

## Structural variation in the ferrobustamite solid solution

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### Abstract

Ferrobustamite,  $\text{Wo}_{82}\text{Fs}_{18}$ , from the Ofuku mine, Yamaguchi Prefecture, Japan, is close to the Fe-poor end of the ferrobustamite solid solution. Its crystal data are: space group  $A\bar{1}$ ,  $a = 7.862$ ,  $b = 7.253$ ,  $c = 13.967$  Å,  $\alpha = 89^\circ 44'$ ,  $\beta = 95^\circ 28'$ ,  $\gamma = 103^\circ 29'$ , and  $12[\text{Ca}_{0.82}\text{Fe}_{0.15}\text{Mn}_{0.03}\text{SiO}_3]$  in the unit cell. Our refinement of its structure reveals that it possesses pseudo-mirrors which are more nearly true mirror planes than those in the  $\text{Wo}_{50}\text{Fs}_{50}$  structure, and the small size of one cation site,  $M3$ , in the structure induces the concentration of the Fe(Mn) content into it, thus giving the solid solution the Fe-poor limit of  $\text{Wo}_{83.3}\text{Fs}_{16.7}$ . The Mössbauer spectra of the specimen showed that, after a heat treatment at  $1,140^\circ\text{C}$ , the degree of concentration of Fe at  $M3$  decreases, suggesting that the site occupancies of Fe atoms vary with the temperature of formation and the cooling process of the crystal.

### Introduction

Bowen *et al.* (1933) presented a phase diagram of the system  $\text{CaO-FeO-SiO}_2$  showing an extensive solid solution at temperatures above  $1,000^\circ\text{C}$ , and called it the "wollastonite solid solution." Tilley (1937) first described a mineral with a composition of 77 mole percent  $\text{CaSiO}_3$  and 23 percent  $\text{FeSiO}_3$  ( $\text{Wo}_{77}\text{Fs}_{23}$ ) from Scawt Hill, County. Antrim, and named it "iron-wollastonite." He further reported another iron-wollastonite from contact skarns at Skye, Scotland (Tilley, 1948).

A reexamination by Rutstein (1971) of the  $\text{CaSiO}_3\text{-CaFeSi}_2\text{O}_6$  system showed that there are two different phases in this system, and these are compositionally separated from each other by a gap extending from  $\text{Wo}_{88}\text{Fs}_{12}$  to  $\text{Wo}_{78}\text{Fs}_{22}$ . Rutstein and White (1971) analyzed infrared spectra of these samples, and suggested that those rich in iron have a structure analogous to that of bustamite.

The crystal structures of two pyroxenoids, a synthetic phase,  $\text{Ca}_{0.5}\text{Fe}_{0.5}\text{SiO}_3$  ( $\text{Wo}_{50}\text{Fs}_{50}$ ), and a natural phase,  $\text{Ca}_{0.79}\text{Fe}_{0.19}\text{Mn}_{0.02}\text{SiO}_3$  ( $\text{Wo}_{79}\text{Fs}_{21}$ ), both refined by Rapoport and Burnham (1973), are similar to each other and to that of bustamite. This species was therefore named ferrobustamite by these authors, who pointed out that the Fe-poor end-member of this phase region is expected on structural grounds to lie at  $\text{Wo}_{5/6}\text{Fs}_{1/6}$ .

From chemical analyses of natural samples,

Shimazaki and Yamanaka (1973) discovered a miscibility gap between wollastonite and ferrobustamite, and suggested that ferrobustamite with an Fe content larger than that of  $\text{Ca}_{5/6}\text{Fe}_{1/6}\text{SiO}_3$  ( $\text{Wo}_{83.3}\text{Fs}_{16.7}$ ) will be stable at the low temperatures appropriate for skarn formation, probably  $300\text{-}600^\circ\text{C}$ . Matsueda (1973, 1974) also reconfirmed that ferrobustamite is distinct from wollastonite in optical and chemical properties and cell dimensions, and considered paragenetic relations between ferrobustamite and wollastonite. Compositional limits of wollastonite, bustamite, and ferrobustamite were also discussed by Mason (1975).

Since the structure refinement of the natural phase,  $\text{Wo}_{79}\text{Fs}_{21}$ , reported by Rapoport and Burnham (1973), was hindered by the twinned crystal used for the structure determination, we consider it necessary to reexamine the structure with a well-specified crystal. Also the structure of ferrobustamite in the Fe-poor limit was of particular importance for clarifying structure variations of the solid solution. We have therefore undertaken a structural investigation of  $\text{Ca}_{0.82}\text{Fe}_{0.15}\text{Mn}_{0.03}\text{SiO}_3$  and compared our results with the data previously obtained from other members of the series.

### Refinement of the ferrobustamite structure

The crystal used in the present investigation was found in the Ofuku mine, Yamaguchi Prefecture,



-1	7	-6	-7	41	-42	0	20	20	-6	35	-36	-3	13	-13	H,L=	5-13	H,L=	-4-12								
H,L=	-6-15	-5	11	-10	-8	H,L=	-2-14	-8	12	13	-1	13	15	-7	19	20	-6	28	28							
-3	26	-27	-3	11	-10	-6	12	13	-2	23	23	H,L=	-3-13	H,L=	10	-8	-4	105	105							
-1	17	17	-1	9	9	-6	26	27	0	33	33	-5	22	-24	H,L=	6-15	H,L=	5	4							
H,L=	-5-15	H,L=	5-15	-7	9	-8	31	-30	H,L=	6-14	-1	11	11	-5	21	22	-5	21	22							
-5	22	-22	-7	9	-8	-2	4	3	-8	29	-31	H,L=	-2-15	H,L=	21	28	-1	27	28							
-3	29	28	-5	31	-32	0	29	-29	-6	16	-16	-7	9	-9	H,L=	7-13	H,L=	7	13							
-1	16	-16	-3	7	8	H,L=	-1-14	-4	27	-27	-5	31	-31	-5	22	-21	-5	22	-21							
H,L=	-4-15	-1	21	-20	-8	39	41	-2	19	21	-1	11	-9	-5	15	16	-5	15	16							
-5	15	18	H,L=	6-15	-6	22	22	-4	0	39	40	H,L=	-1-13	H,L=	8	7	-1	8	7							
-3	11	-11	-3	9	-8	-4	43	43	H,L=	7-14	-5	8	6	H,L=	8-15	H,L=	8-15	-2	-12							
-1	27	26	-1	12	13	-2	42	-41	-6	20	-19	-7	15	15	-7	18	-20	-6	79	-81						
H,L=	-3-15	H,L=	7-15	-7	31	33	0	31	30	-4	23	-23	-3	32	-35	-5	24	-24	-4	4	-5					
-5	7	-6	-7	31	33	H,L=	0-14	-8	47	-39	-2	40	-40	-1	29	28	-3	13	-13	-2	18	-17				
H,L=	-2-15	-7	13	14	-1	18	19	-6	41	41	0	31	31	H,L=	0-15	-1	15	-14	-1	15	-14					
-7	8	-8	-1	18	19	-6	41	41	H,L=	8-14	-7	45	46	H,L=	9-13	H,L=	9-13	-5	12	-15	-5	12	-15			
-5	14	13	H,L=	8-15	-4	13	-13	-4	13	-13	-6	22	22	-5	5	0	-5	12	-15	-5	12	-15				
-3	21	21	-5	11	10	-2	82	81	-4	32	-32	-3	14	15	-3	14	15	-1	13	13	-4	112	-115			
-1	7	-6	-3	24	25	0	37	-35	-2	25	-26	-1	22	-21	H,L=	10-13	H,L=	10-13	-2	19	-19	-2	19	-19		
H,L=	-1-15	-1	18	-18	H,L=	1-14	78	-81	0	54	-56	H,L=	1-13	-5	7	-5	-5	7	-5	0	47	-46				
-7	37	-38	H,L=	9-15	-6	78	-81	H,L=	9-14	-9	18	-18	-9	15	17	-5	15	17	-5	15	17	H,L=	0-12	H,L=	0-12	
-5	8	-9	-1	5	-6	-4	20	20	-6	17	18	-7	22	-22	-1	13	14	-1	13	14	-8	61	64			
-3	17	16	H,L=	-8-14	-2	38	-37	-4	41	41	-4	41	41	H,L=	-9-12	H,L=	-9-12	-4	42	45	-4	42	45			
-1	24	23	0	24	-24	0	98	96	-2	11	-11	-3	31	-31	-2	48	49	-2	48	49	-2	149	-160			
H,L=	0-15	H,L=	-7-14	H,L=	2-14	H,L=	2-14	-8	26	-25	-2	73	78	H,L=	2-13	H,L=	-8-12	H,L=	-8-12	-2	40	42	H,L=	1-12	H,L=	1-12
-5	54	-53	-2	55	-56	-8	26	-25	-2	73	78	H,L=	2-13	H,L=	-8-12	H,L=	-8-12	-2	40	42	-8	42	-45			
-1	11	-9	H,L=	-6-14	-6	17	18	-1	13	13	-5	36	-37	-5	36	-37	0	50	51	-6	83	83				
H,L=	1-15	-2	35	35	-4	93	-93	H,L=	-7-13	-3	26	27	H,L=	-7-12	H,L=	-7-12	-4	50	50	-4	50	50				
-7	17	17	0	18	-18	0	38	-39	-3	24	-24	-1	5	-6	-4	44	-46	-4	44	-46	-2	46	47			
-5	13	12	H,L=	-5-14	-8	69	71	H,L=	-6-13	-9	41	41	H,L=	-6-12	H,L=	-6-12	-8	17	-16	-8	17	-16				
-3	27	-26	-4	29	28	-4	45	45	-5	14	15	-9	15	-15	0	59	60	H,L=	-6-12	H,L=	-6-12	-8	17	-16		
H,L=	2-15	-2	7	-5	-2	76	-77	-2	76	-77	-3	16	-16	-5	15	-15	0	59	60	H,L=	-6-12	H,L=	-6-12	-8	17	-16
-7	28	28	0	49	49	0	8	8	-1	9	9	-1	11	12	-6	19	-20	-6	19	-20	-6	28	-28			
-5	33	33	H,L=	-4-14	-4	31	-32	H,L=	4-14	-8	16	-17	H,L=	4-13	H,L=	4-13	-4	51	-55	-4	51	-55				
-3	17	17	-4	31	-32	-8	16	-17	-3	17	17	-3	17	17	-9	13	14	-9	13	14	-4	102	104			
-1	22	22	-2	6	8	-8	16	-17	-1	14	-14	-1	14	-14	-7	11	11	-7	11	11	-2	79	80			
H,L=	3-15	0	18	-18	-6	64	65	-2	48	49	H,L=	-4-13	-5	14	-14	-6	60	61	-6	60	61	H,L=	3-12	H,L=	3-12	
-7	17	-17	H,L=	-3-14	-6	34	-36	0	36	-37	-5	15	15	-3	29	-29	-2	47	-47	-2	47	-47	-8	47	-48	
-3	44	43	-2	38	-38	H,L=	5-14	-7	13	-12	-7	13	-12	-1	12	12	0	120	-119	0	120	-119	-6	29	-30	

-4	71	-71	-2	8	9	-7	33	-34	-3	9	-10	-8	24	24	-2	35	-34	-4	19	-19	
-2	58	59	0	48	-56	-5	12	13	-1	12	15	-6	14	-14	0	65	66	-2	14	-16	
0	68	69	H,L=	-8-11		-3	20	-21	H,L=	10-11		-4	57	56	H,L=	4-10		0	39	-45	
H,L=	4-12		-1	10	-12	H,L=	2-11		-7	24	24	-2	27	28	-10	38	39	H,L=	11-10		
-8	40	41	H,L=	-7-11		-5	27	-29	-5	8	8	0	12	15	-6	71	-74	-4	34	36	
-6	49	-50	-3	11	-12	-3	29	29	-3	18	20	H,L=	-2-10		-4	5	-5	-2	31	-33	
-4	60	-61	-1	12	-10	-1	14	-13	H,L=	11-11		-8	42	-42	-4	81	-82	0	14	-17	
-2	114	-115	H,L=	-6-11		H,L=	3-11		-5	14	17	-2	63	65	-2	78	78	H,L=	-9	-9	
H,L=	5-12		-5	30	29	-9	42	44	-3	11	-12	0	53	55	0	55	-55	-3	15	-15	
-8	24	24	-3	6	-7	-5	11	-13	H,L=	-10-10		-8	10	-10	H,L=	5-10		-1	24	25	
-6	66	67	H,L=	-5-11		-3	23	-35	0	16	-16	-8	10	-10	-10	9	9	H,L=	-8	-9	
-4	27	-27	-7	12	11	-1	14	-11	H,L=	-9-10		-6	42	-43	-8	60	61	-5	14	-15	
-2	45	-44	-5	25	24	H,L=	4-11		-2	20	-22	-4	25	-26	-6	63	-62	-3	24	24	
0	107	-108	-3	37	36	-9	14	15	0	36	37	-2	24	-25	-4	29	28	-1	32	-32	
H,L=	6-12		-1	21	-20	-7	49	52	H,L=	-8-10		0	23	-24	-2	111	-110	H,L=	-	-9	
-8	26	20	H,L=	-4-11		-5	32	33	-4	19	-19	H,L=	0-10		0	34	34	-5	37	38	
-6	37	37	-7	36	-37	-3	60	-61	-2	39	39	-10	43	45	H,L=	6-10		-5	5	-8	
-4	100	102	-3	20	-20	-1	16	15	0	54	-55	-8	7	7	-10	49	50	H,L=	-6	-9	
-2	40	-40	-1	26	26	H,L=	5-11		H,L=	-7-10		-6	13	-13	-6	99	98	-7	8	-9	
H,L=	7-12		H,L=	-3-11		-9	38	-39	-6	49	-49	-4	6	-5	-4	15	-12	-3	38	37	
-8	69	-69	-5	56	-55	-7	41	41	-4	47	47	-2	21	-22	-2	29	28	-1	14	14	
-6	33	33	-3	11	-11	-5	26	27	-2	36	-36	0	79	-80	0	90	-89	H,L=	-5	-9	
-4	13	12	-1	40	-39	-3	50	50	0	50	49	H,L=	1-10		H,L=	7-10		-7	31	-32	
-2	93	94	H,L=	-2-11		-1	38	-38	H,L=	-6-10		-10	20	21	-8	22	21	-5	37	-38	
0	27	-26	-9	43	45	H,L=	6-11		-6	13	14	-8	30	32	-6	11	-11	-3	9	9	
H,L=	8-12		-7	17	17	-9	26	-27	-4	57	-58	-6	12	15	-4	85	84	H,L=	-4	-9	
-6	81	-83	-5	30	31	-7	55	-55	-2	91	91	-4	42	43	-2	32	34	-5	19	-18	
-4	12	11	-3	16	-17	-5	23	24	0	39	-38	-2	7	-7	H,L=	8-10		-3	47	-46	
-2	7	7	-1	16	-15	-3	6	-5	H,L=	-5-10		0	46	47	-8	62	-60	H,L=	-3	-9	
0	90	95	H,L=	-1-11		-1	34	35	-6	57	-59	H,L=	2-10		H,L=	2-10		-7	44	43	
H,L=	9-12		-7	41	42	H,L=	7-11		-4	38	37	-10	16	-17	-6	27	-28	-7	44	43	
-4	87	-91	-5	45	46	-9	10	-10	-2	64	-64	-8	11	-10	-2	46	47	-3	28	28	
-2	11	-10	-1	20	20	-5	59	-61	0	54	52	-6	49	52	-2	0	16	16	-1	36	-35
H,L=	10-12		H,L=	0-11		-1	27	-28	H,L=	-4-10		-4	16	-16	H,L=	9-10		H,L=	-2	-9	
-6	17	17	-9	38	-39	H,L=	8-11		-8	17	-17	-4	92	94	-6	42	-41	-9	21	-25	
-4	9	10	-7	7	4	-5	8	9	-6	55	57	-2	74	-75	-4	17	-17	-7	24	-25	
-2	88	-96	-3	5	3	-3	44	-45	-4	38	-38	H,L=	3-10		-2	34	-37	-5	57	58	
0	31	-33	-1	27	-28	H,L=	9-11		-2	13	13	-10	52	-54	0	27	30	-3	39	39	
H,L=	11-12		H,L=	1-11		-7	43	43	0	83	-82	-6	61	-65	H,L=	10-10		-1	8	7	
-4	31	32	-9	27	-29	-5	16	16	H,L=	-3-10		-4	78	81	-6	26	27	H,L=	-1	-9	

-9	29	-29	-1	19	18	-4	57	57	H,L=	1	-8	-8	26	26	-1	25	25	-5	41
-7	33	-34	H,L=	7	-9	-2	76	75	-10	67	79	-6	21	21	H,L=	-6	-7	-3	23
-5	17	-18	-9	11	-10	0	62	60	-8	24	-26	-4	111-109	-5	13	12	-1	16	
-1	34	35	-7	39	39	H,L=	-5	-8	-6	10	-10	-2	46	-46	-5	41	-40	H,L=	2
H,L=	0	-9	-1	16	-16	-8	31	-31	-4	183-200	0	126-129	0	126-129	-3	10	-9	-11	10
-9	9	9	H,L=	8	-9	-6	37	-36	-2	11	11	H,L=	8	-8	-1	20	20	-9	9
-7	5	-7	-9	20	-19	-4	36	-35	0	67	67	-8	57	56	H,L=	-5	-7	-7	47
-5	49	-52	-7	11	-10	-2	70	69	H,L=	2	-8	-6	9	10	-7	16	17	-5	35
-3	20	21	-5	26	26	0	72	79	-8	100	106	-4	88	91	-5	36	-35	-3	55
-1	54	-56	-1	15	-14	H,L=	-4	-8	-6	8	8	-2	85	-89	-1	37	-35	-1	37
H,L=	1	-9	H,L=	9	-9	-8	17	15	-4	28	-29	0	18	-17	H,L=	-4	-7	H,L=	3
-9	23	25	-5	16	16	-6	60	-60	-2	114-120	0	66	-67	-8	H,L=	9	-8	-9	30
-7	19	-26	-1	20	21	-4	68	-65	0	66	-67	-8	63	-62	-7	15	14	-7	15
-5	28	30	H,L=	10	-9	-2	86	-85	H,L=	3	-8	-6	73	74	-5	42	42	-5	42
-3	25	-26	-5	18	-19	0	111	141	-8	5	4	-4	17	17	-3	40	-39	-3	40
-1	17	19	-3	29	32	H,L=	-3	-8	-6	65	69	-2	118	126	-1	38	38	-1	38
H,L=	2	-9	-1	34	-37	-8	28	28	-4	57	60	0	33	-35	H,L=	-3	-7	H,L=	4
-7	34	35	H,L=	11	-9	-6	55	54	-2	40	-39	H,L=	10	-8	-9	36	-37	-9	36
-3	38	41	-5	19	21	-4	125-125	125	0	117-117	0	86	-88	-7	26	25	-7	-9	26
-1	27	-28	-5	19	21	-2	25	-24	H,L=	4	-8	-4	42	44	-3	54	53	-3	54
H,L=	3	-9	-3	34	-39	0	156-155	155	-10	28	-30	-2	25	26	-1	25	-25	-1	25
-7	6	-4	H,L=	12	-9	H,L=	-2	-8	-8	35	-37	0	75	86	H,L=	-2	-7	H,L=	14
-5	50	53	-3	11	13	-8	77	76	-4	72	70	H,L=	11	-8	-7	47	-47	-7	47
-3	9	-10	H,L=	-10	-8	-6	19	19	-2	89	89	-6	20	-21	-5	26	26	-5	26
H,L=	4	-9	-2	14	15	-4	134	135	0	89	89	-4	73	-82	-1	60	58	-1	60
-9	49	-50	0	116	122	-2	125-128	128	H,L=	5	-8	-2	24	27	H,L=	-1	-7	H,L=	15
-7	12	-13	H,L=	-9	-8	0	18	-19	-8	33	-31	0	8	9	-9	13	-15	-9	13
-5	5	5	-4	90	-94	H,L=	-1	-8	-6	47	-47	H,L=	12	-8	-7	12	-12	-7	12
-3	8	6	-2	35	-35	-10	9	12	-4	7	-7	-4	14	-15	-5	73	-73	-5	73
-1	7	5	0	16	17	-8	81	-82	-2	144	143	-2	46	-55	-3	16	17	-3	16
H,L=	5	-9	H,L=	-8	-8	-6	84	86	0	115	115	H,L=	-10	-7	-1	18	18	-1	18
-7	33	-32	-4	17	-17	-4	24	24	H,L=	6	-8	-1	8	-10	H,L=	0	-7	H,L=	14
-5	34	-34	-2	92	-92	-2	207	220	-10	26	25	-3	13	-15	-9	38	38	-9	38
-3	41	42	0	68	-69	0	57	-60	-8	19	19	-3	13	-15	-7	18	-18	-7	18
-1	43	-43	H,L=	-7	-8	H,L=	0	-8	-6	71	-70	-1	16	17	-5	51	-53	-5	51
H,L=	6	-9	-6	52	52	-10	39	-40	-4	66	-63	H,L=	-8	-7	-3	30	-32	-3	30
-9	42	42	-4	43	43	-6	144-150	150	-2	33	-32	-3	23	24	-1	36	-36	-1	36
-7	14	-15	-2	18	17	-4	37	40	0	130	129	-1	14	-14	H,L=	1	-7	H,L=	1
-5	20	19	0	62	-61	-2	34	35	H,L=	7	-8	H,L=	-7	-7	-9	42	44	-9	42
-3	24	-24	H,L=	-6	-8	0	234	259	-10	33	33	-5	13	12	-7	30	32	-7	30



K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC				
-4	75	-76	-8	71	69	-8	6	-8	-1	13	15	-1	56	-55	-11	16	-16	0	9	-9	
-2	56	56	-6	13	12	-6	41	38	H,L=-9	-3	H,L=0	-3	-9	46	-45	-9	46	-45	H,L=-8	-2	
0	67	66	-4	101	104	-4	177	174	-5	33	-34	-11	48	-47	-7	47	-44	-6	19	21	
H,L=-6	-4	-2	128-144	0	126-140	0	27	-26	-3	17	-17	-9	51	-51	-5	15	-15	-4	11	11	
-8	52	53	H,L=1	-4	H,L=7	-4	H,L=7	-4	H,L=-8	-3	-5	16	-16	-7	35	-35	-3	9	-9		
-6	25	-24	H,L=48	-49	-8	95	-92	-5	16	-16	-5	62	62	-1	27	25	-1	14	-15		
-4	38	-38	-6	108	114	-2	139	135	-3	20	-22	-3	21	25	H,L=7	-3	H,L=7	-3	-6	25	-24
-2	134	-132	-4	88	97	0	6	5	-1	19	-19	-1	20	21	-9	9	-8	-4	25	22	
0	17	-16	-2	80	94	H,L=8	-4	H,L=26	26	H,L=-7	-3	H,L=1	-3	-7	26	-26	-4	25	22		
H,L=-5	-4	0	197-213	H,L=2	-4	-10	12	-12	-5	35	36	-9	38	-38	-5	71	-68	-2	5	0	
-6	76	75	H,L=45	-47	-8	17	16	-3	11	10	-7	43	-43	-1	56	-56	H,L=0	63	62		
-4	10	10	-10	45	-47	-6	37	-84	H,L=-6	-3	-5	32	-35	H,L=8	-3	H,L=8	-3	-8	27	-26	
-2	61	-59	-6	30	-32	-4	8	-5	-7	5	4	-3	24	24	-9	61	60	-6	10	-7	
0	246	-246	-6	53	-56	-2	27	-26	-5	23	22	-1	53	54	-7	8	8	-4	59	-58	
H,L=-4	-4	-4	160	169	0	134	131	-3	28	27	H,L=2	-3	H,L=2	-3	-5	34	34	-2	89	89	
-6	13	11	-2	66	69	H,L=9	-4	H,L=-5	-3	-9	30	30	-11	30	30	-1	31	30	H,L=0	73	-71
-4	160	159	0	143	145	-6	39	38	-9	21	-21	-9	30	32	-9	30	32	-1	31	30	
-2	80	78	H,L=3	-4	-4	95	-95	-7	23	-22	-5	65	-67	H,L=9	-3	H,L=9	-3	-8	52	51	
0	43	-40	-10	38	41	-2	20	-20	-1	11	-10	-1	65	-61	-9	0	0	-6	80	-79	
H,L=-3	-4	-8	78	-80	0	43	-44	H,L=-4	-3	H,L=41	41	-9	41	41	-7	74	74	-4	43	45	
-10	11	10	-6	51	-52	H,L=10	-4	-9	25	-26	-9	41	41	-5	13	13	-2	72	-69		
-8	68	-66	-4	128-125	-2	116	110	-8	55	55	-7	10	11	-3	17	17	0	116	114		
-6	22	-22	-4	128-125	-2	116	110	-3	24	-23	-5	30	30	-1	13	-12	H,L=-4	-2			
-4	32	32	0	90	88	0	49	-48	-1	40	39	-3	90	-86	H,L=10	-3	H,L=10	-3	-6	65	64
-2	189	188	H,L=4	-4	-8	69	67	H,L=-3	-3	-1	23	-21	-9	23	-23	-4	97	-95			
0	132	125	-8	69	67	-6	77	78	-5	52	-51	H,L=4	-3	-5	33	32	-2	91	88		
H,L=-2	-4	-6	58	-56	-4	26	25	-3	35	33	-9	18	-18	H,L=11	-3	H,L=11	-3	0	117	-111	
-8	7	-6	-4	87	-84	0	23	23	-1	42	-41	-7	60	58	-7	23	-24	H,L=-3	-2		
-6	90	-87	-2	199-196	0	70	-71	H,L=-2	-3	-5	46	46	-5	46	46	-3	12	13	-10	63	-62
-4	47	-46	0	9	9	H,L=12	-4	-9	60	57	-3	12	11	H,L=12	-3	H,L=12	-3	-8	63	62	
-2	95	-92	H,L=5	-4	-6	15	-14	-7	10	9	-1	19	-18	-5	21	-21	-6	29	-28		
0	133	140	-10	15	15	-4	62	63	-5	30	28	H,L=5	-3	H,L=5	-3	-4	111	108			
H,L=-1	-4	-8	33	32	-2	44	45	-3	59	-58	-11	34	-33	-2	26	27	-2	72	-70		
-10	39	38	-6	125	122	0	51	54	-1	7	-5	-9	21	-21	0	49	50	0	110	105	
-6	35	34	-4	10	11	H,L=-11	-3	H,L=-1	-3	-7	9	8	-7	9	8	H,L=-10	-2				
-4	128-128	-2	85	-82	-1	10	-13	-9	15	-15	-5	54	52	-4	42	-44	H,L=-2	-2			
-2	83	-82	0	222-218	-3	10	11	-7	64	63	-3	49	46	0	11	10	-6	46	46		
0	194	-206	H,L=6	-4	H,L=-10	-3	9	12	-5	40	40	-1	17	14	H,L=9	-2	-4	51	-50		
H,L=0	-4	-10	50	-49	-3	10	11	-3	9	12	H,L=6	-3	-2	25	-26	-2	198	192			

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC			
0	66	-62	H,L=	5	-2	H,L=	12	-2	-9	19	19	-11	17	-11	-3	24	24	H,L=	-5	0
H,L=-1	-2	-10	H,L=	36	34	-6	28	28	-7	31	30	-9	26	-25	-1	6	-3	H,L=	53	-51
-10	22	-22	-8	52	49	-4	11	12	-5	65	64	-7	38	-36	H,L=	10	-1	-6	55	-54
-8	6	7	-4	56	55	-2	44	45	-3	56	54	-5	80	78	-9	23	23	-4	62	-61
-6	139	-137	-2	108	-104	0	34	-35	-1	43	-41	-3	63	-58	-7	20	-22	-2	21	18
-4	11	11	0	75	70	H,L=-11	-1	-1	H,L=	-2	-1	-1	51	49	-5	9	-8	0	147	141
-2	8	-8	H,L=	6	-2	-3	20	21	-9	36	-35	H,L=	4	-1	-5	15	-11	H,L=	-4	0
0	31	28	-10	55	53	H,L=-10	-1	-1	-7	48	-35	-11	34	33	-1	23	-24	-1	23	-24
H,L=	0	-2	-8	21	-20	-3	38	-39	-5	48	47	-9	49	-47	H,L=	11	-	-6	21	-20
-10	91	97	-4	77	74	-1	7	8	-3	19	20	-5	29	-28	-5	10	11	-4	117	-114
-6	9	-8	-4	57	-54	H,L=	-9	-1	-1	51	49	-3	98	94	-3	14	-14	-2	75	-74
-4	59	-60	-2	54	53	H,L=	-9	-15	H,L=	-1	-1	-1	7	4	-1	9	9	0	133	125
-2	14	14	0	148	-144	H,L=	-8	-1	-11	19	18	H,L=	5	-1	H,L=	12	-1	H,L=	-5	0
0	31	-35	H,L=	7	-2	-7	15	13	-9	49	-46	-9	37	36	-3	23	25	-10	12	15
H,L=	1	-2	-10	62	-60	-5	27	27	-7	48	-46	-7	57	-55	-1	13	-14	-8	65	64
-10	16	16	-8	42	40	-3	34	35	-5	72	-70	-5	36	-35	H,L=	-11	0	-6	67	65
-8	64	63	-6	40	-38	-1	29	-30	-3	24	-19	-3	9	-7	-2	86	90	-4	75	-72
-6	37	38	-4	101	98	H,L=	-7	-1	H,L=	6	6	-1	9	9	-4	9	9	0	104	-100
-4	51	57	-2	14	12	-7	37	-38	-1	28	27	-11	19	17	-2	28	-29	H,L=	-2	0
-2	31	26	0	45	43	-5	35	37	-9	42	41	-9	26	25	0	136	140	-10	31	-30
0	35	35	H,L=	8	-2	-3	7	7	-11	28	27	-11	19	17	-2	28	-29	H,L=	-2	0
H,L=	2	-2	-8	71	-69	-1	34	33	-7	15	-15	-7	20	19	H,L=	-9	0	-8	33	31
-10	25	-26	-6	11	11	H,L=	-6	-1	-5	32	-31	-5	25	-24	-6	18	19	-6	47	46
-8	20	-22	-4	27	-25	-7	16	-16	-3	5	-5	-3	53	-51	-4	113	-116	-4	109	104
-6	21	23	-2	87	86	-5	49	-48	-1	7	-9	-1	13	-11	-2	29	-29	-2	142	-134
-4	13	13	0	6	7	-3	36	35	H,L=	1	-1	H,L=	7	-1	0	32	-32	0	124	-119
-2	76	73	H,L=	9	-2	-1	14	-14	-11	13	13	-11	18	-17	H,L=	-8	0	H,L=	-1	0
0	74	-71	-6	70	-68	H,L=	-5	-1	-9	45	42	-7	40	38	-4	17	18	-10	12	-11
H,L=	3	-2	-4	7	8	-9	31	33	-7	39	37	-5	33	35	-2	127	-128	-8	64	-62
-10	45	-45	-2	52	-51	-7	28	-28	-5	20	20	-3	27	26	0	49	-47	-6	40	38
-8	35	-36	H,L=	10	-2	-5	25	-24	-3	22	18	-1	42	-41	H,L=	-7	0	-4	29	28
-6	77	-75	-8	15	-14	-3	64	-63	-1	37	36	H,L=	8	-1	-6	97	97	-2	303	317
-4	25	25	-6	14	15	-1	39	38	H,L=	2	-1	-9	23	-22	-4	29	29	0	65	-63
-2	42	35	-4	23	-23	H,L=	-4	-1	-11	28	-28	-7	25	-23	-2	59	59	H,L=	0	0
0	17	8	-2	7	-9	-9	10	9	-9	9	-8	-5	55	54	0	76	-73	-10	19	-19
H,L=	4	-2	0	53	-53	-7	49	48	-7	26	26	-1	45	45	H,L=	-6	0	-8	17	17
-10	36	34	H,L=	11	-2	-5	22	-22	-5	10	-6	H,L=	9	-1	-6	27	-27	-6	150	-142
-4	43	-42	-8	36	36	-3	12	-11	-3	22	24	-9	27	-27	-4	70	70	-4	50	48
-2	127	120	-4	35	35	-1	32	-30	-1	99	-95	-7	4	-5	-2	77	75	-2	7	6
0	28	-29	H,L=	6	-4	H,L=	-3	-1	H,L=	3	-1	-5	41	-40	0	82	80	H,L=	1	0



K	FO	FC	K	FO	FC	K	FO	FC	K	FO	FC	K	FO	FC	K	FO	FC			
-10	67	64	-10	33	34	-4	123-119	-1	26	-29	-7	25	24	-9	82	79	-1	14	-15	
-8	30	-28	H,L=	2	6	-2	16	-14	H,L=-10	1	-5	93	-90	H,L=	6	1	H,L=-12	2		
-6	49	48	-4	10	-11	0	83	80	-3	13	-14	-3	27	25	-5	45	45	0	33	-35
-4	311-340		H,L=	-3	6	H,L=	10	0	-1	6	8	-1	71	-69	H,L=	5	1	H,L=-11	2	
-2	5	5	-10	57	-57	0	136	140	H,L=-9	1	1	H,L=	0	1	-5	33	-35	H,L=-2	37	-40
0	66	-63	H,L=	-4	6	H,L=	7	0	-3	11	11	-9	64	63	H,L=	33	-35	H,L=-10	2	
H,L=	2	0	0	48	-46	-10	23	22	H,L=-8	1	1	-7	13	-12	-3	42	-40	H,L=	42	-40
-10	45	-45	H,L=	10	5	-8	62	60	H,L=	12	13	-7	13	-12	-1	29	-27	-4	12	11
-8	131	131	-7	22	-22	-6	7	6	-5	12	13	-5	37	34	H,L=	6	1	0	53	-55
-6	46	-44	H,L=	4	-18	-4	82	-80	-3	26	25	-3	5	-8	-7	55	52	H,L=	-9	2
-4	34	33	-2	16	15	-2	16	-83	-1	18	-19	-1	6	6	H,L=	7	1	-6	31	-31
-2	307-319		H,L=	1	-18	-2	17	-73	H,L=-7	1	1	H,L=	1	1	-7	27	26	-4	39	31
H,L=	-5	20	-6	8	-7	0	17	-73	-7	22	-23	-11	23	25	-7	24	21	0	9	7
0	67	-65	H,L=	2	0	H,L=	8	0	-5	19	19	-9	15	15	-5	56	55	H,L=	8	2
H,L=	-5	19	0	125-119		-10	14	-13	-3	12	-10	-7	53	51	-1	31	-31	-6	9	-9
-1	27	26	H,L=	3	0	-8	11	40	H,L=-6	47	1	-5	6	2	H,L=	8	1	-4	24	-25
H,L=	4	13	-10	35	34	-4	74	74	H,L=	-6	1	-3	7	-7	-9	14	-14	-2	51	52
-3	5	5	-8	32	-30	-2	64	-63	-1	19	-19	-1	14	-14	-7	46	-45	0	7	7
H,L=	0	13	-6	138	131	0	48	-47	H,L=-5	1	1	-11	38	-37	H,L=	25	24	H,L=-7	88	-88
-7	26	-25	-4	22	22	H,L=	9	0	-9	42	44	-9	11	-8	-5	10	9	-2	45	43
H,L=	-3	11	-2	130	121	-8	51	-49	-3	57	-56	-7	19	20	H,L=	47	47	0	45	43
-9	38	39	0	125-126		-6	43	41	-1	23	-21	-5	43	42	H,L=	9	1	H,L=	15	-15
H,L=	8	10	H,L=	4	0	-4	43	42	H,L=-4	1	1	-3	11	-6	-9	17	-16	-8	15	-15
0	54	-55	-10	59	-57	-2	136	135	-9	9	8	-1	29	-27	-7	15	-15	-6	76	77
H,L=	4	10	-8	15	15	0	33	-32	-7	56	54	-5	57	55	H,L=	58	-59	-4	21	-20
-8	8	9	-6	37	-36	H,L=	10	0	-5	57	55	-9	56	-54	-1	18	18	-2	15	-16
H,L=	11	8	-4	116	110	-8	10	-9	-3	34	33	-11	26	-28	H,L=	10	1	H,L=	147	-144
-4	88	-91	-2	107	102	-6	106	-105	-1	7	-6	-7	47	-45	-9	34	34	-6	17	-16
H,L=	2	8	0	133	125	-4	17	17	H,L=-3	1	1	-5	24	21	-7	25	-26	-4	110	108
0	18	-19	H,L=	5	0	-2	29	29	-9	21	-20	-3	24	25	-5	17	-17	-2	50	-49
H,L=	-6	8	-10	28	26	H,L=	11	0	-7	11	-11	-1	49	46	-3	33	-33	0	75	70
-8	11	12	-8	56	-54	-4	121	-123	-5	25	25	H,L=	4	1	-1	12	-12	H,L=	-4	2
H,L=	-1	7	-6	42	-40	-2	24	25	-3	80	77	-11	31	31	H,L=	11	1	-8	77	-76
-5	28	-28	-4	55	-51	H,L=	12	0	-1	17	-17	-9	13	-15	-7	32	35	-6	32	31
H,L=	-3	7	-2	88	86	-6	16	-16	H,L=-2	1	1	-7	40	-39	-5	13	14	-4	66	-63
-3	10	-10	0	148	141	-4	15	16	-9	23	-22	-5	87	-85	-3	19	-19	-2	114	112
-5	51	51	H,L=	6	0	-2	81	-85	-1	94	90	-3	43	39	-1	17	16	0	28	-29
H,L=	-6	7	-10	16	14	H,L=	-12	1	H,L=-1	1	1	-1	15	15	H,L=	12	1	H,L=	-5	2
-7	31	-31	-8	23	22	-1	22	26	-11	23	23	-5	5	1	-5	13	14	-8	52	51
H,L=	4	6	-6	69	-67	H,L=	-11	1	-9	11	-11	-11	34	32	H,L=	28	29	-6	72	-71

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC
-4	38	36	-4	64	-65	-4	40	-39	-5	6	-5	-9	33	33	-4	95	-95
-2	134	-128	-2	3	2	-2	6	7	-3	12	15	-5	14	-15	-2	25	25
0	15	8	0	66	-62	0	15	-15	-1	67	68	-3	16	-15	H,L=-6	4	4
H,L=-2	2	2	H,L=3	3	2	H,L=9	9	2	H,L=2	2	5	H,L=9	9	5	H,L=9	9	5
-10	64	62	-10	29	30	-8	44	43	-7	32	-34	-7	28	21	-6	38	-38
-8	10	-11	-8	59	59	-6	3	7	-5	83	-87	-5	7	-5	-2	141	-138
-6	70	67	-6	7	-5	-4	22	20	H,L=-4	3	3	-3	23	-22	0	26	-26
-4	34	-33	-4	15	16	-2	22	-21	-9	51	-50	-1	27	-26	H,L=-5	4	4
-2	55	-48	-2	211	-201	0	8	-9	-7	38	-37	H,L=3	3	5	H,L=10	5	5
0	74	-71	0	111	103	H,L=10	10	2	-5	19	-18	-11	11	11	-7	13	12
H,L=-1	2	2	H,L=4	4	2	-8	22	-22	-3	40	36	-9	46	46	-5	33	35
-10	48	-47	-6	148	146	-6	14	14	-1	34	31	-5	5	-3	H,L=11	3	3
-8	41	40	-4	43	-42	-2	19	19	H,L=-3	3	3	-3	54	-54	-7	7	-8
-6	21	21	-2	83	60	0	11	10	-7	26	-24	-1	11	11	-5	9	10
-4	41	41	0	117	-111	H,L=11	11	2	-5	62	-61	H,L=4	4	5	-5	16	17
-2	68	-66	H,L=5	5	2	-6	17	-17	-3	23	-23	-9	20	20	-1	21	22
0	35	35	-10	96	-92	0	48	50	-1	7	6	-7	76	75	H,L=12	3	3
H,L=0	2	2	-8	17	16	H,L=12	12	2	H,L=-2	2	3	-5	45	-44	-5	30	-32
-10	39	-38	-6	44	-42	-4	38	-38	-9	42	41	-3	61	58	-3	8	9
-8	37	-36	-4	115	110	-2	23	-24	-7	32	31	-1	44	-44	-1	9	-10
-6	66	65	-2	82	-79	0	10	-9	-5	16	-16	H,L=5	5	5	H,L=-12	4	4
-4	8	9	0	117	114	H,L=-11	11	3	-3	76	-74	-11	45	-44	0	51	54
-2	25	-18	H,L=6	6	2	-3	22	24	-1	22	22	-9	12	-11	H,L=-11	4	4
0	31	-35	-10	14	14	-1	11	-11	H,L=-1	1	3	-7	17	-17	-2	40	-42
H,L=1	2	2	-8	96	-94	H,L=-10	10	3	-11	31	-31	-5	65	62	0	70	-71
-10	41	-40	-6	22	21	-3	15	16	-9	11	-9	-3	21	-21	H,L=-10	4	4
H,L=-2	1	1	-4	118	-115	H,L=-9	9	3	-7	56	54	-1	23	22	-4	52	53
-7	66	-64	-2	62	59	-1	23	23	-5	14	14	H,L=6	6	5	-2	35	-36
-5	18	-19	0	73	-71	H,L=-8	8	3	-3	45	42	-11	9	9	0	48	-48
-3	90	-85	H,L=7	7	2	-5	29	-30	-1	83	-82	-9	59	-58	H,L=-9	4	4
H,L=1	2	2	-10	12	-12	-1	9	-8	H,L=0	0	3	-7	15	-13	-6	26	26
-8	29	-30	-8	66	65	H,L=-7	7	3	-11	24	-24	-5	23	-22	-4	31	31
-6	11	-11	-6	65	-63	-7	9	9	-5	86	87	-3	10	9	-2	121	123
-4	39	43	-4	40	39	-3	59	-58	-3	41	41	-1	4	5	0	45	-44
-2	15	-16	-2	98	-97	-1	29	29	-7	18	-17	H,L=7	7	3	H,L=-8	4	4
0	32	28	0	64	62	H,L=-6	6	3	-1	15	16	-9	17	15	-6	74	-76
H,L=2	2	2	H,L=8	8	2	-7	60	61	H,L=1	1	3	-7	21	-21	-4	50	50
-10	34	35	-10	66	65	-5	7	-7	-11	22	21	-5	22	-20	-2	31	29
-8	20	-22	-8	5	-5	-3	30	29	-9	40	-41	-3	17	17	0	133	131
-6	32	-35	-6	87	86	-1	58	-56	-7	22	-21	H,L=8	8	5	H,L=-7	4	4

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC			
-10	19	-18	-6	22	22	-3	16	-15	-9	23	-22	-7	21	-21	-2	13	13	0	208	225
-8	73	73	-4	158	155	H,L=	-8	5	-7	47	-48	-5	36	-35	H,L=	-7	6	H,L=	0	6
-6	43	42	-2	51	49	-3	23	-23	-5	57	60	-3	27	26	-6	19	-18	-10	93	94
-4	145	152	0	16	-16	H,L=	-7	5	-3	21	23	H,L=	7	5	-4	10	9	-6	26	28
-2	80	-93	H,L=	7	4	-7	28	29	-1	96	104	-9	25	25	-2	18	17	-4	119	-128
0	126	-140	-8	69	-68	-5	18	19	H,L=	1	5	-7	34	-32	0	21	20	-2	26	28
H,L=	1	4	-6	8	-9	-3	11	11	-11	17	16	-5	35	-34	H,L=	-6	6	0	80	-83
-8	69	-71	-4	18	17	-1	5	-5	-9	41	-42	H,L=	8	5	-8	24	-25	H,L=	1	6
-6	66	69	-2	135	132	H,L=	-6	5	-7	27	-29	-9	47	47	-6	42	-42	-10	12	-15
-4	85	93	0	68	66	-5	9	10	-5	100	-109	-7	24	25	-4	42	-41	-8	70	74
-2	120	135	H,L=	6	4	-3	25	24	-3	13	-12	-5	7	3	-2	49	48	-6	15	-16
0	195	-206	-6	71	-69	H,L=	-5	5	-1	19	18	-3	46	-45	0	14	-14	-4	52	57
H,L=	2	4	-4	28	-27	-9	21	-22	H,L=	2	5	-1	16	16	H,L=	-5	6	-2	84	-90
-10	36	-38	-2	50	-49	-7	32	-31	-11	11	12	H,L=	9	5	-8	52	51	0	5	-5
-8	32	-35	0	93	91	-5	5	5	-9	41	45	-7	55	54	-6	39	-39	H,L=	2	6
-6	102	-110	H,L=	9	4	-3	9	-9	-7	6	-7	-5	21	22	-4	7	-6	-8	33	-35
-4	112	116	-6	25	26	-1	22	20	-5	37	-39	-3	12	12	-2	6	-4	-6	39	43
-2	76	75	-4	82	-82	H,L=	-4	5	-3	54	-54	-1	31	-30	0	114	112	-2	115	115
0	134	140	-2	31	-31	-5	22	-20	-1	32	-30	H,L=	10	5	H,L=	-4	6	0	7	2
H,L=	3	4	0	85	-86	-3	6	-5	H,L=	3	5	-5	40	41	-8	32	33	H,L=	3	6
-10	48	51	H,L=	10	4	-1	40	38	-11	16	17	-3	11	12	-6	54	54	-10	44	-48
-8	56	-57	-8	49	49	H,L=	-3	5	-9	33	34	-1	19	19	-4	67	-65	-8	9	-9
-6	17	-17	-4	61	62	-9	20	20	-7	43	45	H,L=	11	5	-2	31	30	-6	46	-48
-4	115	-114	-2	96	-96	-5	47	-47	-5	49	51	-5	31	-32	H,L=	-3	6	-4	14	13
-2	100	96	0	26	-26	-3	8	-8	H,L=	4	5	-3	31	32	-8	25	24	-2	32	30
0	133	125	H,L=	11	4	-1	21	-20	-11	13	-13	H,L=	12	5	-4	18	-16	0	47	45
H,L=	4	4	-6	77	79	H,L=	-2	5	-9	10	-11	-3	18	-20	-4	71	69	H,L=	4	6
-8	68	66	-4	24	25	-9	26	25	-7	28	29	H,L=	-12	6	-2	127	-126	-8	27	-27
-6	31	-29	-2	48	48	-7	13	14	-5	27	28	0	20	-21	0	30	30	-6	26	-26
-4	52	-49	0	70	-73	-5	17	14	-3	37	36	H,L=	-11	6	H,L=	-2	6	-4	25	-24
-2	179	-176	H,L=	12	4	-1	68	-67	-1	10	-9	0	76	78	-8	87	-87	-2	45	44
0	43	-40	-4	68	71	-1	7	-4	H,L=	5	5	0	76	78	-6	38	37	0	52	-49
H,L=	5	4	-2	24	25	H,L=	-1	5	-11	31	-30	-4	70	-72	-4	54	-55	H,L=	5	6
-10	17	16	H,L=	-11	5	-9	11	-12	-9	25	-27	-2	6	8	-2	197	201	-10	41	42
-6	87	84	-3	16	18	-7	48	48	-7	26	-26	H,L=	-9	6	0	99	-99	-8	27	27
-4	25	24	H,L=	-10	5	-5	46	47	-5	21	21	-2	43	-43	H,L=	-1	6	-6	55	-55
-2	84	-82	-3	7	-9	-3	71	71	-3	16	-16	0	7	-7	-8	41	41	-4	19	19
0	248	-246	-1	18	19	-1	46	-48	-1	34	33	H,L=	-8	6	-6	127	-128	-2	27	-25
H,L=	6	4	H,L=	-9	5	H,L=	0	5	-9	43	42	-6	44	45	-4	53	51	0	51	49
-8	12	-13	-5	25	-25	-11	25	-24	-9	43	-42	-4	17	18	-2	14	11	H,L=	6	6

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC
-10	41	40	-7	40	-39	-7	66	71	-9	35	-35	-6	9	-8
-8	13	11	-5	14	-15	-5	8	-7	-5	15	16	-4	91	-90
-6	37	36	-3	22	22	-3	26	-27	-1	28	27	-2	46	45
-4	55	-54	-1	15	14	-1	52	-54	H,L=	9	7	0	118	115
-2	46	45	H,L=	-6	7	H,L=	2	7	-7	23	-24	H,L=	-4	8
0	49	-47	-5	46	-46	-11	47	-49	-5	39	-38	-8	48	47
H,L=	7	6	-3	20	-20	-9	16	-18	-3	13	12	-6	25	-24
-10	45	-46	-1	17	-17	-7	10	11	-1	18	-17	-4	72	-71
-8	40	39	H,L=	-5	7	-5	66	72	H,L=	10	7	-2	141	-139
-4	67	65	-7	20	19	-3	27	28	-7	17	-18	0	7	5
-2	23	-23	-5	11	11	-1	41	-41	-3	26	-25	H,L=	-3	8
0	35	35	-3	58	-56	H,L=	2	-43	-1	16	16	-8	20	20
H,L=	8	6	-1	27	26	-9	41	7	H,L=	11	7	-6	65	64
-8	66	-65	H,L=	-4	7	-7	35	-37	-5	8	-9	-4	18	-19
-6	16	16	-7	57	57	-5	36	37	-1	12	-12	-2	98	-99
-4	15	-15	-3	27	27	-3	16	15	H,L=	-11	8	0	118	-117
-2	81	81	-1	53	-52	-1	64	63	-2	44	46	H,L=	-2	8
0	35	-35	H,L=	-3	7	H,L=	4	7	0	8	9	-10	28	-27
H,L=	9	6	-1	14	-13	-11	31	34	H,L=	-10	8	-8	18	19
-6	90	-90	H,L=	-2	7	-7	12	-12	-2	24	-25	-6	43	43
-4	11	12	-9	49	-48	-5	64	-64	0	85	86	-4	65	62
-2	29	-30	-7	15	-15	-3	25	25	H,L=	-9	8	-2	37	35
0	32	31	-5	21	20	-1	12	-12	-4	74	-75	0	65	-67
H,L=	10	6	-1	4	4	H,L=	5	7	-2	11	-14	H,L=	-1	8
-6	17	18	H,L=	-1	7	-9	35	35	0	34	-33	-10	17	-16
-4	41	-41	-9	13	-12	-7	21	-21	H,L=	-8	8	-8	14	-13
-2	9	6	-7	46	-47	-5	15	-16	-4	30	28	-4	51	53
0	32	-32	H,L=	-2	7	-3	77	-76	-2	130	-128	-2	113	121
H,L=	11	6	-3	31	32	-1	20	20	0	18	-17	0	67	67
-6	11	11	H,L=	-1	7	H,L=	6	7	H,L=	-7	8	H,L=	0	8
-4	39	40	-3	11	12	-7	46	45	-6	92	92	-8	18	-19
H,L=	-10	7	-1	21	21	-5	21	-21	-2	71	71	-6	52	-54
-3	49	-51	H,L=	0	7	-3	10	9	0	130	-129	-4	16	-16
H,L=	-9	7	-9	42	43	-1	43	-43	H,L=	-6	8	-2	12	-12
-5	13	13	-5	47	-50	H,L=	7	7	-6	56	-56	0	232	259
-1	34	-34	-3	63	-67	-9	20	21	-4	100	99	H,L=	1	8
H,L=	-8	7	-1	20	20	-7	9	11	-2	46	45	-10	21	22
-5	57	58	H,L=	1	7	-5	57	56	0	133	129	-8	13	-14
-3	33	33	-11	11	-11	-3	6	7	H,L=	-5	8	-4	176	-194
H,L=	-7	7	-9	30	31	H,L=	8	7	-8	54	-55	-2	30	-31
0	61	-61	0	56	-60	0	56	-60	0	56	-60	0	61	-61
H,L=	8	8	H,L=	2	8	H,L=	2	8	H,L=	2	8	H,L=	8	8
-8	18	19	-8	16	-15	-10	16	-15	-8	68	94	-8	68	94
-6	34	33	-6	11	-11	-6	11	-11	-6	11	-11	-6	11	-11
-4	46	47	-4	24	26	-4	24	26	-4	24	26	-4	46	47
-2	20	-20	-2	205	-220	-2	205	-220	-2	205	-220	-2	20	-20
0	68	-69	0	68	-69	0	68	-69	0	68	-69	0	68	-69
H,L=	9	8	H,L=	3	8	H,L=	3	8	H,L=	3	8	H,L=	9	8
-8	26	-27	-8	19	21	-10	19	21	-8	14	-14	-8	26	-27
-6	5	5	-6	14	-14	-6	14	-14	-6	138	147	-6	5	5
-4	39	38	-4	12	11	-4	12	11	-4	12	11	-4	39	38
-2	84	85	-2	122	126	-2	122	126	-2	122	126	-2	84	85
0	17	17	0	156	-155	0	156	-155	0	156	-155	0	17	17
H,L=	10	8	H,L=	4	8	H,L=	4	8	H,L=	4	8	H,L=	10	8
-6	49	-49	-6	70	-72	-6	70	-72	-6	70	-72	-6	49	-49
-4	10	-10	-4	133	134	-4	133	134	-4	133	134	-4	10	-10
-2	36	36	-2	25	24	-2	25	24	-2	25	24	-2	36	36
0	117	122	0	141	141	0	141	141	0	141	141	0	117	122
H,L=	-11	9	H,L=	5	8	H,L=	5	8	H,L=	-10	9	H,L=	-11	9
-1	28	-28	-1	79	-80	-1	79	-80	-1	79	-80	-1	28	-28
-3	56	56	-3	18	-17	-3	18	-17	-3	18	-17	-3	56	56
-1	23	-23	-1	118	-118	-1	118	-118	-1	118	-118	-1	23	-23
H,L=	-8	9	H,L=	6	80	H,L=	6	80	H,L=	-8	9	H,L=	-8	9
-5	20	21	-5	81	80	-5	81	80	-5	81	80	-5	20	21
-1	19	19	-1	82	79	-1	82	79	-1	82	79	-1	19	19
H,L=	-7	9	H,L=	14	-14	H,L=	14	-14	H,L=	-7	9	H,L=	-7	9
-5	31	-30	-5	67	67	-5	67	67	-5	67	67	-5	31	-30
H,L=	-6	9	H,L=	53	-52	H,L=	53	-52	H,L=	-6	9	H,L=	-6	9
-5	15	-16	-5	67	-66	-5	67	-66	-5	67	-66	-5	15	-16
-3	11	-11	-3	67	-65	-3	67	-65	-3	67	-65	-3	11	-11
-1	20	-20	-1	7	8	-1	7	8	-1	7	8	-1	20	-20
H,L=	-5	9	H,L=	7	8	H,L=	7	8	H,L=	-5	9	H,L=	-5	9
-5	24	24	-5	33	33	-5	33	33	-5	33	33	-5	24	24
-3	19	-18	-3	54	54	-3	54	54	-3	54	54	-3	19	-18
-1	6	7	-1	38	-36	-1	38	-36	-1	38	-36	-1	6	7
H,L=	-4	9	H,L=	71	-68	H,L=	71	-68	H,L=	-4	9	H,L=	-4	9

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC
-7	33	33	-5	11	-11	0	74	-75	-10	53	-54	-3	35	35	-5	17	-16
-5	11	9	-3	37	38	H,L=-1	10	10	-6	21	-22	-1	35	-34	-3	15	-16
-3	58	58	-1	34	33	-10	50	-51	-4	58	55	H,L=-5	11	11	-1	22	22
-1	43	-44	H,L=4	9	9	-2	59	62	-2	15	13	-7	26	-27	H,L=3	11	11
H,L=-3	9	9	-9	6	6	-4	85	90	-2	15	52	-5	54	55	-9	26	26
-7	37	-37	-7	29	-30	-2	84	-85	4	48	10	-3	27	27	-7	27	29
-5	36	36	-5	62	-64	0	45	47	4	48	-50	-1	52	52	-5	27	-28
-3	6	5	-3	11	-10	H,L=0	45	47	4	48	-49	H,L=-4	11	11	-3	22	-20
-1	15	14	-1	23	-23	H,L=0	18	10	2	63	65	-7	32	-32	H,L=4	11	11
H,L=-2	9	9	H,L=5	9	9	-10	78	-80	0	39	-38	-5	65	-64	-9	16	16
-9	45	-45	-9	37	38	-6	60	63	H,L=7	10	10	-3	43	42	-7	34	37
-7	26	-26	-3	58	-58	-4	12	-13	H,L=94	-95	-95	H,L=-3	11	11	-5	15	16
-5	28	-28	-1	16	-16	0	78	-80	-2	94	-95	-7	36	-37	-3	13	14
-3	12	-11	H,L=6	9	9	H,L=1	10	10	0	50	49	H,L=-3	11	11	-1	42	-45
-1	29	29	-9	9	10	-10	42	-43	H,L=8	10	10	-7	36	-37	H,L=6	1	1
H,L=-1	9	9	-7	54	56	-8	21	-22	-8	17	-17	-5	36	-36	-3	55	-55
-9	19	19	-5	40	40	-6	50	-53	-6	67	68	-1	29	29	H,L=5	11	11
-5	37	-38	-3	22	21	-4	32	34	-4	52	-52	H,L=-2	11	11	-1	5	7
-3	15	17	-1	22	-23	-2	16	17	-2	35	35	-9	23	21	H,L=	1	1
-1	34	-37	H,L=7	9	9	0	23	-24	H,L=9	10	10	-7	68	69	-9	38	-37
H,L=0	9	9	-9	17	-16	H,L=2	10	10	-6	16	-17	-3	11	-10	H,L=5	11	11
-9	42	43	-7	0	-5	-10	49	52	-4	43	44	-1	13	-12	-9	30	-30
-7	11	11	-5	39	39	-6	18	-19	-2	41	-41	H,L=-1	11	11	-7	18	-18
-5	26	27	-3	29	29	-4	18	-19	0	36	37	-7	26	26	-5	60	61
-3	40	-42	H,L=8	9	9	-2	20	22	H,L=10	10	10	-5	43	44	-3	10	10
-1	10	11	-7	29	-30	0	53	55	-4	19	-19	-1	24	-24	H,L=6	11	11
H,L=1	9	9	-5	12	-12	H,L=3	10	10	0	15	-16	H,L=0	11	11	-9	40	-41
-9	14	-16	-3	10	-9	-10	22	24	H,L=-10	11	11	-9	28	-29	-7	28	-26
-7	38	39	-1	24	24	-8	38	41	-1	31	31	-7	40	-41	-5	30	-29
-3	27	29	H,L=9	9	9	-6	22	23	H,L=-9	11	11	-5	23	24	-3	49	48
-1	69	-71	-7	11	-10	-4	21	-22	-3	15	16	-3	9	8	-3	49	48
H,L=2	9	9	-5	38	-40	H,L=-3	10	10	H,L=15	16	16	-1	34	36	-1	10	8
-9	8	-8	-3	13	14	-2	65	-66	H,L=-8	11	11	-1	34	36	H,L=	11	11
-7	24	-26	-1	28	-28	0	12	13	-5	16	-14	-9	27	-29	-7	27	-28
-5	66	71	H,L=10	9	9	H,L=4	10	10	-3	29	-30	-9	27	-29	-5	28	-28
-3	9	7	-5	14	14	-10	20	-22	H,L=-7	11	11	-7	21	-22	-3	23	-23
-1	14	14	-3	30	-31	-6	55	56	-3	35	-35	-5	39	-40	-1	16	16
H,L=3	9	9	-1	14	14	-4	6	5	-1	10	8	-3	23	24	H,L=8	11	11
-9	36	-39	H,L=-11	10	10	-2	26	-27	H,L=-6	11	11	H,L=	2	11	-7	28	29
-7	11	-12	0	17	-17	0	83	-82	-7	34	34	-9	25	27	-5	16	-15
						H,L=5	10	10	-5	18	17	-7	26	-27	-3	20	-21

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC				
-1	16	-17	-8	62	-62	0	29	-29	-1	26	26	-3	5	5	-4	19	-18	H,L=	4	14	
H,L=	9	11	-6	25	-25	H,L=	5	12	H,L=	-4	13	-1	32	32	-2	25	-25		35	-36	
-5	21	22	-2	115	116	-6	59	59	-5	43	-43	H,L=	6	13	0	36	-37		-6	29	-30
-3	12	12	0	68	69	-2	9	-9	-3	29	-29	-7	9	-10	H,L=	-3	14		-4	40	-41
-1	19	-21	H,L=	-2	12	0	119	-119	-1	4	-4	-5	36	-36	-4	37	38		-2	32	32
H,L=	10	11	-6	70	-71	H,L=	6	12	H,L=	-3	13	-3	20	20	-2	37	-38		0	19	-18
-5	26	28	-4	44	-44	-8	12	13	-7	18	17	-1	10	9	0	7	8		H,L=	5	14
-3	15	15	-2	41	-42	-6	14	14	-3	33	-33	H,L=	7	13	H,L=	-2	14		-8	46	47
-1	18	18	0	114	118	-4	99	100	H,L=	-2	13	-7	10	-11	-8	38	-39		-6	25	-27
H,L=	-11	12	H,L=	-1	12	-2	44	44	-7	24	25	-5	21	-20	-6	20	20		-2	11	-10
0	54	-56	-4	14	14	H,L=	4	4	-5	20	21	-3	31	-31	-4	15	-14		0	48	49
H,L=	-10	12	-6	53	34	-8	55	-55	-3	11	10	-1	9	7	-2	81	83		H,L=	6	14
-2	10	-9	-4	78	-79	-6	16	-17	H,L=	-1	13	H,L=	8	15	0	37	-39		-6	40	40
0	32	-33	-2	74	-76	-4	18	18	-5	12	12	-5	5	-6	H,L=	-1	14		-4	26	-26
H,L=	-9	12	0	130	-133	-2	78	78	-3	32	33	-3	18	-18	-8	20	19		-2	12	10
-4	25	26	H,L=	0	12	0	59	60	-1	11	-12	-1	11	-12	-6	65	-66		0	18	-18
-2	94	95	-8	37	37	H,L=	8	12	H,L=	0	13	H,L=	9	13	-4	26	27		H,L=	7	14
H,L=	-8	12	-6	23	24	-6	60	-60	-5	6	8	-5	28	29	-2	8	-8		-4	31	30
-4	16	16	-4	90	91	-4	49	-50	-3	27	-27	-3	14	15	0	97	96		-2	32	-32
-2	6	6	-2	54	-55	-2	24	-23	-1	51	52	H,L=	-9	14	H,L=	0	14		H,L=	8	14
0	95	95	0	90	-90	0	49	51	H,L=	1	13	-2	71	-71	-8	6	-6		-4	11	-10
H,L=	-7	12	H,L=	1	12	H,L=	9	12	-9	28	-30	H,L=	-8	14	-4	91	-91		-2	54	56
-6	17	-16	-8	44	-46	-6	15	15	-5	56	-57	-2	12	9	-2	29	29		0	23	-24
-4	77	-77	-6	28	29	-4	45	-47	-3	6	6	0	56	-56	0	36	-35		H,L=	-9	15
0	26	-26	-4	45	46	-2	41	-42	-1	13	-13	H,L=	-7	14	H,L=	1	14		-1	21	-22
H,L=	-6	12	-2	149	155	0	56	-58	H,L=	2	13	-4	36	36	-8	70	70		H,L=	-8	15
-6	22	-23	0	45	-46	H,L=	10	12	-9	39	40	-2	27	28	-6	15	-14		-3	21	21
-4	13	14	H,L=	2	12	-2	46	-46	-7	10	-9	0	33	31	-4	29	29		-1	8	8
-2	82	-82	-6	78	-81	H,L=	-9	13	-3	38	-39	H,L=	-6	14	-2	75	-75		H,L=	-7	15
H,L=	-5	12	-4	51	53	-1	11	-10	-1	17	18	-6	22	-22	0	31	30		-5	15	-16
-6	69	69	-2	19	19	H,L=	-8	13	H,L=	3	13	-4	40	-40	H,L=	2	14		-3	25	24
-2	36	35	0	147	153	-3	28	-27	-9	25	23	-2	41	41	-8	23	-24		H,L=	-6	15
0	109	-108	H,L=	3	12	H,L=	-7	13	-7	48	49	0	40	40	-6	73	73		-5	15	-16
H,L=	-4	12	-8	41	-43	-1	7	-7	-1	17	-16	H,L=	-5	14	-2	49	49		-3	26	-26
-8	15	15	-4	95	-99	H,L=	-6	13	H,L=	4	13	-6	13	-13	0	28	-29		H,L=	-5	15
-6	21	-20	-2	25	24	-5	24	24	-9	0	-6	-4	31	-31	H,L=	3	14		-3	32	-32
-4	92	90	H,L=	4	12	-3	27	27	-5	27	28	-2	28	-28	-8	11	-11		-1	14	-12
-2	32	32	-8	43	45	H,L=	-5	13	-1	5	-6	0	33	33	-6	44	-45		H,L=	-4	15
0	7	3	-6	39	-41	-7	25	-25	-7	5	13	H,L=	-4	14	-4	33	33		-7	34	34
H,L=	-3	12	-2	107	-109	-3	7	-8	-7	21	-22	-6	34	34	0	19	19		-5	19	18

K	FO	FC	K	FO	FC	K	FO	FC	K	FO	FC	K	FO	FC	K	FO	FC			
-1	38	-37	H,L=	6	15	-2	28	27	-4	28	-29	-1	9	-7	-2	8	-8	-1	19	18
H,L=	-3	15	-7	35	36	0	10	-9	-2	14	-15	H,L=	4	17	0	42	41	H,L=	1	19
-5	44	44	-3	13	13	H,L=	-1	16	0	74	-76	-7	19	-18	H,L=	2	18	-5	26	-25
-3	12	12	H,L=	7	15	-4	18	17	H,L=	-8	17	-3	20	-19	-6	15	14	-3	12	12
-1	9	9	-5	36	38	-2	42	42	-1	28	28	H,L=	6	17	-4	36	-36	-4	15	11
H,L=	-2	15	H,L=	6	15	0	41	40	H,L=	-7	17	-5	16	17	-2	24	22	H,L=	2	19
-7	17	-18	-1	36	-36	H,L=	0	16	-1	19	-20	-3	13	16	0	5	7	-5	20	-19
-3	44	44	H,L=	7	15	-8	22	-22	H,L=	-6	17	-1	18	-20	H,L=	3	18	-6	13	-12
H,L=	-1	15	-3	17	-16	-6	38	38	-3	16	-16	H,L=	-7	18	-6	13	-12	-5	35	-34
-7	34	-34	-1	13	12	-4	30	-20	-1	7	8	H,L=	26	-26	-2	33	-32	-1	20	18
-5	22	-24	H,L=	5	15	-2	6	7	-1	7	8	-?	26	-26	H,L=	4	18	H,L=	3	19
-3	28	-28	-3	21	22	0	71	69	H,L=	-5	17	H,L=	-6	18	H,L=	4	18	-5	18	-18
-1	14	13	H,L=	-9	16	H,L=	1	16	-3	14	13	-4	11	9	-6	30	30	-5	18	7
H,L=	0	15	0	24	-24	-4	61	-59	H,L=	-4	17	-2	20	-20	-4	7	5	-4	27	-25
-7	20	20	H,L=	-8	16	-2	40	-39	-3	19	18	H,L=	-5	18	-2	25	-25	H,L=	4	19
-5	33	-33	-2	65	-65	H,L=	2	16	-1	16	-15	-4	39	38	0	24	-23	H,L=	5	18
-3	56	-55	0	27	-27	-8	41	41	H,L=	-3	17	0	24	-25	-4	28	29	-4	10	10
-1	13	-14	H,L=	-7	16	-6	30	29	-5	27	27	H,L=	-4	18	-2	16	16	H,L=	5	19
H,L=	1	15	-4	9	11	-2	91	-91	-1	26	25	H,L=	62	61	H,L=	6	18	-1	23	25
-7	50	50	-2	58	58	0	45	-45	H,L=	27	25	-2	62	61	-2	16	18	H,L=	-5	20
H,L=	2	15	0	72	-72	H,L=	3	16	-5	25	-23	H,L=	-3	18	H,L=	-7	19	-2	28	27
-1	9	8	H,L=	-6	16	-6	61	60	-3	22	22	-6	44	-45	H,L=	7	19	H,L=	-7	19
H,L=	1	15	-4	70	69	-4	26	26	-3	22	22	-4	11	-9	-1	16	-17	H,L=	-4	20
-5	29	29	-2	19	20	-2	50	50	H,L=	-1	17	-4	17	-16	H,L=	-6	19	H,L=	20	20
-1	42	-41	0	107	106	0	103	-103	-5	18	-17	0	76	74	-3	16	15	-3	32	32
H,L=	2	15	H,L=	-5	16	H,L=	4	16	-3	32	-31	H,L=	-2	18	H,L=	-5	19	H,L=	-3	20
-5	62	62	-4	77	-74	-6	42	-42	H,L=	0	17	-6	41	40	-6	18	17	-4	20	-18
-3	29	29	-2	39	39	-4	75	77	H,L=	28	27	-4	53	-51	H,L=	-4	19	-2	61	58
H,L=	3	15	0	17	16	-2	29	30	-5	28	27	0	65	-62	-3	7	7	H,L=	42	40
-7	30	-32	H,L=	-4	16	0	109	109	H,L=	5	17	-4	72	68	H,L=	-3	19	H,L=	-2	20
-5	16	-16	-6	49	-49	H,L=	5	16	-5	29	28	-4	75	-72	-3	48	-48	-4	22	-20
-3	19	18	-2	120	-121	-4	65	-85	-3	43	43	-2	75	-72	-1	25	25	-2	40	-38
H,L=	4	15	H,L=	-3	16	-2	57	57	-1	29	-27	0	10	11	H,L=	-2	19	H,L=	44	41
-7	24	-24	-6	70	70	0	37	38	H,L=	2	17	-6	41	39	-5	13	-15	H,L=	-1	20
-5	34	-34	-4	22	-22	H,L=	6	16	-7	29	-28	-4	15	-15	-3	8	10	-4	43	-41
-3	25	-25	-2	8	-8	-6	37	-37	-5	24	24	-4	15	-15	-1	31	-30	-2	48	-46
H,L=	5	15	0	88	-86	-4	16	-15	-1	31	29	0	56	-55	H,L=	-1	19	0	69	-65
-7	22	20	H,L=	-2	16	-2	94	-96	H,L=	3	17	H,L=	1	18	-5	41	39	H,L=	0	20
-3	31	-33	-6	19	19	0	24	24	-5	35	-35	-6	60	-59	-1	8	9	-4	41	39
-1	6	6	-4	69	68	H,L=	7	16	-3	10	11	-4	40	39	H,L=	0	19	-2	10	-9

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC
H,L=	1	20	H,L=	2	20	H,L=	3	20	H,L=	4	20	H,L=	-2	21	H,L=	-1	21
-4	35	33	-4	12	13	-4	71	-67	-2	64	-62	-1	7	-10	-3	16	16
-2	84	78	0	83	79	0	24	-22	H,L=	-4	21	-3	13	-15	-1	12	-12
															H,L=	-3	10
															H,L=	0	21

K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC	K	FD	FC
-1	14	14	H,L=	2	21	H,L=	3	21						
H,L=	1	21	-3	34	-32	-1	23	-21						
-1	9	-6	-1	8	10									

DELTA G (SCALE FOR FCALC) IS -0.01288

DELTA B (OVERALL) -0.0221 (BY 2\*2) 0.0119 (BY 1\*1)

ATOM DEL X DEL Y DEL Z DEL B11(B) DEL B22 DEL B33 DEL B12 DEL B13 DEL B23

CA 1 1.00000 0.00000 0.00000 0.00000

SUMFO = 122853.84 SUMFC = 122853.73 SUMDF = 4222.46 R = 0.0344  
(WITHOUT FOBS=0) SUMFC = 122841.53 SUMDF = 4210.27 R = 0.0345

SUM W\*FO\*\*2 = 8201258.10 SUM W\*DF\*\*2 = 16113.32 R = 0.0020