

## 1.1. Symbols and terms used in Parts 1–4

In this chapter the crystallographic symbols and terms that occur in the tables and the text of Parts 1–4 of this volume are defined. The symbols and definitions given below in Tables 1.1.1 to 1.1.3

follow those given in Part 1 of Volume A of *International Tables for Crystallography* (2005).

Table 1.1.1. Printed symbols for crystallographic items

Printed symbol	Explanation
<b>a; b; c</b>	Basis vectors of direct lattice
<i>a; b; c</i>	Length of basis vectors
$\alpha; \beta; \gamma$	Interaxial (lattice) angles $\mathbf{b} \wedge \mathbf{c}$ , $\mathbf{c} \wedge \mathbf{a}$ , $\mathbf{a} \wedge \mathbf{b}$
<b>a'; b'; c'</b>	New basis vectors after a transformation of the basis vectors
( <i>abc</i> )	Setting symbol, notation for the transformation of the basis vectors, e.g. ( <i>bāc</i> ) means $\mathbf{a}' = \mathbf{b}$ , $\mathbf{b}' = -\mathbf{a}$ and $\mathbf{c}' = \mathbf{c}$
<b>r</b>	Position vector of a point or an atom
<i>x, y, z</i>	Coordinates of a point or location of an atom expressed in units of <i>a, b</i> and <i>c</i> ; coordinates of the end point of the position vector <b>r</b>
<b>xa; yb; zc</b>	Components of the position vector <b>r</b>
[ <i>uvw</i> ]	Indices of a three-dimensional lattice direction
[ <i>uv</i> ]	Indices of a two-dimensional lattice direction
( <i>hkl</i> )	Miller indices

Table 1.1.2. Printed symbols for symmetry elements and for the corresponding symmetry operations

Printed symbol	Symmetry element and its orientation	Generating symmetry operation with glide or screw vector
<i>m</i>	Reflection plane, mirror plane (three dimensions) Reflection line, mirror line (two dimensions)	Reflection through a plane Reflection through a line
<i>a, b</i> or <i>c</i>	'Axial' glide plane	Glide reflection through a plane, with glide vector
<i>a</i>	$\perp[010]$ or $\perp[001]$	$\frac{1}{2}\mathbf{a}$
<i>b</i>	$\perp[100]$ or $\perp[001]$	$\frac{1}{2}\mathbf{b}$
<i>c</i>	$\perp[100]$ or $\perp[010]$ $\perp[1\bar{1}0]$ or $\perp[110]$ $\perp[100]$ or $\perp[010]$ or $\perp[1\bar{1}0]$ $\perp[1\bar{1}0]$ or $\perp[120]$ or $\perp[2\bar{1}0]$	$\frac{1}{2}\mathbf{c}$ $\frac{1}{2}\mathbf{c}$ $\frac{1}{2}\mathbf{c}$ , hexagonal coordinate system $\frac{1}{2}\mathbf{c}$ , hexagonal coordinate system
<i>n</i>	'Diagonal' glide plane (in noncentred cells only) $\perp[001]$	Glide reflection through a plane, with glide vector $\frac{1}{2}(\mathbf{a} + \mathbf{b})$
<i>e</i>	'Double' glide plane $\perp[001]$ (in centred cells only)	Two glide reflections through planes with glide vectors $\frac{1}{2}\mathbf{a}$ and $\frac{1}{2}\mathbf{b}$
<i>g</i>	Glide line (two dimensions) $\perp[01]; \perp[10]$	Glide reflection through a line, with glide vector $\frac{1}{2}\mathbf{a}; \frac{1}{2}\mathbf{b}$
1	None	Identity
2, 3, 4, 6	<i>n</i> -fold rotation axis, <i>n</i> (three dimensions) <i>n</i> -fold rotation point, <i>n</i> (two dimensions)	Counterclockwise rotation of $360/n$ degrees about an axis Counterclockwise rotation of $360/n$ degrees about a point
$\bar{1}$	Centre of symmetry, inversion centre	Inversion through a point
$\bar{2} = m, \bar{3}, \bar{4}, \bar{6}$	Rotoinversion axis, $\bar{n}$	Counterclockwise rotation of $360/n$ degrees around an axis, followed by inversion through a point on the axis
2 <sub>1</sub> , 3 <sub>1</sub> , 3 <sub>2</sub> , 4 <sub>1</sub> , 4 <sub>2</sub> , 4 <sub>3</sub> , 6 <sub>1</sub> , 6 <sub>2</sub> , 6 <sub>3</sub> , 6 <sub>4</sub> , 6 <sub>5</sub>	<i>n</i> -fold screw axes, <i>n<sub>p</sub></i>	Right-handed screw rotation of $360/n$ degrees around an axis, with screw vector $(p/n)t$ ; <i>t</i> is the shortest translation vector parallel to the axis in the direction of the screw

# 1.1. SYMBOLS AND TERMS USED IN PARTS 1–4

Table 1.1.3. *Graphical symbols*

(a) Symmetry planes normal to the plane of projection (three dimensions) and symmetry lines in the plane of the figure (two dimensions).

Symmetry plane or symmetry line	Graphical symbol	Glide vectors in units of lattice translation vectors parallel and normal to the projection plane	Printed symbol
Mirror plane, mirror line		None	<i>m</i>
Glide plane, glide line		$\frac{1}{2}$ along line parallel to projection plane; $\frac{1}{2}$ along line in plane	<i>a, b</i> or <i>c; g</i>
Glide plane		$\frac{1}{2}$ normal to projection plane	<i>c</i>

(b) Symmetry planes parallel to plane of projection.

Symmetry plane	Graphical symbol	Glide vector in units of lattice translation vectors parallel to the projection plane	Printed symbol
Mirror plane		None	<i>m</i>
Glide plane		$\frac{1}{2}$ in the direction of arrow	<i>a, b</i> or <i>c</i>
'Double' glide plane		Two glide vectors; $\frac{1}{2}$ in either of the directions of the two arrows	<i>e</i>
'Diagonal' glide plane		$\frac{1}{2}$ in the direction of the arrow	<i>n</i>

(c) Symmetry axes normal to the plane of projection (three dimensions) and symmetry points in the plane of the figure (two dimensions).

Symmetry axis or symmetry point	Graphical symbol	Screw vector of a right-handed screw rotation in units of the shortest lattice translation vector parallel to the axis	Printed symbol
Twofold rotation axis, twofold rotation point		None	2
Twofold screw axis: '2 sub 1'		$\frac{1}{2}$	2 <sub>1</sub>
Threefold rotation axis		None	3
Threefold screw axis: '3 sub 1'		$\frac{1}{3}$	3 <sub>1</sub>
Threefold screw axis: '3 sub 2'		$\frac{2}{3}$	3 <sub>2</sub>
Fourfold rotation axis		None	4
Fourfold screw axis: '4 sub 1'		$\frac{1}{4}$	4 <sub>1</sub>
Fourfold screw axis: '4 sub 2'		$\frac{1}{2}$	4 <sub>2</sub>
Fourfold screw axis: '4 sub 3'		$\frac{3}{4}$	4 <sub>3</sub>
Sixfold rotation axis		None	6

# 1. SUBPERIODIC GROUP TABLES: FRIEZE-GROUP, ROD-GROUP AND LAYER-GROUP TYPES

Table 1.1.3 (cont.)

Symmetry axis or symmetry point	Graphical symbol	Screw vector of a right-handed screw rotation in units of the shortest lattice translation vector parallel to the axis	Printed symbol
Sixfold screw axis: '6 sub 1'		$\frac{1}{6}$	$6_1$
Sixfold screw axis: '6 sub 2'		$\frac{1}{3}$	$6_2$
Sixfold screw axis: '6 sub 3'		$\frac{1}{2}$	$6_3$
Sixfold screw axis: '6 sub 4'		$\frac{2}{3}$	$6_4$
Sixfold screw axis: '6 sub 5'		$\frac{5}{6}$	$6_5$
Centre of symmetry, inversion centre: '1 bar'		None	$\bar{1}$
Twofold rotation axis with centre of symmetry		None	$2/m$
Twofold screw axis with centre of symmetry		$\frac{1}{2}$	$2_1/m$
Inversion axis: '3 bar'		None	$\bar{3}$
Inversion axis: '4 bar'		None	$\bar{4}$
Fourfold rotation axis with centre of symmetry		None	$4/m$
'4 sub 2' screw axis with centre of symmetry		$\frac{1}{2}$	$4_2/m$
Inversion axis: '6 bar'		None	$\bar{6}$
Sixfold rotation axis with centre of symmetry		None	$6/m$
'6 sub 3' screw axis with centre of symmetry		$\frac{1}{2}$	$6_3/m$

(d) Symmetry axes parallel to plane of projection.

Symmetry axis	Graphical symbol	Screw vector of a right-handed screw rotation in units of the shortest lattice translation vector parallel to the axis	Printed symbol
Twofold rotation axis		None	2
Twofold screw axis		$\frac{1}{2}$	$2_1$

## References

*International Tables for Crystallography* (2005). Vol. A. *Space-group symmetry*, edited by Th. Hahn. Heidelberg: Springer. [Previous editions: 1983, 1987, 1992, 1995 and 2002. Abbreviated as *IT A* (2005).]