Monoclinic $Fe_2(SO_4)_3$ Structure: A2B12C3_mP68_14_2e_12e_3e-001

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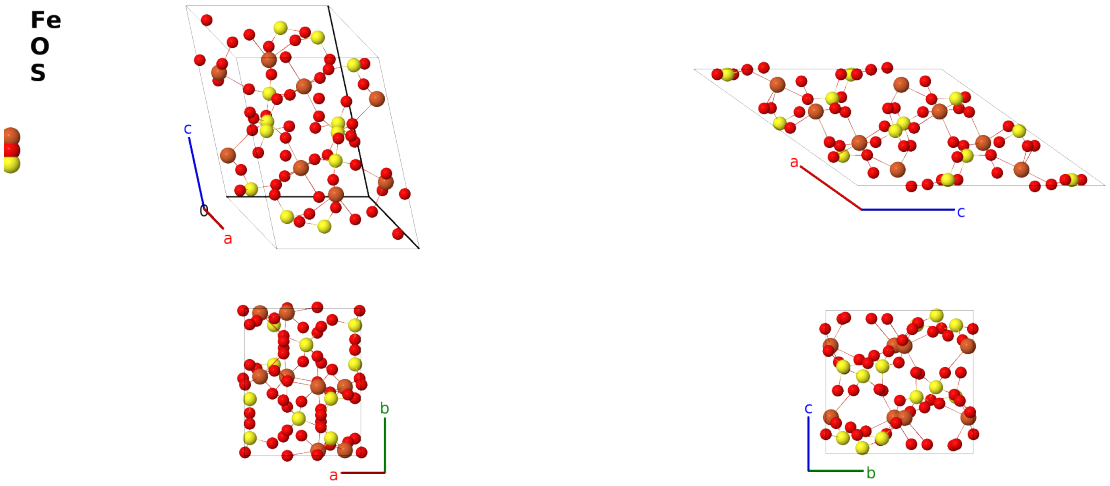
https://aflow.org/prototype-encyclopedia/LK3Z

https://aflow.org/prototype-encyclopedia/A2B12C3_mP68_14_2e_12e_3e-001

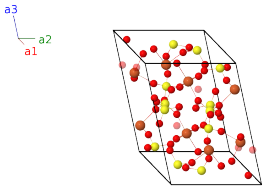


Prototype	$Fe_2O_{12}S_3$
AFLOW prototype label	A2B12C3_mP68_14_2e_12e_3e-001
ICSD	4301
CCDC	1592963
Pearson symbol	mP68
Space group number	14
Space group symbol	$P2_1/c$
AFLOW prototype command	`aflow --proto=A2B12C3_mP68_14_2e_12e_3e-001 --params=`$a, b/a, c/a, \beta, x_1, y_1, z_1, x_2, y_2, z_2, x_3, y_3, z_3, x_4, y_4, z_4, x_5, y_5, z_5, x_6, y_6, z_6, x_7, y_7, z_7, x_8, y_8, z_8, x_9, y_9, z_9, x_{10}, y_{10}, z_{10}, x_{11}, y_{11}, z_{11}, x_{12}, y_{12}, z_{12}, x_{13}, y_{13}, z_{13}, x_{14}, y_{14}, z_{14}, x_{15}, y_{15}, z_{15}, x_{16}, y_{16}, z_{16}, x_{17}, y_{17}, z_{17}$

- $Fe_2O_{12}S_3$ can also be found as the rhombohedral mineral mikasaite.

Simple Monoclinic primitive vectors

$$
\begin{aligned}
\mathbf{a_1} &= a\,\hat{\mathbf{x}} \\
\mathbf{a_2} &= b\,\hat{\mathbf{y}} \\
\mathbf{a_3} &= c\cos\beta\,\hat{\mathbf{x}} + c\sin\beta\,\hat{\mathbf{z}}
\end{aligned}
$$



Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	=	$x_1\,\mathbf{a}_1 + y_1\,\mathbf{a}_2 + z_1\,\mathbf{a}_3$	=	$(ax_1 + cz_1\cos\beta)\,\hat{\mathbf{x}} + by_1\,\hat{\mathbf{y}} + cz_1\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe I
$\mathbf{B_2}$	=	$-x_1\,\mathbf{a}_1 + \left(y_1 + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_1 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_1 + c\left(z_1 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_1 + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_1 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe I
$\mathbf{B_3}$	=	$-x_1\,\mathbf{a}_1 - y_1\,\mathbf{a}_2 - z_1\,\mathbf{a}_3$	=	$-\left(ax_1 + cz_1\cos\beta\right)\,\hat{\mathbf{x}} - by_1\,\hat{\mathbf{y}} - cz_1\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe I
$\mathbf{B_4}$	=	$x_1\,\mathbf{a}_1 - \left(y_1 - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_1 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_1 + c\left(z_1 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_1 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_1 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe I
$\mathbf{B_5}$	=	$x_2\,\mathbf{a}_1 + y_2\,\mathbf{a}_2 + z_2\,\mathbf{a}_3$	=	$(ax_2 + cz_2\cos\beta)\,\hat{\mathbf{x}} + by_2\,\hat{\mathbf{y}} + cz_2\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe II
$\mathbf{B_6}$	=	$-x_2\,\mathbf{a}_1 + \left(y_2 + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_2 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_2 + c\left(z_2 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_2 + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_2 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe II
$\mathbf{B_7}$	=	$-x_2\,\mathbf{a}_1 - y_2\,\mathbf{a}_2 - z_2\,\mathbf{a}_3$	=	$-\left(ax_2 + cz_2\cos\beta\right)\,\hat{\mathbf{x}} - by_2\,\hat{\mathbf{y}} - cz_2\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe II
$\mathbf{B_8}$	=	$x_2\,\mathbf{a}_1 - \left(y_2 - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_2 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_2 + c\left(z_2 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_2 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_2 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	Fe II
$\mathbf{B_9}$	=	$x_3\,\mathbf{a}_1 + y_3\,\mathbf{a}_2 + z_3\,\mathbf{a}_3$	=	$(ax_3 + cz_3\cos\beta)\,\hat{\mathbf{x}} + by_3\,\hat{\mathbf{y}} + cz_3\sin\beta\,\hat{\mathbf{z}}$	(4e)	O I
$\mathbf{B_{10}}$	=	$-x_3\,\mathbf{a}_1 + \left(y_3 + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_3 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_3 + c\left(z_3 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_3 + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_3 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O I
$\mathbf{B_{11}}$	=	$-x_3\,\mathbf{a}_1 - y_3\,\mathbf{a}_2 - z_3\,\mathbf{a}_3$	=	$-\left(ax_3 + cz_3\cos\beta\right)\,\hat{\mathbf{x}} - by_3\,\hat{\mathbf{y}} - cz_3\sin\beta\,\hat{\mathbf{z}}$	(4e)	O I
$\mathbf{B_{12}}$	=	$x_3\,\mathbf{a}_1 - \left(y_3 - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_3 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_3 + c\left(z_3 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_3 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_3 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O I
$\mathbf{B_{13}}$	=	$x_4\,\mathbf{a}_1 + y_4\,\mathbf{a}_2 + z_4\,\mathbf{a}_3$	=	$(ax_4 + cz_4\cos\beta)\,\hat{\mathbf{x}} + by_4\,\hat{\mathbf{y}} + cz_4\sin\beta\,\hat{\mathbf{z}}$	(4e)	O II
$\mathbf{B_{14}}$	=	$-x_4\,\mathbf{a}_1 + \left(y_4 + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_4 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_4 + c\left(z_4 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_4 + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_4 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O II
$\mathbf{B_{15}}$	=	$-x_4\,\mathbf{a}_1 - y_4\,\mathbf{a}_2 - z_4\,\mathbf{a}_3$	=	$-\left(ax_4 + cz_4\cos\beta\right)\,\hat{\mathbf{x}} - by_4\,\hat{\mathbf{y}} - cz_4\sin\beta\,\hat{\mathbf{z}}$	(4e)	O II
$\mathbf{B_{16}}$	=	$x_4\,\mathbf{a}_1 - \left(y_4 - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_4 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_4 + c\left(z_4 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_4 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_4 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O II
$\mathbf{B_{17}}$	=	$x_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2 + z_5\,\mathbf{a}_3$	=	$(ax_5 + cz_5\cos\beta)\,\hat{\mathbf{x}} + by_5\,\hat{\mathbf{y}} + cz_5\sin\beta\,\hat{\mathbf{z}}$	(4e)	O III
$\mathbf{B_{18}}$	=	$-x_5\,\mathbf{a}_1 + \left(y_5 + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_5 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_5 + c\left(z_5 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_5 + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_5 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O III
$\mathbf{B_{19}}$	=	$-x_5\,\mathbf{a}_1 - y_5\,\mathbf{a}_2 - z_5\,\mathbf{a}_3$	=	$-\left(ax_5 + cz_5\cos\beta\right)\,\hat{\mathbf{x}} - by_5\,\hat{\mathbf{y}} - cz_5\sin\beta\,\hat{\mathbf{z}}$	(4e)	O III
$\mathbf{B_{20}}$	=	$x_5\,\mathbf{a}_1 - \left(y_5 - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_5 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_5 + c\left(z_5 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_5 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_5 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O III
$\mathbf{B_{21}}$	=	$x_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2 + z_6\,\mathbf{a}_3$	=	$(ax_6 + cz_6\cos\beta)\,\hat{\mathbf{x}} + by_6\,\hat{\mathbf{y}} + cz_6\sin\beta\,\hat{\mathbf{z}}$	(4e)	O IV
$\mathbf{B_{22}}$	=	$-x_6\,\mathbf{a}_1 + \left(y_6 + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_6 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_6 + c\left(z_6 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_6 + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_6 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O IV
$\mathbf{B_{23}}$	=	$-x_6\,\mathbf{a}_1 - y_6\,\mathbf{a}_2 - z_6\,\mathbf{a}_3$	=	$-\left(ax_6 + cz_6\cos\beta\right)\,\hat{\mathbf{x}} - by_6\,\hat{\mathbf{y}} - cz_6\sin\beta\,\hat{\mathbf{z}}$	(4e)	O IV
$\mathbf{B_{24}}$	=	$x_6\,\mathbf{a}_1 - \left(y_6 - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_6 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_6 + c\left(z_6 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_6 - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_6 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O IV

$$
\begin{array}{lcccccc}
\mathbf{B_{25}} & = & x_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2 + z_7\,\mathbf{a}_3 & = & (ax_7 + cz_7\cos\beta)\,\hat{\mathbf{x}} + by_7\,\hat{\mathbf{y}} + cz_7\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O V} \\
\mathbf{B_{26}} & = & -x_7\,\mathbf{a}_1 + \left(y_7 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_7 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -\left(ax_7 + c\left(z_7 - \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_7 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_7 - \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O V} \\
\mathbf{B_{27}} & = & -x_7\,\mathbf{a}_1 - y_7\,\mathbf{a}_2 - z_7\,\mathbf{a}_3 & = & -\left(ax_7 + cz_7\cos\beta\right)\,\hat{\mathbf{x}} - by_7\,\hat{\mathbf{y}} - cz_7\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O V} \\
\mathbf{B_{28}} & = & x_7\,\mathbf{a}_1 - \left(y_7 - \tfrac{1}{2}\right)\,\mathbf{a}_2 + \left(z_7 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & \left(ax_7 + c\left(z_7 + \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_7 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_7 + \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O V} \\
\mathbf{B_{29}} & = & x_8\,\mathbf{a}_1 + y_8\,\mathbf{a}_2 + z_8\,\mathbf{a}_3 & = & (ax_8 + cz_8\cos\beta)\,\hat{\mathbf{x}} + by_8\,\hat{\mathbf{y}} + cz_8\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VI} \\
\mathbf{B_{30}} & = & -x_8\,\mathbf{a}_1 + \left(y_8 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_8 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -\left(ax_8 + c\left(z_8 - \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_8 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_8 - \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VI} \\
\mathbf{B_{31}} & = & -x_8\,\mathbf{a}_1 - y_8\,\mathbf{a}_2 - z_8\,\mathbf{a}_3 & = & -\left(ax_8 + cz_8\cos\beta\right)\,\hat{\mathbf{x}} - by_8\,\hat{\mathbf{y}} - cz_8\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VI} \\
\mathbf{B_{32}} & = & x_8\,\mathbf{a}_1 - \left(y_8 - \tfrac{1}{2}\right)\,\mathbf{a}_2 + \left(z_8 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & \left(ax_8 + c\left(z_8 + \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_8 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_8 + \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VI} \\
\mathbf{B_{33}} & = & x_9\,\mathbf{a}_1 + y_9\,\mathbf{a}_2 + z_9\,\mathbf{a}_3 & = & (ax_9 + cz_9\cos\beta)\,\hat{\mathbf{x}} + by_9\,\hat{\mathbf{y}} + cz_9\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VII} \\
\mathbf{B_{34}} & = & -x_9\,\mathbf{a}_1 + \left(y_9 + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_9 - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -\left(ax_9 + c\left(z_9 - \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_9 + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_9 - \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VII} \\
\mathbf{B_{35}} & = & -x_9\,\mathbf{a}_1 - y_9\,\mathbf{a}_2 - z_9\,\mathbf{a}_3 & = & -\left(ax_9 + cz_9\cos\beta\right)\,\hat{\mathbf{x}} - by_9\,\hat{\mathbf{y}} - cz_9\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VII} \\
\mathbf{B_{36}} & = & x_9\,\mathbf{a}_1 - \left(y_9 - \tfrac{1}{2}\right)\,\mathbf{a}_2 + \left(z_9 + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & \left(ax_9 + c\left(z_9 + \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_9 - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_9 + \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VII} \\
\mathbf{B_{37}} & = & x_{10}\,\mathbf{a}_1 + y_{10}\,\mathbf{a}_2 + z_{10}\,\mathbf{a}_3 & = & (ax_{10} + cz_{10}\cos\beta)\,\hat{\mathbf{x}} + by_{10}\,\hat{\mathbf{y}} + cz_{10}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VIII} \\
\mathbf{B_{38}} & = & -x_{10}\,\mathbf{a}_1 + \left(y_{10} + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{10} - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -\left(ax_{10} + c\left(z_{10} - \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{10} + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{10} - \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VIII} \\
\mathbf{B_{39}} & = & -x_{10}\,\mathbf{a}_1 - y_{10}\,\mathbf{a}_2 - z_{10}\,\mathbf{a}_3 & = & -\left(ax_{10} + cz_{10}\cos\beta\right)\,\hat{\mathbf{x}} - by_{10}\,\hat{\mathbf{y}} - cz_{10}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VIII} \\
\mathbf{B_{40}} & = & x_{10}\,\mathbf{a}_1 - \left(y_{10} - \tfrac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{10} + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & \left(ax_{10} + c\left(z_{10} + \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{10} - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{10} + \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O VIII} \\
\mathbf{B_{41}} & = & x_{11}\,\mathbf{a}_1 + y_{11}\,\mathbf{a}_2 + z_{11}\,\mathbf{a}_3 & = & (ax_{11} + cz_{11}\cos\beta)\,\hat{\mathbf{x}} + by_{11}\,\hat{\mathbf{y}} + cz_{11}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O IX} \\
\mathbf{B_{42}} & = & -x_{11}\,\mathbf{a}_1 + \left(y_{11} + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{11} - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -\left(ax_{11} + c\left(z_{11} - \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{11} + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{11} - \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O IX} \\
\mathbf{B_{43}} & = & -x_{11}\,\mathbf{a}_1 - y_{11}\,\mathbf{a}_2 - z_{11}\,\mathbf{a}_3 & = & -\left(ax_{11} + cz_{11}\cos\beta\right)\,\hat{\mathbf{x}} - by_{11}\,\hat{\mathbf{y}} - cz_{11}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O IX} \\
\mathbf{B_{44}} & = & x_{11}\,\mathbf{a}_1 - \left(y_{11} - \tfrac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{11} + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & \left(ax_{11} + c\left(z_{11} + \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{11} - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{11} + \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O IX} \\
\mathbf{B_{45}} & = & x_{12}\,\mathbf{a}_1 + y_{12}\,\mathbf{a}_2 + z_{12}\,\mathbf{a}_3 & = & (ax_{12} + cz_{12}\cos\beta)\,\hat{\mathbf{x}} + by_{12}\,\hat{\mathbf{y}} + cz_{12}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O X} \\
\mathbf{B_{46}} & = & -x_{12}\,\mathbf{a}_1 + \left(y_{12} + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{12} - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -\left(ax_{12} + c\left(z_{12} - \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{12} + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{12} - \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O X} \\
\mathbf{B_{47}} & = & -x_{12}\,\mathbf{a}_1 - y_{12}\,\mathbf{a}_2 - z_{12}\,\mathbf{a}_3 & = & -\left(ax_{12} + cz_{12}\cos\beta\right)\,\hat{\mathbf{x}} - by_{12}\,\hat{\mathbf{y}} - cz_{12}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O X} \\
\mathbf{B_{48}} & = & x_{12}\,\mathbf{a}_1 - \left(y_{12} - \tfrac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{12} + \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & \left(ax_{12} + c\left(z_{12} + \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{12} - \tfrac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{12} + \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O X} \\
\mathbf{B_{49}} & = & x_{13}\,\mathbf{a}_1 + y_{13}\,\mathbf{a}_2 + z_{13}\,\mathbf{a}_3 & = & (ax_{13} + cz_{13}\cos\beta)\,\hat{\mathbf{x}} + by_{13}\,\hat{\mathbf{y}} + cz_{13}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O XI} \\
\mathbf{B_{50}} & = & -x_{13}\,\mathbf{a}_1 + \left(y_{13} + \tfrac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{13} - \tfrac{1}{2}\right)\,\mathbf{a}_3 & = & -\left(ax_{13} + c\left(z_{13} - \tfrac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{13} + \tfrac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{13} - \tfrac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O XI} \\
\mathbf{B_{51}} & = & -x_{13}\,\mathbf{a}_1 - y_{13}\,\mathbf{a}_2 - z_{13}\,\mathbf{a}_3 & = & -\left(ax_{13} + cz_{13}\cos\beta\right)\,\hat{\mathbf{x}} - by_{13}\,\hat{\mathbf{y}} - cz_{13}\sin\beta\,\hat{\mathbf{z}} & \text{(4e)} & \text{O XI}
\end{array}
$$

$\mathbf{B_{52}}$	$=$	$x_{13}\,\mathbf{a}_1 - \left(y_{13} - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{13} + \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$\left(ax_{13} + c\left(z_{13} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{13} - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{13} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O XI
$\mathbf{B_{53}}$	$=$	$x_{14}\,\mathbf{a}_1 + y_{14}\,\mathbf{a}_2 + z_{14}\,\mathbf{a}_3$	$=$	$(ax_{14} + cz_{14}\cos\beta)\,\hat{\mathbf{x}} + by_{14}\,\hat{\mathbf{y}} + cz_{14}\sin\beta\,\hat{\mathbf{z}}$	(4e)	O XII
$\mathbf{B_{54}}$	$=$	$-x_{14}\,\mathbf{a}_1 + \left(y_{14} + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{14} - \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$-\left(ax_{14} + c\left(z_{14} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{14} + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{14} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O XII
$\mathbf{B_{55}}$	$=$	$-x_{14}\,\mathbf{a}_1 - y_{14}\,\mathbf{a}_2 - z_{14}\,\mathbf{a}_3$	$=$	$-\left(ax_{14} + cz_{14}\cos\beta\right)\,\hat{\mathbf{x}} - by_{14}\,\hat{\mathbf{y}} - cz_{14}\sin\beta\,\hat{\mathbf{z}}$	(4e)	O XII
$\mathbf{B_{56}}$	$=$	$x_{14}\,\mathbf{a}_1 - \left(y_{14} - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{14} + \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$\left(ax_{14} + c\left(z_{14} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{14} - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{14} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	O XII
$\mathbf{B_{57}}$	$=$	$x_{15}\,\mathbf{a}_1 + y_{15}\,\mathbf{a}_2 + z_{15}\,\mathbf{a}_3$	$=$	$(ax_{15} + cz_{15}\cos\beta)\,\hat{\mathbf{x}} + by_{15}\,\hat{\mathbf{y}} + cz_{15}\sin\beta\,\hat{\mathbf{z}}$	(4e)	S I
$\mathbf{B_{58}}$	$=$	$-x_{15}\,\mathbf{a}_1 + \left(y_{15} + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{15} - \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$-\left(ax_{15} + c\left(z_{15} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{15} + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{15} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	S I
$\mathbf{B_{59}}$	$=$	$-x_{15}\,\mathbf{a}_1 - y_{15}\,\mathbf{a}_2 - z_{15}\,\mathbf{a}_3$	$=$	$-\left(ax_{15} + cz_{15}\cos\beta\right)\,\hat{\mathbf{x}} - by_{15}\,\hat{\mathbf{y}} - cz_{15}\sin\beta\,\hat{\mathbf{z}}$	(4e)	S I
$\mathbf{B_{60}}$	$=$	$x_{15}\,\mathbf{a}_1 - \left(y_{15} - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{15} + \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$\left(ax_{15} + c\left(z_{15} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{15} - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{15} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	S I
$\mathbf{B_{61}}$	$=$	$x_{16}\,\mathbf{a}_1 + y_{16}\,\mathbf{a}_2 + z_{16}\,\mathbf{a}_3$	$=$	$(ax_{16} + cz_{16}\cos\beta)\,\hat{\mathbf{x}} + by_{16}\,\hat{\mathbf{y}} + cz_{16}\sin\beta\,\hat{\mathbf{z}}$	(4e)	S II
$\mathbf{B_{62}}$	$=$	$-x_{16}\,\mathbf{a}_1 + \left(y_{16} + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{16} - \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$-\left(ax_{16} + c\left(z_{16} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{16} + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{16} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	S II
$\mathbf{B_{63}}$	$=$	$-x_{16}\,\mathbf{a}_1 - y_{16}\,\mathbf{a}_2 - z_{16}\,\mathbf{a}_3$	$=$	$-\left(ax_{16} + cz_{16}\cos\beta\right)\,\hat{\mathbf{x}} - by_{16}\,\hat{\mathbf{y}} - cz_{16}\sin\beta\,\hat{\mathbf{z}}$	(4e)	S II
$\mathbf{B_{64}}$	$=$	$x_{16}\,\mathbf{a}_1 - \left(y_{16} - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{16} + \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$\left(ax_{16} + c\left(z_{16} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{16} - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{16} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	S II
$\mathbf{B_{65}}$	$=$	$x_{17}\,\mathbf{a}_1 + y_{17}\,\mathbf{a}_2 + z_{17}\,\mathbf{a}_3$	$=$	$(ax_{17} + cz_{17}\cos\beta)\,\hat{\mathbf{x}} + by_{17}\,\hat{\mathbf{y}} + cz_{17}\sin\beta\,\hat{\mathbf{z}}$	(4e)	S III
$\mathbf{B_{66}}$	$=$	$-x_{17}\,\mathbf{a}_1 + \left(y_{17} + \frac{1}{2}\right)\,\mathbf{a}_2 - \left(z_{17} - \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$-\left(ax_{17} + c\left(z_{17} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + b\left(y_{17} + \frac{1}{2}\right)\,\hat{\mathbf{y}} - c\left(z_{17} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	S III
$\mathbf{B_{67}}$	$=$	$-x_{17}\,\mathbf{a}_1 - y_{17}\,\mathbf{a}_2 - z_{17}\,\mathbf{a}_3$	$=$	$-\left(ax_{17} + cz_{17}\cos\beta\right)\,\hat{\mathbf{x}} - by_{17}\,\hat{\mathbf{y}} - cz_{17}\sin\beta\,\hat{\mathbf{z}}$	(4e)	S III
$\mathbf{B_{68}}$	$=$	$x_{17}\,\mathbf{a}_1 - \left(y_{17} - \frac{1}{2}\right)\,\mathbf{a}_2 + \left(z_{17} + \frac{1}{2}\right)\,\mathbf{a}_3$	$=$	$\left(ax_{17} + c\left(z_{17} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - b\left(y_{17} - \frac{1}{2}\right)\,\hat{\mathbf{y}} + c\left(z_{17} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4e)	S III

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