be in black.

4 Meter Capacity Scale (for snow depths up to 4 meters)

The inner cylinder shall be calibrated on one side in increments equivalent to two centimeters. The scale shall be such that the increments will be from 0 to 340 and weigh 3,795 grams over 283.3 mm distance on the inner cylinder. Each increment shall be stamped at intervals of approximately 1.667 mm and be equal to a weight increment of approximately 22.32 grams. Beginning with zero at the bottom of the inner cylinder, each fifth increment shall be stamped with the numerals 10, 20, 30, 40, etc., through 340. Along the scale increments opposite to the numerals, the cylinder shall be stamped "cm water with WSC snow sampler." Each outer cylinder shall have the capacity stamped on it; i.e., "CAPACITY = 4 METERS."

The scale spring shall be 190.5 mm long and shall be pre-tensioned for 1,250 grams such that the weight of a 1.5-meter (2 sections) snow sampling tube (empty) will read slightly greater than zero on the scale. Scales shall be accurate to 15 grams over the full span of the scale.

6 Meter Capacity Scale (for snow depths between 4 and 6 meters)

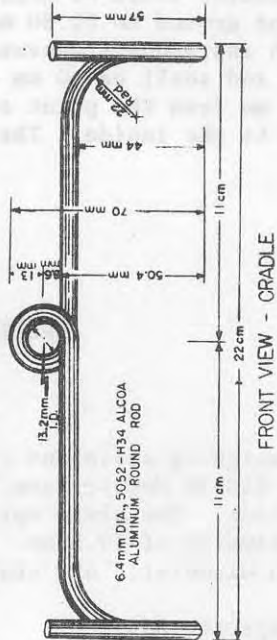
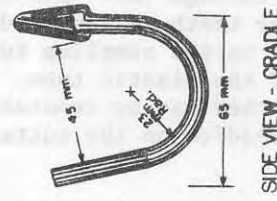
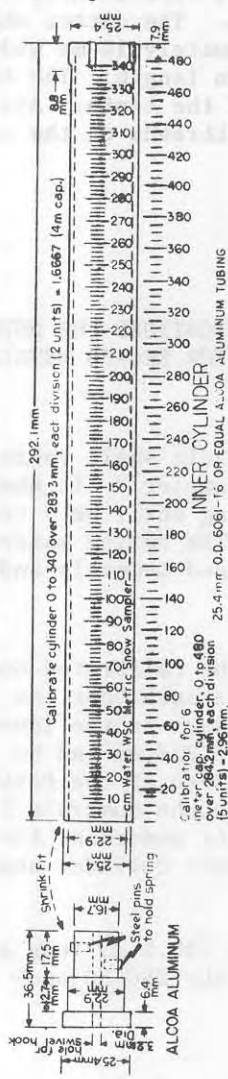
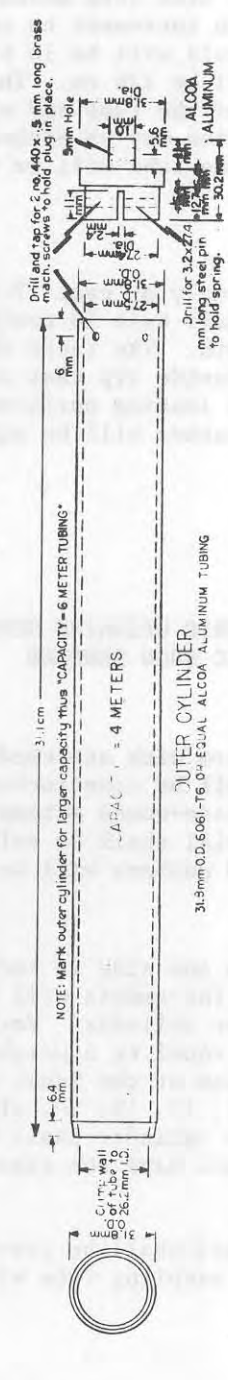
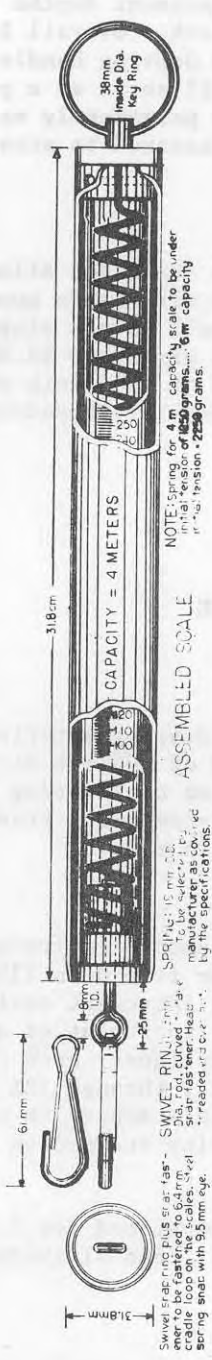
The inner cylinder shall be calibrated on one side in increments equivalent to five centimeters. The scale shall be such that the increments will be from 0 to 480 and weigh 5,357 grams over 284.2 mm distance on the inner cylinder. Each increment shall be stamped at intervals of approximately 2.96 mm and be equal to a weight increment of approximately 55.75 grams. Beginning with zero at the bottom of the inner cylinder, each fourth increment shall be stamped with the numerals 20, 40, 60, 80, etc., through to 480. Along the scale increments opposite the numerals, the cylinder shall be stamped "cm water with WSC snow sampler." Each outer cylinder shall have the capacity stamped on it; i.e., "CAPACITY = 6 METERS."

The scale spring shall be 139.7 mm long and shall be pre-tensioned for 2,250 grams such that the weight of a 3-meter (4 sections) snow sampling tube (empty) will read slightly greater than zero on the scale. Scales shall be accurate to 15 grams over the full span of the scale.

Cradle

Surgical rubber or rubber tubing shall cover the arms of the cradle to prevent the snow sampling tube from slipping in the cradle. The cradle shall be attached to the scale assembly by a swivel snap and swivel ring.





JANUARY 1982  
 Scale in centimeters  
 3 2 1 0 1 2 3 4 5

METRIC SCALE FOR WSC METRIC SNOW SAMPLER

PRELIMINARY DRAFT  
 SUBJECT TO REVISION

## SPECIFICATIONS FOR ESC-30 METRIC SNOW SAMPLER

### General

The ESC-30 metric snow sampler shall conform with the attached drawing entitled "ESC-30 Metric Snow Sampler."

### Tube

Clear plastic tube with ID of 69.85 mm and OD of 76.2 mm TENITE-BUTYRATE 516E-MH, or equivalent, with a length of 121.5 cm will be used for the tube. Markings are to be stamped or routed on the tube every centimeter with zero measured from the cutter teeth. Numerals shall be stamped or routed every fifth increment to represent depths of 5, 10, 15, 20, etc., through 120. All markings and numerals will be in black. Overall length of tube from cutter teeth to top of driving handle will be 126 cm. The driving handle collar shall be secured to the sampling tube near the end of the tube and will serve as a protector for the end of the plastic tube. The driving handles may be either permanently secured to the collar or they may be removable. The end of the tube will be threaded to accept the 1 square thread/cm on the cutter.

### Cutter

The cutter shall be milled 4130 aircraft moly or cast 17-4 stainless alloy, heat treated and ground to 61.80 mm. The cutter shall have 16 teeth with lands approximately 2 mm width and grooves approximately 10 mm width. The teeth shall have a slope angle of 7 degrees and shall be 40 mm in length. The inside lip that is ground to 61.80 mm shall extend 15 mm from the point of the teeth. All leading surfaces of the teeth will be sharpened to the inside. The threads on the cutter will be square, 1 thread/cm.

## SPECIFICATIONS FOR METRIC WEIGHING SCALE FOR ESC-30 METRIC SNOW SAMPLER

### General

The weighing scale and cradle shall conform with attached drawing entitled "Metric Scale for ESC-30 Metric Snow Sampler." It shall be constructed of 6061-T6 Alcoa aluminum or equivalent. The scale spring shall be a close-wound extension coil spring with an outside diameter of 19.8 mm. The spring material shall be self-tempering steel spring wire 1.63 mm in diameter. All stamped numerals and numbers will be in red.

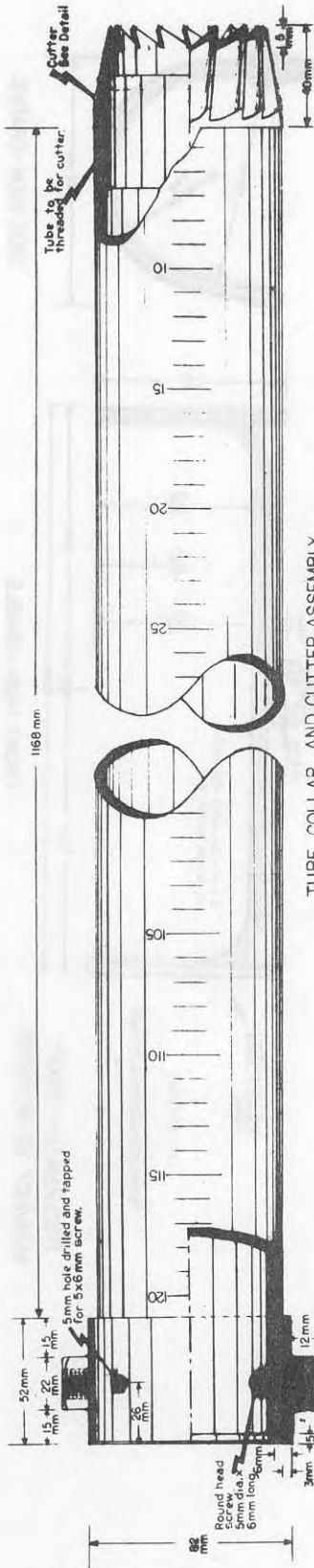
### 1 Meter Capacity Scale

The inner cylinder shall be calibrated on one side in increments equivalent to one centimeter. The scale shall be such that the increments will be from 0 to 125 and weigh 3,747 grams over 279.7 mm distance on the inner cylinder. Each increment shall be stamped at intervals of approximately 2.238 mm and be equal to a weight increment of approximately 29.976 grams. Beginning with zero at the bottom of the inner cylinder, each fifth increment shall be stamped with the numerals 5, 10, 15, 20, etc., through 125. Along the scale increments opposite to the numerals, the cylinder shall be stamped "cm water with ESC-30 snow sampler." Each outer cylinder shall have the capacity stamped on it; i.e., "CAPACITY = 1 METER."

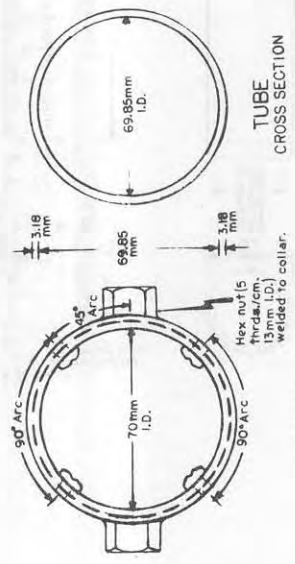
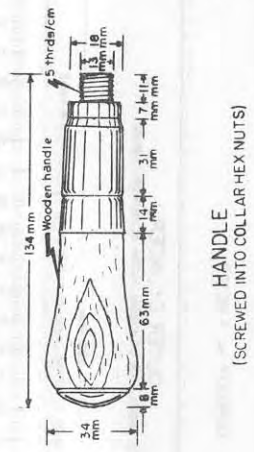
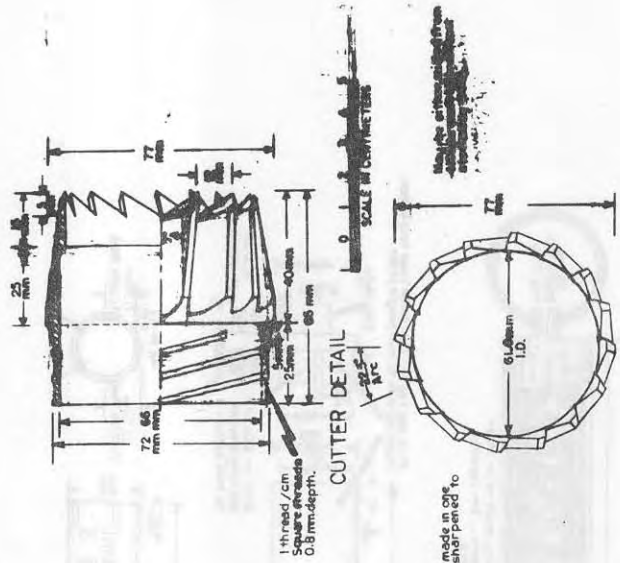
The scale spring shall be 190.5 mm long and shall be pre-tensioned for 1,250 grams such that the empty weight of the ESC-30 snow sampling tube will read slightly greater than zero on the scale.

### Cradle

Surgical rubber or rubber tubing shall cover the arms of the cradle to prevent the snow sampling tube from slipping in the cradle. The cradle shall be attached to the scale assembly by a swivel snap and swivel ring.



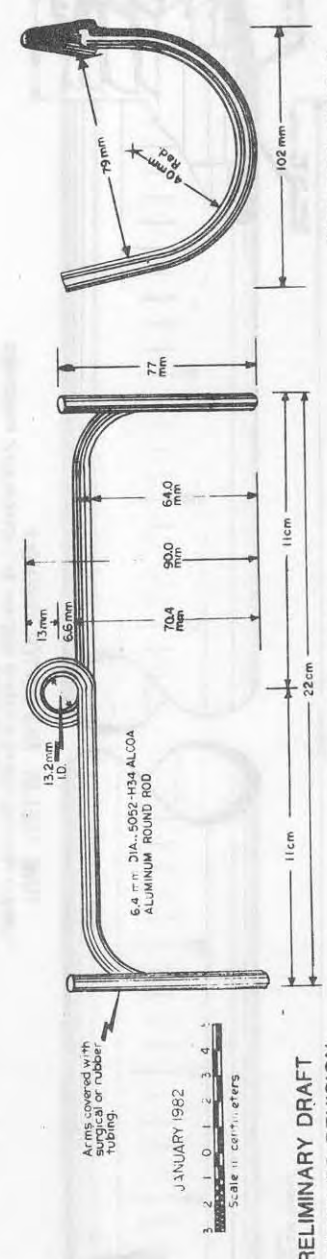
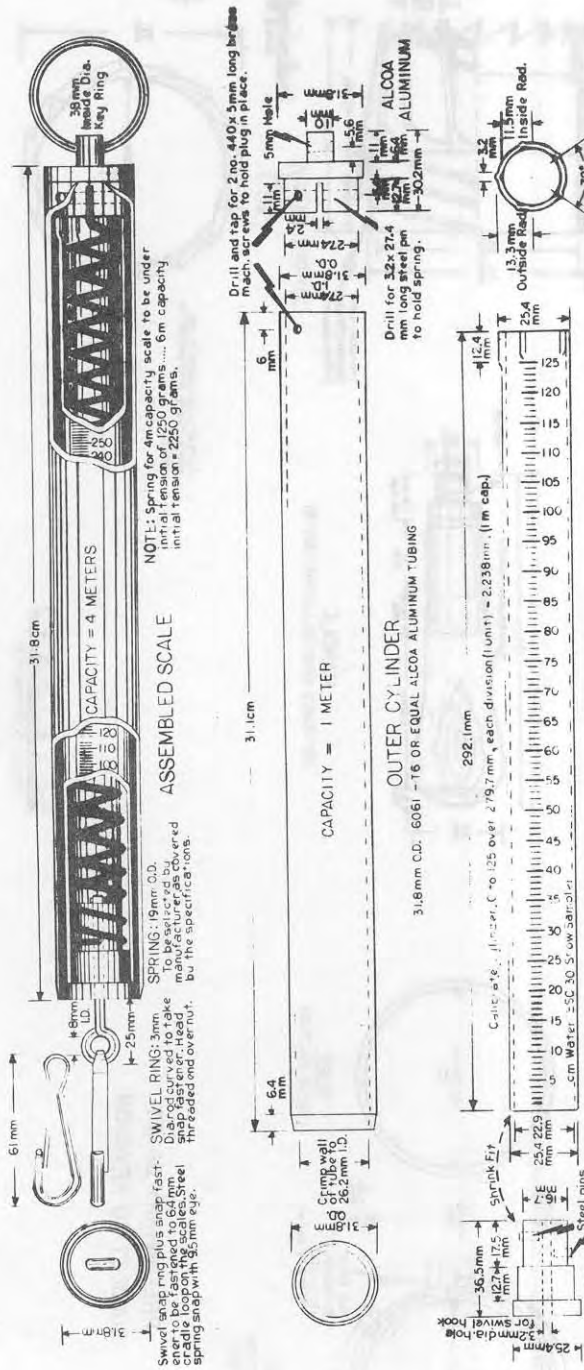
TUBE, COLLAR, AND CUTTER ASSEMBLY  
TUBING = 76mm O.D. TENITE BUTYRATE 516E-MH BY THERMOPLASTIC PROCESSES  
INC. OR EQUAL



PRELIMINARY DRAFT  
SUBJECT TO REVISION



ESC 30 METRIC SNOW SAMPLER



PRELIMINARY DRAFT  
SUBJECT TO REVISION

METRIC SCALE FOR ESC 30 METRIC SNOW SAMPLER



References:

Farnes, Phillip E., Barry E. Goodison, Ned R. Peterson, and Robert P. Richards, 1980:  
Proposed Metric Snow Samplers by Western Snow Conference Metrication Committee, Proceedings  
of 48th Annual Meeting of Western Snow Conference, Laramie, Wyoming, pp. 107-119.