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Appendix A – Reference Materials

Table A.1 Nozzle Characteristics (Spray Systems, 1996)

Spray Angle at 40 psi	Capacity Size	VEEJET NOZZLES NOZZLE TYPE/INLET CONNECTION												Equiv. Orifice Diam. Inches	CAPACITY (gallons per minute)											SPRAY ANGLE			
		H-VV		H-VVL		H-U					U																		
		1/8	1/4	1/8	1/4	1/8	1/4	3/8	1/2	3/4	1	1-1/4	2		5 psi	10 psi	20 psi	30 psi	40 psi	60 psi	80 psi	100 psi	200 psi	300 psi	500 psi	20 psi	40 psi	80 psi	200 psi
	5001	●	●	●	●									.026		.05	.07	.09	.10	.12	.14	.16	.22	.27	.35	37°	50°	59°	65°
	5002	●	●	●	●									.036		.10	.14	.17	.20	.25	.28	.32	.45	.55	.71	39°	50°	57°	63°
	5003	●	●	●	●									.043	.11	.15	.21	.26	.30	.37	.42	.47	.67	.82	1.1	40°	50°	56°	62°
	5004	●	●	●	●									.052	.14	.20	.28	.35	.40	.49	.57	.63	.89	1.1	1.4	42°	50°	56°	61°
	5005	●	●	●	●									.057	.18	.25	.35	.43	.50	.61	.71	.79	1.1	1.4	1.8	44°	50°	56°	61°
	5006	●	●	●	●									.062	.21	.30	.42	.52	.60	.73	.85	.95	1.3	1.6	2.1	45°	50°	56°	60°
	5008	●	●	●	●									.072	.28	.40	.56	.69	.80	.98	1.1	1.3	1.8	2.2	2.8	45°	50°	55°	60°
	5010					●	●	●						5/64	.35	.50	.71	.86	1.0	1.2	1.4	1.6	2.2	2.7	3.5	45°	50°	55°	59°
	5015						●	●	●					3/32	.53	.75	1.1	1.3	1.5	1.8	2.1	2.4	3.4	4.1	5.3	45°	50°	55°	59°
50°	5020					●	●	●	●					7/64	.71	1.0	1.4	1.7	2.0	2.5	2.8	3.2	4.5	5.5	7.1	45°	50°	55°	59°
	5030					●	●	●	●					9/64	1.1	1.5	2.1	2.6	3.0	3.7	4.2	4.7	6.7	8.2	10.6	45°	50°	55°	59°
	5040					●	●	●						5/32	1.4	2.0	2.8	3.5	4.0	4.9	5.7	6.3	8.9	11.0	14.2	46°	50°	54°	59°
	5050					●	●	●						11/64	1.8	2.5	3.5	4.3	5.0	6.1	7.1	7.9	11.2	13.7	17.7	46°	50°	54°	59°
	5060						●	●						3/16	2.1	3.0	4.2	5.2	6.0	7.3	8.5	9.5	13.4	16.4	21	46°	50°	54°	59°
	5070						●	●	●					13/64	2.5	3.5	4.9	6.1	7.0	8.6	9.9	11.1	15.7	19.2	25	46°	50°	54°	59°
	50100							●	●					1/4	3.5	5.0	7.1	8.6	10.0	12.2	14.1	15.8	22	27	35	44°	50°	52°	54°

Table A.2 Flow Characteristics of the HKD Spectrum with Various Nozzle Configurations (modified, Snow Economics, 1994)

Top Nozzle Type	5040	5040	5040	5020	5020	5020	5020	5020	5020	5020	5010	5010	5010	5010
Middle Nozzle Type	5040	5040	5040	5040	5040	5040	5020	5020	5020	5020	5020	5020	5020	6020
Bottom Nozzle Type	5060	5040	OFF	5060	5040	OFF	5060	5040	5020	OFF	5060	5040	5020	OFF
Water Pressure (PSI)	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM	Flow GPM
180	57	40	33	49	41	24	41	33	24	16	37	28	20	12
200	60	52	34	52	43	26	43	34	26	17	39	30	22	13
220	63	54	36	54	45	27	45	36	27	18	41	32	23	14
240	66	57	38	57	47	28	47	38	28	19	43	33	24	14
260	69	59	40	59	50	30	50	40	30	20	45	35	25	15
280	72	62	41	62	52	31	52	41	31	21	46	36	26	15
300	75	64	43	64	53	32	53	43	32	21	48	37	27	16
320	77	66	44	66	55	33	55	44	33	22	50	39	28	17
340	80	68	46	68	57	34	57	46	34	23	51	40	29	17
360	82	71	47	71	59	35	59	47	35	24	53	41	29	18
380	85	73	48	73	60	36	60	48	36	24	54	42	30	18
400	87	75	50	75	62	37	62	50	37	25	56	43	31	19
420	89	76	51	76	64	38	64	51	38	25	57	45	32	19
440	91	78	52	78	65	39	65	52	39	26	59	46	33	20
460	93	80	53	80	67	40	67	53	40	27	60	47	33	20
480	96	82	55	82	68	41	68	55	41	27	61	48	34	20
500	98	84	56	84	70	42	70	56	42	28	63	49	35	21
520	100	85	57	85	71	43	71	57	43	28	64	50	36	21
540	101	87	58	87	72	43	72	58	43	29	65	51	36	22
560	103	89	59	89	74	44	74	59	44	30	66	52	37	22
580	105	90	60	90	75	45	75	60	45	30	68	53	38	23
600	107	92	61	92	77	46	77	61	46	31	69	54	38	23
620	109	93	62	93	78	47	78	62	47	31	70	54	39	23
640	111	95	63	95	79	47	79	63	47	32	71	55	40	24
660	112	96	64	96	80	48	80	64	48	32	72	56	40	24
680	114	98	65	98	82	49	82	65	49	33	73	57	41	24
700	116	99	66	99	83	50	83	66	50	33	75	58	41	25
710	117	100	67	100	83	50	83	67	50	33	75	58	42	25

Table A.3 Theoretical Effectiveness of Snomax™ at various Micron Droplet Size and INA (York Snow, 1999)

MICRON DROPLET SIZE	MILLIONS OF MICRON DROPLETS IN 100,000 GALLONS	ICE NUCLEATION SITES SNOMAX @ 10.76 IN 300 GRAM BAGS	ICE NUCLEATION SITES SNOMAX @ 11.17 IN 270 GRAM BAGS	ICE NUCLEATION SITES SNOMAX @ 11.33 IN 270 GRAM BAGS	ICE NUCLEATION SITES SNOMAX @ 11.44 IN 270 GRAM BAGS
500	5,783,978	**17,263,198**	**39,935,926**	**57,724,976**	**74,364,175**
450	7,934,832	**17,263,198**	**39,935,926**	**57,724,976**	**74,364,175**
400	11,296,832	**17,263,198**	**39,935,926**	**57,724,976**	**74,364,175**
350	16,862,910	**17,263,198**	**39,935,926**	**57,724,976**	**74,364,175**
300	26,777,676	17,263,198	**39,935,926**	**57,724,976**	**74,364,175**
250	46,271,825	17,263,198	39,935,926	**57,724,976**	**74,364,175**
200	90,374,658	17,263,198	39,935,926	57,724,976	74,364,175
150	214,221,411	17,263,198	39,935,926	57,724,976	74,364,175
100	722,997,264	17,263,198	39,935,926	57,724,976	74,364,175

Table A.4 Standard Error of Density Samples

Sample	Density (lbs/cf)	
1	25.1	Mean = 26.3
2	27.6	
3	26.9	Std Error = 1.0 (3.8%)
4	26.9	
5	25.2	

Table A.5 Dry Bulb to Wet Bulb Conversion Chart (Snow Economics, 1994)

	D.B. 38.0	D.B. 36.0	D.B. 34.0	D.B. 32.0	D.B. 30.0	D.B. 28.0	D.B. 26.0	D.B. 24.0	D.B. 22.0	D.B. 20.0	D.B. 18.0	D.B. 16.0	D.B. 14.0	D.B. 12.0
R.H.	W.B.	W.B.	W.B.	W.B.	W.B.	W.B.	W.B.	W.B.	W.B.	W.B.	W.B.	W.B	W.B.	W.B.
100%	38.0	36.0	34.0	32.0	30.0	28.0	26.0	24.0	22.0	20.0	18.0	16.0	14.0	12.0
90%	36.9	35.0	33.0	31.0	29.1	27.2	25.0	23.2	21.3	19.4	17.3	15.3	13.5	11.5
80%	35.8	33.9	32.0	30.0	28.1	26.1	24.2	22.4	20.5	18.6	16.8	14.9	12.9	11.0
70%	34.5	32.5	30.9	28.9	27.2	25.0	23.1	21.5	19.8	18.0	16.0	14.2	12.2	10.4
60%	33.0	31.1	29.4	27.8	26.0	24.2	22.4	20.8	19.0	17.2	15.4	13.5	11.8	9.9
50%	31.5	30.0	28.2	26.6	25.0	23.1	21.5	19.9	18.1	16.3	14.6	13.0	11.0	9.2
40%	30.1	28.5	27.0	25.4	23.9	22.2	20.6	19.0	17.3	15.6	13.9	12.2	10.4	8.8
30%	28.8	27.2	25.8	24.2	22.8	21.2	19.6	18.2	16.5	14.8	13.2	11.6	9.9	8.2
20%	27.2	26.0	24.5	23.0	21.6	20.1	18.6	17.2	15.6	14.0	12.5	10.9	9.2	7.5
10%	26.0	24.5	23.2	22.0	20.5	19.0	17.6	16.2	14.8	13.2	11.8	10.1	8.5	7.0
0%	24.5	23.0	22.0	20.8	19.5	18.0	16.7	15.3	13.9	12.5	11.0	9.6	8.0	6.5

D.B. = Dry Bulb Temperature (°F) W.B. = Wet Bulb Temperature (°F) R.H. = Relative Humidity

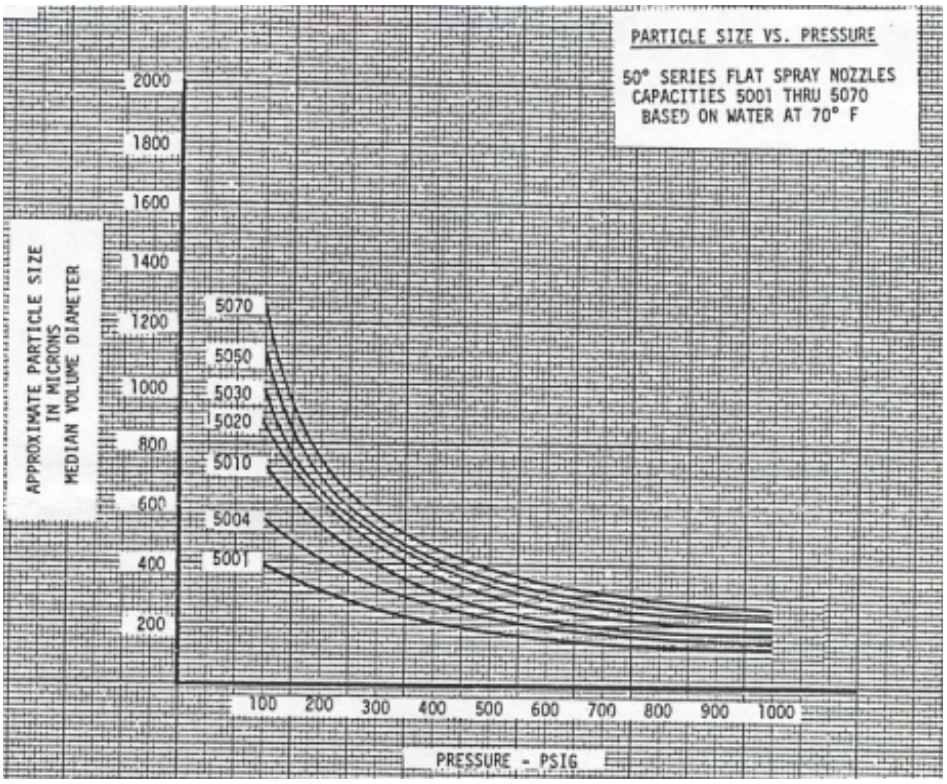

Figure A.1 Relationship Between Particle Size and Water Pressure for Nozzles (Spray Systems, 1973)

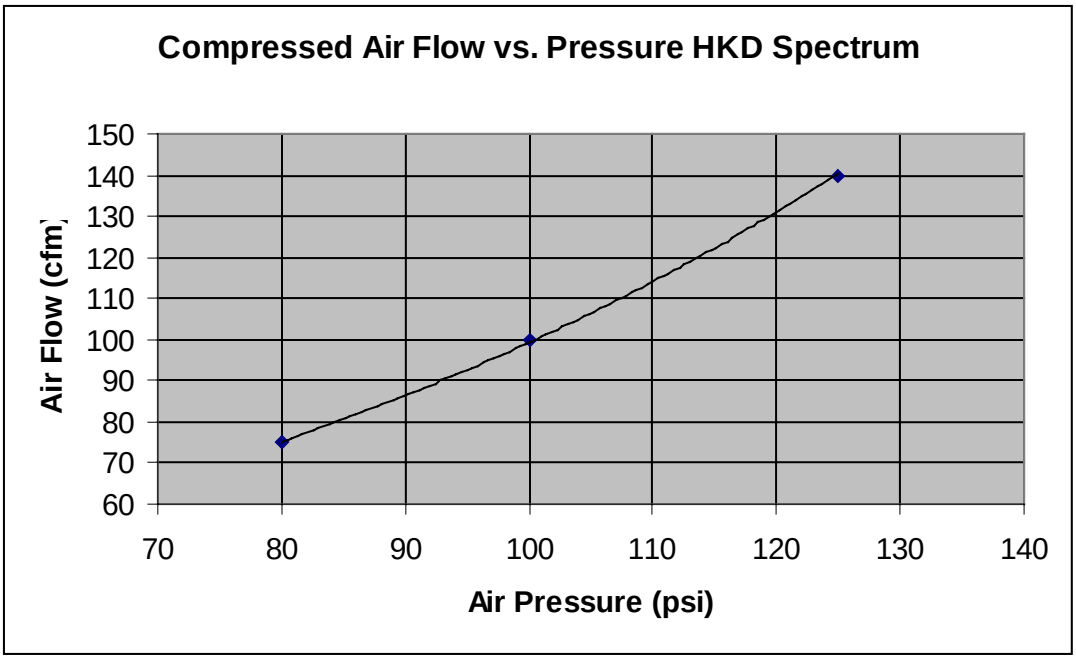

Figure A.2 Relationship Between Air Pressure and Flowrate in the HKD Spectrum

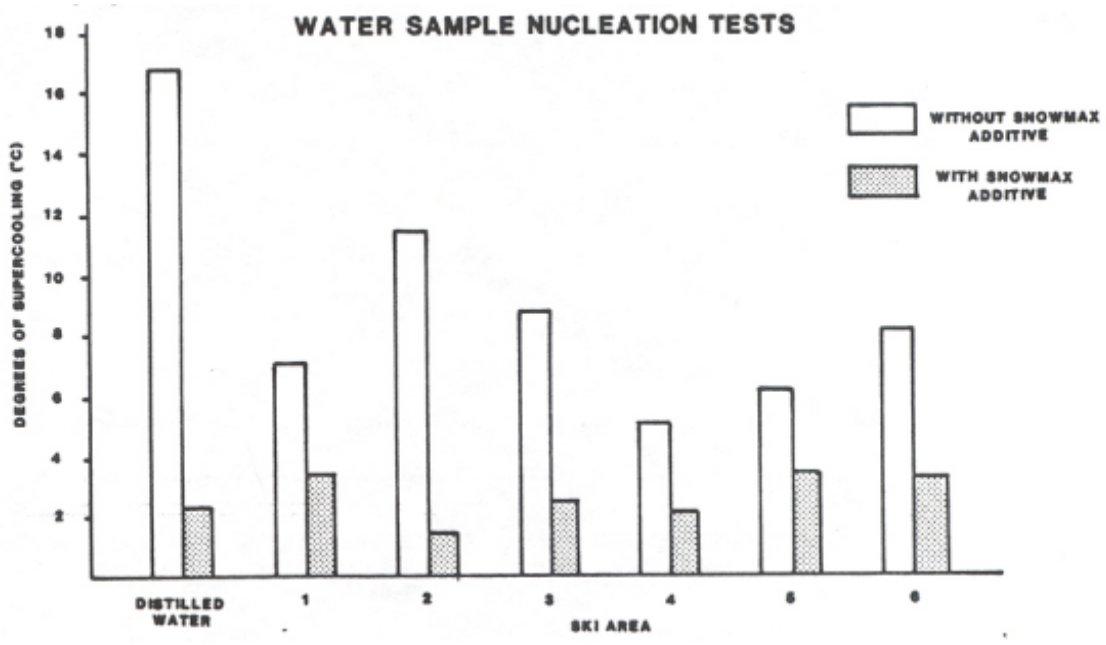

Figure A.3 Water Sample Nucleation Tests (Barthold, 1986)

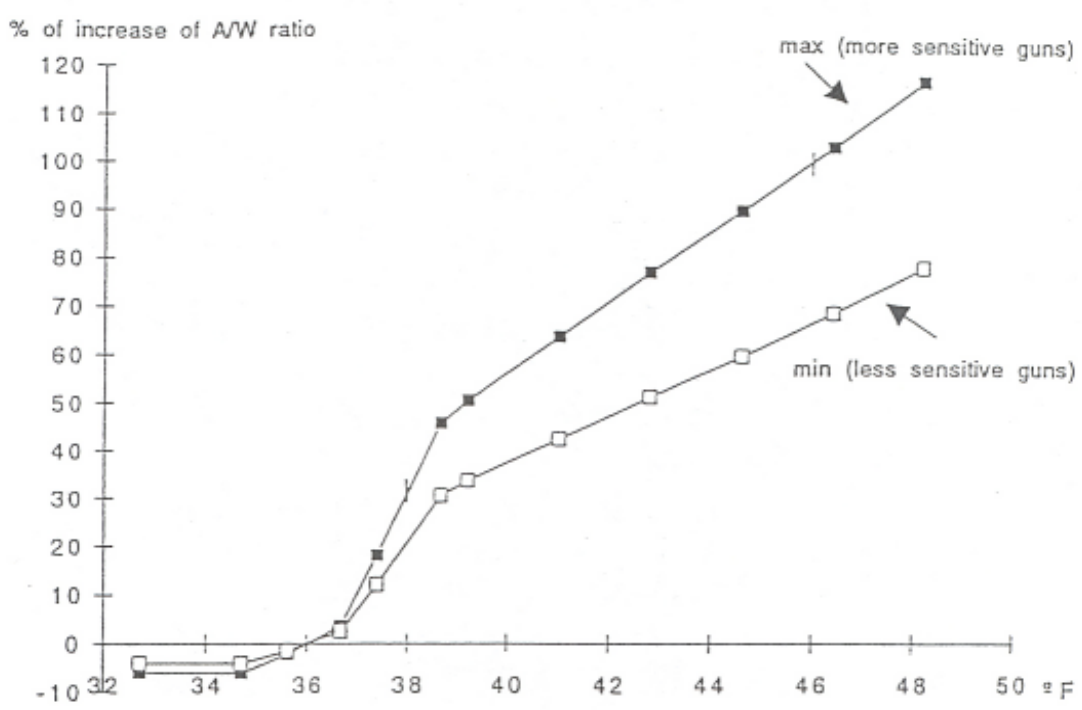

Figure A.4 Effect of Inflow Water Temperature on Air/Water Ratio (Alford, 1998)

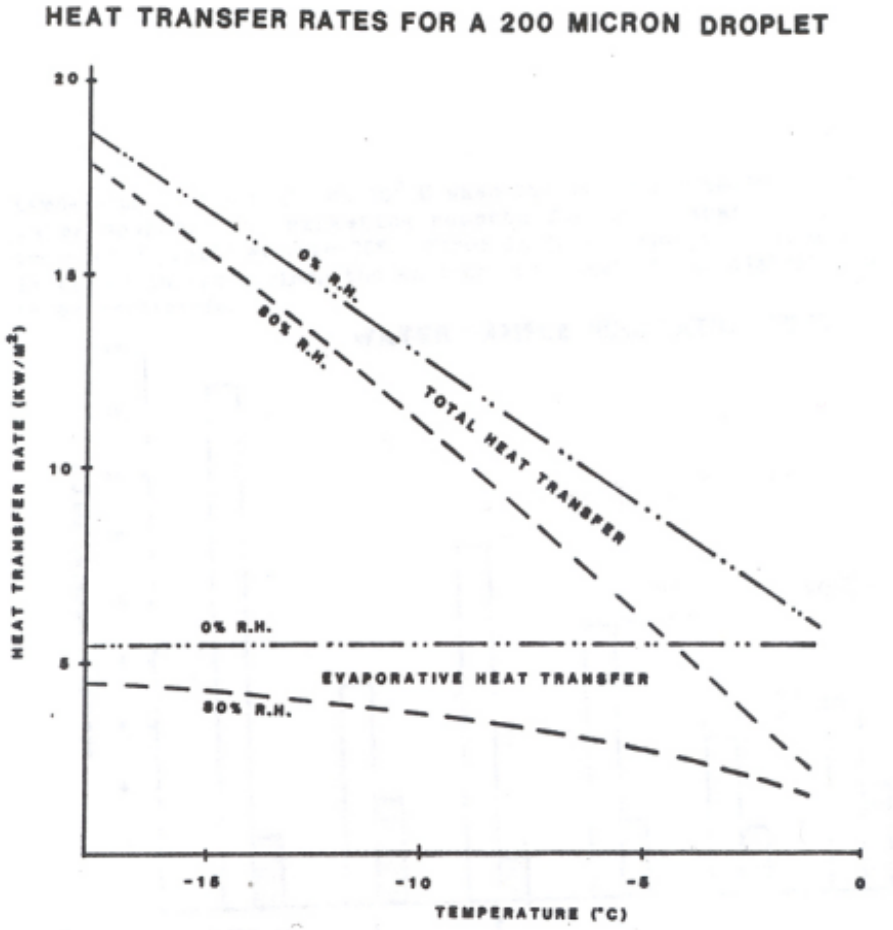

Figure A.5 Heat Transfer Rates for a 200 Micron Droplet (Barthold, 1986)

TESTING SESSION #: _____ DATE(S): _____

TOWER # , LOCATION: _____

WEATHER: _____

NAT"L SNOW ACCUM: _____

GROUND COVER: _____

TEST CONDITIONS

NOZZLE CONFIG (T-M-B): _____ SNOMAX LTRS/KGAL: _____

	BEGIN - - - - - -		- - - - - - END	
TIME				
DRY BULB - F				
HUMIDITY - %				
WET BULB - F				
WIND - MPH/DRXN				
	SYS / HYD	SYS / HYD	SYS / HYD	SYS / HYD
WATER PRESS. - PSI				
WATER FLOW - GPM				
AIR PRESS. - PSI				
AIR FLOW - GPM				
FLOWMETER ?				

SAMPLE	WGT / DENSITY	SAMPLE	WGT / DENSITY

Figure A.6 Data Collection Form, Front

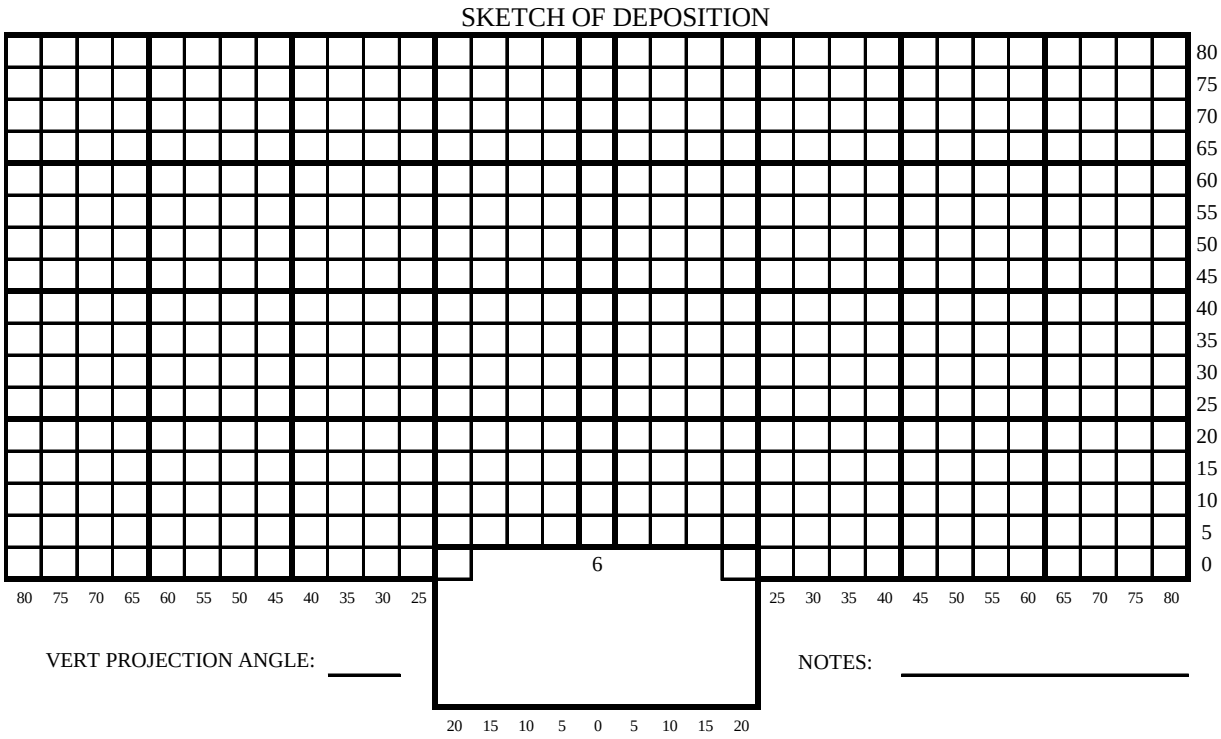

Figure A.7 Data Collection Form, Back