VRML General Position/Symmetry Diagrams of the 80 Layer Groups

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The Numbering and Symbols of the 80 Layer Groups:

1) p1
2) $p\bar{1}$
3) p112
4) p11m
5) p11a
6) p112/m
7) p112/a
8) p211
9) $p2_111$
10) c211
11) pm11
12) pb11
13) cm11
14) p2/m11
15) $p2_1/m11$
16) p2/b11
17) $p2_1/b11$
18) c2/m11
19) p222
20) $p2_122$
21) $p2_12_12$
22) c222
23) pmm2
24) pma2
25) pba2
26) cmm2
27) pm2m
28) $pm2_1b$
29) $pb2_1m$
30) pb2b
31) pm2a
32) $pm2_1n$
33) $pb2_1a$
34) pb2n
35) cm2m
36) cm2a
37) pmmm
38) pmaa
39) pban
40) pmam
41) pmma
42) pman
43) pbaa
44) pbam
45) pbma
46) pmmn
47) cmmm
48) cmme
49) p4
50) $p\bar{4}$
51) p4/m
52) p4/n
53) p422
54) $p42_12$

55) p4mm
56) p4bm
57) $p\bar{4}2m$
58) $p\bar{4}2_1m$
59) $p\bar{4}m2$
60) $p\bar{4}b2$
61) p4/mmm
62) p4/nbm
63) p4/mbm
64) p4/nmm
65) p3
66) $p\bar{3}$
67) p312
68) p321
69) p3m1
70) p31m
71) $p\bar{3}1m$
72) $p\bar{3}m1$
73) p6
74) $p\bar{6}$
75) p6/m
76) p622
77) p6mm
78) $p\bar{6}m2$
79) $p\bar{6}2m$
80) p6/mmm

General Positions/Symmetry Diagram:

Atoms are represented by small red and blue spheres. Atoms at positions related by proper rotations, translations, and rotation/translations (screw axes) are of the same color. Atoms at positions related by improper rotations, i.e. inversion, mirror planes, and glide planes, and improper rotation/translations are of opposite colors. The unit cell is outlined by a thin solid black line.

In the initial General Position/Symmetry Diagrams the origin of the coordinate system is in the upper left-hand corner of the diagram. The y-axis is horizontally to the right, the x-axis is downward, the exact direction depending on the group, and the z-axis is perpendicular towards the viewer.

The two-dimensional translations are in the x-y plane. Symbols of symmetry elements which are in the x-y plane are:

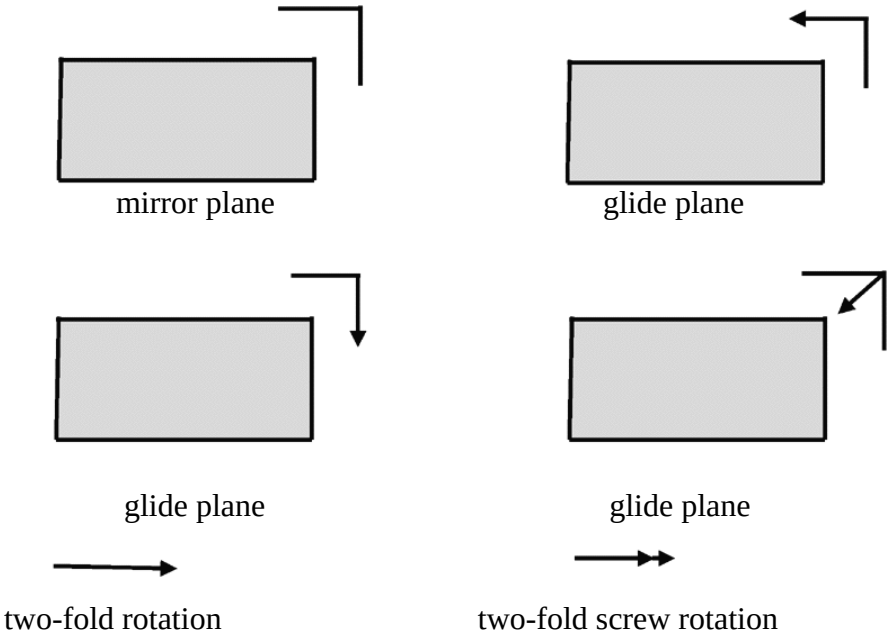
Inversion: represented by a small white sphere.

Mirror Plane: represented by a transparent plane outlined with a solid black line, with an additional corner line at one corner of the plane.

Glide Plane: represented by a transparent plane outlined with a solid black line, with an additional corner line, with an arrow denoting the glide direction, at one corner of the plane.

Two-fold rotation: represented by a single headed arrow.

Two-fold screw rotation: represented by a double headed arrow.



Symbols of symmetry elements which are perpendicular to the x-y plane are:

Mirror Plane: represented by a transparent plane outlined with a solid black line.

Glide Plane: represented by a transparent plane outlined with a broken black line. The direction of the glide is along the intersection of the plane with the x-y plane.

Rotation and rotation/inversion axes are denoted by a rod perpendicular to the x-y plane with an additional symbol at each end to denote the type of rotation or rotation/inversion. For each type of rotation or rotation/inversion this additional symbol is:

Two-fold rotation: an arrow head.

Three-fold rotation: a triangle.

Four-fold rotation: a square.

Four-fold rotation/inversion: a square with a black elliptical area within the square.

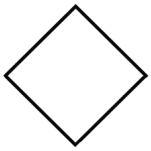
Six-fold rotation: a hexagon.

Six-fold rotation/inversion: a hexagon with a black triangular area within the hexagon.

mirror plane

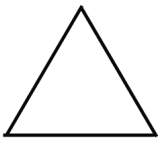
glide plane

two-fold rotation



four-fold rotation

four-fold rotation/inversion



three-fold rotation

six-fold rotation

six-fold rotation/inversion