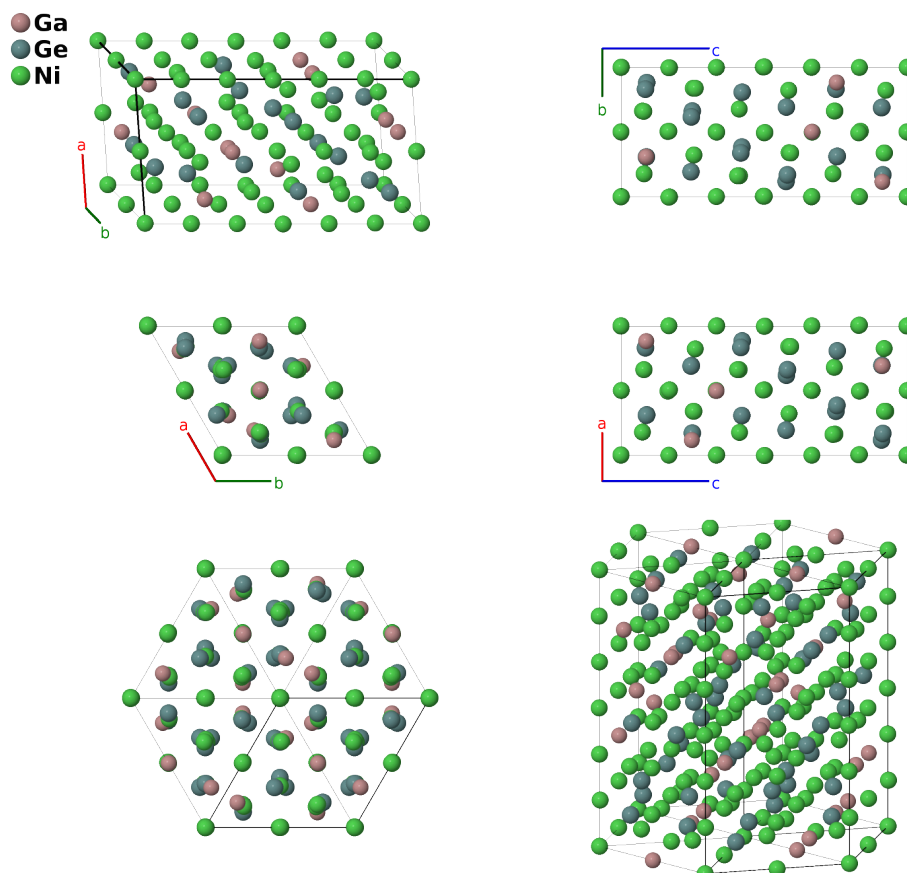


Ni₁₃Ga₃Ge₆ Structure: A3B6C13_hP66_152_ac_3c_a2b5c-001

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<https://aflow.org/p/A5TG>

https://aflow.org/p/A3B6C13_hP66_152_ac_3c_a2b5c-001

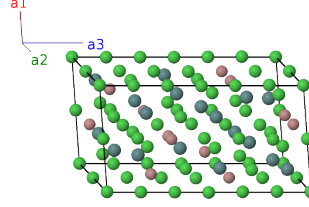


Prototype	Ga ₃ Ge ₆ Ni ₁₃
AFLOW prototype label	A3B6C13_hP66_152_ac_3c_a2b5c-001
ICSD	52177
Pearson symbol	hP66
Space group number	152
Space group symbol	<i>P</i> 3 ₁ 21
AFLOW prototype command	aflow --proto=A3B6C13_hP66_152_ac_3c_a2b5c-001 --params= <i>a</i> , <i>c/a</i> , <i>x</i> ₁ , <i>x</i> ₂ , <i>x</i> ₃ , <i>x</i> ₄ , <i>x</i> ₅ , <i>y</i> ₅ , <i>z</i> ₅ , <i>x</i> ₆ , <i>y</i> ₆ , <i>z</i> ₆ , <i>x</i> ₇ , <i>y</i> ₇ , <i>z</i> ₇ , <i>x</i> ₈ , <i>y</i> ₈ , <i>z</i> ₈ , <i>x</i> ₉ , <i>y</i> ₉ , <i>z</i> ₉ , <i>x</i> ₁₀ , <i>y</i> ₁₀ , <i>z</i> ₁₀ , <i>x</i> ₁₁ , <i>y</i> ₁₁ , <i>z</i> ₁₁ , <i>x</i> ₁₂ , <i>y</i> ₁₂ , <i>z</i> ₁₂ , <i>x</i> ₁₃ , <i>y</i> ₁₃ , <i>z</i> ₁₃

- This structure can also exist in the enantiomorphic space group *P*3₂21 #154.

Trigonal (Hexagonal) primitive vectors

$$\begin{aligned}\mathbf{a}_1 &= \frac{1}{2}a \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a \hat{\mathbf{y}} \\ \mathbf{a}_2 &= \frac{1}{2}a \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a \hat{\mathbf{y}} \\ \mathbf{a}_3 &= c \hat{\mathbf{z}}\end{aligned}$$



Basis vectors

	Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
\mathbf{B}_1	$= x_1 \mathbf{a}_1 + \frac{1}{3} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_1 \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_1 \hat{\mathbf{y}} + \frac{1}{3}c \hat{\mathbf{z}}$	(3a)	Ga I
\mathbf{B}_2	$= x_1 \mathbf{a}_2 + \frac{2}{3} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_1 \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_1 \hat{\mathbf{y}} + \frac{2}{3}c \hat{\mathbf{z}}$	(3a)	Ga I
\mathbf{B}_3	$= -x_1 \mathbf{a}_1 - x_1 \mathbf{a}_2$	$=$	$-ax_1 \hat{\mathbf{x}}$	(3a)	Ga I
\mathbf{B}_4	$= x_2 \mathbf{a}_1 + \frac{1}{3} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_2 \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_2 \hat{\mathbf{y}} + \frac{1}{3}c \hat{\mathbf{z}}$	(3a)	Ni I
\mathbf{B}_5	$= x_2 \mathbf{a}_2 + \frac{2}{3} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_2 \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_2 \hat{\mathbf{y}} + \frac{2}{3}c \hat{\mathbf{z}}$	(3a)	Ni I
\mathbf{B}_6	$= -x_2 \mathbf{a}_1 - x_2 \mathbf{a}_2$	$=$	$-ax_2 \hat{\mathbf{x}}$	(3a)	Ni I
\mathbf{B}_7	$= x_3 \mathbf{a}_1 + \frac{5}{6} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_3 \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_3 \hat{\mathbf{y}} + \frac{5}{6}c \hat{\mathbf{z}}$	(3b)	Ni II
\mathbf{B}_8	$= x_3 \mathbf{a}_2 + \frac{1}{6} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_3 \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_3 \hat{\mathbf{y}} + \frac{1}{6}c \hat{\mathbf{z}}$	(3b)	Ni II
\mathbf{B}_9	$= -x_3 \mathbf{a}_1 - x_3 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$-ax_3 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	(3b)	Ni II
\mathbf{B}_{10}	$= x_4 \mathbf{a}_1 + \frac{5}{6} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_4 \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_4 \hat{\mathbf{y}} + \frac{5}{6}c \hat{\mathbf{z}}$	(3b)	Ni III
\mathbf{B}_{11}	$= x_4 \mathbf{a}_2 + \frac{1}{6} \mathbf{a}_3$	$=$	$\frac{1}{2}ax_4 \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_4 \hat{\mathbf{y}} + \frac{1}{6}c \hat{\mathbf{z}}$	(3b)	Ni III
\mathbf{B}_{12}	$= -x_4 \mathbf{a}_1 - x_4 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$-ax_4 \hat{\mathbf{x}} + \frac{1}{2}c \hat{\mathbf{z}}$	(3b)	Ni III
\mathbf{B}_{13}	$= x_5 \mathbf{a}_1 + y_5 \mathbf{a}_2 + z_5 \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_5 + y_5) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_5 - y_5) \hat{\mathbf{y}} + cz_5 \hat{\mathbf{z}}$	(6c)	Ga II
\mathbf{B}_{14}	$= -y_5 \mathbf{a}_1 + (x_5 - y_5) \mathbf{a}_2 + (z_5 + \frac{1}{3}) \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_5 - 2y_5) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_5 \hat{\mathbf{y}} + c(z_5 + \frac{1}{3}) \hat{\mathbf{z}}$	(6c)	Ga II
\mathbf{B}_{15}	$= -(x_5 - y_5) \mathbf{a}_1 - x_5 \mathbf{a}_2 + (z_5 + \frac{2}{3}) \mathbf{a}_3$	$=$	$-\frac{1}{2}a(2x_5 - y_5) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_5 \hat{\mathbf{y}} + \frac{1}{3}c(3z_5 + 2) \hat{\mathbf{z}}$	(6c)	Ga II
\mathbf{B}_{16}	$= y_5 \mathbf{a}_1 + x_5 \mathbf{a}_2 - z_5 \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_5 + y_5) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_5 - y_5) \hat{\mathbf{y}} - cz_5 \hat{\mathbf{z}}$	(6c)	Ga II
\mathbf{B}_{17}	$= (x_5 - y_5) \mathbf{a}_1 - y_5 \mathbf{a}_2 - (z_5 - \frac{2}{3}) \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_5 - 2y_5) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_5 \hat{\mathbf{y}} - \frac{1}{3}c(3z_5 - 2) \hat{\mathbf{z}}$	(6c)	Ga II
\mathbf{B}_{18}	$= -x_5 \mathbf{a}_1 - (x_5 - y_5) \mathbf{a}_2 - (z_5 - \frac{1}{3}) \mathbf{a}_3$	$=$	$-\frac{1}{2}a(2x_5 - y_5) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_5 \hat{\mathbf{y}} - c(z_5 - \frac{1}{3}) \hat{\mathbf{z}}$	(6c)	Ga II
\mathbf{B}_{19}	$= x_6 \mathbf{a}_1 + y_6 \mathbf{a}_2 + z_6 \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_6 + y_6) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_6 - y_6) \hat{\mathbf{y}} + cz_6 \hat{\mathbf{z}}$	(6c)	Ge I
\mathbf{B}_{20}	$= -y_6 \mathbf{a}_1 + (x_6 - y_6) \mathbf{a}_2 + (z_6 + \frac{1}{3}) \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_6 - 2y_6) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_6 \hat{\mathbf{y}} + c(z_6 + \frac{1}{3}) \hat{\mathbf{z}}$	(6c)	Ge I
\mathbf{B}_{21}	$= -(x_6 - y_6) \mathbf{a}_1 - x_6 \mathbf{a}_2 + (z_6 + \frac{2}{3}) \mathbf{a}_3$	$=$	$-\frac{1}{2}a(2x_6 - y_6) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_6 \hat{\mathbf{y}} + \frac{1}{3}c(3z_6 + 2) \hat{\mathbf{z}}$	(6c)	Ge I
\mathbf{B}_{22}	$= y_6 \mathbf{a}_1 + x_6 \mathbf{a}_2 - z_6 \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_6 + y_6) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_6 - y_6) \hat{\mathbf{y}} - cz_6 \hat{\mathbf{z}}$	(6c)	Ge I
\mathbf{B}_{23}	$= (x_6 - y_6) \mathbf{a}_1 - y_6 \mathbf{a}_2 - (z_6 - \frac{2}{3}) \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_6 - 2y_6) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_6 \hat{\mathbf{y}} - \frac{1}{3}c(3z_6 - 2) \hat{\mathbf{z}}$	(6c)	Ge I
\mathbf{B}_{24}	$= -x_6 \mathbf{a}_1 - (x_6 - y_6) \mathbf{a}_2 - (z_6 - \frac{1}{3}) \mathbf{a}_3$	$=$	$-\frac{1}{2}a(2x_6 - y_6) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_6 \hat{\mathbf{y}} - c(z_6 - \frac{1}{3}) \hat{\mathbf{z}}$	(6c)	Ge I
\mathbf{B}_{25}	$= x_7 \mathbf{a}_1 + y_7 \mathbf{a}_2 + z_7 \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_7 + y_7) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_7 - y_7) \hat{\mathbf{y}} + cz_7 \hat{\mathbf{z}}$	(6c)	Ge II
\mathbf{B}_{26}	$= -y_7 \mathbf{a}_1 + (x_7 - y_7) \mathbf{a}_2 + (z_7 + \frac{1}{3}) \mathbf{a}_3$	$=$	$\frac{1}{2}a(x_7 - 2y_7) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_7 \hat{\mathbf{y}} + c(z_7 + \frac{1}{3}) \hat{\mathbf{z}}$	(6c)	Ge II

$$\begin{aligned}
\mathbf{B}_{27} &= -(x_7 - y_7) \mathbf{a}_1 - x_7 \mathbf{a}_2 + (z_7 + \frac{2}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_7 - y_7) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_7 \hat{\mathbf{y}} + \frac{1}{3}c(3z_7 + 2) \hat{\mathbf{z}} & (6c) & \text{Ge II} \\
\mathbf{B}_{28} &= y_7 \mathbf{a}_1 + x_7 \mathbf{a}_2 - z_7 \mathbf{a}_3 = \frac{1}{2}a(x_7 + y_7) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_7 - y_7) \hat{\mathbf{y}} - cz_7 \hat{\mathbf{z}} & (6c) & \text{Ge II} \\
\mathbf{B}_{29} &= (x_7 - y_7) \mathbf{a}_1 - y_7 \mathbf{a}_2 - (z_7 - \frac{2}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_7 - 2y_7) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_7 \hat{\mathbf{y}} - \frac{1}{3}c(3z_7 - 2) \hat{\mathbf{z}} & (6c) & \text{Ge II} \\
\mathbf{B}_{30} &= -x_7 \mathbf{a}_1 - (x_7 - y_7) \mathbf{a}_2 - (z_7 - \frac{1}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_7 - y_7) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_7 \hat{\mathbf{y}} - c(z_7 - \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ge II} \\
\mathbf{B}_{31} &= x_8 \mathbf{a}_1 + y_8 \mathbf{a}_2 + z_8 \mathbf{a}_3 = \frac{1}{2}a(x_8 + y_8) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_8 - y_8) \hat{\mathbf{y}} + cz_8 \hat{\mathbf{z}} & (6c) & \text{Ge III} \\
\mathbf{B}_{32} &= -y_8 \mathbf{a}_1 + (x_8 - y_8) \mathbf{a}_2 + (z_8 + \frac{1}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_8 - 2y_8) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_8 \hat{\mathbf{y}} + c(z_8 + \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ge III} \\
\mathbf{B}_{33} &= -(x_8 - y_8) \mathbf{a}_1 - x_8 \mathbf{a}_2 + (z_8 + \frac{2}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_8 - y_8) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_8 \hat{\mathbf{y}} + \frac{1}{3}c(3z_8 + 2) \hat{\mathbf{z}} & (6c) & \text{Ge III} \\
\mathbf{B}_{34} &= y_8 \mathbf{a}_1 + x_8 \mathbf{a}_2 - z_8 \mathbf{a}_3 = \frac{1}{2}a(x_8 + y_8) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_8 - y_8) \hat{\mathbf{y}} - cz_8 \hat{\mathbf{z}} & (6c) & \text{Ge III} \\
\mathbf{B}_{35} &= (x_8 - y_8) \mathbf{a}_1 - y_8 \mathbf{a}_2 - (z_8 - \frac{2}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_8 - 2y_8) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_8 \hat{\mathbf{y}} - \frac{1}{3}c(3z_8 - 2) \hat{\mathbf{z}} & (6c) & \text{Ge III} \\
\mathbf{B}_{36} &= -x_8 \mathbf{a}_1 - (x_8 - y_8) \mathbf{a}_2 - (z_8 - \frac{1}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_8 - y_8) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_8 \hat{\mathbf{y}} - c(z_8 - \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ge III} \\
\mathbf{B}_{37} &= x_9 \mathbf{a}_1 + y_9 \mathbf{a}_2 + z_9 \mathbf{a}_3 = \frac{1}{2}a(x_9 + y_9) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_9 - y_9) \hat{\mathbf{y}} + cz_9 \hat{\mathbf{z}} & (6c) & \text{Ni IV} \\
\mathbf{B}_{38} &= -y_9 \mathbf{a}_1 + (x_9 - y_9) \mathbf{a}_2 + (z_9 + \frac{1}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_9 - 2y_9) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_9 \hat{\mathbf{y}} + c(z_9 + \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ni IV} \\
\mathbf{B}_{39} &= -(x_9 - y_9) \mathbf{a}_1 - x_9 \mathbf{a}_2 + (z_9 + \frac{2}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_9 - y_9) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_9 \hat{\mathbf{y}} + \frac{1}{3}c(3z_9 + 2) \hat{\mathbf{z}} & (6c) & \text{Ni IV} \\
\mathbf{B}_{40} &= y_9 \mathbf{a}_1 + x_9 \mathbf{a}_2 - z_9 \mathbf{a}_3 = \frac{1}{2}a(x_9 + y_9) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_9 - y_9) \hat{\mathbf{y}} - cz_9 \hat{\mathbf{z}} & (6c) & \text{Ni IV} \\
\mathbf{B}_{41} &= (x_9 - y_9) \mathbf{a}_1 - y_9 \mathbf{a}_2 - (z_9 - \frac{2}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_9 - 2y_9) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_9 \hat{\mathbf{y}} - \frac{1}{3}c(3z_9 - 2) \hat{\mathbf{z}} & (6c) & \text{Ni IV} \\
\mathbf{B}_{42} &= -x_9 \mathbf{a}_1 - (x_9 - y_9) \mathbf{a}_2 - (z_9 - \frac{1}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_9 - y_9) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_9 \hat{\mathbf{y}} - c(z_9 - \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ni IV} \\
\mathbf{B}_{43} &= x_{10} \mathbf{a}_1 + y_{10} \mathbf{a}_2 + z_{10} \mathbf{a}_3 = \frac{1}{2}a(x_{10} + y_{10}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_{10} - y_{10}) \hat{\mathbf{y}} + cz_{10} \hat{\mathbf{z}} & (6c) & \text{Ni V} \\
\mathbf{B}_{44} &= -y_{10} \mathbf{a}_1 + (x_{10} - y_{10}) \mathbf{a}_2 + (z_{10} + \frac{1}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_{10} - 2y_{10}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_{10} \hat{\mathbf{y}} + c(z_{10} + \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ni V} \\
\mathbf{B}_{45} &= -(x_{10} - y_{10}) \mathbf{a}_1 - x_{10} \mathbf{a}_2 + (z_{10} + \frac{2}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_{10} - y_{10}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_{10} \hat{\mathbf{y}} + \frac{1}{3}c(3z_{10} + 2) \hat{\mathbf{z}} & (6c) & \text{Ni V} \\
\mathbf{B}_{46} &= y_{10} \mathbf{a}_1 + x_{10} \mathbf{a}_2 - z_{10} \mathbf{a}_3 = \frac{1}{2}a(x_{10} + y_{10}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_{10} - y_{10}) \hat{\mathbf{y}} - cz_{10} \hat{\mathbf{z}} & (6c) & \text{Ni V} \\
\mathbf{B}_{47} &= (x_{10} - y_{10}) \mathbf{a}_1 - y_{10} \mathbf{a}_2 - (z_{10} - \frac{2}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_{10} - 2y_{10}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_{10} \hat{\mathbf{y}} - \frac{1}{3}c(3z_{10} - 2) \hat{\mathbf{z}} & (6c) & \text{Ni V} \\
\mathbf{B}_{48} &= -x_{10} \mathbf{a}_1 - (x_{10} - y_{10}) \mathbf{a}_2 - (z_{10} - \frac{1}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_{10} - y_{10}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_{10} \hat{\mathbf{y}} - c(z_{10} - \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ni V} \\
\mathbf{B}_{49} &= x_{11} \mathbf{a}_1 + y_{11} \mathbf{a}_2 + z_{11} \mathbf{a}_3 = \frac{1}{2}a(x_{11} + y_{11}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_{11} - y_{11}) \hat{\mathbf{y}} + cz_{11} \hat{\mathbf{z}} & (6c) & \text{Ni VI} \\
\mathbf{B}_{50} &= -y_{11} \mathbf{a}_1 + (x_{11} - y_{11}) \mathbf{a}_2 + (z_{11} + \frac{1}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_{11} - 2y_{11}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_{11} \hat{\mathbf{y}} + c(z_{11} + \frac{1}{3}) \hat{\mathbf{z}} & (6c) & \text{Ni VI} \\
\mathbf{B}_{51} &= -(x_{11} - y_{11}) \mathbf{a}_1 - x_{11} \mathbf{a}_2 + (z_{11} + \frac{2}{3}) \mathbf{a}_3 = -\frac{1}{2}a(2x_{11} - y_{11}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_{11} \hat{\mathbf{y}} + \frac{1}{3}c(3z_{11} + 2) \hat{\mathbf{z}} & (6c) & \text{Ni VI} \\
\mathbf{B}_{52} &= y_{11} \mathbf{a}_1 + x_{11} \mathbf{a}_2 - z_{11} \mathbf{a}_3 = \frac{1}{2}a(x_{11} + y_{11}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_{11} - y_{11}) \hat{\mathbf{y}} - cz_{11} \hat{\mathbf{z}} & (6c) & \text{Ni VI} \\
\mathbf{B}_{53} &= (x_{11} - y_{11}) \mathbf{a}_1 - y_{11} \mathbf{a}_2 - (z_{11} - \frac{2}{3}) \mathbf{a}_3 = \frac{1}{2}a(x_{11} - 2y_{11}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_{11} \hat{\mathbf{y}} - \frac{1}{3}c(3z_{11} - 2) \hat{\mathbf{z}} & (6c) & \text{Ni VI}
\end{aligned}$$

$$\begin{aligned}
\mathbf{B}_{54} &= \begin{matrix} -x_{11} \mathbf{a}_1 - (x_{11} - y_{11}) \mathbf{a}_2 - \\ (z_{11} - \frac{1}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} -\frac{1}{2}a(2x_{11} - y_{11}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_{11} \hat{\mathbf{y}} - \\ c(z_{11} - \frac{1}{3}) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VI} \\
\mathbf{B}_{55} &= \begin{matrix} x_{12} \mathbf{a}_1 + y_{12} \mathbf{a}_2 + z_{12} \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{12} + y_{12}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_{12} - y_{12}) \hat{\mathbf{y}} + \\ cz_{12} \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VII} \\
\mathbf{B}_{56} &= \begin{matrix} -y_{12} \mathbf{a}_1 + (x_{12} - y_{12}) \mathbf{a}_2 + \\ (z_{12} + \frac{1}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{12} - 2y_{12}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_{12} \hat{\mathbf{y}} + \\ c(z_{12} + \frac{1}{3}) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VII} \\
\mathbf{B}_{57} &= \begin{matrix} -(x_{12} - y_{12}) \mathbf{a}_1 - x_{12} \mathbf{a}_2 + \\ (z_{12} + \frac{2}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} -\frac{1}{2}a(2x_{12} - y_{12}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_{12} \hat{\mathbf{y}} + \\ \frac{1}{3}c(3z_{12} + 2) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VII} \\
\mathbf{B}_{58} &= \begin{matrix} y_{12} \mathbf{a}_1 + x_{12} \mathbf{a}_2 - z_{12} \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{12} + y_{12}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_{12} - y_{12}) \hat{\mathbf{y}} - \\ cz_{12} \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VII} \\
\mathbf{B}_{59} &= \begin{matrix} (x_{12} - y_{12}) \mathbf{a}_1 - y_{12} \mathbf{a}_2 - \\ (z_{12} - \frac{2}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{12} - 2y_{12}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_{12} \hat{\mathbf{y}} - \\ \frac{1}{3}c(3z_{12} - 2) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VII} \\
\mathbf{B}_{60} &= \begin{matrix} -x_{12} \mathbf{a}_1 - (x_{12} - y_{12}) \mathbf{a}_2 - \\ (z_{12} - \frac{1}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} -\frac{1}{2}a(2x_{12} - y_{12}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_{12} \hat{\mathbf{y}} - \\ c(z_{12} - \frac{1}{3}) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VII} \\
\mathbf{B}_{61} &= \begin{matrix} x_{13} \mathbf{a}_1 + y_{13} \mathbf{a}_2 + z_{13} \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{13} + y_{13}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}a(x_{13} - y_{13}) \hat{\mathbf{y}} + \\ cz_{13} \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VIII} \\
\mathbf{B}_{62} &= \begin{matrix} -y_{13} \mathbf{a}_1 + (x_{13} - y_{13}) \mathbf{a}_2 + \\ (z_{13} + \frac{1}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{13} - 2y_{13}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ax_{13} \hat{\mathbf{y}} + \\ c(z_{13} + \frac{1}{3}) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VIII} \\
\mathbf{B}_{63} &= \begin{matrix} -(x_{13} - y_{13}) \mathbf{a}_1 - x_{13} \mathbf{a}_2 + \\ (z_{13} + \frac{2}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} -\frac{1}{2}a(2x_{13} - y_{13}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ay_{13} \hat{\mathbf{y}} + \\ \frac{1}{3}c(3z_{13} + 2) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VIII} \\
\mathbf{B}_{64} &= \begin{matrix} y_{13} \mathbf{a}_1 + x_{13} \mathbf{a}_2 - z_{13} \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{13} + y_{13}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}a(x_{13} - y_{13}) \hat{\mathbf{y}} - \\ cz_{13} \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VIII} \\
\mathbf{B}_{65} &= \begin{matrix} (x_{13} - y_{13}) \mathbf{a}_1 - y_{13} \mathbf{a}_2 - \\ (z_{13} - \frac{2}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} \frac{1}{2}a(x_{13} - 2y_{13}) \hat{\mathbf{x}} - \frac{\sqrt{3}}{2}ax_{13} \hat{\mathbf{y}} - \\ \frac{1}{3}c(3z_{13} - 2) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VIII} \\
\mathbf{B}_{66} &= \begin{matrix} -x_{13} \mathbf{a}_1 - (x_{13} - y_{13}) \mathbf{a}_2 - \\ (z_{13} - \frac{1}{3}) \mathbf{a}_3 \end{matrix} = \begin{matrix} -\frac{1}{2}a(2x_{13} - y_{13}) \hat{\mathbf{x}} + \frac{\sqrt{3}}{2}ay_{13} \hat{\mathbf{y}} - \\ c(z_{13} - \frac{1}{3}) \hat{\mathbf{z}} \end{matrix} & (6c) & \text{Ni VIII}
\end{aligned}$$

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