

AlPO₄-8 Structure:

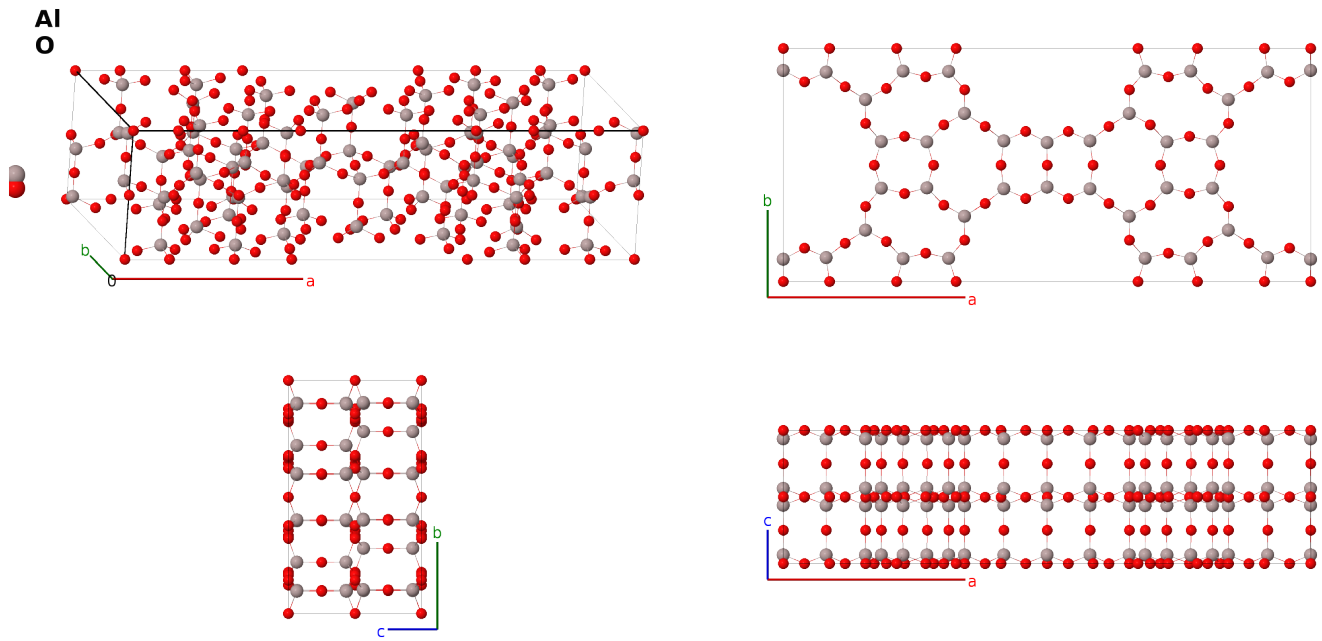
AB2_oC216_63_f4h_ac3e4g5h-001

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- D. Hicks, M. J. Mehl, M. Esters, C. Oses, O. Levy, G. L. W. Hart, C. Toher, and S. Curtarolo, *The AFLOW Library of Crystallographic Prototypes: Part 3*, Comput. Mater. Sci. **199**, 110450 (2021), doi: 10.1016/j.commatsci.2021.110450.

<https://aflow.org/prototype-encyclopedia/YH65>

https://aflow.org/prototype-encyclopedia/AB2_oC216_63_f4h_ac3e4g5h-001



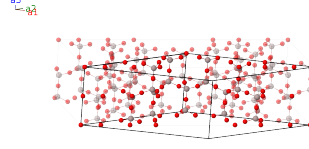
Prototype	AlO ₄ P
AFLOW prototype label	AB2_oC216_63_f4h_ac3e4g5h-001
ICSD	153161
CCDC	1669874
Pearson symbol	oC216
Space group number	63
Space group symbol	<i>Cmcm</i>
AFLOW prototype command	<pre>aflow --proto=AB2_oC216_63_f4h_ac3e4g5h-001 --params=a,b/a,c/a,y2,x3,x4,x5,y6,z6,x7,y7,x8,y8,x9,y9,x10,y10,x11,y11,z11,x12, y12,z12,x13,y13,z13,x14,y14,z14,x15,y15,z15,x16,y16,z16,x17,y17,z17,x18,y18,z18,x19,y19, z19</pre>

- This is one of a variety of SiO₂-like aluminum phosphates. We give more detail about all of these structures in the Silica and Aluminum Phosphate tutorial page.

- The metallic sites in this lattice are randomly occupied by aluminum and phosphorous atoms. We have arbitrarily labeled these as aluminum.
- Both (Withers, 2005) and the earlier work of (Richardson, 1992) sometimes refer to this structure as being in space group $Cmc2_1$, but they present data for an “averaged” structure in space group $Cmcm$. We use that data here.

Base-centered Orthorhombic primitive vectors

$$\begin{aligned} \mathbf{a}_1 &= \frac{1}{2}a \hat{\mathbf{x}} - \frac{1}{2}b \hat{\mathbf{y}} \\ \mathbf{a}_2 &= \frac{1}{2}a \hat{\mathbf{x}} + \frac{1}{2}b \hat{\mathbf{y}} \\ \mathbf{a}_3 &= c \hat{\mathbf{z}} \end{aligned}$$



Basis vectors

	Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B}_1$	$=$	0	$=$	0	O I
$\mathbf{B}_2$	$=$	$\frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{2}c \hat{\mathbf{z}}$	O I
$\mathbf{B}_3$	$=$	$-y_2 \mathbf{a}_1 + y_2 \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3$	$=$	$by_2 \hat{\mathbf{y}} + \frac{1}{4}c \hat{\mathbf{z}}$	O II
$\mathbf{B}_4$	$=$	$y_2 \mathbf{a}_1 - y_2 \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3$	$=$	$-by_2 \hat{\mathbf{y}} + \frac{3}{4}c \hat{\mathbf{z}}$	O II
$\mathbf{B}_5$	$=$	$x_3 \mathbf{a}_1 + x_3 \mathbf{a}_2$	$=$	$ax_3 \hat{\mathbf{x}}$	O III
$\mathbf{B}_6$	$=$	$-x_3 \mathbf{a}_1 - x_3 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$-ax_3 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	O III
$\mathbf{B}_7$	$=$	$-x_3 \mathbf{a}_1 - x_3 \mathbf{a}_2$	$=$	$-ax_3 \hat{\mathbf{x}}$	O III
$\mathbf{B}_8$	$=$	$x_3 \mathbf{a}_1 + x_3 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$ax_3 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	O III
$\mathbf{B}_9$	$=$	$x_4 \mathbf{a}_1 + x_4 \mathbf{a}_2$	$=$	$ax_4 \hat{\mathbf{x}}$	O IV
$\mathbf{B}_{10}$	$=$	$-x_4 \mathbf{a}_1 - x_4 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$-ax_4 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	O IV
$\mathbf{B}_{11}$	$=$	$-x_4 \mathbf{a}_1 - x_4 \mathbf{a}_2$	$=$	$-ax_4 \hat{\mathbf{x}}$	O IV
$\mathbf{B}_{12}$	$=$	$x_4 \mathbf{a}_1 + x_4 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$ax_4 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	O IV
$\mathbf{B}_{13}$	$=$	$x_5 \mathbf{a}_1 + x_5 \mathbf{a}_2$	$=$	$ax_5 \hat{\mathbf{x}}$	O V
$\mathbf{B}_{14}$	$=$	$-x_5 \mathbf{a}_1 - x_5 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$-ax_5 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	O V
$\mathbf{B}_{15}$	$=$	$-x_5 \mathbf{a}_1 - x_5 \mathbf{a}_2$	$=$	$-ax_5 \hat{\mathbf{x}}$	O V
$\mathbf{B}_{16}$	$=$	$x_5 \mathbf{a}_1 + x_5 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$ax_5 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	O V
$\mathbf{B}_{17}$	$=$	$-y_6 \mathbf{a}_1 + y_6 \mathbf{a}_2 + z_6 \mathbf{a}_3$	$=$	$by_6 \hat{\mathbf{y}} + cz_6 \hat{\mathbf{z}}$	Al I
$\mathbf{B}_{18}$	$=$	$y_6 \mathbf{a}_1 - y_6 \mathbf{a}_2 + (z_6 + \frac{1}{2}) \mathbf{a}_3$	$=$	$-by_6 \hat{\mathbf{y}} + c(z_6 + \frac{1}{2}) \hat{\mathbf{z}}$	Al I
$\mathbf{B}_{19}$	$=$	$-y_6 \mathbf{a}_1 + y_6 \mathbf{a}_2 - (z_6 - \frac{1}{2}) \mathbf{a}_3$	$=$	$by_6 \hat{\mathbf{y}} - c(z_6 - \frac{1}{2}) \hat{\mathbf{z}}$	Al I
$\mathbf{B}_{20}$	$=$	$y_6 \mathbf{a}_1 - y_6 \mathbf{a}_2 - z_6 \mathbf{a}_3$	$=$	$-by_6 \hat{\mathbf{y}} - cz_6 \hat{\mathbf{z}}$	Al I
$\mathbf{B}_{21}$	$=$	$(x_7 - y_7) \mathbf{a}_1 + (x_7 + y_7) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3$	$=$	$ax_7 \hat{\mathbf{x}} + by_7 \hat{\mathbf{y}} + \frac{1}{4}c \hat{\mathbf{z}}$	O VI
$\mathbf{B}_{22}$	$=$	$-(x_7 - y_7) \mathbf{a}_1 - (x_7 + y_7) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3$	$=$	$-ax_7 \hat{\mathbf{x}} - by_7 \hat{\mathbf{y}} + \frac{3}{4}c \hat{\mathbf{z}}$	O VI
$\mathbf{B}_{23}$	$=$	$-(x_7 + y_7) \mathbf{a}_1 - (x_7 - y_7) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3$	$=$	$-ax_7 \hat{\mathbf{x}} + by_7 \hat{\mathbf{y}} + \frac{1}{4}c \hat{\mathbf{z}}$	O VI
$\mathbf{B}_{24}$	$=$	$(x_7 + y_7) \mathbf{a}_1 + (x_7 - y_7) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3$	$=$	$ax_7 \hat{\mathbf{x}} - by_7 \hat{\mathbf{y}} + \frac{3}{4}c \hat{\mathbf{z}}$	O VI
$\mathbf{B}_{25}$	$=$	$(x_8 - y_8) \mathbf{a}_1 + (x_8 + y_8) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3$	$=$	$ax_8 \hat{\mathbf{x}} + by_8 \hat{\mathbf{y}} + \frac{1}{4}c \hat{\mathbf{z}}$	O VII

$$\begin{aligned}
\mathbf{B}_{26} &= -(x_8 - y_8) \mathbf{a}_1 - (x_8 + y_8) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3 = -ax_8 \hat{\mathbf{x}} - by_8 \hat{\mathbf{y}} + \frac{3}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O VII} \\
\mathbf{B}_{27} &= -(x_8 + y_8) \mathbf{a}_1 - (x_8 - y_8) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3 = -ax_8 \hat{\mathbf{x}} + by_8 \hat{\mathbf{y}} + \frac{1}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O VII} \\
\mathbf{B}_{28} &= (x_8 + y_8) \mathbf{a}_1 + (x_8 - y_8) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3 = ax_8 \hat{\mathbf{x}} - by_8 \hat{\mathbf{y}} + \frac{3}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O VII} \\
\mathbf{B}_{29} &= (x_9 - y_9) \mathbf{a}_1 + (x_9 + y_9) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3 = ax_9 \hat{\mathbf{x}} + by_9 \hat{\mathbf{y}} + \frac{1}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O VIII} \\
\mathbf{B}_{30} &= -(x_9 - y_9) \mathbf{a}_1 - (x_9 + y_9) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3 = -ax_9 \hat{\mathbf{x}} - by_9 \hat{\mathbf{y}} + \frac{3}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O VIII} \\
\mathbf{B}_{31} &= -(x_9 + y_9) \mathbf{a}_1 - (x_9 - y_9) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3 = -ax_9 \hat{\mathbf{x}} + by_9 \hat{\mathbf{y}} + \frac{1}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O VIII} \\
\mathbf{B}_{32} &= (x_9 + y_9) \mathbf{a}_1 + (x_9 - y_9) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3 = ax_9 \hat{\mathbf{x}} - by_9 \hat{\mathbf{y}} + \frac{3}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O VIII} \\
\mathbf{B}_{33} &= (x_{10} - y_{10}) \mathbf{a}_1 + (x_{10} + y_{10}) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3 = ax_{10} \hat{\mathbf{x}} + by_{10} \hat{\mathbf{y}} + \frac{1}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O IX} \\
\mathbf{B}_{34} &= -(x_{10} - y_{10}) \mathbf{a}_1 - (x_{10} + y_{10}) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3 = -ax_{10} \hat{\mathbf{x}} - by_{10} \hat{\mathbf{y}} + \frac{3}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O IX} \\
\mathbf{B}_{35} &= -(x_{10} + y_{10}) \mathbf{a}_1 - (x_{10} - y_{10}) \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3 = -ax_{10} \hat{\mathbf{x}} + by_{10} \hat{\mathbf{y}} + \frac{1}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O IX} \\
\mathbf{B}_{36} &= (x_{10} + y_{10}) \mathbf{a}_1 + (x_{10} - y_{10}) \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3 = ax_{10} \hat{\mathbf{x}} - by_{10} \hat{\mathbf{y}} + \frac{3}{4} c \hat{\mathbf{z}} & (8g) & \quad \text{O IX} \\
\mathbf{B}_{37} &= (x_{11} - y_{11}) \mathbf{a}_1 + (x_{11} + y_{11}) \mathbf{a}_2 + z_{11} \mathbf{a}_3 = ax_{11} \hat{\mathbf{x}} + by_{11} \hat{\mathbf{y}} + cz_{11} \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{38} &= -(x_{11} - y_{11}) \mathbf{a}_1 - (x_{11} + y_{11}) \mathbf{a}_2 + (z_{11} + \frac{1}{2}) \mathbf{a}_3 = -ax_{11} \hat{\mathbf{x}} - by_{11} \hat{\mathbf{y}} + c(z_{11} + \frac{1}{2}) \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{39} &= -(x_{11} + y_{11}) \mathbf{a}_1 - (x_{11} - y_{11}) \mathbf{a}_2 - (z_{11} - \frac{1}{2}) \mathbf{a}_3 = -ax_{11} \hat{\mathbf{x}} + by_{11} \hat{\mathbf{y}} - c(z_{11} - \frac{1}{2}) \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{40} &= (x_{11} + y_{11}) \mathbf{a}_1 + (x_{11} - y_{11}) \mathbf{a}_2 - z_{11} \mathbf{a}_3 = ax_{11} \hat{\mathbf{x}} - by_{11} \hat{\mathbf{y}} - cz_{11} \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{41} &= -(x_{11} - y_{11}) \mathbf{a}_1 - (x_{11} + y_{11}) \mathbf{a}_2 - z_{11} \mathbf{a}_3 = -ax_{11} \hat{\mathbf{x}} - by_{11} \hat{\mathbf{y}} - cz_{11} \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{42} &= (x_{11} - y_{11}) \mathbf{a}_1 + (x_{11} + y_{11}) \mathbf{a}_2 - (z_{11} - \frac{1}{2}) \mathbf{a}_3 = ax_{11} \hat{\mathbf{x}} + by_{11} \hat{\mathbf{y}} - c(z_{11} - \frac{1}{2}) \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{43} &= (x_{11} + y_{11}) \mathbf{a}_1 + (x_{11} - y_{11}) \mathbf{a}_2 + (z_{11} + \frac{1}{2}) \mathbf{a}_3 = ax_{11} \hat{\mathbf{x}} - by_{11} \hat{\mathbf{y}} + c(z_{11} + \frac{1}{2}) \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{44} &= -(x_{11} + y_{11}) \mathbf{a}_1 - (x_{11} - y_{11}) \mathbf{a}_2 + z_{11} \mathbf{a}_3 = -ax_{11} \hat{\mathbf{x}} + by_{11} \hat{\mathbf{y}} + cz_{11} \hat{\mathbf{z}} & (16h) & \quad \text{Al II} \\
\mathbf{B}_{45} &= (x_{12} - y_{12}) \mathbf{a}_1 + (x_{12} + y_{12}) \mathbf{a}_2 + z_{12} \mathbf{a}_3 = ax_{12} \hat{\mathbf{x}} + by_{12} \hat{\mathbf{y}} + cz_{12} \hat{\mathbf{z}} & (16h) & \quad \text{Al III} \\
\mathbf{B}_{46} &= -(x_{12} - y_{12}) \mathbf{a}_1 - (x_{12} + y_{12}) \mathbf{a}_2 + (z_{12} + \frac{1}{2}) \mathbf{a}_3 = -ax_{12} \hat{\mathbf{x}} - by_{12} \hat{\mathbf{y}} + c(z_{12} + \frac{1}{2}) \hat{\mathbf{z}} & (16h) & \quad \text{Al III} \\
\mathbf{B}_{47} &= -(x_{12} + y_{12}) \mathbf{a}_1 - (x_{12} - y_{12}) \mathbf{a}_2 - (z_{12} - \frac{1}{2}) \mathbf{a}_3 = -ax_{12} \hat{\mathbf{x}} + by_{12} \hat{\mathbf{y}} - c(z_{12} - \frac{1}{2}) \hat{\mathbf{z}} & (16h) & \quad \text{Al III} \\
\mathbf{B}_{48} &= (x_{12} + y_{12}) \mathbf{a}_1 + (x_{12} - y_{12}) \mathbf{a}_2 - z_{12} \mathbf{a}_3 = ax_{12} \hat{\mathbf{x}} - by_{12} \hat{\mathbf{y}} - cz_{12} \hat{\mathbf{z}} & (16h) & \quad \text{Al III} \\
\mathbf{B}_{49} &= -(x_{12} - y_{12}) \mathbf{a}_1 - (x_{12} + y_{12}) \mathbf{a}_2 - z_{12} \mathbf{a}_3 = -ax_{12} \hat{\mathbf{x}} - by_{12} \hat{\mathbf{y}} - cz_{12} \hat{\mathbf{z}} & (16h) & \quad \text{Al III} \\
\mathbf{B}_{50} &= (x_{12} - y_{12}) \mathbf{a}_1 + (x_{12} + y_{12}) \mathbf{a}_2 - (z_{12} - \frac{1}{2}) \mathbf{a}_3 = ax_{12} \hat{\mathbf{x}} + by_{12} \hat{\mathbf{y}} - c(z_{12} - \frac{1}{2}) \hat{\mathbf{z}} & (16h) & \quad \text{Al III}
\end{aligned}$$

$\mathbf{B}_{51} =$	$(x_{12} + y_{12}) \mathbf{a}_1 +$ $(x_{12} - y_{12}) \mathbf{a}_2 + (z_{12} + \frac{1}{2}) \mathbf{a}_3$	$=$	$ax_{12} \hat{\mathbf{x}} - by_{12} \hat{\mathbf{y}} + c(z_{12} + \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al III
$\mathbf{B}_{52} =$	$-(x_{12} + y_{12}) \mathbf{a}_1 -$ $(x_{12} - y_{12}) \mathbf{a}_2 + z_{12} \mathbf{a}_3$	$=$	$-ax_{12} \hat{\mathbf{x}} + by_{12} \hat{\mathbf{y}} + cz_{12} \hat{\mathbf{z}}$	(16h)	Al III
$\mathbf{B}_{53} =$	$(x_{13} - y_{13}) \mathbf{a}_1 +$ $(x_{13} + y_{13}) \mathbf{a}_2 + z_{13} \mathbf{a}_3$	$=$	$ax_{13} \hat{\mathbf{x}} + by_{13} \hat{\mathbf{y}} + cz_{13} \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{54} =$	$-(x_{13} - y_{13}) \mathbf{a}_1 -$ $(x_{13} + y_{13}) \mathbf{a}_2 + (z_{13} + \frac{1}{2}) \mathbf{a}_3$	$=$	$-ax_{13} \hat{\mathbf{x}} - by_{13} \hat{\mathbf{y}} + c(z_{13} + \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{55} =$	$-(x_{13} + y_{13}) \mathbf{a}_1 -$ $(x_{13} - y_{13}) \mathbf{a}_2 - (z_{13} - \frac{1}{2}) \mathbf{a}_3$	$=$	$-ax_{13} \hat{\mathbf{x}} + by_{13} \hat{\mathbf{y}} - c(z_{13} - \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{56} =$	$(x_{13} + y_{13}) \mathbf{a}_1 +$ $(x_{13} - y_{13}) \mathbf{a}_2 - z_{13} \mathbf{a}_3$	$=$	$ax_{13} \hat{\mathbf{x}} - by_{13} \hat{\mathbf{y}} - cz_{13} \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{57} =$	$-(x_{13} - y_{13}) \mathbf{a}_1 -$ $(x_{13} + y_{13}) \mathbf{a}_2 - z_{13} \mathbf{a}_3$	$=$	$-ax_{13} \hat{\mathbf{x}} - by_{13} \hat{\mathbf{y}} - cz_{13} \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{58} =$	$(x_{13} - y_{13}) \mathbf{a}_1 +$ $(x_{13} + y_{13}) \mathbf{a}_2 - (z_{13} - \frac{1}{2}) \mathbf{a}_3$	$=$	$ax_{13} \hat{\mathbf{x}} + by_{13} \hat{\mathbf{y}} - c(z_{13} - \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{59} =$	$(x_{13} + y_{13}) \mathbf{a}_1 +$ $(x_{13} - y_{13}) \mathbf{a}_2 + (z_{13} + \frac{1}{2}) \mathbf{a}_3$	$=$	$ax_{13} \hat{\mathbf{x}} - by_{13} \hat{\mathbf{y}} + c(z_{13} + \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{60} =$	$-(x_{13} + y_{13}) \mathbf{a}_1 -$ $(x_{13} - y_{13}) \mathbf{a}_2 + z_{13} \mathbf{a}_3$	$=$	$-ax_{13} \hat{\mathbf{x}} + by_{13} \hat{\mathbf{y}} + cz_{13} \hat{\mathbf{z}}$	(16h)	Al IV
$\mathbf{B}_{61} =$	$(x_{14} - y_{14}) \mathbf{a}_1 +$ $(x_{14} + y_{14}) \mathbf{a}_2 + z_{14} \mathbf{a}_3$	$=$	$ax_{14} \hat{\mathbf{x}} + by_{14} \hat{\mathbf{y}} + cz_{14} \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{62} =$	$-(x_{14} - y_{14}) \mathbf{a}_1 -$ $(x_{14} + y_{14}) \mathbf{a}_2 + (z_{14} + \frac{1}{2}) \mathbf{a}_3$	$=$	$-ax_{14} \hat{\mathbf{x}} - by_{14} \hat{\mathbf{y}} + c(z_{14} + \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{63} =$	$-(x_{14} + y_{14}) \mathbf{a}_1 -$ $(x_{14} - y_{14}) \mathbf{a}_2 - (z_{14} - \frac{1}{2}) \mathbf{a}_3$	$=$	$-ax_{14} \hat{\mathbf{x}} + by_{14} \hat{\mathbf{y}} - c(z_{14} - \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{64} =$	$(x_{14} + y_{14}) \mathbf{a}_1 +$ $(x_{14} - y_{14}) \mathbf{a}_2 - z_{14} \mathbf{a}_3$	$=$	$ax_{14} \hat{\mathbf{x}} - by_{14} \hat{\mathbf{y}} - cz_{14} \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{65} =$	$-(x_{14} - y_{14}) \mathbf{a}_1 -$ $(x_{14} + y_{14}) \mathbf{a}_2 - z_{14} \mathbf{a}_3$	$=$	$-ax_{14} \hat{\mathbf{x}} - by_{14} \hat{\mathbf{y}} - cz_{14} \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{66} =$	$(x_{14} - y_{14}) \mathbf{a}_1 +$ $(x_{14} + y_{14}) \mathbf{a}_2 - (z_{14} - \frac{1}{2}) \mathbf{a}_3$	$=$	$ax_{14} \hat{\mathbf{x}} + by_{14} \hat{\mathbf{y}} - c(z_{14} - \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{67} =$	$(x_{14} + y_{14}) \mathbf{a}_1 +$ $(x_{14} - y_{14}) \mathbf{a}_2 + (z_{14} + \frac{1}{2}) \mathbf{a}_3$	$=$	$ax_{14} \hat{\mathbf{x}} - by_{14} \hat{\mathbf{y}} + c(z_{14} + \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{68} =$	$-(x_{14} + y_{14}) \mathbf{a}_1 -$ $(x_{14} - y_{14}) \mathbf{a}_2 + z_{14} \mathbf{a}_3$	$=$	$-ax_{14} \hat{\mathbf{x}} + by_{14} \hat{\mathbf{y}} + cz_{14} \hat{\mathbf{z}}$	(16h)	Al V
$\mathbf{B}_{69} =$	$(x_{15} - y_{15}) \mathbf{a}_1 +$ $(x_{15} + y_{15}) \mathbf{a}_2 + z_{15} \mathbf{a}_3$	$=$	$ax_{15} \hat{\mathbf{x}} + by_{15} \hat{\mathbf{y}} + cz_{15} \hat{\mathbf{z}}$	(16h)	O X
$\mathbf{B}_{70} =$	$-(x_{15} - y_{15}) \mathbf{a}_1 -$ $(x_{15} + y_{15}) \mathbf{a}_2 + (z_{15} + \frac{1}{2}) \mathbf{a}_3$	$=$	$-ax_{15} \hat{\mathbf{x}} - by_{15} \hat{\mathbf{y}} + c(z_{15} + \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	O X
$\mathbf{B}_{71} =$	$-(x_{15} + y_{15}) \mathbf{a}_1 -$ $(x_{15} - y_{15}) \mathbf{a}_2 - (z_{15} - \frac{1}{2}) \mathbf{a}_3$	$=$	$-ax_{15} \hat{\mathbf{x}} + by_{15} \hat{\mathbf{y}} - c(z_{15} - \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	O X
$\mathbf{B}_{72} =$	$(x_{15} + y_{15}) \mathbf{a}_1 +$ $(x_{15} - y_{15}) \mathbf{a}_2 - z_{15} \mathbf{a}_3$	$=$	$ax_{15} \hat{\mathbf{x}} - by_{15} \hat{\mathbf{y}} - cz_{15} \hat{\mathbf{z}}$	(16h)	O X
$\mathbf{B}_{73} =$	$-(x_{15} - y_{15}) \mathbf{a}_1 -$ $(x_{15} + y_{15}) \mathbf{a}_2 - z_{15} \mathbf{a}_3$	$=$	$-ax_{15} \hat{\mathbf{x}} - by_{15} \hat{\mathbf{y}} - cz_{15} \hat{\mathbf{z}}$	(16h)	O X
$\mathbf{B}_{74} =$	$(x_{15} - y_{15}) \mathbf{a}_1 +$ $(x_{15} + y_{15}) \mathbf{a}_2 - (z_{15} - \frac{1}{2}) \mathbf{a}_3$	$=$	$ax_{15} \hat{\mathbf{x}} + by_{15} \hat{\mathbf{y}} - c(z_{15} - \frac{1}{2}) \hat{\mathbf{z}}$	(16h)	O X

$$\begin{aligned}
\mathbf{B}_{99} &= \begin{pmatrix} (x_{18} + y_{18}) \mathbf{a}_1 + \\ (x_{18} - y_{18}) \mathbf{a}_2 + (z_{18} + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = ax_{18} \hat{\mathbf{x}} - by_{18} \hat{\mathbf{y}} + c \left(z_{18} + \frac{1}{2} \right) \hat{\mathbf{z}} & (16h) & \text{O XIII} \\
\mathbf{B}_{100} &= \begin{pmatrix} -(x_{18} + y_{18}) \mathbf{a}_1 - \\ (x_{18} - y_{18}) \mathbf{a}_2 + z_{18} \mathbf{a}_3 \end{pmatrix} = -ax_{18} \hat{\mathbf{x}} + by_{18} \hat{\mathbf{y}} + cz_{18} \hat{\mathbf{z}} & (16h) & \text{O XIII} \\
\mathbf{B}_{101} &= \begin{pmatrix} (x_{19} - y_{19}) \mathbf{a}_1 + \\ (x_{19} + y_{19}) \mathbf{a}_2 + z_{19} \mathbf{a}_3 \end{pmatrix} = ax_{19} \hat{\mathbf{x}} + by_{19} \hat{\mathbf{y}} + cz_{19} \hat{\mathbf{z}} & (16h) & \text{O XIV} \\
\mathbf{B}_{102} &= \begin{pmatrix} -(x_{19} - y_{19}) \mathbf{a}_1 - \\ (x_{19} + y_{19}) \mathbf{a}_2 + (z_{19} + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -ax_{19} \hat{\mathbf{x}} - by_{19} \hat{\mathbf{y}} + c \left(z_{19} + \frac{1}{2} \right) \hat{\mathbf{z}} & (16h) & \text{O XIV} \\
\mathbf{B}_{103} &= \begin{pmatrix} -(x_{19} + y_{19}) \mathbf{a}_1 - \\ (x_{19} - y_{19}) \mathbf{a}_2 - (z_{19} - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -ax_{19} \hat{\mathbf{x}} + by_{19} \hat{\mathbf{y}} - c \left(z_{19} - \frac{1}{2} \right) \hat{\mathbf{z}} & (16h) & \text{O XIV} \\
\mathbf{B}_{104} &= \begin{pmatrix} (x_{19} + y_{19}) \mathbf{a}_1 + \\ (x_{19} - y_{19}) \mathbf{a}_2 - z_{19} \mathbf{a}_3 \end{pmatrix} = ax_{19} \hat{\mathbf{x}} - by_{19} \hat{\mathbf{y}} - cz_{19} \hat{\mathbf{z}} & (16h) & \text{O XIV} \\
\mathbf{B}_{105} &= \begin{pmatrix} -(x_{19} - y_{19}) \mathbf{a}_1 - \\ (x_{19} + y_{19}) \mathbf{a}_2 - z_{19} \mathbf{a}_3 \end{pmatrix} = -ax_{19} \hat{\mathbf{x}} - by_{19} \hat{\mathbf{y}} - cz_{19} \hat{\mathbf{z}} & (16h) & \text{O XIV} \\
\mathbf{B}_{106} &= \begin{pmatrix} (x_{19} - y_{19}) \mathbf{a}_1 + \\ (x_{19} + y_{19}) \mathbf{a}_2 - (z_{19} - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = ax_{19} \hat{\mathbf{x}} + by_{19} \hat{\mathbf{y}} - c \left(z_{19} - \frac{1}{2} \right) \hat{\mathbf{z}} & (16h) & \text{O XIV} \\
\mathbf{B}_{107} &= \begin{pmatrix} (x_{19} + y_{19}) \mathbf{a}_1 + \\ (x_{19} - y_{19}) \mathbf{a}_2 + (z_{19} + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = ax_{19} \hat{\mathbf{x}} - by_{19} \hat{\mathbf{y}} + c \left(z_{19} + \frac{1}{2} \right) \hat{\mathbf{z}} & (16h) & \text{O XIV} \\
\mathbf{B}_{108} &= \begin{pmatrix} -(x_{19} + y_{19}) \mathbf{a}_1 - \\ (x_{19} - y_{19}) \mathbf{a}_2 + z_{19} \mathbf{a}_3 \end{pmatrix} = -ax_{19} \hat{\mathbf{x}} + by_{19} \hat{\mathbf{y}} + cz_{19} \hat{\mathbf{z}} & (16h) & \text{O XIV}
\end{aligned}$$

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