

Thermal stability of the stilbite-type framework: crystal structure of the dehydrated sodium/ammonium exchange form

WILFRIED J. MORTIER

Katholieke Universiteit Leuven
Centrum voor Oppervlaktescheikunde en Colloïdale Scheikunde
de Croylaan 42 B-3030 Leuven (Heverlee), Belgium

Abstract

The crystal structure of dehydrated Na/NH₄ exchanged stilbite, $(\text{NH}_4)_{6.76}\text{Na}_{2.45}\text{K}_{0.15}\text{Ca}_{0.06}\text{Al}_{9.48}\text{Si}_{26.52}\text{O}_{72} \cdot x\text{H}_2\text{O}$; $a = 13.57$, $b = 18.26$, $c = 11.32\text{\AA}$, $\beta = 126.96^\circ$ has been refined in space group $C2/m$. The framework characteristics are consistent with those of the hydrated natural form and the dehydrated hydrogen form. Only slight displacements of the fundamental structural units exist, but 10% breaking of one of the T-O bonds of the T-O-T bridges between them occurs. The cations are located at the six-ring site and the flat eight-ring site, and residual water molecules at the boat-shaped eight-ring. The framework distortions are cation-induced and readily affect the cuboid polyhedron of the framework which is formed by joining adjacent structural units.

Introduction

Stilbite-type minerals are zeolites with a two-dimensional interconnected channel system. Ten-membered rings of (Si, Al) O₄ tetrahedra (free diameter $4.1 \times 6.2\text{\AA}$, Meier and Olson, 1978) limit the pore size of the largest channels. These intersect with smaller channels with eight-ring apertures (free diameter $2.7 \times 5.7\text{\AA}$, Meier and Olson, 1978). The inner surface should therefore be readily accessible to small molecules and these minerals could have a potential use as molecular sieves or catalysts. This would require an "activation" at elevated temperatures to remove the adsorbed water molecules. Unfortunately, in the presence of exchangeable cations, stilbite contracts on heating and the framework is destroyed (Passaglia, 1980). Contraction and destruction are related to the attractive force of the extra-framework cations. When a crystal of an isostructural phase, Nabarrerite is heated to 250°C (Alberti and Vezzalini, 1978), the framework is very much distorted and T-O-T bonds are broken. A similar behavior, but with a much smaller fraction of broken T-O-T bonds, occurs in dehydrated stellerite, the Ca variety of stilbite (Alberti *et al.*, 1978).

Jacobs *et al.*, (1979) characterized the hydrogen form as the most stable. This was confirmed by a structural study of the mineral after ammonium exchange and dehydration (Pearce *et al.*, 1980). Only very minor differences were found between the framework parameters of the hydrated form (Slaughter, 1970; Galli, 1971) and those of the dehydrated hydrogen form. By a reduction of the cation-framework interactions, which become progressively pronounced as the water ligands are removed, a collapse of the framework can be prevented. Not only

protons, but also cations such as K⁺ and Rb⁺ with a sufficiently low ionic potential (Passaglia, 1980) may "stabilize" the stilbite-type framework. The K and Rb forms do not undergo appreciable contraction and their destruction occurs only at fusion, *i.e.*, at about 1000°C .

As the dehydrated Ca-form exhibits a smaller fraction of broken T-O-T bonds (Alberti *et al.*, 1978) than the dehydrated Na-form (Alberti *et al.*, 1978), the number of cations might be an important parameter. A further reduction of the number of cations is attempted here in the study of a dehydrated Na-H-stilbite form. It will be shown that the framework-contraction and the framework-destruction steps can be separated.

Methods and results

Crystals of natural stilbite (STI) from the Faroe Islands (Denmark; Virginia Polytechnic Institute and State University Sample number B179) were exchanged in a 1N 1:1 NaCl:NH₄Cl solution for five months. The exchange solution was renewed three times during this period. Electron microprobe analyses were made on crystals of the same batch. (The analysis was made at the Department of Geophysical Sciences, The University of Chicago under the following conditions: solid-state detector, Reed-Ware data reduction, beam current: 100 nA, no corrections for water or Na loss, total wt.% between 80.2 and 82.3). Calibration factors for the different elements were determined using An₇₀ glass for Ca, Si, Na and Al, and asbestos microcline for K. Taken strictly at face value, when calculated to 72 oxygens with sufficient NH₄ added to balance the charges, the unit cell of Na-NH₄STI contains before dehydration:

a. Framework

T(1)-O(1)	1.640(3)	O(1)-T(1)-O(3)	109.5(2)
-O(3)	1.648(3)	-O(4)	111.8(2)
-O(4)	1.644(3)	-O(7)	106.4(2)
-O(7)	1.648(3)	O(3)-T(1)-O(4)	110.4(2)
mean	1.645	-O(7)	109.8(2)
		O(4)-T(1)-O(7)	108.8(2)
T(2)-O(2)	1.626(3)		
-O(5)	1.637(3)	O(2)-T(2)-O(5)	109.3(2)
-O(6)	1.627(3)	-O(6)	111.3(2)
-O(7)	1.631(3)	-O(7)	106.9(2)
mean	1.630	O(5)-T(2)-O(6)	110.2(2)
		-O(7)	109.9(2)
T(3)-O(4)	1.645(3)	O(6)-T(2)-O(7)	109.1(2)
-O(6)	1.650(3)		
-O(8)	1.650(3)	O(4)-T(3)-O(6)	109.7(2)
-O(9)	1.626(1)	-O(8)	111.3(2)
mean	1.643	-O(9)	107.1(2)
		O(6)-T(3)-O(8)	110.9(2)
T(4)-O(3)	1.619(3)	-O(9)	106.7(2)
-O(5)	1.620(3)	O(8)-T(3)-O(9)	110.9(2)
-O(8)	1.624(3)		
-O(10)	1.628(2)	O(3)-T(4)-O(5)	108.6(2)
mean	1.623	-O(8)	111.2(2)
		-O(10)	110.3(1)
T(5)-2 O(1)	1.627(3)	O(5)-T(4)-O(8)	111.0(2)
-2 O(2)	1.626(3)	-O(10)	110.1(1)
mean	1.626	O(8)-T(4)-O(10)	105.4(2)
T(5)-O(1)-T(1)	146.0(2)	O(1)-T(5)-O(1)	109.6(2)
T(2)-O(2)-T(5)	145.7(2)	2 -O(2)	109.6(2)
T(1)-O(3)-T(4)	151.8(2)	2 -O(2)	109.7(1)
T(1)-O(4)-T(3)	144.5(2)	O(2)-T(5)-O(2)	108.5(2)
T(2)-O(5)-T(4)	151.0(2)		
T(2)-O(6)-T(3)	146.7(2)	T(2)'-O(?)	1.75(1)
T(1)-O(7)-T(2)	147.3(2)	-O(5)	1.58(1)
T(3)-O(8)-T(4)	138.7(3)	-O(6)	1.80(1)
T(3)-O(9)-T(3)	165.9(3)		
T(4)-O(10)-T(4)	141.5(3)	T(1)'-O(1)	1.74(1)
		-O(3)	1.57(1)
		-O(4)	1.81(1)

b. Cations

Na(1)-O(7)	2.238(14)	Na(2)-2 O(10)	2.811(4)
-O(7)	2.269(14)	-4 O(8)	3.179(3)
-O(1)	2.749(14)		
-O(2)	2.800(14)	Na(3)-2 O(4)	2.999(6)
-O(1)	2.892(14)	-2 O(6)	3.054(6)
-O(2)	2.943(14)	-2 O(9)	3.265(8)

Am Min Mortier Table 2
For Deposit
AM-83-218

(92-569)

a. Framework

T(1)-O(1)	1.640(3)	O(1)-T(1)-O(3)	109.5(2)
-O(3)	1.648(3)	-O(4)	111.8(2)
-O(4)	1.644(3)	-O(7)	106.4(2)
-O(7)	1.648(3)	O(3)-T(1)-O(4)	110.4(2)
mean	1.645	-O(7)	109.8(2)
		O(4)-T(1)-O(7)	108.8(2)
T(2)-O(2)	1.626(3)	O(2)-T(2)-O(5)	109.3(2)
-O(5)	1.637(3)	-O(6)	111.3(2)
-O(6)	1.627(3)	-O(7)	106.9(2)
-O(7)	1.631(3)	O(5)-T(2)-O(6)	110.2(2)
mean	1.630	-O(7)	109.9(2)
T(3)-O(4)	1.645(3)	O(6)-T(2)-O(7)	109.1(2)
-O(6)	1.650(3)	O(4)-T(3)-O(6)	109.7(2)
-O(8)	1.650(3)	-O(8)	111.3(2)
-O(9)	1.626(1)	-O(9)	107.1(2)
mean	1.643	O(6)-T(3)-O(8)	110.9(2)
		-O(9)	106.7(2)
T(4)-O(3)	1.619(3)	O(8)-T(3)-O(9)	110.9(2)
-O(5)	1.620(3)	O(3)-T(4)-O(5)	108.6(2)
-O(8)	1.624(3)	-O(8)	111.2(2)
-O(10)	1.628(2)	-O(10)	110.3(1)
mean	1.623	O(5)-T(4)-O(8)	111.0(2)
		-O(10)	110.1(1)
T(5)-2 O(1)	1.627(3)	O(8)-T(4)-O(10)	105.4(2)
-2 O(2)	1.626(3)		
mean	1.626		
T(5)-O(1)-T(1)	146.0(2)	O(1)-T(5)-O(1)	109.6(2)
T(2)-O(2)-T(5)	145.7(2)	2 -O(2)	109.6(2)
T(1)-O(3)-T(4)	151.8(2)	2 -O(2)	109.7(1)
T(1)-O(4)-T(3)	144.5(2)	O(2)-T(5)-O(2)	108.5(2)
T(2)-O(5)-T(4)	151.0(2)		
T(2)-O(6)-T(3)	146.7(2)	T(2)'-O(2)	1.75(1)
T(1)-O(7)-T(2)	147.3(2)	-O(5)	1.58(1)
T(3)-O(8)-T(4)	138.7(3)	-O(6)	1.80(1)
T(3)-O(9)-T(3)	165.9(3)		
T(4)-O(10)-T(4)	141.5(3)	T(1)'-O(1)	1.74(1)
		-O(3)	1.57(1)
		-O(4)	1.81(1)

b. Cations

Na(1)-O(7)	2.238(14)	Na(2)-2 O(10)	2.811(4)
-O(7)	2.269(14)	-4 O(8)	3.179(3)
-O(1)	2.749(14)		
-O(2)	2.800(14)	Na(3)-2 O(4)	2.999(6)
-O(1)	2.892(14)	-2 O(6)	3.054(6)
-O(2)	2.943(14)	-2 O(9)	3.265(8)

		H= 0		10	4	617	649	1	-4	120	106
K	L	FOBS	FCALC	10	5	714	720	1	-3	514	479
0	1	1659	1577	10	7	251	245	1	-2	564	551
0	2	432	414	10	8	338	342	1	-1	349	343
0	3	339	332	10	9	214	226	1	1	354	343
0	4	1041	1056	10	10	59	34	1	2	517	477
0	5	962	931	12	1	304	315	1	3	137	127
0	6	475	489	12	2	656	672	1	5	111	114
0	7	645	665	12	3	350	359	1	6	102	96
0	8	972	995	12	4	388	386	1	7	77	81
0	9	213	207	12	5	40	20	1	8	41	25
0	10	81	72	12	6	422	435	1	9	54	71
2	0	1920	2025	12	7	96	97	1	10	79	83
2	1	526	508	12	8	133	124	3-12	51	48	
2	2	542	495	12	9	102	106	3-11	211	218	
2	3	576	475	12	10	205	208	3-10	190	190	
2	4	114	120	14	0	435	445	3-8	46	9	
2	6	200	183	14	1	151	158	3-7	427	434	
2	8	456	450	14	2	148	142	3-6	470	473	
2	9	81	64	14	3	77	80	3-5	147	149	
2	11	160	148	14	4	293	299	3-4	122	128	
4	0	173	149	14	6	180	173	3-3	661	615	
4	1	811	792	14	7	77	79	3-2	1097	1080	
4	2	328	314	14	8	229	240	3-1	113	118	
4	3	575	561	14	9	47	38	3-0	107	109	
4	4	84	60	16	0	565	562	2-1	1091	1083	
4	5	336	340	16	1	57	29	3-2	634	595	
4	6	255	258	16	2	202	216	3-3	133	130	
4	7	342	323	16	3	76	88	3-4	132	124	
4	9	171	171	16	4	247	241	3-5	451	447	
4	10	44	24	16	6	136	130	3-6	424	422	
4	11	163	147	16	8	264	269	3-7	41	45	
6	0	227	215	18	0	463	478	3-9	181	186	
6	1	130	126	18	1	63	24	3-10	209	214	
6	2	520	528	18	2	49	55	3-11	48	45	
6	3	642	621	18	3	142	129	5-11	191	175	
6	4	365	364	18	4	384	396	5-10	115	121	
6	5	260	251	18	5	94	110	5-9	59	38	
6	6	522	500	18	6	139	144	5-8	40	21	
6	7	60	46	20	0	205	195	5-7	591	583	
6	8	60	58	20	1	131	132	5-6	478	479	
6	9	118	117	20	2	64	76	5-5	205	202	
6	10	114	90	20	4	196	190	5-4	397	374	
8	0	392	378	20	6	164	156	5-3	329	325	
8	1	324	306	22	0	190	151	5-2	1029	1058	
8	2	455	449	22	1	290	276	5-1	50	18	
8	3	855	855	22	2	170	166	5-0	64	32	
8	4	693	700	22	3	269	248	5-1	1053	1081	
8	5	525	528	22	4	180	165	5-2	316	320	
8	6	533	530					5-3	371	348	
8	7	75	36					5-4	202	201	
8	8	278	292					5-5	487	488	
8	9	240	244	K	L	FOBS	FCALC	5-6	612	610	
8	10	49	11	1	-11	101	83	5-8	61	21	
8	11	99	104	1	-10	68	71	5-9	112	125	
10	0	1231	1299	1	-9	55	24	5-10	192	177	
10	1	406	435	1	-8	62	64	7-9	79	89	
10	2	192	186	1	-7	106	102	7-8	74	69	
10	3	613	620	1	-6	118	119	7-7	241	249	

H= 1

7 - 6	116	107	13 - 3	464	477	21	2	94	87
7 - 5	308	302	13 - 2	431	451	21	3	116	115
7 - 4	424	412	13 - 1	275	272	21	4	98	111
7 - 3	167	174	13 0	271	272	23	-3	115	116
7 - 2	241	233	13 - 1	426	443	23	-2	154	146
7 - 1	62	73	13 2	446	459	23	0	44	28
7 0	91	87	13 3	149	159	23	1	137	139
7 1	223	210	13 5	218	229	23	2	112	107
7 2	211	215	13 6	198	203			H= 2	
7 3	424	418	13 7	62	86				
7 4	372	299	13 9	172	171				
7 5	108	107	15 - 9	99	98	K	L	FORS	FCALC
7 6	236	250	15 - 8	107	127	0	-12	48	29
7 7	102	103	15 - 7	116	96	0	-11	186	185
7 8	105	95	15 - 6	80	78	0	-10	67	38
7 10	58	28	15 - 5	104	117	0	-9	248	254
9 - 10	80	78	15 - 4	64	12	0	-8	51	31
9 - 9	61	57	15 - 3	193	184	0	-7	330	324
9 - 8	92	89	15 - 2	168	167	0	-6	372	379
9 - 7	62	79	15 - 1	302	308	0	-5	82	80
9 - 6	169	169	15 0	282	291	0	-4	69	14
9 - 5	186	178	15 1	195	197	0	-3	922	878
9 - 4	96	107	15 2	204	189	0	-2	135	114
9 - 3	147	132	15 3	57	11	0	-1	695	676
9 - 2	174	175	15 4	126	130	0	0	149	124
9 - 1	153	156	15 5	83	79	0	1	904	890
9 0	171	171	15 6	121	102	0	2	60	22
9 1	178	183	15 7	129	129	0	3	72	46
9 2	158	141	15 8	82	84	0	4	371	372
9 3	85	100	17 - 8	110	107	0	5	357	351
9 4	159	152	17 - 7	68	48	0	6	46	35
9 5	163	163	17 - 6	99	90	0	7	252	252
9 6	63	81	17 - 5	158	159	0	9	189	190
9 7	110	103	17 - 4	123	116	2	-12	108	121
9 8	70	55	17 - 3	138	133	2	-11	58	56
9 9	70	73	17 - 2	127	124	2	-10	181	185
11 - 10	125	122	17 - 1	193	195	2	-9	47	14
11 - 9	52	37	17 0	184	189	2	-8	275	286
11 - 7	150	161	17 1	126	108	2	-7	89	85
11 - 6	171	178	17 2	148	141	2	-6	92	76
11 - 5	43	70	17 3	137	128	2	-5	330	309
11 - 3	337	350	17 4	146	166	2	-4	497	488
11 - 2	408	425	17 5	96	91	2	-3	56	6
11 - 1	235	241	17 7	105	115	2	-2	600	588
11 0	233	240	19 - 7	108	121	2	-1	109	87
11 1	382	402	19 - 6	123	125	2	0	563	566
11 2	326	331	19 - 4	56	34	2	1	37	5
11 3	58	20	19 - 3	89	108	2	2	533	524
11 4	72	77	19 - 2	143	145	2	3	331	312
11 5	187	189	19 1	145	145	2	4	99	94
11 6	161	170	19 2	108	118	2	5	67	61
11 7	47	43	19 3	54	31	2	6	266	275
11 8	43	38	19 5	114	108	2	7	43	17
11 9	121	112	19 6	112	111	2	8	174	170
13 - 10	166	176	21 - 5	98	106	2	9	54	53
13 - 8	73	71	21 - 4	106	120	2	10	106	122
13 - 7	187	204	21 - 3	108	84	4	-12	92	93
13 - 6	219	228	21 - 2	159	148	4	-11	57	58
13 - 5	67	17	21 0	45	42	4	-10	135	131
13 - 4	147	161	21 1	162	146	4	-8	203	218

DEHYDRATED MATH-STILBITE

10(FOBS) AND 10(ECALC) PAGE 3

4 - 7	53	21	- 4	394	409	16	6	109	120
4 - 6	229	232	10 - 3	307	315	18	- 7	89	95
4 - 5	67	66	10 - 2	340	350	18	- 5	83	67
4 - 4	206	205	10 - 1	210	201	13	- 3	170	177
4 - 3	99	86	10 0	337	343	18	- 1	170	154
4 - 2	482	487	10 1	290	302	18	1	180	183
4 - 1	169	164	10 2	390	399	18	2	49	16
4 0	478	481	10 4	446	468	18	3	63	60
4 1	74	89	10 5	96	96	18	5	86	26
4 2	236	239	10 6	180	184	18	6	42	18
4 3	81	74	10 7	42	15	20	- 6	50	8
4 4	227	227	10 8	102	122	20	- 5	53	44
4 6	179	194	10 9	67	66	20	- 3	118	109
4 8	138	127	12 - 11	66	69	20	- 2	69	63
4 10	107	99	12 - 10	45	35	20	- 1	104	101
6 - 11	147	147	12 - 9	146	150	20	0	66	60
6 - 10	88	73	12 - 7	182	187	20	1	109	98
6 - 9	234	240	12 - 5	305	315	20	2	44	12
6 - 8	138	138	12 - 4	69	52	20	5	74	54
6 - 7	353	358	12 - 3	290	299	22	- 4	120	111
6 - 6	60	47	12 - 2	67	71	22	- 3	59	46
6 - 5	588	600	12 - 1	91	116	22	- 2	133	134
6 - 4	245	247	12 0	63	67	22	0	131	134
6 - 3	372	373	12 1	261	276	22	1	70	57
6 - 2	411	423	12 2	79	60	22	2	114	128
6 - 1	837	850	12 3	291	308	H = 3			
6 0	372	389	12 5	187	186	K	L	FOBS	ECALC
6 1	329	338	12 6	42	22				
6 2	203	206	12 7	152	152	1 - 11		48	9
6 3	565	585	12 9	68	64	1 - 10		107	111
6 4	74	54	14 - 10	57	57	1 - 9		195	197
6 5	341	350	14 - 9	56	56	1 - 8		38	60
6 6	130	130	14 - 8	71	82	1 - 7		177	177
6 7	222	231	14 - 7	59	70	1 - 6		180	175
6 8	83	56	14 - 6	85	92	1 - 5		134	127
6 9	135	130	14 - 5	59	59	1 - 4		141	133
8 - 10	51	38	14 - 4	129	128	1 - 3		182	201
8 - 9	79	96	14 - 3	143	146	1 - 2		594	573
8 - 7	184	191	14 - 2	51	65	1 - 1		585	559
8 - 6	272	278	14 - 1	82	84	1 0		175	192
8 - 5	280	288	14 0	72	97	1 1		138	130
8 - 4	100	109	14 1	105	111	1 2		184	181
8 - 3	59	60	14 2	119	120	1 3		179	170
8 - 2	98	85	14 3	70	66	1 4		73	54
8 - 1	276	259	14 4	57	82	1 5		195	191
8 0	96	78	14 5	69	81	1 6		107	105
8 1	74	67	14 6	79	76	1 7		162	162
8 2	101	100	14 7	72	53	3 - 12		140	136
8 3	274	286	14 8	86	66	3 - 11		62	58
8 4	254	272	16 - 8	138	130	3 - 10		118	105
8 5	171	175	16 - 6	133	131	3 - 9		87	86
8 7	78	105	16 - 5	132	118	3 - 8		445	438
8 8	52	44	16 - 4	206	212	3 - 7		149	142
10 - 11	67	61	16 - 2	222	220	3 - 6		145	147
10 - 10	93	111	16 - 1	64	43	3 - 5		528	501
10 - 9	48	28	16 0	213	216	3 - 4		348	367
10 - 8	189	194	16 1	55	39	3 - 3		724	714
10 - 7	87	68	16 2	186	192	3 - 2		193	173
10 - 6	438	450	16 3	117	110	3 - 1		180	162
10 - 5	61	63	16 4	131	127				

3 0	717	698	9 6	57	40	17 1	239	245
3 1	740	360	9 8	70	65	17 2	200	192
3 2	516	505	9 9	67	41	17 3	241	241
3 3	167	163	11-11	67	44	17 4	157	161
3 4	142	146	11-10	94	110	17 5	92	87
3 5	453	443	11 -9	141	130	17 6	160	151
3 6	78	80	11 -8	95	106	19 -8	83	87
3 8	130	127	11 -7	82	63	19 -7	61	57
3 9	160	156	11 -6	123	184	19 -5	50	42
5-12	136	135	11 -5	49	52	19 -4	73	67
5-11	115	97	11 -2	270	275	19 -3	80	69
5-10	56	23	11 -1	269	262	19 0	76	67
5-9	45	63	11 0	43	10	19 1	71	57
5-8	679	666	11 3	193	179	19 4	87	65
5-7	277	271	11 5	101	99	19 5	94	85
5-6	217	305	11 6	129	132	21 -6	143	153
5-4	340	309	11 7	72	97	21 -5	176	161
5-2	562	554	11 8	71	51	21 -4	45	43
5-2	253	261	13-11	196	194	21 -3	60	40
5-1	265	275	13 -8	307	298	21 -2	66	77
5 0	548	544	13 -7	205	197	21 -1	83	73
5 1	328	299	13 -6	146	157	21 1	56	45
5 3	304	299	13 -5	473	480	21 2	156	158
5 4	295	298	13 -4	579	593	21 3	145	147
5 5	685	678	13 -3	567	570	23 -3	235	201
5 6	71	76	13 -2	54	58	23 -2	72	52
5 8	112	89	13 -1	60	51	23 -1	61	54
5 0	138	141	13 0	570	570	23 0	233	201
7-12	62	15	13 1	585	593			
7-11	67	63	13 2	482	490	H= 4		
7-10	125	96	13 3	136	153			
7-9	44	51	13 4	211	199	K L	FOBS	FCALC
7-8	280	291	13 5	309	299	0-12	326	331
7-7	44	38	13 5	46	21	0-11	207	202
7-6	390	392	13 7	68	44	0-10	417	428
7-5	198	189	13 8	191	193	0 -9	361	346
7-4	256	238	15 -9	123	115	0 -8	228	233
7-3	428	425	15 -8	101	116	0 -7	437	445
7-2	99	72	15 -7	54	30	0 -6	59	61
7-1	97	80	15 -6	73	49	0 -5	451	426
7 0	424	419	15 -5	120	117	0 -4	660	637
7 1	253	230	15 -4	106	112	0 -3	920	906
7 2	187	179	15 -3	179	173	0 -2	1194	1175
7 3	399	411	15 -2	246	250	0 -1	911	893
7 5	284	292	15 -1	247	253	0 0	656	643
7 6	62	46	15 0	161	162	0 1	438	426
7 7	112	94	15 1	115	113	0 2	72	70
7 8	63	73	15 2	134	134	0 3	437	460
9-11	60	55	15 5	103	124	0 4	238	247
9-9	53	51	15 6	108	107	0 5	363	358
9-8	121	108	17 -9	152	152	0 6	418	427
9-7	85	77	17 -8	110	87	0 7	198	187
9-6	59	54	17 -7	155	152	0 8	312	313
9-4	147	153	17 -6	236	229	0 9	45	27
9-2	96	107	17 -5	204	199	2-12	209	205
9-1	92	104	17 -4	238	247	2-11	236	234
9 1	130	143	17 -3	137	150	2-10	326	333
9 3	59	69	17 -2	299	298	2 -9	267	271
9 4	84	84	17 -1	304	305	2 -8	241	230
9 5	103	97	17 0	152	160	2 -7	464	466

2 - 6	198	198	8 - 7	255	261	14 2	181	185
2 - 4	430	430	8 - 6	992	990	14 3	255	251
2 - 3	778	776	8 - 5	263	272	14 5	189	185
2 - 2	972	947	8 - 4	64	67	14 6	151	140
2 - 1	722	777	8 - 3	97	99	14 7	151	147
2 0	433	426	8 - 2	440	492	16-10	263	257
2 - 2	192	200	8 - 1	103	98	16 -9	177	168
2 - 3	480	489	8 0	92	87	16 -8	83	72
2 - 4	238	236	8 1	270	282	16 -7	258	261
2 - 5	282	279	8 2	968	993	16 -6	307	305
2 - 6	335	333	8 3	268	274	16 -5	217	203
2 - 7	233	224	8 4	218	230	16 -4	97	73
2 - 8	195	190	8 5	159	159	16 -3	373	367
2 - 9	45	22	8 6	440	423	16 -2	429	454
4-12	83	71	8 7	135	142	16 -1	352	352
4-11	109	116	10-12	86	83	16 0	80	73
4-10	42	13	10-10	316	313	16 1	201	195
4 - 9	146	139	10 -9	76	96	16 2	288	299
4 - 8	142	144	10 -8	109	121	16 3	237	252
4 - 7	190	172	10 -7	121	136	16 4	85	83
4 - 6	105	104	10 -6	568	565	16 5	177	169
4 - 5	269	262	10 -5	59	43	16 6	245	246
4 - 4	125	125	10 -4	88	86	18 -9	58	34
4 - 3	237	234	10 -3	38	39	18 -8	297	280
4 - 2	138	143	10 -2	564	584	18 -6	198	186
4 - 1	235	233	10 -1	50	37	18 -5	93	81
4 0	131	127	10 0	75	71	18 -4	269	264
4 1	264	268	10 1	55	38	18 -3	50	38
4 2	100	113	10 2	548	553	18 -2	130	137
4 3	172	168	10 3	119	137	18 -1	52	27
4 4	173	161	10 4	120	132	18 0	267	260
4 5	140	124	10 5	86	85	18 1	100	83
4 6	56	22	10 6	320	319	18 2	206	194
4 7	122	110	10 7	59	27	18 3	87	78
4 9	51	35	10 8	52	70	18 4	287	274
6-12	96	80	12-11	62	44	20 -5	48	26
6-11	121	132	12-10	147	147	20 -4	227	217
6-10	387	376	12 -9	66	40	20 -3	68	69
6 - 9	81	77	12 -6	204	195	20 -2	70	46
6 - 7	193	192	12 -5	162	154	20 -1	64	70
6 - 6	774	771	12 -4	57	55	20 0	223	210
6 - 5	235	239	12 -2	462	453	20 1	45	27
6 - 4	318	340	12 0	69	63	22 -4	97	100
6 - 3	106	98	12 1	159	158	22 -2	104	110
6 - 2	225	234	12 2	200	188	22 -1	66	46
6 - 1	128	122	12 5	58	42	22 0	112	97
6 0	303	325	12 6	136	144			
6 1	219	221	12 7	49	50		H= 5	
6 2	750	760	14-11	141	145			
6 3	185	183	14-10	154	136	K L	FOBS	FCALC
6 4	45	19	14 -9	171	175	1-12	172	169
6 5	72	77	14 -7	276	260	1-11	60	47
6 6	389	365	14 -6	185	181	1-10	149	148
6 7	110	114	14 -5	203	202	1 -9	270	278
6 8	72	75	14 -4	60	9	1 -8	337	335
6 9	48	19	14 -3	385	381	1 -7	166	166
8-11	139	143	14 -2	292	300	1 -6	213	209
8-10	432	412	14 -1	392	386	1 -5	458	467
8 - 9	175	181	14 0	55	28	1 -4	219	215
8 - 8	225	228	14 1	198	208	1 -3	281	293

1 - 2	269	281	7 - 2	267	278	15 - 10	96	81	
1 - 1	229	222	7 - 1	349	357	15 - 9	57	36	
1 - 0	452	469	7 - 0	519	530	15 - 8	92	90	
1 - 1	272	210	7 - 1	55	31	15 - 7	130	126	
1 - 2	162	175	7 - 3	392	399	15 - 6	163	157	
1 - 3	331	334	7 - 4	296	300	15 - 5	195	202	
1 - 4	265	269	7 - 5	121	119	15 - 3	177	177	
1 - 5	141	132	7 - 6	62	54	15 - 2	168	165	
1 - 6	55	48	7 - 7	147	149	15 - 1	55	35	
1 - 7	194	176	7 - 8	178	176	15 - 0	205	206	
1 - 8	182	179	9 - 9	105	86	15 - 1	174	169	
3 - 12	197	186	9 - 8	48	31	15 - 2	135	129	
3 - 11	157	169	9 - 6	130	116	15 - 3	88	84	
3 - 10	57	48	9 - 5	156	168	15 - 5	104	87	
3 - 9	345	340	9 - 4	103	114	17 - 9	45	13	
3 - 8	288	338	9 - 1	120	115	17 - 8	61	64	
3 - 7	219	222	9 - 0	165	184	17 - 6	45	3	
3 - 6	191	181	9 - 1	100	105	17 - 5	114	112	
3 - 5	628	654	9 - 2	55	11	17 - 4	64	43	
3 - 4	69	70	9 - 3	41	30	17 - 2	46	28	
3 - 3	73	55	9 - 4	119	92	17 - 1	69	55	
3 - 2	104	83	9 - 7	46	37	17 - 0	108	108	
3 - 1	92	97	11 - 12	265	250	17 - 2	57	47	
3 - 0	624	657	11 - 11	106	89	17 - 3	55	62	
3 - 1	191	189	11 - 10	187	179	19 - 8	210	205	
3 - 2	217	218	11 - 9	418	413	19 - 7	89	74	
3 - 3	376	373	11 - 8	448	444	19 - 6	123	115	
3 - 4	327	324	11 - 7	218	228	19 - 5	285	268	
3 - 6	167	164	11 - 6	349	354	19 - 4	284	272	
3 - 7	200	198	11 - 5	752	786	19 - 3	155	152	
3 - 8	278	257	11 - 4	543	560	19 - 2	165	159	
5 - 12	113	114	11 - 3	339	341	19 - 1	296	282	
5 - 11	243	261	11 - 2	326	337	19 - 0	298	279	
5 - 9	271	274	11 - 1	518	543	19 - 1	128	115	
5 - 8	359	358	11 - 0	746	773	19 - 2	65	59	
5 - 7	250	251	11 - 1	335	339	19 - 3	209	197	
5 - 6	280	284	11 - 2	223	233	21 - 6	51	30	
5 - 5	526	523	11 - 3	468	461	21 - 5	297	282	
5 - 4	83	73	11 - 4	414	420	21 - 4	250	247	
5 - 3	169	171	11 - 5	184	172	21 - 3	113	82	
5 - 2	146	152	11 - 6	90	83	21 - 2	91	87	
5 - 1	129	110	11 - 7	266	245	21 - 1	264	253	
5 - 0	513	518	13 - 11	178	172	21 - 0	294	283	
5 - 1	291	302	13 - 10	82	92	21 - 1	65	28	
5 - 2	243	241	13 - 9	108	107				
5 - 3	358	361	13 - 8	147	130	H = 6			
5 - 4	269	277	13 - 7	232	212				
5 - 5	50	31	13 - 6	172	177	K L	FOBS	FCALC	
5 - 6	238	251	13 - 5	357	360	0 - 11	114	107	
5 - 7	128	125	13 - 4	72	56	0 - 10	313	330	
5 - 8	182	199	13 - 3	293	294	0 - 9	95	91	
7 - 12	143	144	13 - 2	288	296	0 - 8	270	268	
7 - 11	46	55	13 - 1	77	54	0 - 7	409	394	
7 - 10	137	141	13 - 0	341	348	0 - 6	270	272	
7 - 9	306	300	13 - 1	191	191	0 - 5	134	120	
7 - 8	388	391	13 - 2	221	207	0 - 4	346	347	
7 - 6	39	24	13 - 3	150	136	0 - 3	927	895	
7 - 5	548	560	13 - 4	113	105	0 - 2	323	323	
7 - 4	349	363	13 - 5	111	106	0 - 1	166	149	
7 - 3	324	308	13 - 6	162	171	0 - 0	238	242	

0 1	411	404	8 -9	59	29	16 -5	137	133
0 2	299	302	8 -8	202	205	16 -3	167	173
0 3	93	103	8 -7	168	156	16 -1	122	126
0 4	308	329	8 -6	45	58	16 0	46	43
0 5	115	116	8 -5	79	76	16 1	278	282
0 6	49	8	8 -4	625	631	16 3	75	60
0 7	62	60	8 -3	239	233	18 -9	55	46
2-12	68	47	8 -2	624	634	18 -7	175	164
2-11	207	203	8 -1	111	112	18 -6	96	76
2-10	94	99	8 0	57	61	18 -4	45	29
2 -9	176	181	8 1	174	156	18 -3	162	148
2 -7	565	568	8 2	185	179	18 -1	44	8
2 -5	190	189	8 3	48	13	18 0	68	72
2 -4	269	256	8 4	173	183	18 1	167	162
2 -3	80	96	8 5	128	120	20 -7	46	13
2 -2	278	264	8 6	160	155	20 -6	160	156
2 -1	155	157	8 7	145	148	20 -5	93	79
2 1	561	576	10-12	114	118	20 -4	94	68
2 2	63	25	10 -9	147	147	20 -2	92	70
2 3	147	164	10 -8	49	22	20 -1	85	76
2 4	105	108	10 -6	57	13	20 0	140	139
2 5	210	210	10 -5	256	267	20 1	50	14
2 6	50	34	10 -4	167	181			
2 8	45	18	10 -3	311	308	H= 7		
4-12	60	48	10 -2	183	185			
4-11	106	126	10 -1	265	279	K L	FOBS	FCALC
4 -9	253	258	10 0	39	9	1-12	77	86
4 -8	51	55	10 2	60	51	1-11	68	66
4 -7	193	198	10 3	148	152	1-10	121	116
4 -6	94	100	10 6	102	104	1 -9	213	216
4 -5	221	230	12-12	124	113	1 -8	212	213
4 -4	155	145	12-11	54	25	1 -7	272	279
4 -3	294	285	12 -9	58	68	1 -6	470	482
4 -2	143	137	12 -8	64	58	1 -5	372	380
4 -1	229	237	12 -7	94	91	1 -4	45	41
4 0	62	62	12 -6	170	181	1 -3	60	47
4 1	224	221	12 -5	93	100	1 -2	384	385
4 2	61	56	12 -4	207	213	1 -1	471	475
4 3	242	253	12 -3	135	154	1 0	278	285
4 5	107	130	12 -2	187	196	1 1	213	217
6-12	152	153	12 -1	110	116	1 2	200	209
6-11	78	65	12 0	187	195	1 3	115	117
6-10	171	174	12 1	90	89	1 4	70	70
6 -8	207	203	12 2	42	48	1 5	89	92
6 -7	54	33	12 3	67	59	1 6	117	114
6 -6	103	99	12 4	59	38	1 7	117	116
6 -5	34	13	12 6	98	101	3-10	75	82
6 -4	386	397	14-11	122	106	3 -9	226	227
6 -2	391	397	14 -7	185	179	3 -8	65	58
6 -1	47	44	14 -6	38	15	3 -6	317	304
6 0	90	110	14 -5	137	142	3 -5	270	269
6 1	62	51	14 -4	54	63	3 -4	113	99
6 2	210	213	14 -3	173	189	3 -3	106	85
6 4	188	183	14 -1	134	151	3 -2	285	282
6 5	80	74	14 1	183	172	3 -1	287	279
6 6	146	152	14 2	43	16	3 1	61	67
6 7	74	79	14 5	128	105	3 2	201	210
8-12	170	171	16 -9	72	57	3 3	69	80
8-11	126	121	16 -7	274	275	3 6	76	63
8-10	167	193	16 -6	45	39	3 7	115	117

5-12	143	128	13-7	46	40	0-3	100	78		
5-11	87	74	13-6	115	118	0-2	613	619		
5-10	93	109	13-5	55	47	0-1	462	464		
5-9	141	146	13-4	369	373	0-0	463	475		
5-8	285	291	13-3	356	365	0-1	305	312		
5-7	513	519	13-2	52	46	0-2	44	59		
5-6	70	83	13-1	114	109	0-3	42	13		
5-5	151	150	13-1	89	93	0-4	298	305		
5-4	26	31	13-3	108	102	0-5	47	7		
5-3	28	30	13-4	132	142	0-6	201	205		
5-2	161	155	13-5	77	76	2-12	382	391		
5-1	90	93	15-11	113	118	2-11	126	130		
5-0	481	485	15-8	51	64	2-10	182	178		
5-1	257	261	15-7	53	38	2-8	718	732		
5-2	143	144	15-6	67	54	2-7	37	3		
5-3	127	122	15-4	207	205	2-6	76	65		
5-4	72	58	15-3	201	208	2-5	421	418		
5-5	115	103	15-1	64	61	2-4	932	917		
5-6	73	70	15-0	53	24	2-3	398	401		
7-11	76	78	15-1	83	61	2-2	69	50		
7-10	212	214	15-4	90	109	2-1	61	44		
7-9	218	221	17-10	101	83	2-0	687	715		
7-8	41	28	17-9	129	117	2-2	195	189		
7-7	149	156	17-8	94	85	2-3	127	133		
7-6	47	42	17-7	99	84	2-4	380	388		
7-5	215	219	17-6	86	81	2-5	118	114		
7-4	262	266	17-5	110	113	2-6	44	42		
7-3	252	255	17-4	136	127	4-12	161	158		
7-2	208	212	17-3	114	116	4-11	49	16		
7-1	55	30	17-2	110	105	4-10	146	145		
7-0	144	146	17-1	78	88	4-9	54	59		
7-2	197	206	17-0	102	91	4-8	278	284		
7-3	209	214	17-1	72	76	4-7	98	101		
7-4	59	77	17-2	108	101	4-6	162	155		
9-3	42	30	17-3	89	84	4-4	369	360		
9-2	53	36	19-6	88	97	4-3	51	43		
9-0	41	31	19-5	98	92	4-2	158	156		
9-2	44	36	19-4	65	49	4-1	72	82		
11-12	55	64	19-3	73	60	4-0	279	284		
11-11	103	91	19-2	108	100	4-2	146	142		
11-10	147	150	19-1	77	89	4-3	43	21		
11-9	214	223	21-6	126	108	4-4	159	158		
11-8	126	118	21-5	144	134	4-6	67	38		
11-7	141	149	21-4	95	89	6-12	192	197		
11-6	386	380	21-3	100	95	6-11	242	229		
11-5	340	342	21-2	146	137	6-9	379	372		
11-4	86	85	21-1	118	106	6-8	578	598		
11-3	100	99				6-7	589	598		
11-2	344	345		H= 8		6-5	533	544		
11-1	370	369				6-4	406	408		
11-0	148	155	K L	FOBS FCALC		6-3	519	520		
11-1	140	133	0-12	313	307	6-1	604	612		
11-2	226	228	0-11	39	22	6-0	575	594		
11-3	146	148	0-10	81	79	6-1	370	371		
11-4	94	93	0-9	299	301	6-3	246	241		
11-5	85	75	0-8	496	504	6-4	190	199		
13-12	77	88	0-7	508	518	6-5	292	274		
13-11	137	146	0-6	590	605	8-12	157	176		
13-10	107	102	0-5	112	92	8-11	113	101		
13-9	83	98	0-4	816	797	8-10	196	204		

DEHYDRATED Na-H-STILBITE

10(FBBS) AND 10(FCALC) PAGE 9

8 - 9	195	207	16 - 3	168	160	5 - 6	623	630
8 - 8	608	638	16 - 1	90	82	5 - 4	47	33
8 - 7	408	410	16 - 0	404	401	5 - 3	668	663
8 - 6	252	255	16 - 1	70	68	5 - 2	786	800
8 - 5	363	376	18 - 9	62	71	5 - 1	95	83
8 - 4	255	261	18 - 8	271	265	5 - 0	56	64
8 - 3	353	359	18 - 7	65	48	5 - 1	440	458
8 - 2	257	259	18 - 6	135	137	5 - 2	380	380
8 - 1	448	446	18 - 4	164	164	5 - 3	84	78
8 - 0	509	622	18 - 3	72	31	5 - 4	77	70
8 - 1	184	189	18 - 2	138	145	5 - 5	209	219
8 - 2	188	192	18 - 0	269	264	7 - 11	96	84
8 - 3	115	110	18 - 1	75	74	7 - 10	69	79
8 - 4	154	177	20 - 7	100	94	7 - 9	159	169
8 - 5	228	231	20 - 6	123	127	7 - 8	250	255
10 - 11	40	49	20 - 5	85	98	7 - 7	195	217
10 - 10	338	339	20 - 3	92	91	7 - 6	60	32
10 - 9	57	63	20 - 2	115	123	7 - 5	227	234
10 - 8	199	203	20 - 1	108	88	7 - 4	216	225
10 - 7	94	98				7 - 3	56	51
10 - 6	610	629	H = 9			7 - 2	190	203
10 - 3	50	17				7 - 1	269	274
10 - 2	624	627	K L	FBBS	FCALC	7 - 0	133	139
10 - 1	77	68	1 - 11	115	124	7 - 1	110	98
10 - 0	181	181	1 - 10	139	129	7 - 2	75	82
10 - 1	64	80	1 - 9	96	80	7 - 3	55	68
10 - 2	331	329	1 - 8	147	149	7 - 4	137	148
10 - 5	90	73	1 - 7	203	199	9 - 12	73	59
12 - 12	58	50	1 - 6	182	176	9 - 11	91	91
12 - 11	108	90	1 - 5	94	73	9 - 10	133	139
12 - 10	53	61	1 - 4	80	69	9 - 9	160	148
12 - 9	107	92	1 - 3	182	182	9 - 8	192	211
12 - 8	129	134	1 - 2	185	189	9 - 7	185	193
12 - 7	110	97	1 - 1	140	154	9 - 6	245	252
12 - 6	117	132	1 - 0	74	63	9 - 5	117	122
12 - 5	228	230	1 - 1	124	131	9 - 4	130	128
12 - 3	234	232	1 - 2	107	114	9 - 3	248	259
12 - 2	143	147	1 - 4	66	59	9 - 2	182	192
12 - 1	126	104	1 - 5	68	49	9 - 1	194	210
12 - 0	103	124	3 - 12	54	61	9 - 0	143	140
12 - 1	115	94	3 - 11	338	348	9 - 1	134	136
12 - 2	45	52	3 - 10	381	390	9 - 2	96	97
12 - 3	117	95	3 - 9	57	38	9 - 3	76	70
14 - 11	55	35	3 - 8	175	179	9 - 4	110	93
14 - 10	92	81	3 - 7	570	588	11 - 11	180	172
14 - 9	45	38	3 - 6	475	484	11 - 10	198	205
14 - 8	199	207	3 - 5	54	28	11 - 9	45	43
14 - 6	73	66	3 - 3	516	522	11 - 8	49	19
14 - 5	52	48	3 - 2	571	572	11 - 7	367	357
14 - 4	312	317	3 - 1	201	198	11 - 6	321	312
14 - 3	51	43	3 - 1	381	399	11 - 5	118	113
14 - 2	93	82	3 - 2	317	332	11 - 4	111	110
14 - 0	200	207	3 - 3	63	54	11 - 3	318	314
14 - 2	90	75	3 - 4	69	81	11 - 2	348	334
16 - 10	48	32	3 - 5	181	178	11 - 1	51	34
16 - 9	66	74	5 - 12	114	96	11 - 1	216	215
16 - 8	409	397	5 - 11	417	406	11 - 2	168	170
16 - 7	71	69	5 - 10	449	464	13 - 11	208	217
16 - 5	195	175	5 - 8	66	38	13 - 10	229	224
16 - 4	484	452	5 - 7	818	830	13 - 9	79	106

DEHYDRATED Na-H-STILBITE

10(FOBS) AND 10(FCALC) PAGE 10

13 - 8	114	114	0 - 3	269	255	10 - 7	68	78
13 - 7	357	368	0 - 4	252	240	10 - 6	118	116
13 - 6	292	281	2 - 11	181	201	10 - 5	559	557
13 - 5	129	121	2 - 10	156	148	10 - 4	87	83
13 - 4	120	114	2 - 9	81	87	10 - 3	87	78
13 - 3	294	296	2 - 8	148	168	10 - 2	141	126
13 - 2	345	349	2 - 7	332	334	10 - 1	378	376
13 - 1	114	133	2 - 5	142	124	10 - 0	110	91
13 0	60	84	2 - 3	325	324	10 - 1	54	52
13 - 1	223	237	2 - 2	173	188	10 - 2	47	32
13 - 2	291	208	2 - 1	79	94	10 - 3	269	260
15 - 11	123	123	2 - 0	122	121	12 - 12	216	222
15 - 10	121	116	2 - 1	197	217	12 - 11	155	154
15 - 9	119	107	2 - 3	47	26	12 - 10	180	180
15 - 8	105	108	4 - 12	68	20	12 - 9	43	23
15 - 7	273	253	4 - 11	177	178	12 - 8	231	229
15 - 6	159	140	4 - 9	237	247	12 - 7	179	182
15 - 5	118	111	4 - 8	154	148	12 - 6	299	298
15 - 4	113	103	4 - 7	368	370	12 - 5	109	93
15 - 3	187	163	4 - 5	155	168	12 - 4	326	323
15 - 2	258	244	4 - 4	62	57	12 - 3	188	185
15 - 1	127	130	4 - 3	365	366	12 - 2	217	218
15 0	102	103	4 - 2	138	136	12 - 0	201	194
15 - 1	116	116	4 - 1	217	235	12 - 1	151	157
15 - 2	103	109	4 - 0	49	21	12 - 2	211	208
17 - 10	108	95	4 - 1	169	187	14 - 11	65	39
17 - 9	140	128	4 - 3	127	124	14 - 10	106	98
17 - 8	128	129	6 - 12	77	69	14 - 9	45	55
17 - 7	47	29	6 - 11	56	21	14 - 8	191	178
17 - 6	145	135	6 - 10	102	113	14 - 6	86	103
17 - 5	177	169	6 - 9	121	110	14 - 4	97	114
17 - 4	171	166	6 - 8	142	144	14 - 2	194	174
17 - 3	124	122	6 - 7	119	117	14 - 0	102	99
17 - 2	54	31	6 - 6	111	116	14 - 1	47	40
17 - 1	147	134	6 - 5	354	353	16 - 10	59	47
17 0	123	119	6 - 4	135	135	16 - 8	68	70
17 - 1	83	85	6 - 3	129	118	16 - 7	184	188
19 - 7	126	121	6 - 2	133	141	16 - 4	43	18
19 - 6	167	165	6 - 1	111	111	16 - 3	182	187
19 - 5	55	33	6 - 0	117	113	16 - 2	79	75
19 - 3	180	176	6 - 2	71	66	16 - 1	50	37
19 - 2	129	129	6 - 3	115	120	18 - 8	121	106
			6 - 4	53	72	18 - 7	70	72
H = 10			8 - 12	84	66	18 - 6	136	144
			8 - 11	86	83	18 - 5	206	204

K	L	FOBS	FCALC	8 - 10	43	56	18 - 4	137	129
0 - 12	264	206	8 - 9	263	268	18 - 3	62	75	
0 - 11	38	8	8 - 6	110	105	18 - 2	120	115	
0 - 10	514	516	8 - 5	661	672				
0 - 9	618	644	8 - 4	67	65				
0 - 8	698	744	8 - 3	41	37				
0 - 7	56	74	8 - 1	271	271				
0 - 6	459	458	8 - 0	44	37	K	L	FOBS	FCALC
0 - 5	687	653	8 - 1	90	73	1	- 9	55	39
0 - 4	427	419	8 - 2	62	65	1	- 8	84	79
0 - 3	76	94	8 - 3	269	272	1	- 6	45	28
0 - 2	735	764	10 - 11	62	59	1	- 4	70	60
0 - 1	624	644	10 - 10	114	113	1	- 3	73	83
0 0	474	483	10 - 9	372	369	1	- 2	44	36
0 2	211	216	10 - 8	124	113	3 - 10		123	120

3 - 9	72	99	13 1	64	69	6 -1	70	63
3 - 8	60	57	15 -8	103	112	6 0	64	82
3 - 7	207	209	15 -6	44	12	6 1	141	138
3 - 6	78	95	15 -3	101	118	6 2	118	114
3 - 5	125	120	17 -9	59	4	8-11	151	131
3 - 4	187	198	17 -8	61	57	8-10	459	446
3 - 3	84	72	17 -4	48	16	8 -8	48	21
3 - 2	93	101	17 -3	77	63	8 -7	136	122
3 - 1	114	105				8 -6	423	413
3 0	56	32		H= 12		8 -5	121	109
3 - 3	105	98				8 -2	475	451
5 - 12	59	64	K L	FOBS	FCALC	8 -1	117	113
5 - 11	63	79	0-11	332	321	8 1	71	55
5 - 10	63	73	0-10	282	311	10-12	65	30
5 - 9	119	118	0 -9	128	138	10-11	94	99
5 - 8	90	88	0 -8	199	188	10-10	371	381
5 - 7	70	63	0 -7	453	447	10 -9	50	14
5 - 6	192	189	0 -6	372	378	10 -7	128	120
5 - 5	157	159	0 -5	442	438	10 -6	369	372
5 - 4	56	57	0 -4	211	197	10 -5	124	114
5 - 3	74	93	0 -3	160	164	10 -2	390	384
5 - 2	117	126	0 -2	308	324	10 -1	88	85
5 - 1	44	62	0 -1	306	303	12-12	77	71
5 0	50	67	0 0	61	55	12-11	137	130
5 - 2	31	87	0 1	122	116	12-10	46	53
5 - 3	103	89	0 2	259	245	12 -9	195	186
7 - 12	61	58	2-12	158	147	12 -8	159	159
7 - 11	77	80	2-11	168	150	12 -7	151	143
7 - 10	41	32	2-10	104	99	12 -5	153	149
7 - 9	71	84	2 -8	322	319	12 -4	162	166
7 - 8	103	86	2 -7	238	228	12 -3	199	180
7 - 6	140	150	2 -6	153	138	12 -2	60	55
7 - 5	117	125	2 -5	239	219	12 -1	133	128
7 - 4	49	14	2 -4	329	328	12 0	56	66
7 - 3	98	90	2 -2	102	109	14-11	130	110
7 - 2	62	77	2 -1	160	136	14 -9	86	92
7 0	83	77	2 0	163	153	14 -7	113	103
7 1	80	70	2 2	99	95	14 -6	68	68
7 2	91	99	4-12	91	94	14 -5	127	106
9 - 10	44	26	4-11	42	28	14 -3	95	97
9 - 1	45	28	4-10	124	120	14 -1	107	98
9 0	46	12	4 -8	216	211	16 -9	55	32
9 1	42	12	4 -7	91	93	16 -8	154	141
9 2	46	23	4 -6	104	89	16 -7	71	62
11 - 12	59	33	4 -5	107	92	16 -6	84	84
11 - 9	78	68	4 -4	210	207	16 -4	136	141
11 - 8	133	138	4 -2	124	111	16 -3	76	45
11 - 6	51	42	4 0	93	96			
11 - 3	131	138	4 2	77	58		H= 13	
11 - 2	59	63	6-12	91	92			
11 - 1	44	30	6-11	63	64	K L	FOBS	FCALC
11 0	51	41	6-10	185	178	1-11	122	130
13 - 12	62	73	6 -9	137	131	1-10	102	106
13 - 11	67	39	6 -8	68	63	1 -7	90	97
13 - 8	106	95	6 -7	147	146	1 -6	75	89
13 - 7	100	109	6 -6	77	95	1 -3	116	111
13 - 6	127	134	6 -5	167	156	1 -2	114	129
13 - 5	152	145	6 -4	70	73	1 0	82	84
13 - 4	108	107	6 -3	129	120	1 1	63	53
13 - 3	117	99	6 -2	197	191	3-12	201	198

3-11	34	93	15 -7	90	92	10 -7	179	208
3-10	53	18	15 -6	68	74	10 -6	120	101
3-9	324	321	15 -5	167	158	10 -5	85	75
3-8	365	366	15 -4	114	120	10 -4	153	139
3-5	376	378				10 -3	113	108
3-4	313	314		H= 14		10 -2	161	149
3-2	122	95				12-10	90	89
3-1	219	222	K L	FOBS	FCALC	12 -9	87	74
2-0	349	339	0-12	155	150	12 -7	44	22
3-1	46	9	0-11	336	350	12 -5	71	68
5-12	244	223	0-10	92	110	12 -4	94	91
5-10	112	113	0 -9	78	63	14 -8	84	72
5-9	406	418	0 -8	48	31	14 -7	191	177
5-8	416	412	0 -7	346	346	14 -6	86	78
5-5	433	433	0 -5	86	76			
5-4	402	409	0 -4	103	110		H= 15	
5-3	96	93	0 -3	353	360			
5-1	256	257	0 -2	143	125	K L	FOBS	FCALC
5-0	374	354	0 -1	98	103	1-12	95	83
7-11	141	128	2-12	100	97	1-11	111	104
7-10	73	61	2-11	239	246	1-10	87	95
7-9	118	115	2 -8	53	35	1 -9	119	111
7-8	120	110	2 -7	331	310	1 -8	164	142
7-7	132	190	2 -3	262	256	1 -7	162	139
7-6	165	169	2 -2	106	78	1 -6	100	108
7-5	125	121	4-10	82	73	1 -5	104	96
7-4	100	107	4 -9	46	46	1 -4	109	101
7-3	71	73	4 -8	45	66	1 -3	79	80
7-2	147	132	4 -7	123	136	1 -2	97	96
7-0	178	107	4 -6	66	75	3-11	67	52
9-12	70	69	4 -5	63	50	3 -8	74	54
9-11	68	66	4 -4	80	74	3 -7	68	45
9-10	117	106	4 -3	66	60	3 -4	63	45
9-9	145	127	4 -1	66	40	3 -2	53	46
9-8	108	98	6-12	189	189	5-12	91	65
9-7	52	60	6-11	94	96	5-10	93	83
9-5	108	95	6-10	139	135	5 -9	140	93
9-4	150	127	6 -9	46	31	5 -8	85	86
9-3	117	103	6 -8	201	204	5 -7	94	91
9-1	67	65	6 -7	183	192	5 -6	125	98
9-0	77	62	6 -6	193	196	5 -5	96	79
11-12	70	73	6 -4	143	131	5 -3	65	64
11-11	110	92	6 -3	98	95	5 -2	53	35
11-9	157	159	6 -2	187	178	7-12	80	89
11-8	151	152	8-12	195	169	7-11	158	133
11-7	113	112	8-11	92	70	7-10	109	85
11-6	94	104	8-10	61	63	7 -9	118	102
11-5	155	153	8 -9	148	141	7 -8	106	91
11-4	150	149	8 -8	161	150	7 -7	104	92
11-2	96	87	8 -7	271	261	7 -6	116	101
11-1	96	86	8 -6	146	132	7 -5	101	84
13-10	85	59	8 -5	141	140	7 -4	156	130
13-9	332	312	8 -4	57	66	7 -3	93	88
13-8	373	354	8 -3	93	83	9-11	47	35
13-7	46	39	8 -2	180	161	9 -7	65	26
13-5	380	361	10-12	150	161	9 -6	51	39
13-4	332	301	10-11	118	99	11-10	131	128
13-3	83	47	10-10	146	136	11 -9	115	128
15-9	135	127	10 -9	79	78	11 -8	195	170
15-8	162	146	10 -8	121	124	11 -7	182	166

11 - 6	128	130
11 - 5	149	134