

SG No. 119  $D_{2d}^9$   $I\bar{4}m2$  [ tetragonal ]

\* plus set:  $+[0, 0, 0]$ ,  $+[\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$

\* Wyckoff site: 2a, site symmetry: -4m2

Table 1: Wyckoff bond: 2a@2a

No.	vector	center	mapping
1	$[0, 0, Z]$	$[0, 0, 0]$	$[1, 2, -3, -4, 5, 6, -7, -8]$

Table 2: Wyckoff bond: 4b@2a

No.	vector	center	mapping
1	$[X, 0, 0]$	$[0, 0, 0]$	$[1, -2, 5, -6]$
2	$[0, -X, 0]$	$[0, 0, 0]$	$[3, -4, -7, 8]$

Table 3: Wyckoff bond: 4c@2a

No.	vector	center	mapping
1	$[X, X, 0]$	$[0, 0, 0]$	$[1, -2, 7, -8]$
2	$[X, -X, 0]$	$[0, 0, 0]$	$[3, -4, 5, -6]$

Table 4: Wyckoff bond: 8d@2a

No.	vector	center	mapping
1	$[X, 0, Z]$	$[0, 0, 0]$	$[1, 5]$
2	$[-X, 0, Z]$	$[0, 0, 0]$	$[2, 6]$
3	$[0, -X, -Z]$	$[0, 0, 0]$	$[3, 8]$
4	$[0, X, -Z]$	$[0, 0, 0]$	$[4, 7]$

Table 5: Wyckoff bond: 8e@2a

No.	vector	center	mapping
1	$[X, X, Z]$	$[0, 0, 0]$	$[1, -8]$
2	$[-X, -X, Z]$	$[0, 0, 0]$	$[2, -7]$
3	$[X, -X, -Z]$	$[0, 0, 0]$	$[3, -6]$
4	$[-X, X, -Z]$	$[0, 0, 0]$	$[4, -5]$

Table 6: Wyckoff bond: 8f@2a

No.	vector	center	mapping
1	[X, Y, 0]	[0, 0, 0]	[1, -2]
2	[Y, -X, 0]	[0, 0, 0]	[3, -4]
3	[X, -Y, 0]	[0, 0, 0]	[5, -6]
4	[Y, X, 0]	[0, 0, 0]	[7, -8]

Table 7: Wyckoff bond: 16g@2a

No.	vector	center	mapping
1	[X, Y, Z]	[0, 0, 0]	[1]
2	[-X, -Y, Z]	[0, 0, 0]	[2]
3	[Y, -X, -Z]	[0, 0, 0]	[3]
4	[-Y, X, -Z]	[0, 0, 0]	[4]
5	[X, -Y, Z]	[0, 0, 0]	[5]
6	[-X, Y, Z]	[0, 0, 0]	[6]
7	[Y, X, -Z]	[0, 0, 0]	[7]
8	[-Y, -X, -Z]	[0, 0, 0]	[8]

\* Wyckoff site: 2b, site symmetry: -4m2

Table 8: Wyckoff bond: 2a@2b

No.	vector	center	mapping
1	[0, 0, Z]	[0, 0, $\frac{1}{2}$ ]	[1, 2, -3, -4, 5, 6, -7, -8]

Table 9: Wyckoff bond: 4b@2b

No.	vector	center	mapping
1	[X, 0, 0]	[0, 0, $\frac{1}{2}$ ]	[1, -2, 5, -6]
2	[0, -X, 0]	[0, 0, $\frac{1}{2}$ ]	[3, -4, -7, 8]

Table 10: Wyckoff bond: 4c@2b

No.	vector	center	mapping
1	[X, X, 0]	[0, 0, $\frac{1}{2}$ ]	[1, -2, 7, -8]
2	[X, -X, 0]	[0, 0, $\frac{1}{2}$ ]	[3, -4, 5, -6]

Table 11: Wyckoff bond: 8d@2b

No.	vector	center	mapping
1	$[X, 0, Z]$	$[0, 0, \frac{1}{2}]$	[1,5]
2	$[-X, 0, Z]$	$[0, 0, \frac{1}{2}]$	[2,6]
3	$[0, -X, -Z]$	$[0, 0, \frac{1}{2}]$	[3,8]
4	$[0, X, -Z]$	$[0, 0, \frac{1}{2}]$	[4,7]

Table 12: Wyckoff bond: 8e@2b

No.	vector	center	mapping
1	$[X, X, Z]$	$[0, 0, \frac{1}{2}]$	[1,-8]
2	$[-X, -X, Z]$	$[0, 0, \frac{1}{2}]$	[2,-7]
3	$[X, -X, -Z]$	$[0, 0, \frac{1}{2}]$	[3,-6]
4	$[-X, X, -Z]$	$[0, 0, \frac{1}{2}]$	[4,-5]

Table 13: Wyckoff bond: 8f@2b

No.	vector	center	mapping
1	$[X, Y, 0]$	$[0, 0, \frac{1}{2}]$	[1,-2]
2	$[Y, -X, 0]$	$[0, 0, \frac{1}{2}]$	[3,-4]
3	$[X, -Y, 0]$	$[0, 0, \frac{1}{2}]$	[5,-6]
4	$[Y, X, 0]$	$[0, 0, \frac{1}{2}]$	[7,-8]

Table 14: Wyckoff bond: 16g@2b

No.	vector	center	mapping
1	$[X, Y, Z]$	$[0, 0, \frac{1}{2}]$	[1]
2	$[-X, -Y, Z]$	$[0, 0, \frac{1}{2}]$	[2]
3	$[Y, -X, -Z]$	$[0, 0, \frac{1}{2}]$	[3]
4	$[-Y, X, -Z]$	$[0, 0, \frac{1}{2}]$	[4]
5	$[X, -Y, Z]$	$[0, 0, \frac{1}{2}]$	[5]
6	$[-X, Y, Z]$	$[0, 0, \frac{1}{2}]$	[6]
7	$[Y, X, -Z]$	$[0, 0, \frac{1}{2}]$	[7]
8	$[-Y, -X, -Z]$	$[0, 0, \frac{1}{2}]$	[8]

\* Wyckoff site: 2c, site symmetry: -4m2

Table 15: Wyckoff bond: 2a@2c

No.	vector	center	mapping
1	[0, 0, Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[1, 2, -3, -4, 5, 6, -7, -8]

Table 16: Wyckoff bond: 4b@2c

No.	vector	center	mapping
1	[X, 0, 0]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[1, -2, 5, -6]
2	[0, -X, 0]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[3, -4, -7, 8]

Table 17: Wyckoff bond: 4c@2c

No.	vector	center	mapping
1	[X, X, 0]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[1, -2, 7, -8]
2	[X, -X, 0]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[3, -4, 5, -6]

Table 18: Wyckoff bond: 8d@2c

No.	vector	center	mapping
1	[X, 0, Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[1, 5]
2	[-X, 0, Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[2, 6]
3	[0, -X, -Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[3, 8]
4	[0, X, -Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[4, 7]

Table 19: Wyckoff bond: 8e@2c

No.	vector	center	mapping
1	[X, X, Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[1, -8]
2	[-X, -X, Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[2, -7]
3	[X, -X, -Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[3, -6]
4	[-X, X, -Z]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[4, -5]

Table 20: Wyckoff bond: 8f@2c

No.	vector	center	mapping
1	[X, Y, 0]	[0, $\frac{1}{2}$ , $\frac{1}{4}$ ]	[1, -2]

*continued ...*

Table 20

No.	vector	center	mapping
2	$[Y, -X, 0]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[3,-4]
3	$[X, -Y, 0]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[5,-6]
4	$[Y, X, 0]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[7,-8]

Table 21: Wyckoff bond: 16g@2c

No.	vector	center	mapping
1	$[X, Y, Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[1]
2	$[-X, -Y, Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[2]
3	$[Y, -X, -Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[3]
4	$[-Y, X, -Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[4]
5	$[X, -Y, Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[5]
6	$[-X, Y, Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[6]
7	$[Y, X, -Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[7]
8	$[-Y, -X, -Z]$	$[0, \frac{1}{2}, \frac{1}{4}]$	[8]

\* Wyckoff site: 2d, site symmetry: -4m2

Table 22: Wyckoff bond: 2a@2d

No.	vector	center	mapping
1	$[0, 0, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[1,2,-3,-4,5,6,-7,-8]

Table 23: Wyckoff bond: 4b@2d

No.	vector	center	mapping
1	$[X, 0, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[1,-2,5,-6]
2	$[0, -X, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[3,-4,-7,8]

Table 24: Wyckoff bond: 4c@2d

No.	vector	center	mapping
1	$[X, X, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[1,-2,7,-8]
2	$[X, -X, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[3,-4,5,-6]

Table 25: Wyckoff bond: 8d@2d

No.	vector	center	mapping
1	$[X, 0, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[1,5]
2	$[-X, 0, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[2,6]
3	$[0, -X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[3,8]
4	$[0, X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[4,7]

Table 26: Wyckoff bond: 8e@2d

No.	vector	center	mapping
1	$[X, X, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[1,-8]
2	$[-X, -X, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[2,-7]
3	$[X, -X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[3,-6]
4	$[-X, X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[4,-5]

Table 27: Wyckoff bond: 8f@2d

No.	vector	center	mapping
1	$[X, Y, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[1,-2]
2	$[Y, -X, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[3,-4]
3	$[X, -Y, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[5,-6]
4	$[Y, X, 0]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[7,-8]

Table 28: Wyckoff bond: 16g@2d

No.	vector	center	mapping
1	$[X, Y, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[1]
2	$[-X, -Y, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[2]
3	$[Y, -X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[3]
4	$[-Y, X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[4]
5	$[X, -Y, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[5]
6	$[-X, Y, Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[6]
7	$[Y, X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[7]
8	$[-Y, -X, -Z]$	$[0, \frac{1}{2}, \frac{3}{4}]$	[8]

\* Wyckoff site: 4e, site symmetry: 2mm.

Table 29: Wyckoff bond: 4a@4e

No.	vector	center	mapping
1	[ $X, 0, 0$ ]	[ $0, 0, z$ ]	[1,-2,5,-6]
2	[ $0, -X, 0$ ]	[ $0, 0, -z$ ]	[3,-4,-7,8]

Table 30: Wyckoff bond: 4b@4e

No.	vector	center	mapping
1	[ $0, 0, Z$ ]	[ $0, 0, z$ ]	[1,2,5,6]
2	[ $0, 0, -Z$ ]	[ $0, 0, -z$ ]	[3,4,7,8]

Table 31: Wyckoff bond: 8c@4e

No.	vector	center	mapping
1	[ $X, 0, Z$ ]	[ $0, 0, z$ ]	[1,5]
2	[ $-X, 0, Z$ ]	[ $0, 0, z$ ]	[2,6]
3	[ $0, -X, -Z$ ]	[ $0, 0, -z$ ]	[3,8]
4	[ $0, X, -Z$ ]	[ $0, 0, -z$ ]	[4,7]

Table 32: Wyckoff bond: 8d@4e

No.	vector	center	mapping
1	[ $X, Y, 0$ ]	[ $0, 0, z$ ]	[1,-2]
2	[ $Y, -X, 0$ ]	[ $0, 0, -z$ ]	[3,-4]
3	[ $X, -Y, 0$ ]	[ $0, 0, z$ ]	[5,-6]
4	[ $Y, X, 0$ ]	[ $0, 0, -z$ ]	[7,-8]

Table 33: Wyckoff bond: 16e@4e

No.	vector	center	mapping
1	[ $X, Y, Z$ ]	[ $0, 0, z$ ]	[1]
2	[ $-X, -Y, Z$ ]	[ $0, 0, z$ ]	[2]
3	[ $Y, -X, -Z$ ]	[ $0, 0, -z$ ]	[3]
4	[ $-Y, X, -Z$ ]	[ $0, 0, -z$ ]	[4]
5	[ $X, -Y, Z$ ]	[ $0, 0, z$ ]	[5]
6	[ $-X, Y, Z$ ]	[ $0, 0, z$ ]	[6]
7	[ $Y, X, -Z$ ]	[ $0, 0, -z$ ]	[7]
8	[ $-Y, -X, -Z$ ]	[ $0, 0, -z$ ]	[8]

\* Wyckoff site: 4f, site symmetry: 2mm.

Table 34: Wyckoff bond: 4a@4f

No.	vector	center	mapping
1	[X, 0, 0]	[0, $\frac{1}{2}$ , z]	[1, -2, 5, -6]
2	[0, -X, 0]	[ $\frac{1}{2}$ , 0, -z]	[3, -4, -7, 8]

Table 35: Wyckoff bond: 4b@4f

No.	vector	center	mapping
1	[0, 0, Z]	[0, $\frac{1}{2}$ , z]	[1, 2, 5, 6]
2	[0, 0, -Z]	[ $\frac{1}{2}$ , 0, -z]	[3, 4, 7, 8]

Table 36: Wyckoff bond: 8c@4f

No.	vector	center	mapping
1	[X, 0, Z]	[0, $\frac{1}{2}$ , z]	[1, 5]
2	[-X, 0, Z]	[0, $\frac{1}{2}$ , z]	[2, 6]
3	[0, -X, -Z]	[ $\frac{1}{2}$ , 0, -z]	[3, 8]
4	[0, X, -Z]	[ $\frac{1}{2}$ , 0, -z]	[4, 7]

Table 37: Wyckoff bond: 8d@4f

No.	vector	center	mapping
1	[X, Y, 0]	[0, $\frac{1}{2}$ , z]	[1, -2]
2	[Y, -X, 0]	[ $\frac{1}{2}$ , 0, -z]	[3, -4]
3	[X, -Y, 0]	[0, $\frac{1}{2}$ , z]	[5, -6]
4	[Y, X, 0]	[ $\frac{1}{2}$ , 0, -z]	[7, -8]

Table 38: Wyckoff bond: 16e@4f

No.	vector	center	mapping
1	[X, Y, Z]	[0, $\frac{1}{2}$ , z]	[1]
2	[-X, -Y, Z]	[0, $\frac{1}{2}$ , z]	[2]
3	[Y, -X, -Z]	[ $\frac{1}{2}$ , 0, -z]	[3]
4	[-Y, X, -Z]	[ $\frac{1}{2}$ , 0, -z]	[4]
5	[X, -Y, Z]	[0, $\frac{1}{2}$ , z]	[5]
6	[-X, Y, Z]	[0, $\frac{1}{2}$ , z]	[6]

*continued ...*

Table 38

No.	vector	center	mapping
7	$[Y, X, -Z]$	$[\frac{1}{2}, 0, -z]$	[7]
8	$[-Y, -X, -Z]$	$[\frac{1}{2}, 0, -z]$	[8]

\* Wyckoff site: 8g, site symmetry: . . 2

Table 39: Wyckoff bond: 8a@8g

No.	vector	center	mapping
1	$[X, -X, Z]$	$[x, x, 0]$	[1, -7]
2	$[-X, X, Z]$	$[-x, -x, 0]$	[2, -8]
3	$[-X, -X, -Z]$	$[x, -x, 0]$	[3, -5]
4	$[X, X, -Z]$	$[-x, x, 0]$	[4, -6]

Table 40: Wyckoff bond: 8b@8g

No.	vector	center	mapping
1	$[X, X, 0]$	$[x, x, 0]$	[1, 7]
2	$[-X, -X, 0]$	$[-x, -x, 0]$	[2, 8]
3	$[X, -X, 0]$	$[x, -x, 0]$	[3, 5]
4	$[-X, X, 0]$	$[-x, x, 0]$	[4, 6]

Table 41: Wyckoff bond: 16c@8g

No.	vector	center	mapping
1	$[X, Y, Z]$	$[x, x, 0]$	[1]
2	$[-X, -Y, Z]$	$[-x, -x, 0]$	[2]
3	$[Y, -X, -Z]$	$[x, -x, 0]$	[3]
4	$[-Y, X, -Z]$	$[-x, x, 0]$	[4]
5	$[X, -Y, Z]$	$[x, -x, 0]$	[5]
6	$[-X, Y, Z]$	$[-x, x, 0]$	[6]
7	$[Y, X, -Z]$	$[x, x, 0]$	[7]
8	$[-Y, -X, -Z]$	$[-x, -x, 0]$	[8]

\* Wyckoff site: 8h, site symmetry: . . 2

Table 42: Wyckoff bond: 8a@8h

No.	vector	center	mapping
1	$[X, -X, Z]$	$[x, x + \frac{1}{2}, \frac{1}{4}]$	[1,-7]
2	$[-X, X, Z]$	$[-x, \frac{1}{2} - x, \frac{1}{4}]$	[2,-8]
3	$[-X, -X, -Z]$	$[x + \frac{1}{2}, -x, \frac{3}{4}]$	[3,-5]
4	$[X, X, -Z]$	$[\frac{1}{2} - x, x, \frac{3}{4}]$	[4,-6]

Table 43: Wyckoff bond: 8b@8h

No.	vector	center	mapping
1	$[X, X, 0]$	$[x, x + \frac{1}{2}, \frac{1}{4}]$	[1,7]
2	$[-X, -X, 0]$	$[-x, \frac{1}{2} - x, \frac{1}{4}]$	[2,8]
3	$[X, -X, 0]$	$[x + \frac{1}{2}, -x, \frac{3}{4}]$	[3,5]
4	$[-X, X, 0]$	$[\frac{1}{2} - x, x, \frac{3}{4}]$	[4,6]

Table 44: Wyckoff bond: 16c@8h

No.	vector	center	mapping
1	$[X, Y, Z]$	$[x, x + \frac{1}{2}, \frac{1}{4}]$	[1]
2	$[-X, -Y, Z]$	$[-x, \frac{1}{2} - x, \frac{1}{4}]$	[2]
3	$[Y, -X, -Z]$	$[x + \frac{1}{2}, -x, \frac{3}{4}]$	[3]
4	$[-Y, X, -Z]$	$[\frac{1}{2} - x, x, \frac{3}{4}]$	[4]
5	$[X, -Y, Z]$	$[x + \frac{1}{2}, -x, \frac{3}{4}]$	[5]
6	$[-X, Y, Z]$	$[\frac{1}{2} - x, x, \frac{3}{4}]$	[6]
7	$[Y, X, -Z]$	$[x, x + \frac{1}{2}, \frac{1}{4}]$	[7]
8	$[-Y, -X, -Z]$	$[-x, \frac{1}{2} - x, \frac{1}{4}]$	[8]

\* Wyckoff site: 8i, site symmetry: .m.

Table 45: Wyckoff bond: 8a@8i

No.	vector	center	mapping
1	$[X, 0, Z]$	$[x, 0, z]$	[1,5]
2	$[-X, 0, Z]$	$[-x, 0, z]$	[2,6]
3	$[0, -X, -Z]$	$[0, -x, -z]$	[3,8]
4	$[0, X, -Z]$	$[0, x, -z]$	[4,7]

Table 46: Wyckoff bond: 8b@8i

No.	vector	center	mapping
1	[0, X, 0]	[x, 0, z]	[1, -5]
2	[0, -X, 0]	[-x, 0, z]	[2, -6]
3	[X, 0, 0]	[0, -x, -z]	[3, -8]
4	[-X, 0, 0]	[0, x, -z]	[4, -7]

Table 47: Wyckoff bond: 16c@8i

No.	vector	center	mapping
1	[X, Y, Z]	[x, 0, z]	[1]
2	[-X, -Y, Z]	[-x, 0, z]	[2]
3	[Y, -X, -Z]	[0, -x, -z]	[3]
4	[-Y, X, -Z]	[0, x, -z]	[4]
5	[X, -Y, Z]	[x, 0, z]	[5]
6	[-X, Y, Z]	[-x, 0, z]	[6]
7	[Y, X, -Z]	[0, x, -z]	[7]
8	[-Y, -X, -Z]	[0, -x, -z]	[8]

\* Wyckoff site: 16j, site symmetry: 1

Table 48: Wyckoff bond: 16a@16j

No.	vector	center	mapping
1	[X, Y, Z]	[x, y, z]	[1]
2	[-X, -Y, Z]	[-x, -y, z]	[2]
3	[Y, -X, -Z]	[y, -x, -z]	[3]
4	[-Y, X, -Z]	[-y, x, -z]	[4]
5	[X, -Y, Z]	[x, -y, z]	[5]
6	[-X, Y, Z]	[-x, y, z]	[6]
7	[Y, X, -Z]	[y, x, -z]	[7]
8	[-Y, -X, -Z]	[-y, -x, -z]	[8]