

PG No. 4  $C_s$   $m$  (b-axis setting) [ monoclinic ] (polar, internal polar quadrupole)

\* Harmonics for rank 0

$$\bar{Q}_0^{(2,2)}[q](A')$$

\*\* symmetry

$$1$$

\*\* expression

$$-\frac{\sqrt{5}Q_u(x^2 + y^2 - 2z^2)}{10} + \frac{\sqrt{15}Q_v(x - y)(x + y)}{10} + \frac{\sqrt{15}Q_{xy}xy}{5} + \frac{\sqrt{15}Q_{xz}xz}{5} + \frac{\sqrt{15}Q_{yz}yz}{5}$$

\* Harmonics for rank 1

$$\bar{Q}_1^{(2,0)}[q](A', 1)$$

\*\* symmetry

$$x$$

\*\* expression

$$-\frac{\sqrt{10}Q_u x}{10} + \frac{\sqrt{30}Q_v x}{10} + \frac{\sqrt{30}Q_{xy}y}{10} + \frac{\sqrt{30}Q_{xz}z}{10}$$

$$\bar{Q}_1^{(2,0)}[q](A', 2)$$

\*\* symmetry

$$z$$

\*\* expression

$$\frac{\sqrt{10}Q_u z}{5} + \frac{\sqrt{30}Q_{xz}x}{10} + \frac{\sqrt{30}Q_{yz}y}{10}$$

$$\bar{Q}_1^{(2,2)}[q](A', 1)$$

\*\* symmetry

$$x$$

\*\* expression

$$-\frac{3\sqrt{35}Q_u x(x^2 + y^2 - 4z^2)}{70} + \frac{\sqrt{105}Q_v x(3x^2 - 7y^2 - 2z^2)}{70} + \frac{\sqrt{105}Q_{xy}y(4x^2 - y^2 - z^2)}{35} + \frac{\sqrt{105}Q_{xz}z(4x^2 - y^2 - z^2)}{35} + \frac{\sqrt{105}Q_{yz}xyz}{7}$$

$$\bar{Q}_1^{(2,2)}[q](A', 2)$$

\*\* symmetry

$$z$$

\*\* expression

$$-\frac{3\sqrt{35}Q_u z(3x^2 + 3y^2 - 2z^2)}{70} + \frac{\sqrt{105}Q_v z(x - y)(x + y)}{14} + \frac{\sqrt{105}Q_{xy}xyz}{7} - \frac{\sqrt{105}Q_{xz}x(x^2 + y^2 - 4z^2)}{35} - \frac{\sqrt{105}Q_{yz}y(x^2 + y^2 - 4z^2)}{35}$$

$$\bar{Q}_1^{(2,0)}[q](A'')$$

\*\* symmetry

$$y$$

\*\* expression

$$-\frac{\sqrt{10}Q_u y}{10} - \frac{\sqrt{30}Q_v y}{10} + \frac{\sqrt{30}Q_{xy}x}{10} + \frac{\sqrt{30}Q_{yz}z}{10}$$

$$\bar{Q}_1^{(2,2)}[q](A'')$$

\*\* symmetry

$$y$$

\*\* expression

$$-\frac{3\sqrt{35}Q_u y(x^2 + y^2 - 4z^2)}{70} + \frac{\sqrt{105}Q_v y(7x^2 - 3y^2 + 2z^2)}{70} - \frac{\sqrt{105}Q_{xy}x(x^2 - 4y^2 + z^2)}{35} + \frac{\sqrt{105}Q_{xz}xyz}{7} - \frac{\sqrt{105}Q_{yz}z(x^2 - 4y^2 + z^2)}{35}$$

\* Harmonics for rank 2

$$\bar{Q}_2^{(2,-2)}[q](A', 1)$$

\*\* symmetry

$$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$$

\*\* expression

$$Q_u$$

$$\bar{Q}_2^{(2,-2)}[q](A', 2)$$

\*\* symmetry

$$\frac{\sqrt{3}(x-y)(x+y)}{2}$$

\*\* expression

$$Q_v$$

$$\bar{Q}_2^{(2,-2)}[q](A', 3)$$

\*\* symmetry

$$\sqrt{3}xz$$

\*\* expression

$$Q_{xz}$$

$$\bar{Q}_2^{(2,0)}[q](A', 1)$$

\*\* symmetry

$$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$$

\*\* expression

$$-\frac{\sqrt{14}Q_u(x^2+y^2-2z^2)}{14} - \frac{\sqrt{42}Q_v(x-y)(x+y)}{14} - \frac{\sqrt{42}Q_{xy}xy}{7} + \frac{\sqrt{42}Q_{xz}xz}{14} + \frac{\sqrt{42}Q_{yz}yz}{14}$$

$$\bar{Q}_2^{(2,0)}[q](A', 2)$$

\*\* symmetry

$$\frac{\sqrt{3}(x-y)(x+y)}{2}$$

\*\* expression

$$-\frac{\sqrt{42}Q_u(x-y)(x+y)}{14} + \frac{\sqrt{14}Q_v(x^2+y^2-2z^2)}{14} + \frac{3\sqrt{14}Q_{xz}xz}{14} - \frac{3\sqrt{14}Q_{yz}yz}{14}$$

$$\bar{Q}_2^{(2,0)}[q](A', 3)$$

\*\* symmetry

$$\sqrt{3}xz$$

\*\* expression

$$\frac{\sqrt{42}Q_{uxz}}{14} + \frac{3\sqrt{14}Q_{vzx}}{14} + \frac{3\sqrt{14}Q_{xyyz}}{14} + \frac{\sqrt{14}Q_{xz}(x^2-2y^2+z^2)}{14} + \frac{3\sqrt{14}Q_{yzxy}}{14}$$

$$\bar{Q}_2^{(2,2)}[q](A', 1)$$

\*\* symmetry

$$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$$

\*\* expression

$$\frac{\sqrt{14}Q_u(3x^4+6x^2y^2-24x^2z^2+3y^4-24y^2z^2+8z^4)}{56} - \frac{5\sqrt{42}Q_v(x-y)(x+y)(x^2+y^2-6z^2)}{168} - \frac{5\sqrt{42}Q_{xy}xy(x^2+y^2-6z^2)}{84} - \frac{5\sqrt{42}Q_{xz}xz(3x^2+3y^2-4z^2)}{84} - \frac{5\sqrt{42}Q_{yz}yz(3x^2+3y^2-4z^2)}{84}$$

$$\bar{Q}_2^{(2,2)}[q](A', 2)$$

\*\* symmetry

$$\frac{\sqrt{3}(x-y)(x+y)}{2}$$

\*\* expression

$$-\frac{5\sqrt{42}Q_u(x-y)(x+y)(x^2+y^2-6z^2)}{168} + \frac{\sqrt{14}Q_v(19x^4-102x^2y^2-12x^2z^2+19y^4-12y^2z^2+4z^4)}{168} + \frac{5\sqrt{14}Q_{xy}xy(x-y)(x+y)}{12} + \frac{5\sqrt{14}Q_{xz}xz(5x^2-9y^2-2z^2)}{84} + \frac{5\sqrt{14}Q_{yz}yz(9x^2-5y^2+2z^2)}{84}$$

$$\bar{Q}_2^{(2,2)}[q](A', 3)$$

\*\* symmetry

$$\sqrt{3}xz$$

\*\* expression

$$-\frac{5\sqrt{42}Q_{uxz}(3x^2+3y^2-4z^2)}{84} + \frac{5\sqrt{14}Q_{v,xz}(5x^2-9y^2-2z^2)}{84} + \frac{5\sqrt{14}Q_{xy,yz}(6x^2-y^2-z^2)}{42} \\ - \frac{\sqrt{14}Q_{xz}(4x^4+3x^2y^2-27x^2z^2-y^4+3y^2z^2+4z^4)}{42} - \frac{5\sqrt{14}Q_{yz,xy}(x^2+y^2-6z^2)}{42}$$

$$\bar{Q}_2^{(2,-2)}[q](A'', 1)$$

\*\* symmetry

$$\sqrt{3}yz$$

\*\* expression

$$Q_{yz}$$

$$\bar{Q}_2^{(2,-2)}[q](A'', 2)$$

\*\* symmetry

$$\sqrt{3}xy$$

\*\* expression

$$Q_{xy}$$

$$\bar{Q}_2^{(2,0)}[q](A'', 1)$$

\*\* symmetry

$$\sqrt{3}yz$$

\*\* expression

$$\frac{\sqrt{42}Q_{u,yz}}{14} - \frac{3\sqrt{14}Q_{v,yz}}{14} + \frac{3\sqrt{14}Q_{xy,xz}}{14} + \frac{3\sqrt{14}Q_{xz,xy}}{14} - \frac{\sqrt{14}Q_{yz}(2x^2-y^2-z^2)}{14}$$

$$\bar{Q}_2^{(2,0)}[q](A'', 2)$$

\*\* symmetry

$$\sqrt{3}xy$$

\*\* expression

$$-\frac{\sqrt{42}Q_{u,xy}}{7} + \frac{\sqrt{14}Q_{xy}(x^2+y^2-2z^2)}{14} + \frac{3\sqrt{14}Q_{xz,yz}}{14} + \frac{3\sqrt{14}Q_{yz,xz}}{14}$$

$$\bar{Q}_2^{(2,2)}[q](A'', 1)$$

\*\* symmetry

$$\sqrt{3}yz$$

\*\* expression

$$-\frac{5\sqrt{42}Q_{u,yz}(3x^2+3y^2-4z^2)}{84} + \frac{5\sqrt{14}Q_{v,yz}(9x^2-5y^2+2z^2)}{84} - \frac{5\sqrt{14}Q_{xy,xz}(x^2-6y^2+z^2)}{42} \\ - \frac{5\sqrt{14}Q_{xz,xy}(x^2+y^2-6z^2)}{42} + \frac{\sqrt{14}Q_{yz}(x^4-3x^2y^2-3x^2z^2-4y^4+27y^2z^2-4z^4)}{42}$$

$$\bar{Q}_2^{(2,2)}[q](A'', 2)$$

\*\* symmetry

$$\sqrt{3}xy$$

\*\* expression

$$-\frac{5\sqrt{42}Q_{u,xy}(x^2+y^2-6z^2)}{84} + \frac{5\sqrt{14}Q_{v,xy}(x-y)(x+y)}{12} - \frac{\sqrt{14}Q_{xy}(4x^4-27x^2y^2+3x^2z^2+4y^4+3y^2z^2-z^4)}{42} \\ + \frac{5\sqrt{14}Q_{xz,yz}(6x^2-y^2-z^2)}{42} - \frac{5\sqrt{14}Q_{yz,xz}(x^2-6y^2+z^2)}{42}$$

\* Harmonics for rank 3

$$\bar{Q}_3^{(2,-2)}[q](A', 1)$$

\*\* symmetry

$$\frac{x(2x^2 - 3y^2 - 3z^2)}{2}$$

\*\* expression

$$-\frac{\sqrt{15}Q_u x}{10} + \frac{3\sqrt{5}Q_v x}{10} - \frac{\sqrt{5}Q_{xy} y}{5} - \frac{\sqrt{5}Q_{xz} z}{5}$$

$$\bar{Q}_3^{(2,-2)}[q](A', 2)$$

\*\* symmetry

$$-\frac{z(3x^2 + 3y^2 - 2z^2)}{2}$$

\*\* expression

$$\frac{\sqrt{15}Q_u z}{5} - \frac{\sqrt{5}Q_{xz} x}{5} - \frac{\sqrt{5}Q_{yz} y}{5}$$

$$\bar{Q}_3^{(2,-2)}[q](A', 3)$$

\*\* symmetry

$$\frac{\sqrt{15}x(y-z)(y+z)}{2}$$

\*\* expression

$$-\frac{Q_u x}{2} - \frac{\sqrt{3}Q_v x}{6} + \frac{\sqrt{3}Q_{xy} y}{3} - \frac{\sqrt{3}Q_{xz} z}{3}$$

$$\bar{Q}_3^{(2,-2)}[q](A', 4)$$

\*\* symmetry

$$\frac{\sqrt{15}z(x-y)(x+y)}{2}$$

\*\* expression

$$\frac{\sqrt{3}Q_v z}{3} + \frac{\sqrt{3}Q_{xz} x}{3} - \frac{\sqrt{3}Q_{yz} y}{3}$$

$$\bar{Q}_3^{(2,0)}[q](A', 1)$$

\*\* symmetry

$$\frac{x(2x^2 - 3y^2 - 3z^2)}{2}$$

\*\* expression

$$-\frac{\sqrt{15}Q_u x(4x^2 - 21y^2 + 9z^2)}{60} + \frac{\sqrt{5}Q_v x(4x^2 - y^2 - 11z^2)}{20} + \frac{\sqrt{5}Q_{xy} y(4x^2 - y^2 - z^2)}{20} + \frac{\sqrt{5}Q_{xz} z(4x^2 - y^2 - z^2)}{20} - \sqrt{5}Q_{yz} x y z$$

$$\bar{Q}_3^{(2,0)}[q](A', 2)$$

\*\* symmetry

$$-\frac{z(3x^2 + 3y^2 - 2z^2)}{2}$$

\*\* expression

$$-\frac{\sqrt{15}Q_u z(3x^2 + 3y^2 - 2z^2)}{15} - \frac{\sqrt{5}Q_v z(x-y)(x+y)}{2} - \sqrt{5}Q_{xy} x y z - \frac{\sqrt{5}Q_{xz} x(x^2 + y^2 - 4z^2)}{20} - \frac{\sqrt{5}Q_{yz} y(x^2 + y^2 - 4z^2)}{20}$$

$$\bar{Q}_3^{(2,0)}[q](A', 3)$$

\*\* symmetry

$$\frac{\sqrt{15}x(y-z)(y+z)}{2}$$

\*\* expression

$$\frac{Q_u x(2x^2 - 3y^2 - 3z^2)}{4} + \frac{\sqrt{3}Q_v x(2x^2 - 3y^2 - 3z^2)}{12} + \frac{\sqrt{3}Q_{xy} y(6x^2 + y^2 - 9z^2)}{12} - \frac{\sqrt{3}Q_{xz} z(6x^2 - 9y^2 + z^2)}{12}$$

$$\bar{Q}_3^{(2,0)}[q](A', 4)$$

\*\* symmetry

$$\frac{\sqrt{15}z(x-y)(x+y)}{2}$$

\*\* expression

$$\frac{\sqrt{3}Q_v z (3x^2 + 3y^2 - 2z^2)}{6} + \frac{\sqrt{3}Q_{xz} x (x^2 - 9y^2 + 6z^2)}{12} + \frac{\sqrt{3}Q_{yz} y (9x^2 - y^2 - 6z^2)}{12}$$

$$\bar{Q}_3^{(2,2)}[q](A', 1)$$

\*\* symmetry

$$\frac{x (2x^2 - 3y^2 - 3z^2)}{2}$$

\*\* expression

$$\begin{aligned} & -\frac{\sqrt{330}Q_{ux} (4x^4 + x^2y^2 - 41x^2z^2 - 3y^4 + 15y^2z^2 + 18z^4)}{264} + \frac{\sqrt{110}Q_v x (4x^4 - 27x^2y^2 - 13x^2z^2 + 11y^4 + 15y^2z^2 + 4z^4)}{88} \\ & + \frac{\sqrt{110}Q_{xy} y (8x^4 - 12x^2y^2 - 12x^2z^2 + y^4 + 2y^2z^2 + z^4)}{44} + \frac{\sqrt{110}Q_{xz} z (8x^4 - 12x^2y^2 - 12x^2z^2 + y^4 + 2y^2z^2 + z^4)}{44} + \frac{7\sqrt{110}Q_{yz} x y z (2x^2 - y^2 - z^2)}{44} \end{aligned}$$

$$\bar{Q}_3^{(2,2)}[q](A', 2)$$

\*\* symmetry

$$\frac{z (3x^2 + 3y^2 - 2z^2)}{2}$$

\*\* expression

$$\begin{aligned} & \frac{\sqrt{330}Q_{uz} (15x^4 + 30x^2y^2 - 40x^2z^2 + 15y^4 - 40y^2z^2 + 8z^4)}{264} - \frac{7\sqrt{110}Q_v z (x-y)(x+y)(x^2+y^2-2z^2)}{88} - \frac{7\sqrt{110}Q_{xy} x y z (x^2+y^2-2z^2)}{44} \\ & + \frac{\sqrt{110}Q_{xz} x (x^4 + 2x^2y^2 - 12x^2z^2 + y^4 - 12y^2z^2 + 8z^4)}{44} + \frac{\sqrt{110}Q_{yz} y (x^4 + 2x^2y^2 - 12x^2z^2 + y^4 - 12y^2z^2 + 8z^4)}{44} \end{aligned}$$

$$\bar{Q}_3^{(2,2)}[q](A', 3)$$

\*\* symmetry

$$\frac{\sqrt{15}x (y-z)(y+z)}{2}$$

\*\* expression

$$\begin{aligned} & -\frac{\sqrt{22}Q_{ux} (2x^4 + 11x^2y^2 - 31x^2z^2 + 9y^4 - 87y^2z^2 + 30z^4)}{88} - \frac{\sqrt{66}Q_v x (2x^4 - 73x^2y^2 + 53x^2z^2 + 51y^4 - 87y^2z^2 - 12z^4)}{264} \\ & - \frac{\sqrt{66}Q_{xy} y (12x^4 - 46x^2y^2 + 66x^2z^2 + 5y^4 - 4y^2z^2 - 9z^4)}{132} \\ & + \frac{\sqrt{66}Q_{xz} z (12x^4 + 66x^2y^2 - 46x^2z^2 - 9y^4 - 4y^2z^2 + 5z^4)}{132} + \frac{21\sqrt{66}Q_{yz} x y z (y-z)(y+z)}{44} \end{aligned}$$

$$\bar{Q}_3^{(2,2)}[q](A', 4)$$

\*\* symmetry

$$\frac{\sqrt{15}z (x-y)(x+y)}{2}$$

\*\* expression

$$\begin{aligned} & -\frac{21\sqrt{22}Q_{uz} (x-y)(x+y)(x^2+y^2-2z^2)}{88} + \frac{\sqrt{66}Q_v z (39x^4 - 174x^2y^2 - 20x^2z^2 + 39y^4 - 20y^2z^2 + 4z^4)}{264} + \frac{21\sqrt{66}Q_{xy} x y z (x-y)(x+y)}{44} \\ & - \frac{\sqrt{66}Q_{xz} x (5x^4 - 4x^2y^2 - 46x^2z^2 - 9y^4 + 66y^2z^2 + 12z^4)}{132} - \frac{\sqrt{66}Q_{yz} y (9x^4 + 4x^2y^2 - 66x^2z^2 - 5y^4 + 46y^2z^2 - 12z^4)}{132} \end{aligned}$$

$$\bar{Q}_3^{(2,-2)}[q](A'', 1)$$

\*\* symmetry

$$\sqrt{15}xyz$$

\*\* expression

$$\frac{\sqrt{3}Q_{xy} z}{3} + \frac{\sqrt{3}Q_{xz} y}{3} + \frac{\sqrt{3}Q_{yz} x}{3}$$

$$\bar{Q}_3^{(2,-2)}[q](A'', 2)$$

\*\* symmetry

$$\frac{y (3x^2 - 2y^2 + 3z^2)}{2}$$

\*\* expression

$$-\frac{\sqrt{15}Q_{uy}}{10} - \frac{3\sqrt{5}Q_{vy}}{10} - \frac{\sqrt{5}Q_{xy} x}{5} - \frac{\sqrt{5}Q_{yz} z}{5}$$

$$\bar{Q}_3^{(2,-2)}[q](A'', 3)$$

\*\* symmetry

$$-\frac{\sqrt{15}y(x-z)(x+z)}{2}$$

\*\* expression

$$\frac{Q_{uy}}{2} - \frac{\sqrt{3}Q_{vy}}{6} - \frac{\sqrt{3}Q_{xyx}}{3} + \frac{\sqrt{3}Q_{yzz}}{3}$$

$$\bar{Q}_3^{(2,0)}[q](A'', 1)$$

\*\* symmetry

$$\sqrt{15}xyz$$

\*\* expression

$$\frac{\sqrt{3}Q_{xyx}(3x^2+3y^2-2z^2)}{6} + \frac{\sqrt{3}Q_{xzy}(3x^2-2y^2+3z^2)}{6} - \frac{\sqrt{3}Q_{yzz}(2x^2-3y^2-3z^2)}{6}$$

$$\bar{Q}_3^{(2,0)}[q](A'', 2)$$

\*\* symmetry

$$-\frac{y(3x^2-2y^2+3z^2)}{2}$$

\*\* expression

$$\frac{\sqrt{15}Q_{uy}(21x^2-4y^2-9z^2)}{60} + \frac{\sqrt{5}Q_{vy}(x^2-4y^2+11z^2)}{20} - \frac{\sqrt{5}Q_{xyx}(x^2-4y^2+z^2)}{20} - \sqrt{5}Q_{xzy} - \frac{\sqrt{5}Q_{yzz}(x^2-4y^2+z^2)}{20}$$

$$\bar{Q}_3^{(2,0)}[q](A'', 3)$$

\*\* symmetry

$$-\frac{\sqrt{15}y(x-z)(x+z)}{2}$$

\*\* expression

$$\frac{Q_{uy}(3x^2-2y^2+3z^2)}{4} - \frac{\sqrt{3}Q_{vy}(3x^2-2y^2+3z^2)}{12} - \frac{\sqrt{3}Q_{xyx}(x^2+6y^2-9z^2)}{12} - \frac{\sqrt{3}Q_{yzz}(9x^2-6y^2-z^2)}{12}$$

$$\bar{Q}_3^{(2,2)}[q](A'', 1)$$

\*\* symmetry

$$\sqrt{15}xyz$$

\*\* expression

$$-\frac{21\sqrt{22}Q_{uxyz}(x^2+y^2-2z^2)}{44} + \frac{21\sqrt{66}Q_{vxyz}(x-y)(x+y)}{44} - \frac{\sqrt{66}Q_{xyx}(6x^4-51x^2y^2+5x^2z^2+6y^4+5y^2z^2-z^4)}{66} - \frac{\sqrt{66}Q_{xzy}(6x^4+5x^2y^2-51x^2z^2-y^4+5y^2z^2+6z^4)}{66} + \frac{\sqrt{66}Q_{yzz}(x^4-5x^2y^2-5x^2z^2-6y^4+51y^2z^2-6z^4)}{66}$$

$$\bar{Q}_3^{(2,2)}[q](A'', 2)$$

\*\* symmetry

$$-\frac{y(3x^2-2y^2+3z^2)}{2}$$

\*\* expression

$$\frac{\sqrt{330}Q_{uy}(3x^4-x^2y^2-15x^2z^2-4y^4+41y^2z^2-18z^4)}{264} - \frac{\sqrt{110}Q_{vy}(11x^4-27x^2y^2+15x^2z^2+4y^4-13y^2z^2+4z^4)}{88} + \frac{\sqrt{110}Q_{xyx}(x^4-12x^2y^2+2x^2z^2+8y^4-12y^2z^2+z^4)}{44} - \frac{7\sqrt{110}Q_{xzy}(x^2-2y^2+z^2)}{44} + \frac{\sqrt{110}Q_{yzz}(x^4-12x^2y^2+2x^2z^2+8y^4-12y^2z^2+z^4)}{44}$$

$$\bar{Q}_3^{(2,2)}[q](A'', 3)$$

\*\* symmetry

$$-\frac{\sqrt{15}y(x-z)(x+z)}{2}$$

\*\* expression

$$\frac{\sqrt{22}Q_{uy}(9x^4+11x^2y^2-87x^2z^2+2y^4-31y^2z^2+30z^4)}{88} - \frac{\sqrt{66}Q_{vy}(51x^4-73x^2y^2-87x^2z^2+2y^4+53y^2z^2-12z^4)}{264} + \frac{\sqrt{66}Q_{xyx}(5x^4-46x^2y^2-4x^2z^2+12y^4+66y^2z^2-9z^4)}{132} - \frac{21\sqrt{66}Q_{xzy}(x-z)(x+z)}{44} + \frac{\sqrt{66}Q_{yzz}(9x^4-66x^2y^2+4x^2z^2-12y^4+46y^2z^2-5z^4)}{132}$$

\* Harmonics for rank 4

$$\bar{Q}_4^{(2,-2)}[q](A', 1)$$

\*\* symmetry

$$\frac{\sqrt{21} (x^4 - 3x^2y^2 - 3x^2z^2 + y^4 - 3y^2z^2 + z^4)}{6}$$

\*\* expression

$$-\frac{\sqrt{30}Q_u (x^2 + y^2 - 2z^2)}{20} + \frac{3\sqrt{10}Q_v (x - y) (x + y)}{20} - \frac{\sqrt{10}Q_{xy}xy}{5} - \frac{\sqrt{10}Q_{xz}xz}{5} - \frac{\sqrt{10}Q_{yz}yz}{5}$$

$$\bar{Q}_4^{(2,-2)}[q](A', 2)$$

\*\* symmetry

$$-\frac{\sqrt{15} (x^4 - 12x^2y^2 + 6x^2z^2 + y^4 + 6y^2z^2 - 2z^4)}{12}$$

\*\* expression

$$-\frac{\sqrt{42}Q_u (x^2 + y^2 - 2z^2)}{28} - \frac{3\sqrt{14}Q_v (x - y) (x + y)}{28} + \frac{2\sqrt{14}Q_{xy}xy}{7} - \frac{\sqrt{14}Q_{xz}xz}{7} - \frac{\sqrt{14}Q_{yz}yz}{7}$$

$$\bar{Q}_4^{(2,-2)}[q](A', 3)$$

\*\* symmetry

$$\frac{\sqrt{5} (x - y) (x + y) (x^2 + y^2 - 6z^2)}{4}$$

\*\* expression

$$-\frac{3\sqrt{14}Q_u (x - y) (x + y)}{28} + \frac{\sqrt{42}Q_v (x^2 + y^2 - 2z^2)}{28} - \frac{\sqrt{42}Q_{xz}xz}{7} + \frac{\sqrt{42}Q_{yz}yz}{7}$$

$$\bar{Q}_4^{(2,-2)}[q](A', 4)$$

\*\* symmetry

$$-\frac{\sqrt{35}xz (x - z) (x + z)}{2}$$

\*\* expression

$$\frac{3\sqrt{2}Q_u xz}{4} - \frac{\sqrt{6}Q_v xz}{4} - \frac{\sqrt{6}Q_{xz} (x - z) (x + z)}{4}$$

$$\bar{Q}_4^{(2,-2)}[q](A', 5)$$

\*\* symmetry

$$-\frac{\sqrt{5}xz (x^2 - 6y^2 + z^2)}{2}$$

\*\* expression

$$-\frac{3\sqrt{14}Q_u xz}{28} - \frac{3\sqrt{42}Q_v xz}{28} + \frac{\sqrt{42}Q_{xy}yz}{7} - \frac{\sqrt{42}Q_{xz} (x^2 - 2y^2 + z^2)}{28} + \frac{\sqrt{42}Q_{yz}xy}{7}$$

$$\bar{Q}_4^{(2,0)}[q](A', 1)$$

\*\* symmetry

$$\frac{\sqrt{21} (x^4 - 3x^2y^2 - 3x^2z^2 + y^4 - 3y^2z^2 + z^4)}{6}$$

\*\* expression

$$-\frac{\sqrt{165}Q_u (x^4 - 12x^2y^2 + 6x^2z^2 + y^4 + 6y^2z^2 - 2z^4)}{66} + \frac{\sqrt{55}Q_v (x - y) (x + y) (x^2 + y^2 - 6z^2)}{22} + \frac{\sqrt{55}Q_{xy}xy (x^2 + y^2 - 6z^2)}{22} + \frac{\sqrt{55}Q_{xz}xz (x^2 - 6y^2 + z^2)}{22} - \frac{\sqrt{55}Q_{yz}yz (6x^2 - y^2 - z^2)}{22}$$

$$\bar{Q}_4^{(2,0)}[q](A', 2)$$

\*\* symmetry

$$-\frac{\sqrt{15} (x^4 - 12x^2y^2 + 6x^2z^2 + y^4 + 6y^2z^2 - 2z^4)}{12}$$

\*\* expression

$$\frac{\sqrt{231}Q_u (8x^4 - 33x^2y^2 - 15x^2z^2 + 8y^4 - 15y^2z^2 + 5z^4)}{231} + \frac{\sqrt{77}Q_v (x - y) (x + y) (x^2 + y^2 - 6z^2)}{77} + \frac{\sqrt{77}Q_{xy}xy (x^2 + y^2 - 6z^2)}{14} - \frac{\sqrt{77}Q_{xz}xz (16x^2 - 33y^2 - 5z^2)}{154} + \frac{\sqrt{77}Q_{yz}yz (33x^2 - 16y^2 + 5z^2)}{154}$$

$$\bar{Q}_4^{(2,0)}[q](A', 3)$$

\*\* symmetry

$$\frac{\sqrt{5}(x-y)(x+y)(x^2+y^2-6z^2)}{4}$$

\*\* expression

$$\frac{\sqrt{77}Q_u(x-y)(x+y)(x^2+y^2-6z^2)}{77} + \frac{\sqrt{231}Q_v(2x^4-3x^2y^2-9x^2z^2+2y^4-9y^2z^2+3z^4)}{77}$$

$$+ \frac{\sqrt{231}Q_{xyxy}(x-y)(x+y)}{22} - \frac{\sqrt{231}Q_{xzxz}(2x^2-33y^2+9z^2)}{154} - \frac{\sqrt{231}Q_{yzyz}(33x^2-2y^2-9z^2)}{154}$$

$$\bar{Q}_4^{(2,0)}[q](A', 4)$$

\*\* symmetry

$$-\frac{\sqrt{35}xz(x-z)(x+z)}{2}$$

\*\* expression

$$-\frac{\sqrt{11}Q_{uxxz}(11x^2+18y^2-17z^2)}{44} - \frac{\sqrt{33}Q_vxz(15x^2-6y^2-13z^2)}{44} - \frac{7\sqrt{33}Q_{xyyz}(3x^2-z^2)}{44}$$

$$-\frac{\sqrt{33}Q_{xz}(x-z)(x+z)(x^2-6y^2+z^2)}{44} - \frac{7\sqrt{33}Q_{yzxy}(x^2-3z^2)}{44}$$

$$\bar{Q}_4^{(2,0)}[q](A', 5)$$

\*\* symmetry

$$-\frac{\sqrt{5}xz(x^2-6y^2+z^2)}{2}$$

\*\* expression

$$\frac{\sqrt{77}Q_{uxxz}(25x^2-24y^2-17z^2)}{308} - \frac{\sqrt{231}Q_vxz(3x^2+24y^2-11z^2)}{308} + \frac{\sqrt{231}Q_{xyyz}(39x^2+18y^2-31z^2)}{308}$$

$$-\frac{\sqrt{231}Q_{xz}(x^4-36x^2y^2+30x^2z^2+12y^4-36y^2z^2+z^4)}{308} - \frac{\sqrt{231}Q_{yzxy}(31x^2-18y^2-39z^2)}{308}$$

$$\bar{Q}_4^{(2,2)}[q](A', 1)$$

\*\* symmetry

$$\frac{\sqrt{21}(x^4-3x^2y^2-3x^2z^2+y^4-3y^2z^2+z^4)}{6}$$

\*\* expression

$$-\frac{\sqrt{15015}Q_u(x^6-15x^4z^2+15x^2z^4+y^6-15y^4z^2+15y^2z^4-2z^6)}{572}$$

$$+ \frac{3\sqrt{5005}Q_v(x-y)(x+y)(x^4-9x^2y^2-5x^2z^2+y^4-5y^2z^2+5z^4)}{572} + \frac{\sqrt{5005}Q_{xyxy}(7x^4-19x^2y^2-13x^2z^2+7y^4-13y^2z^2+13z^4)}{286}$$

$$+ \frac{\sqrt{5005}Q_{xzxz}(7x^4-13x^2y^2-19x^2z^2+13y^4-13y^2z^2+7z^4)}{286} + \frac{\sqrt{5005}Q_{yzyz}(13x^4-13x^2y^2-13x^2z^2+7y^4-19y^2z^2+7z^4)}{286}$$

$$\bar{Q}_4^{(2,2)}[q](A', 2)$$

\*\* symmetry

$$-\frac{\sqrt{15}(x^4-12x^2y^2+6x^2z^2+y^4+6y^2z^2-2z^4)}{12}$$

\*\* expression

$$-\frac{\sqrt{429}Q_u(x^6+45x^4y^2-60x^4z^2+45x^2y^4-540x^2y^2z^2+150x^2z^4+y^6-60y^4z^2+150y^2z^4-20z^6)}{1144}$$

$$-\frac{21\sqrt{143}Q_v(x-y)(x+y)(x^4-20x^2y^2+6x^2z^2+y^4+6y^2z^2-6z^4)}{1144} - \frac{7\sqrt{143}Q_{xyxy}(x^4-4x^2y^2+2x^2z^2+y^4+2y^2z^2-2z^4)}{52}$$

$$+ \frac{7\sqrt{143}Q_{xzxz}(x^4+56x^2y^2-22x^2z^2-11y^4-34y^2z^2+10z^4)}{572} - \frac{7\sqrt{143}Q_{yzyz}(11x^4-56x^2y^2+34x^2z^2-y^4+22y^2z^2-10z^4)}{572}$$

$$\bar{Q}_4^{(2,2)}[q](A', 3)$$

\*\* symmetry

$$\frac{\sqrt{5}(x-y)(x+y)(x^2+y^2-6z^2)}{4}$$

\*\* expression

$$\begin{aligned} & - \frac{21\sqrt{143}Q_u(x-y)(x+y)(x^4+2x^2y^2-16x^2z^2+y^4-16y^2z^2+16z^4)}{1144} \\ & + \frac{\sqrt{429}Q_v(13x^6-45x^4y^2-150x^4z^2-45x^2y^4+540x^2y^2z^2+60x^2z^4+13y^6-150y^4z^2+60y^2z^4-8z^6)}{1144} \\ & + \frac{21\sqrt{429}Q_{xy}xy(x-y)(x+y)(x^2+y^2-10z^2)}{572} + \frac{7\sqrt{429}Q_{xz}xz(7x^4-4x^2y^2-22x^2z^2-11y^4+26y^2z^2+4z^4)}{572} \\ & + \frac{7\sqrt{429}Q_{yz}yz(11x^4+4x^2y^2-26x^2z^2-7y^4+22y^2z^2-4z^4)}{572} \end{aligned}$$

$$\bar{Q}_4^{(2,2)}[q](A', 4)$$

\*\* symmetry

$$- \frac{\sqrt{35}xz(x-z)(x+z)}{2}$$

\*\* expression

$$\begin{aligned} & \frac{3\sqrt{1001}Q_uxz(11x^4+13x^2y^2-41x^2z^2+2y^4-17y^2z^2+14z^4)}{572} \\ & - \frac{\sqrt{3003}Q_vxz(17x^4-47x^2y^2-41x^2z^2+2y^4+43y^2z^2+8z^4)}{572} - \frac{3\sqrt{3003}Q_{xy}yz(8x^4-3x^2y^2-13x^2z^2+y^2z^2+z^4)}{286} \\ & + \frac{\sqrt{3003}Q_{xz}(x-z)(x+z)(2x^4+x^2y^2-29x^2z^2-y^4+y^2z^2+2z^4)}{286} + \frac{3\sqrt{3003}Q_{yz}xy(x^4+x^2y^2-13x^2z^2-3y^2z^2+8z^4)}{286} \end{aligned}$$

$$\bar{Q}_4^{(2,2)}[q](A', 5)$$

\*\* symmetry

$$- \frac{\sqrt{5}xz(x^2-6y^2+z^2)}{2}$$

\*\* expression

$$\begin{aligned} & \frac{21\sqrt{143}Q_uxz(x^4-7x^2y^2-x^2z^2-8y^4+23y^2z^2-2z^4)}{572} - \frac{21\sqrt{429}Q_vxz(x^4-13x^2y^2+x^2z^2+8y^4-3y^2z^2)}{572} \\ & - \frac{7\sqrt{429}Q_{xy}yz(8x^4-23x^2y^2+7x^2z^2+2y^4+y^2z^2-z^4)}{286} \\ & + \frac{\sqrt{429}Q_{xz}(2x^6-15x^4y^2-15x^4z^2-15x^2y^4+180x^2y^2z^2-15x^2z^4+2y^6-15y^4z^2-15y^2z^4+2z^6)}{286} \\ & + \frac{7\sqrt{429}Q_{yz}xy(x^4-x^2y^2-7x^2z^2-2y^4+23y^2z^2-8z^4)}{286} \end{aligned}$$

$$\bar{Q}_4^{(2,-2)}[q](A'', 1)$$

\*\* symmetry

$$\frac{\sqrt{35}yz(y-z)(y+z)}{2}$$

\*\* expression

$$- \frac{3\sqrt{2}Q_uyz}{4} - \frac{\sqrt{6}Q_vyz}{4} + \frac{\sqrt{6}Q_{yz}(y-z)(y+z)}{4}$$

$$\bar{Q}_4^{(2,-2)}[q](A'', 2)$$

\*\* symmetry

$$\frac{\sqrt{35}xy(x-y)(x+y)}{2}$$

\*\* expression

$$\frac{\sqrt{6}Q_vxy}{2} + \frac{\sqrt{6}Q_{xy}(x-y)(x+y)}{4}$$

$$\bar{Q}_4^{(2,-2)}[q](A'', 3)$$

\*\* symmetry

$$\frac{\sqrt{5}yz(6x^2-y^2-z^2)}{2}$$

\*\* expression

$$- \frac{3\sqrt{14}Q_uyz}{28} + \frac{3\sqrt{42}Q_vyz}{28} + \frac{\sqrt{42}Q_{xy}xz}{7} + \frac{\sqrt{42}Q_{xz}xy}{7} + \frac{\sqrt{42}Q_{yz}(2x^2-y^2-z^2)}{28}$$

$$\bar{Q}_4^{(2,-2)}[q](A'', 4)$$

\*\* symmetry

$$-\frac{\sqrt{5}xy(x^2+y^2-6z^2)}{2}$$

\*\* expression

$$\frac{3\sqrt{14}Q_u xy}{14} - \frac{\sqrt{42}Q_{xy}(x^2+y^2-2z^2)}{28} + \frac{\sqrt{42}Q_{xz}yz}{7} + \frac{\sqrt{42}Q_{yz}xz}{7}$$

$$\bar{Q}_4^{(2,0)}[q](A'', 1)$$

\*\* symmetry

$$\frac{\sqrt{35}yz(y-z)(y+z)}{2}$$

\*\* expression

$$\frac{\sqrt{11}Q_u yz(18x^2+11y^2-17z^2)}{44} + \frac{\sqrt{33}Q_v yz(6x^2-15y^2+13z^2)}{44} + \frac{7\sqrt{33}Q_{xy}xz(3y^2-z^2)}{44} \\ + \frac{7\sqrt{33}Q_{xz}xy(y^2-3z^2)}{44} - \frac{\sqrt{33}Q_{yz}(y-z)(y+z)(6x^2-y^2-z^2)}{44}$$

$$\bar{Q}_4^{(2,0)}[q](A'', 2)$$

\*\* symmetry

$$\frac{\sqrt{35}xy(x-y)(x+y)}{2}$$

\*\* expression

$$-\frac{7\sqrt{11}Q_u xy(x-y)(x+y)}{11} + \frac{\sqrt{33}Q_v xy(x^2+y^2-6z^2)}{22} \\ + \frac{\sqrt{33}Q_{xy}(x-y)(x+y)(x^2+y^2-6z^2)}{44} + \frac{7\sqrt{33}Q_{xz}yz(3x^2-y^2)}{44} + \frac{7\sqrt{33}Q_{yz}xz(x^2-3y^2)}{44}$$

$$\bar{Q}_4^{(2,0)}[q](A'', 3)$$

\*\* symmetry

$$\frac{\sqrt{5}yz(6x^2-y^2-z^2)}{2}$$

\*\* expression

$$-\frac{\sqrt{77}Q_u yz(24x^2-25y^2+17z^2)}{308} + \frac{\sqrt{231}Q_v yz(24x^2+3y^2-11z^2)}{308} + \frac{\sqrt{231}Q_{xy}xz(18x^2+39y^2-31z^2)}{308} \\ + \frac{\sqrt{231}Q_{xz}xy(18x^2-31y^2+39z^2)}{308} - \frac{\sqrt{231}Q_{yz}(12x^4-36x^2y^2-36x^2z^2+y^4+30y^2z^2+z^4)}{308}$$

$$\bar{Q}_4^{(2,0)}[q](A'', 4)$$

\*\* symmetry

$$-\frac{\sqrt{5}xy(x^2+y^2-6z^2)}{2}$$

\*\* expression

$$-\frac{2\sqrt{77}Q_u xy(x^2+y^2-6z^2)}{77} - \frac{\sqrt{231}Q_v xy(x-y)(x+y)}{22} - \frac{\sqrt{231}Q_{xy}(x^4+30x^2y^2-36x^2z^2+y^4-36y^2z^2+12z^4)}{308} \\ + \frac{\sqrt{231}Q_{xz}yz(39x^2-31y^2+18z^2)}{308} - \frac{\sqrt{231}Q_{yz}xz(31x^2-39y^2-18z^2)}{308}$$

$$\bar{Q}_4^{(2,2)}[q](A'', 1)$$

\*\* symmetry

$$\frac{\sqrt{35}yz(y-z)(y+z)}{2}$$

\*\* expression

$$-\frac{3\sqrt{1001}Q_u yz(2x^4+13x^2y^2-17x^2z^2+11y^4-41y^2z^2+14z^4)}{572} - \frac{\sqrt{3003}Q_v yz(2x^4-47x^2y^2+43x^2z^2+17y^4-41y^2z^2+8z^4)}{572} \\ - \frac{3\sqrt{3003}Q_{xy}xz(3x^2y^2-x^2z^2-8y^4+13y^2z^2-z^4)}{286} - \frac{3\sqrt{3003}Q_{xz}xy(x^2y^2-3x^2z^2+y^4-13y^2z^2+8z^4)}{286} \\ + \frac{\sqrt{3003}Q_{yz}(y-z)(y+z)(x^4-x^2y^2-x^2z^2-2y^4+29y^2z^2-2z^4)}{286}$$

$$\bar{Q}_4^{(2,2)}[q](A'', 2)$$

\*\* symmetry

$$\frac{\sqrt{35}xy(x-y)(x+y)}{2}$$

\*\* expression

$$\begin{aligned} & -\frac{9\sqrt{1001}Q_u xy(x-y)(x+y)(x^2+y^2-10z^2)}{572} + \frac{\sqrt{3003}Q_v xy(25x^4-82x^2y^2-4x^2z^2+25y^4-4y^2z^2+4z^4)}{572} \\ & -\frac{\sqrt{3003}Q_{xy}(x-y)(x+y)(2x^4-29x^2y^2+x^2z^2+2y^4+y^2z^2-z^4)}{286} \\ & +\frac{3\sqrt{3003}Q_{xz}yz(8x^4-13x^2y^2-3x^2z^2+y^4+y^2z^2)}{286} -\frac{3\sqrt{3003}Q_{yz}xz(x^4-13x^2y^2+x^2z^2+8y^4-3y^2z^2)}{286} \end{aligned}$$

$$\bar{Q}_4^{(2,2)}[q](A'', 3)$$

\*\* symmetry

$$\frac{\sqrt{5}yz(6x^2-y^2-z^2)}{2}$$

\*\* expression

$$\begin{aligned} & -\frac{21\sqrt{143}Q_u yz(8x^4+7x^2y^2-23x^2z^2-y^4+y^2z^2+2z^4)}{572} + \frac{21\sqrt{429}Q_v yz(8x^4-13x^2y^2-3x^2z^2+y^4+y^2z^2)}{572} \\ & -\frac{7\sqrt{429}Q_{xy}xz(2x^4-23x^2y^2+x^2z^2+8y^4+7y^2z^2-z^4)}{286} -\frac{7\sqrt{429}Q_{xz}xy(2x^4+x^2y^2-23x^2z^2-y^4+7y^2z^2+8z^4)}{286} \\ & +\frac{\sqrt{429}Q_{yz}(2x^6-15x^4y^2-15x^4z^2-15x^2y^4+180x^2y^2z^2-15x^2z^4+2y^6-15y^4z^2-15y^2z^4+2z^6)}{286} \end{aligned}$$

$$\bar{Q}_4^{(2,2)}[q](A'', 4)$$

\*\* symmetry

$$-\frac{\sqrt{5}xy(x^2+y^2-6z^2)}{2}$$

\*\* expression

$$\begin{aligned} & \frac{21\sqrt{143}Q_u xy(x^4+2x^2y^2-16x^2z^2+y^4-16y^2z^2+16z^4)}{572} -\frac{21\sqrt{429}Q_v xy(x-y)(x+y)(x^2+y^2-10z^2)}{572} \\ & +\frac{\sqrt{429}Q_{xy}(2x^6-15x^4y^2-15x^4z^2-15x^2y^4+180x^2y^2z^2-15x^2z^4+2y^6-15y^4z^2-15y^2z^4+2z^6)}{286} \\ & -\frac{7\sqrt{429}Q_{xz}yz(8x^4+7x^2y^2-23x^2z^2-y^4+y^2z^2+2z^4)}{286} +\frac{7\sqrt{429}Q_{yz}xz(x^4-7x^2y^2-x^2z^2-8y^4+23y^2z^2-2z^4)}{286} \end{aligned}$$