METRICATION OF MANUAL SNOW SAMPLING EQUIPMENT

705-82

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^2) 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^2 overmeasure very little when compared with the Glacier sampler (cutter area of 81.9 cm^2), 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^2 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^2 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^2	OVERMEASUREMENT (Percent)	CORRECTION FACTOR 1/
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^3)		7.1 2/	.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 Metrication Committee 1979-1982.

---> All SWE in mm

Location	No.	Date	Glacier Depth (cm)	Glacier Density	Glacier	Standard Federal	Sharpened Federal	1978 Metric (short)	1979 Metric	1980 Metric	1981 Metric	Broken Tooth Fed.	Pit or Template	Profile Gage	McCall	Adirondack	CRREL	Alum. Tubing	ESC 50 Fiberglass	ESC 50 Plastic	PVC Tubing	Utah	ESC 40	ESC 30	MSC
Inside Dia mm					102	37.7	37.7	35.7	35.6	35.7	36.4	37.7	---	---	37.7	67.4	50.9	99.1	79.6	79.5	51.6	37.7	71.8	61.7	70.5
AREA cm^2					81.9	11.2	11.2	10.0	9.9	10.0	10.4	11.2	---	---	11.2	35.7	20.4	77.1	49.7	49.6	20.9	11.2	40.5	29.8	39.1
SHARP or BLUNT					Sharp	Blunt	Sharp	Sharp	Sharp	Sharp	Sharp	Blunt	---	---	SHARP	SHARP	SHARP	SHARP	SHARP	SHARP	SHARP	SHARP	SHARP	SHARP	SHARP
No Teeth					0	16	16	16	16	16	16	15	---	---	16	0	8	0			0	32	16	16	16
Tubing Material					Stainless Steel	Alum.	Alum.	Alum.	Alum.	Alum.	Alum.	Alum.	---	---	Alum.	Fiberglass		Alum.	Fiberglass	Plastic	PVC	Steel	Plastic	Plastic	Alum.
THE FOLLOWING DATA WERE OBTAINED USING CONTROL DESIGNED AND MANUFACTURED EQUIPMENT.																									
Maynard Creek S, MT	79-MT-1	1/30/79	99	28	275	275	277		297																
Maynard Creek N, MT	79-MT-2	1/30/79	95	25	236	264	249		265																
New World W, MT	79-MT-3	1/31/79	90	22	199	236	208		225																
New World E, MT	79-MT-4	1/31/79	90	24	212	250	215		250																
New World N, MT	79-MT-5	1/31/79	86	22	189	229	209		214																
Lower New World E, MT	79-MT-6	1/31/79	99	23	232	244	244		262																
Lower New World W, MT	79-MT-7	1/31/79	100	23	227	251	242		270																
Porcupine S, MT	79-MT-8	2/21/79	93	26	241	282	263	262	258																
Porcupine W, MT	79-MT-9	2/21/79	91	25	223	243	232	231	247																
Lower New World SE, MT	79-MT-10	2/26/79	139	29	400	460	459	462	454																
Lower New World SW, MT	79-MT-11	2/26/79	133	28	376	425	431	426	432																
Twenty-one Mile W, MT	79-MT-12	3/9/79	145	26	379	428	408	403	417																
Twenty-one Mile SW, MT	79-MT-13	3/9/79	141	26	360	414	392	396	404																
Twenty-one Mile SE, MT	79-MT-14	3/9/79	146	26	375	431	411	408	414																
Star Lake NW, MT	79-MT-15	3/21/79	254	35	885	986	993	993	1005																
Star Lake S, MT	79-MT-16	3/21/79	252	35	871	984	966	972	970																
Fisher Creek S, MT	79-MT-17	3/22/79	249	36	893	983	959	978	960																
Fisher Creek N, MT	79-MT-18	3/22/79	248	36	882	988	973	989	968																
Cooke Station W, MT	79-MT-19	3/22/79	186	33	616	678	693	692	693																
Cooke Station E, MT	79-MT-20	3/22/79	195	34	667	725	725	737	739																
White Mill S, MT	79-MT-21	3/22/79	211	34	715	818	809	839	817																
White Mill N, MT	79-MT-22	3/22/79	208	34	703	798	793	826	805																
Lick Creek N, MT	79-MT-23	4/26/79	79	37	295	291	284	256	264																
Lick Creek S, MT	79-MT-24	4/26/79	81	35	281	296	285	263	275																
Shower Falls W, MT	79-MT-25	4/27/79	196	36	704	778	741	748	740					725											
Shower Falls E, MT	79-MT-26	4/27/79	195	34	671	757	731	733	739					701											
Clark Fork W, MT	79-MT-27	5/15/79	110	43	472	566	560	544	525																
Clark Fork E, MT	79-MT-28	5/15/79	113	47	531	593	571	558	543																
Fisher Creek NW, MT	79-MT-29	5/16/79	209	41	867	956	932	935	920																
Fisher Creek S, MT	79-MT-30	5/16/79	213	42	892	998	974	989	943																
Star Lake N, MT	79-MT-31	5/29/79	214	42	892	987	958	1004	942						924										
Star Lake SW, MT	79-MT-32	5/29/79	204	42	850	928	903	943	901						889										
White Mill W, MT	79-MT-33	5/30/79	126	40	500	568	569	551	565						551			495							
White Mill E, MT	79-MT-34	5/30/79	137	41	555	629	622	606	613					581	567			560							
Cooke Station W, MT	79-MT-35	5/30/79	99	39	390	456	440	449	425					411	412			391							
Cooke Station E, MT	79-MT-36	5/30/79	89	40	356	398	403	401	382						365			368							
Spaulding, CA	79-CA-1	2/28/79	206	32	655	660	641		626																
Alpha, CA	79-CA-2	3/15/79	211	34	713	761	721	734	721																
Spaulding, CA	79-CA-3	3/16/79	168	40	664	680	651	664	684																
Spaulding, CA	79-CA-4	4/2/79	146	45	651	693	676	685	666																
Alpha, CA	79-CA-5	4/4/79	196	36	709	771	731	736	742																
Alpha, CA	79-CA-6	5/2/79	152	46	692	731	742	719	739																
Forbidden Plateau, BC	79-BC-1	2/9/79	153	26	390	413	402		394																
Whistler Mtn, BC	79-BC-2	2/20/79	133	23	307	335	319		314			335													
Blackwall Pk, BC	79-BC-3	2/21/79	169	26	442	487	467		489			448													
New Copper Mtn, BC	79-BC-4	2/22/79	58	21	119	104	104		117			120													
Newcastle Ridge, BC	79-BC-5	3/9/79	319	38	1207	1315	1241		1294			1339													
Whistler Mtn, BC	79-BC-6	3/13/79	103	35	365	399	386		396			394													
Blackwall Pk, BC	79-BC-7	3/14/79	162	31	505	555	532		545			567													
New Copper Mtn, BC	79-BC-8	3/14/79	37	27	100	96	96		88			94													
Newcastle Ridge, BC	79-BC-9	4/19/79	332	45	1493	1630	1572		1612			1674													
Newcastle Ridge, BC	79-BC-10	4/19/79	330	42	1388	1550	1478		1498			1559													
Whistler Mtn, BC	79-BC-11	4/21/79	130	33	434	476	454		483			485													
Whistler Mtn, BC	79-BC-12	4/21/79	122	32	396	442	411		458			473													
Blackwall, BC	79-BC-13	4/23/79	156	34	534	587	564		580			591													
Blackwall, BC	79-BC-14	4/23/79	162	34	543	620	596		606			623													
Newcastle Ridge, BC	79-BC-15	5/7/79	1996	49	976	1108	1057	1045	1102			1122													
Newcastle Ridge, BC	79-BC-16	5/7/79	2259	52	1167	1271	1216	1101	1239			1306													
Ottawa, ONT	79-ON-1	2/1/79	45	35	157	146	144		162							141									142
Cold Creek #1, ONT	79-ON-2	2/16/79	27	21	57	68	67		68							56									61
Cold Creek #2, ONT	79-ON-3	2/16/79	28	22	61	64	60		70							53									55
Monticello, ONT	79-ON-4	2/28/79	95	29	278	310	302		303							283									298
Monticello #1, ONT	79-ON-5	3/8/79	37	34	124	121	122		124							125									125
Monticello #2, ONT	79-ON-6	3/8/79	26	36	93	97	93		92							93									97
Peterborough, ONT	79-ON-7	3/19/79	29	43	124	138	128		126							114									136
Ottawa, ONT	79-ON-8	3/21/79	36	49	175	169	164		158							158									174

Table II (Continued)

---> All SWE in mm

Location	No.	Date	Glacier Depth (cm)	Glacier Density	Glacier	Standard Federal	Sharpened Federal	1978 Metric (short)	1979 Metric	1980 Metric	1981 Metric	Broken Tooth Fed.	Pit or Template	Profile Gage	McCall	Adirondack	CRREL	Alum. Tubing	ESC 50 Fiberglass	ESC 50 Plastic	PVC Tubing	Utah	ESC 40	ESC 30	MSC
Porcupine S, MT	80-MT-1	2/1/80	44	22	95	97	89	106		87								95							
Porcupine N, MT	80-MT-2	2/1/80	44	22	96	97	89	106		87								95							
Tepee Creek W, MT	80-MT-3	2/14/80	82	22	181	203	178	188		186								177							
Tepee Creek E, MT	80-MT-4	2/14/80	79	21	165	193	171	184		182								171							
New World W, MT	80-MT-5	2/26/80	104	24	250	268	275	259		257															
New World E, MT	80-MT-6	2/26/80	104	24	248	270	275	263		262															
New World Gulch W, MT	80-MT-7	2/26/80	118	24	290	320	318	309		306															
New World Gulch E, MT	80-MT-8	2/26/80	115	24	273	311	303	294		288															
Bridger Bowl W, MT	80-MT-9	2/28/80	128	30	379	404	395	402		391															
Bridger Bowl E, MT	80-MT-10	2/28/80	120	28	337	367	378	375		356															
Sacajawea SC W, MT	80-MT-11	3/14/80	151	28	428	471	459	473		459															
Sacajawea SC E, MT	80-MT-12	3/14/80	149	28	414	469	456	477		461															
Sacajawea W, MT	80-MT-13	3/14/80	128	24	310	342	329	347		328															
Sacajawea E, MT	80-MT-14	3/14/80	140	26	359	397	383	389		387															
Maynard Cr. S, MT	80-MT-15	4/11/80	147	33	489											476	491		478						
Maynard Cr. N, MT	80-MT-16	4/11/80	144	34	489	530	503	521		507						482	477		491						
Battle Ridge S, MT	80-MT-17	4/11/80	84	32	272	271	269	253		256						267	252		273	286					
Battle Ridge N, MT	80-MT-18	4/11/80	86	32	277	273	270	258		260						278	284		267	286					
Star Lake E, MT	80-MT-19	4/22/80	208	38	790	868	838	852		836					819					780	778				
Star Lake W, MT	80-MT-20	4/22/80	219	39	846	922	886	899		891					883					853	857				
Star Lake C, MT	80-MT-21	4/22/80	214	39	830	907	861	869		867					863					826	825				
White Mill E, MT	80-MT-22	4/23/80	162	38	618	673	641	668		642					655					615	622				
White Mill W, MT	80-MT-23	4/23/80	165	38	630	687	654	686		653					658					625	634				
NE Entrance E, MT	80-MT-24	4/23/80	55	37	202	204	192	191		184										184	194				
NE Entrance W, MT	80-MT-25	4/23/80	51	38	197	194	183	182		183										180	182				
Hyalite Creek W, MT	80-MT-26	4/28/80	80	34	271	284	282	290		274					264					274	271	274			
Hyalite Creek E, MT	80-MT-27	4/28/80	84	33	278	306	300	300		286					283					278	281	286			
Window Rock N, MT	80-MT-28	4/28/80	57	36	206	230	209	190		214					187					206	187	191			
Window Rock S, MT	80-MT-29	4/28/80	61	34	206	230	225	207		222					200					216	225	207			
Arch Falls W, MT	80-MT-30	4/29/80	92	35	322	350	324	369		340										331	326	348			
Arch Falls E, MT	80-MT-31	4/29/80	98	35	344	376	340	387		364										351	349	373			
Spaulding, CA	80-CA-1	1/2/80	55	39	215	227	214	221	217																
Alpha, CA	80-CA-2	1/4/80	138	32	435	477	452	463	478																
Darrington, CA	80-CA-3	1/30/80	161	35	567	609	565	632	595	545															
Alpha, CA	80-CA-4	1/31/80	183	37	652	731	708	690	720	702															
Alpha, CA	80-CA-5	2/14/80	175	38	673	751	688	728	690	657			660												
Spaulding, CA	80-CA-6	2/27/80	56	43	242	254	253	253	242	247															
Alpha, CA	80-CA-7	2/28/80	272	35	957	1071	998	1001	1016	1046															
Alpha, CA	80-CA-8	3/13/80	279	39	1090	1168	1163	1152	1112	1096															
Darrington, 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	1191	1181															
Alpha, CA	80-CA-11	5/1/80	172	46	792	914	892		830	875			803												
Blackwall, BC	80-BC-1	2/12/80	154	30	456	535	507		516	508															
Blackwall, BC	80-BC-2	2/12/80	156	29	454	493	477		478	471															
New Copper, BC	80-BC-3	2/13/80	43	25	107	94	90		90	94															
New Copper, BC	80-BC-4	2/13/80	44	23	99	94	90		90	91															
Whistler, BC	80-BC-5	2/14/80	121	29	338	397	387		405	381															
Whistler, BC	80-BC-6	2/14/80	120	28	339	388	385		427	348															
Newcastle Ridge, BC	80-BC-7	2/15/80	231	40	916	1029	965		998	965															
Newcastle Ridge, BC	80-BC-8	2/15/80	228	39	888	1037	972		994	949															
Newcastle Ridge, BC	80-BC-9	2/20/80	224	39	875	955	916		927	893															
Blackwall, BC	80-BC-10	2/28/80	145	31	456	518	518		508	495															
New Copper, BC	80-BC-11	2/29/80	38	28	106	96	97		94	94															
Whistler, BC	80-BC-12	3/2/80	125	33	410	449	444		438	445															
Blackwall, BC	80-BC-13	3/18/80	200	32	631	728	704		733	706															
Blackwall, BC	80-BC-14	3/18/80	200	32	642	724	702		718	691															
McBride, BC	80-BC-15	3/21/80	125	25	314	348	351		354	335															
McBride, BC	80-BC-16	3/21/80	125	25	318	354	353		340	327															
Whistler, BC	80-BC-17	3/25/80	125	30	373	412	387		394	398															
Whistler, BC	80-BC-18	3/25/80	125	32	403	387	373		398	388															
Alpha, CA	81-CA-1	2/4/81	109	24	263	279	267		275	269	273														
Alpha, CA	81-CA-2	2/17/81	86	34	293	304	291		283	287	290														
Alpha, CA	81-CA-3	3/3/81	99	37	363	409	376		378	378	369														
Alpha, CA	81-CA-4	3/18/81	90	39	355	373	358		357	351	358													353	
Alpha, CA	81-CA-5	4/3/81	157	37	576	582	568		586	576	578													563	
Alpha, CA	81-CA-6	4/16/81	96	43	409	451	444		441	416	420													400	

Table II (Continued)

---> All SWE in mm

Location	No.	Date	Glacier Depth (cm)	Glacier Density	Glacier	Standard Federal	Sharpened Federal	1978 Metric (short)	1979 Metric	1980 Metric	1981 Metric	Broken Tooth Fed.	Pit or Template	Profile Gage	McCall	Adirondack	CRREL	Alum. Tubing	ESC 50 Fiberglass	ESC 50 Plastic	PVC Tubing	Utah	ESC 40	ESC 30	MSC
Blackwall, BC	81-BC-1	2/26/81	165	26	438	485	461		461	450	452														
Newcastle Ridge, BC	81-BC-2	3/3/81	80	29	231	204	206		207	201	195														
Ottawa, ONT	81-ON-1	2/10/81	43	35	152	147	152				142					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			87												88		
Lower New World W, MT	81-MT-3	1/29/81	28	15	41	43	40	38			41												38		
Lower New World E, MT	81-MT-4	1/29/81	28	15	42	41	40	42			39												37		
Lick Creek W, MT	81-MT-5	3/12/81	81	28	226	243	240	251			236												220	221	
Lick Creek E, MT	81-MT-6	3/12/81	83	28	230	249	246	247			241												229	230	
Skylark Trail N, MT	81-MT-7	3/25/81	115	33	376	386	384	397			389												372	386	
Skylark Trail S, MT	81-MT-8	3/25/81	112	32	359	379	375	383			368												356	369	
Palace Butte NW, MT	81-MT-9	3/30/81	48	27	131	144	144	157			146												122	126	
Palace Butte NE, MT	81-MT-10	3/30/81	47	27	127	141	141	153			142												119	123	
Palace Butte SW, MT	81-MT-11	3/30/81	52	28	146	163	152	158			160												127	125	
Palace Butte SE, MT	81-MT-12	3/30/81	52	26	138	163	152	158			160												127	125	
Lick Creek W, MT	81-MT-13	3/30/81	55	30	167	187	164	181			178												184	165	
Lick Creek E, MT	81-MT-14	3/30/81	52	32	165	170	153	170			153												174	160	
Shower Falls W, MT	81-MT-15	3/31/81	179	24	432	471	458	425			450												430	428	
Shower Falls E, MT	81-MT-16	3/31/81	183	24	441	475	468	425			453												452	446	
Arch Falls N, MT	81-MT-17	3/31/81	117	26	301	304	314	282			293												288	285	
Arch Falls SE, MT	81-MT-18	3/31/81	120	27	330	319	312	294			298												302	304	
Cooke City E, MT	81-MT-19	4/8/81	111	27	303	326	331	319			318												304	287	
Cooke City W, MT	81-MT-20	4/8/81	105	27	276	299	287	293			291												273	286	
Jardine E, MT	81-MT-21	4/9/81	53	25	135	135	130	137			136												132	138	
Jardine W, MT	81-MT-22	4/9/81	55	25	136	142	133	138			146												135	147	
Black Bear E, MT	81-MT-23	4/22/81	162	41	666	675	664	673			657												680	677	
Black Bear W, MT	81-MT-24	4/22/81	159	40	640	677	652	654			646												627	627	
Whiskey Creek E, MT	81-MT-25	4/23/81	37	36	132	153	142	143			142												130	138	
Whiskey Creek W, MT	81-MT-26	4/23/81	36	36	132	149	141	137			141												126	130	
Fisher Creek N, MT	81-MT-27	5/11/81	185	34	619	670	664	698			655												642	639	
Fisher Creek S, MT	81-MT-28	5/11/81	178	35	617	642	633	652			613												614	618	
Cooke Pass N, MT	81-MT-29	5/12/81	65	38	246	250	239	242			231												244	239	
Cooke Pass S, MT	81-MT-30	5/12/81	70	38	265	279	265	263			255												265	257	
Cooke Station N, MT	81-MT-31	5/12/81	110	32	356	376	357	381			365												361	357	
Cooke Station S, MT	81-MT-32	5/12/81	109	32	348	385	368	390			384												365	362	
Luther Marsh, ONT	82-ON-1	1/8/82	22	22	48	49					48													48	48
Luther Marsh, ONT	82-ON-2	1/8/82	20	19	38	42					36													40	38
Peterborough, ONT	82-ON-3	1/13/82	23	20	47	52					49													46	46
Dorset, ONT	82-ON-4	1/22/82	48	22	104	114					112													106	103
Dorset, ONT	82-ON-5	1/22/82	51	23	118	125					118													108	110
Peterborough, ONT	82-ON-6	2/8/82	60	21	127	134					124													127	131
Peterborough, ONT	82-ON-7	2/8/82	58	22	129	131					120													123	128
Luther Marsh, ONT	82-ON-8	2/10/82	55	22	120	114					114													118	124
Battle Ridge S, MT	82-MT-1	12/29/81	68	22	147	140	136	135			127												145	141	
Battle Ridge N, MT	82-MT-2	12/29/81	66	20	133	146	128	131			124												153	145	
Battle Ridge W, MT	82-MT-3	12/29/81	38	19	74	66	66	57			64												62	62	
Battle Ridge E, MT	82-MT-4	12/29/81	35	19	65	61	64	55			59												65	59	
Shower Falls N, MT	82-MT-5	1/26/82	171	26	450	503	496	508			484												445	447	
Shower Falls S, MT	82-MT-6	1/26/82	172	26	451	522	501	510			487												457	450	
Shower Falls E, MT	82-MT-7	3/29/82	269	28	744	805	788	815			830														
Shower Falls W, MT	82-MT-8	3/29/82	264	28	734	831	805	821			824														
Lick Creek N, MT	82-MT-9	3/30/82	115	25	282	321	308	305			303														
Lick Creek S, MT	82-MT-10	3/30/82	118	26	310	337	323	330			322														
Alpha, CA	82-CA-1	2/2/82	212	31	649	698	685		683	664	677														
Alpha, CA	82-CA-2	2/19/82	173	39	677	734	691		683	694	680														
Alpha, CA	82-CA-3	2/25/82	157	39	620	647	625		623	621	626														
Alpha, CA	82-CA-4	3/15/82	206	36	742	803	760		785	806	781														

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 wil 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

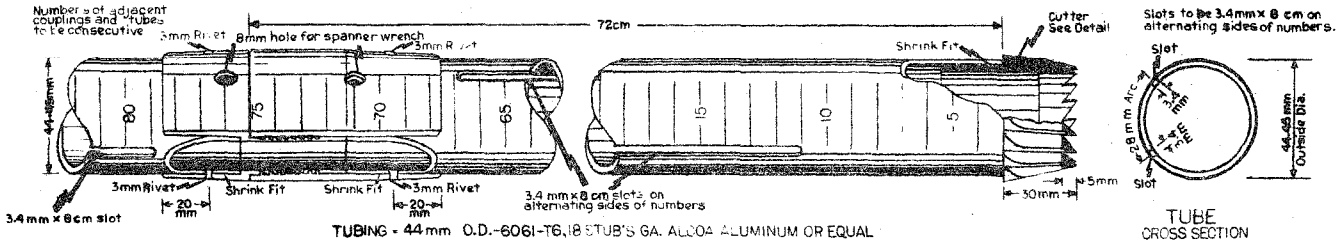
The male and female couplings shall have a shrink fit on the tubing and have smooth surface inside the tube when screwed together. Threads are to be modified Acme with three threads per centimeter.

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

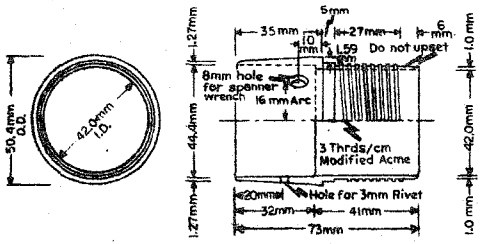
The spanner wrench will be constructed from light-weight steel stock and be bent so as to fit smoothly around the couplings and secure each tube section so any stuck or frozen threads can be released with moderate pressure. Two spanner wrenches are required for each sampler.



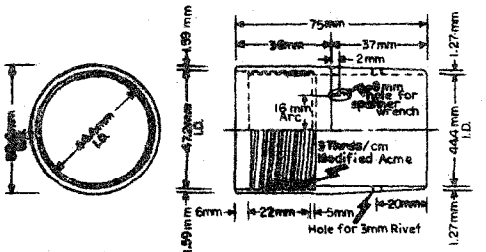
TUBING - 44 mm O.D.-6061-T6,18 STUB'S GA. ALCOA ALUMINUM OR EQUAL

TUBE, COUPLING AND CUTTER ASSEMBLY

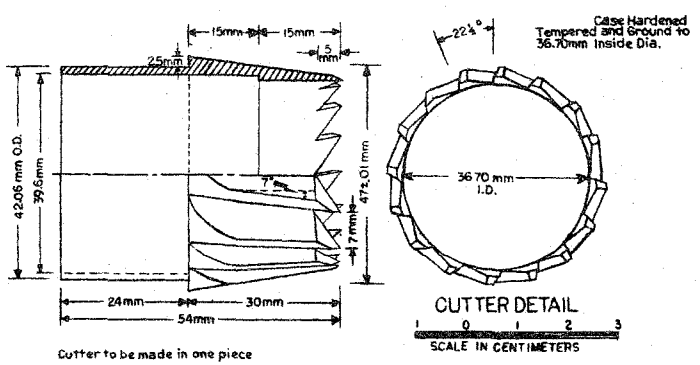
TUBE
CROSS SECTION



MALE COUPLING
ALCOA ALUMINUM 6061 - T6 OR EQUAL

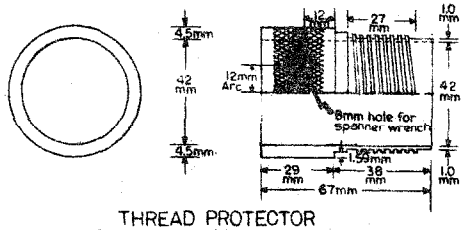


FEMALE COUPLING
ALCOA ALUMINUM 6061-T6 OR EQUAL



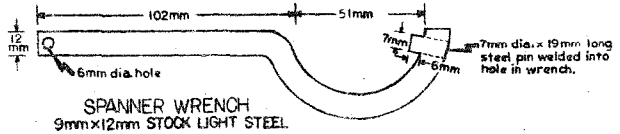
Cutter to be made in one piece

CUTTER DETAIL



THREAD PROTECTOR
ALCOA ALUMINUM 6061-T6 OR EQUAL

PRELIMINARY DRAFT
SUBJECT TO REVISION



SPANNER WRENCH
9mm x 12mm STOCK LIGHT STEEL

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

WSC METRIC SNOW 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.

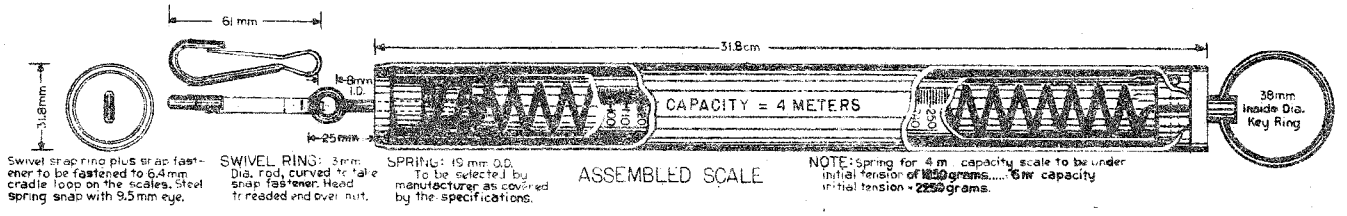
6 Meter Capacity Scale (for snow depths between 4 and 6 meters)

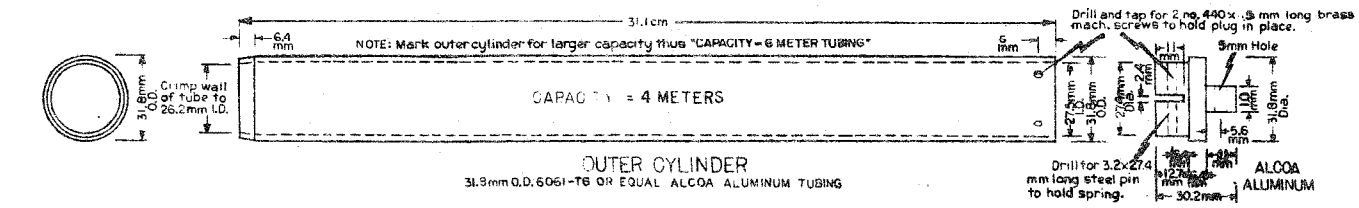
The inner cylinder shall be calibrated on one side in increments equivalent to five centimeters. The scale shall be such that the increments will be from 0 to 480 and weigh 5,357 grams over 284.2 mm distance on the inner cylinder. Each increment shall be stamped at intervals of approximately 2.96 mm 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."

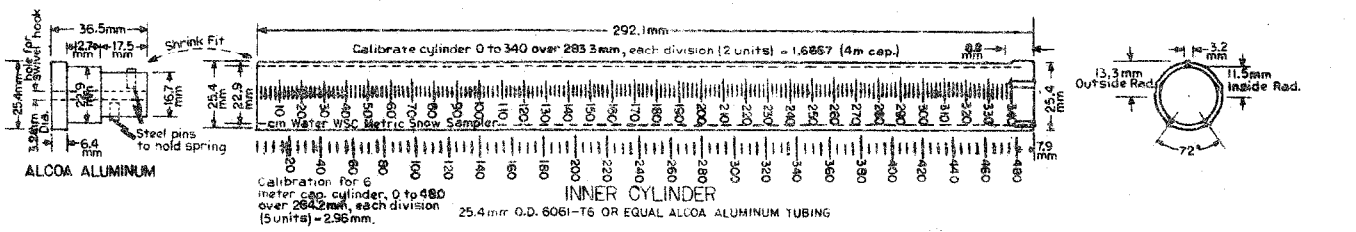
The scale spring shall be 139.7 mm long and shall be pre-tensioned for 2,250 grams such that the weight of a 3-meter (4 sections) snow sampling tube (empty) will read slightly greater than zero on the scale. Scales shall be accurate to 15 grams over the full span of the scale.

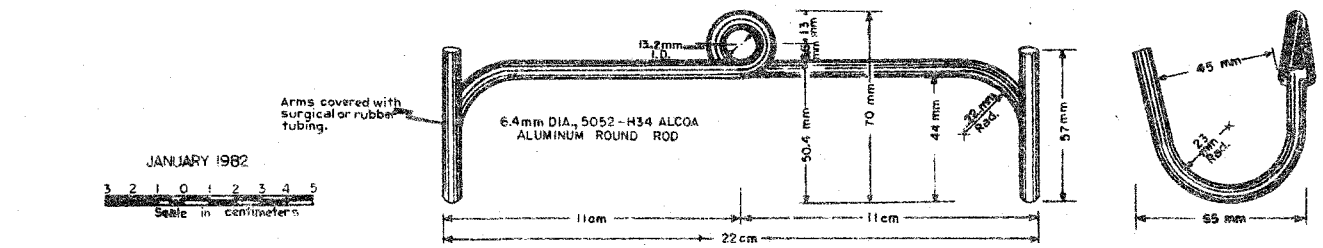
Cradle

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

3 2 1 0 1 2 3 4 5

Scale in centimeters

PRELIMINARY DRAFT
SUBJECT TO REVISION

METRIC SCALE FOR WSC METRIC SNOW SAMPLER

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.

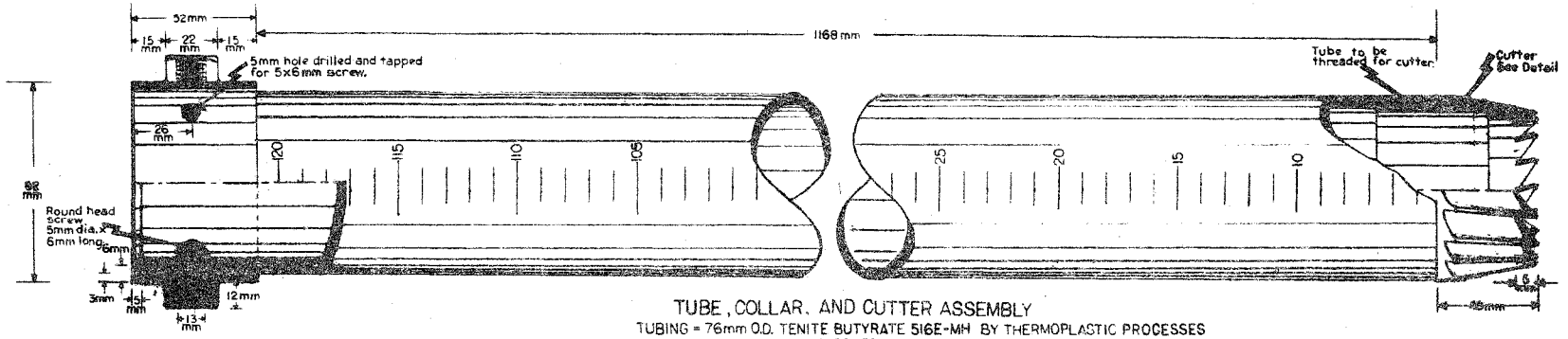
1 Meter Capacity Scale

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."

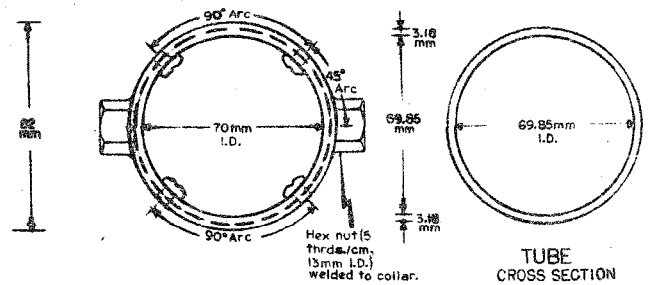
The scale spring shall be 190.5 mm long and shall be pre-tensioned for 1,250 grams such that the empty weight of the ESC-30 snow sampling tube will read slightly greater than zero on the scale.

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.

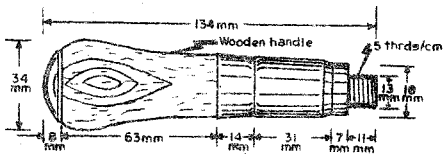


TUBE, COLLAR, AND CUTTER ASSEMBLY
TUBING = 76mm O.D. TENITE BUTYRATE 516E-MH BY THERMOPLASTIC PROCESSES INC. OR EQUAL

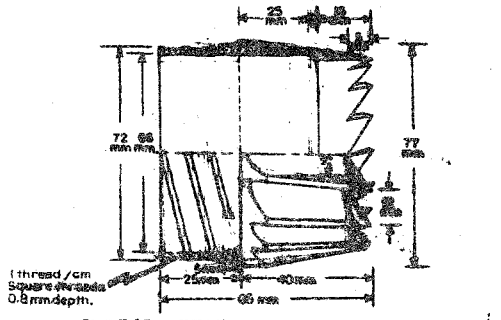


COLLAR
CROSS SECTION
(STAINLESS STEEL)

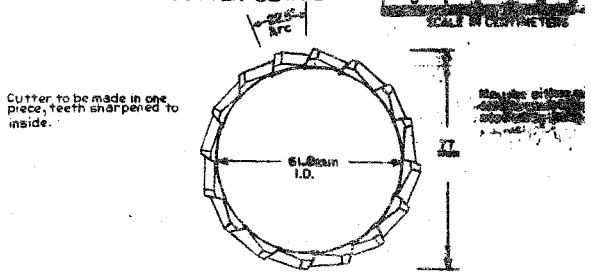
TUBE
CROSS SECTION



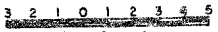
HANDLE
(SCREWED INTO COLLAR HEX NUTS)



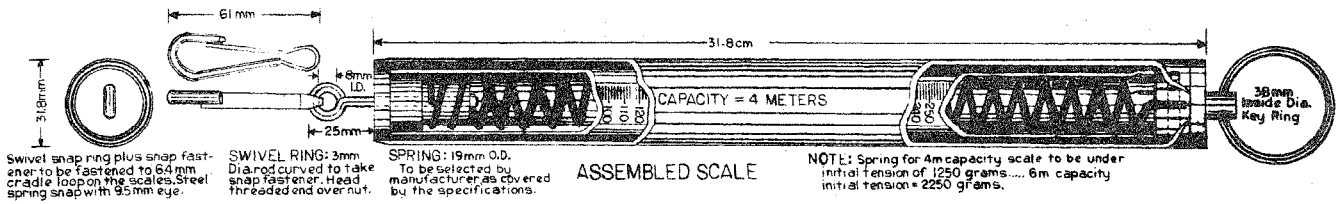
CUTTER DETAIL

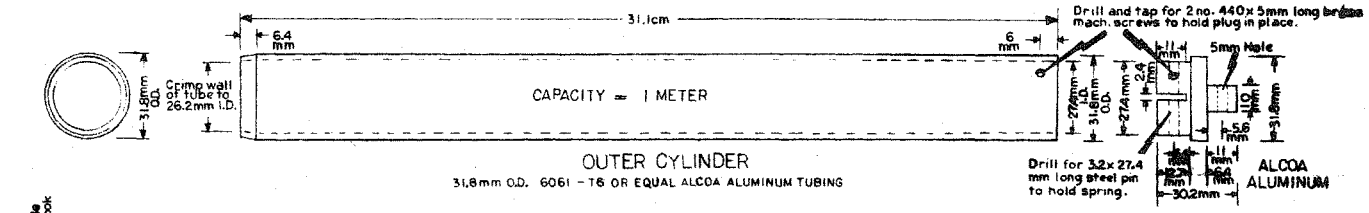


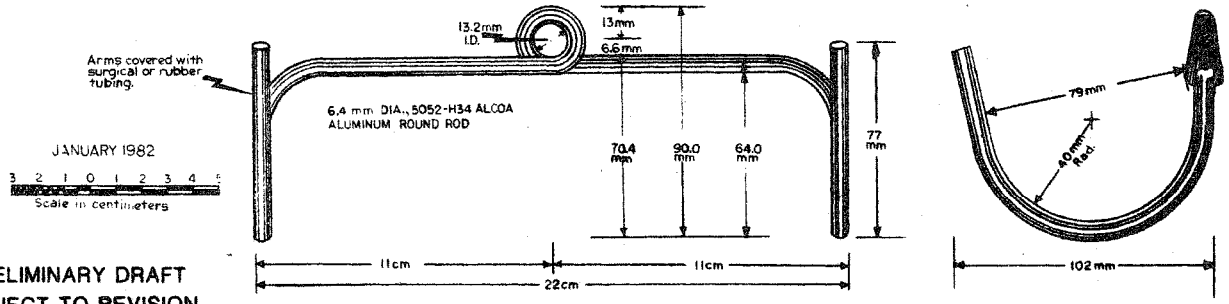
PRELIMINARY DRAFT
SUBJECT TO REVISION



ESC 30 METRIC SNOW SAMPLER







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.