

MPG No. 2.3.5  $\bar{1}'$  [ Type III, triclinic ] [M tensor]

\* Rank 0 tensor.

$$[M]$$

$$M = M_s^{(1)}$$

\* Rank 1 tensor. \* Rank 2 tensor (s).

$$\begin{bmatrix} M_{xx} & M_{xy} & M_{xz} \\ M_{xy} & M_{yy} & M_{yz} \\ M_{xz} & M_{yz} & M_{zz} \end{bmatrix}$$

$$M_{xx} = -M_{du}^{(1)} + M_{dv}^{(1)} + M_s^{(1)}$$

$$M_{xy} = M_{dxy}^{(1)}$$

$$M_{xz} = M_{dxz}^{(1)}$$

$$M_{yy} = -M_{du}^{(1)} - M_{dv}^{(1)} + M_s^{(1)}$$

$$M_{yz} = M_{dyz}^{(1)}$$

$$M_{zz} = 2M_{du}^{(1)} + M_s^{(1)}$$

\* Rank 2 tensor (a).

$$\begin{bmatrix} 0 & M_{xy} & M_{xz} \\ -M_{xy} & 0 & M_{yz} \\ -M_{xz} & -M_{yz} & 0 \end{bmatrix}$$

$$M_{xy} = T_{pz}^{(1)}$$

$$M_{xz} = -T_{py}^{(1)}$$

$$M_{yz} = T_{px}^{(1)}$$

\* Rank 3 tensor (s). \* Rank 3 tensor (a). \* Rank 4 tensor (sss).

$$\begin{bmatrix} M_{xxxx} & M_{xxyy} & M_{xxzz} & M_{xxyz} & M_{xxzx} & M_{xxxz} \\ M_{xxyy} & M_{yyyy} & M_{yyzz} & M_{yyyz} & M_{yyzx} & M_{yyxy} \\ M_{xxzz} & M_{yyzz} & M_{zzzz} & M_{zzyz} & M_{zzzx} & M_{zzxy} \\ M_{xxyz} & M_{yyyz} & M_{zzyz} & M_{yzyz} & M_{yzzx} & M_{yzxy} \\ M_{xxzx} & M_{yyzx} & M_{zzzx} & M_{yzzx} & M_{zxzx} & M_{zxxy} \\ M_{xxxz} & M_{yyxy} & M_{zzxy} & M_{yzxy} & M_{zxxy} & M_{xyxy} \end{bmatrix}$$

$$M_{xxxx} = -2M_{du}^{(1)} - 4M_{du}^{(2)} + 2M_{dv}^{(1)} + 4M_{dv}^{(2)} - M_{gu}^{(1)} + M_{gv}^{(1)} + 2M_g^{(1)} + M_s^{(1)} + 2M_s^{(2)}$$

$$M_{xxyy} = -2M_{du}^{(1)} + 2M_{gu}^{(1)} - M_g^{(1)} + M_s^{(1)}$$

$$M_{xxzz} = M_{du}^{(1)} + M_{dv}^{(1)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)}$$

$$M_{xxyz} = M_{dusz}^{(1)} + 2M_{gbx}^{(1)}$$

$$M_{xxzx} = M_{daz}^{(1)} + 2M_{dxz}^{(2)} - M_{gaz}^{(1)} - M_{gbx}^{(1)}$$

$$M_{xxxz} = M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{gaz}^{(1)} - M_{gbx}^{(1)}$$

$$M_{yyyy} = -2M_{du}^{(1)} - 4M_{du}^{(2)} - 2M_{dv}^{(1)} - 4M_{dv}^{(2)} - M_{gu}^{(1)} - M_{gv}^{(1)} + 2M_g^{(1)} + M_s^{(1)} + 2M_s^{(2)}$$

$$M_{yyzz} = M_{du}^{(1)} - M_{dv}^{(1)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)}$$

$$M_{yyyz} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{gax}^{(1)} - M_{gbx}^{(1)}$$

$$M_{yyzx} = M_{dazz}^{(1)} + 2M_{gbx}^{(1)}$$

$$M_{yyxy} = M_{dxy}^{(1)} + 2M_{dxy}^{(2)} - M_{gaz}^{(1)} - M_{gbx}^{(1)}$$

$$M_{zzzz} = 4M_{du}^{(1)} + 8M_{du}^{(2)} + 2M_{gu}^{(1)} + 2M_g^{(1)} + M_s^{(1)} + 2M_s^{(2)}$$

$$M_{zzyz} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} - M_{gax}^{(1)} - M_{gbx}^{(1)}$$

$$M_{zzzx} = M_{daz}^{(1)} + 2M_{dxz}^{(2)} + M_{gaz}^{(1)} - M_{gbx}^{(1)}$$

$$M_{zzxy} = M_{dxy}^{(1)} + 2M_{gbx}^{(1)}$$

$$M_{yzyz} = M_{du}^{(2)} - M_{dv}^{(2)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(2)}$$

$$M_{yzzx} = M_{dxy}^{(2)} + 2M_{gbx}^{(1)}$$

$$M_{yzxy} = M_{dazz}^{(2)} + 2M_{gbx}^{(1)}$$

$$M_{zxzx} = M_{du}^{(2)} + M_{dv}^{(2)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(2)}$$

$$M_{zxxz} = M_{dyz}^{(2)} + 2M_{gbx}^{(1)}$$

$$M_{xyxy} = -2M_{du}^{(2)} + 2M_{gu}^{(1)} - M_g^{(1)} + M_s^{(2)}$$

\* Rank 4 tensor (ssa).

$$\begin{bmatrix} 0 & M_{xxyy} & M_{xxzz} & M_{xxyz} & M_{xxzx} & M_{xxxz} \\ -M_{xxyy} & 0 & M_{yyzz} & M_{yyyz} & M_{yyzx} & M_{yyxy} \\ -M_{xxzz} & -M_{yyzz} & 0 & M_{zzyz} & M_{zzzx} & M_{zzyx} \\ -M_{xxyz} & -M_{yyyz} & -M_{zzyz} & 0 & M_{yzzx} & M_{yzxy} \\ -M_{xxzx} & -M_{yyzx} & -M_{zzzx} & -M_{yzzx} & 0 & M_{zxxz} \\ -M_{xxxz} & -M_{yyxy} & -M_{zzxy} & -M_{yzxy} & -M_{zxxz} & 0 \end{bmatrix}$$

$$\begin{aligned}
M_{xxyy} &= -2M_{dv}^{(3)} + 4T_{f3}^{(1)} \\
M_{xxzz} &= 3M_{du}^{(3)} - M_{dv}^{(3)} - 4T_{f3}^{(1)} \\
M_{xxyz} &= M_{dyz}^{(3)} - 4T_{fbx}^{(1)} \\
M_{xxzx} &= M_{dxz}^{(3)} + 2T_{fay}^{(1)} + 2T_{fbz}^{(1)} - 2T_{py}^{(1)} \\
M_{xxxy} &= M_{dxy}^{(3)} - 2T_{faz}^{(1)} + 2T_{fbz}^{(1)} + 2T_{pz}^{(1)} \\
M_{yyzz} &= 3M_{du}^{(3)} + M_{dv}^{(3)} + 4T_{f3}^{(1)} \\
M_{yyyz} &= M_{dyz}^{(3)} - 2T_{fax}^{(1)} + 2T_{fbx}^{(1)} + 2T_{px}^{(1)} \\
M_{yyzx} &= M_{dzz}^{(3)} - 4T_{fbz}^{(1)} \\
M_{yyxy} &= M_{dxy}^{(3)} + 2T_{faz}^{(1)} + 2T_{fbz}^{(1)} - 2T_{pz}^{(1)} \\
M_{zzyz} &= M_{dyz}^{(3)} + 2T_{fax}^{(1)} + 2T_{fbx}^{(1)} - 2T_{px}^{(1)} \\
M_{zzzx} &= M_{daz}^{(3)} - 2T_{fay}^{(1)} + 2T_{fbz}^{(1)} + 2T_{py}^{(1)} \\
M_{zzxy} &= M_{dxy}^{(3)} - 4T_{fbz}^{(1)} \\
M_{yzzx} &= -4T_{faz}^{(1)} - T_{pz}^{(1)} \\
M_{yzxy} &= 4T_{fay}^{(1)} + T_{py}^{(1)} \\
M_{zxxz} &= -4T_{fax}^{(1)} - T_{px}^{(1)}
\end{aligned}$$

\* Rank 4 tensor (aas).

$$\begin{bmatrix} M_{yzyz} & M_{yzzx} & M_{yzxy} \\ M_{yzzx} & M_{zxzx} & M_{zxxy} \\ M_{yzxy} & M_{zxxy} & M_{xyxy} \end{bmatrix}$$

$$\begin{aligned}
M_{yzyz} &= -2M_{du}^{(4)} + 2M_{dv}^{(4)} + M_s^{(3)} \\
M_{yzzx} &= 2M_{dxy}^{(4)} \\
M_{yzxy} &= 2M_{dxz}^{(4)} \\
M_{zxzx} &= -2M_{du}^{(4)} - 2M_{dv}^{(4)} + M_s^{(3)} \\
M_{zxxy} &= 2M_{dyz}^{(4)} \\
M_{xyxy} &= 4M_{du}^{(4)} + M_s^{(3)}
\end{aligned}$$

\* Rank 4 tensor (aaa).

$$\begin{bmatrix} 0 & M_{yzzx} & M_{yzxy} \\ -M_{yzzx} & 0 & M_{zxxy} \\ -M_{yzxy} & -M_{zxxy} & 0 \end{bmatrix}$$

$$\begin{aligned}
M_{yzzx} &= -T_{pz}^{(2)} \\
M_{yzxy} &= T_{py}^{(2)} \\
M_{zxxy} &= -T_{px}^{(2)}
\end{aligned}$$

\* Rank 4 tensor (sa).

$$\begin{bmatrix} M_{xxyz} & M_{xxzx} & M_{xxxy} \\ M_{yyyz} & M_{yzyx} & M_{yyxy} \\ M_{zzyz} & M_{zzyx} & M_{zzxy} \\ M_{yzyz} & M_{yzyx} & M_{yzxy} \\ M_{zxyz} & M_{zzyx} & M_{zxxy} \\ M_{xyyz} & M_{xyzx} & M_{xyxy} \end{bmatrix}$$

$$\begin{aligned}
M_{xxyz} &= 2T_{fax}^{(2)} + T_{px}^{(3)} + 2T_{px}^{(4)} \\
M_{xxzx} &= 2M_{dxz}^{(5)} - T_{fay}^{(2)} - T_{fbz}^{(2)} + T_{py}^{(3)} \\
M_{xxxy} &= -2M_{dxy}^{(5)} - T_{faz}^{(2)} + T_{fbz}^{(2)} + T_{pz}^{(3)} \\
M_{yyyz} &= -2M_{dyz}^{(5)} - T_{fax}^{(2)} + T_{fbx}^{(2)} + T_{px}^{(3)} \\
M_{yyzx} &= 2T_{fay}^{(2)} + T_{py}^{(3)} + 2T_{py}^{(4)} \\
M_{yyxy} &= 2M_{dxy}^{(5)} - T_{faz}^{(2)} - T_{fbz}^{(2)} + T_{pz}^{(3)} \\
M_{zzyz} &= 2M_{dyz}^{(5)} - T_{fax}^{(2)} - T_{fbx}^{(2)} + T_{px}^{(3)} \\
M_{zzzx} &= -2M_{dxz}^{(5)} - T_{fay}^{(2)} + T_{fbz}^{(2)} + T_{py}^{(3)} \\
M_{zzxy} &= 2T_{faz}^{(2)} + T_{pz}^{(3)} + 2T_{pz}^{(4)} \\
M_{yzyz} &= -3M_{du}^{(5)} - M_{dv}^{(5)} + T_{f3}^{(2)} \\
M_{yzzx} &= -M_{dxy}^{(5)} - T_{faz}^{(2)} - T_{fbz}^{(2)} + T_{pz}^{(4)} \\
M_{yzxy} &= M_{dxz}^{(5)} - T_{fay}^{(2)} + T_{fbz}^{(2)} + T_{py}^{(4)} \\
M_{zxyz} &= M_{dxy}^{(5)} - T_{faz}^{(2)} + T_{fbz}^{(2)} + T_{pz}^{(4)} \\
M_{zxzx} &= 3M_{du}^{(5)} - M_{dv}^{(5)} + T_{f3}^{(2)} \\
M_{zxxxy} &= -M_{dyz}^{(5)} - T_{fax}^{(2)} - T_{fbx}^{(2)} + T_{px}^{(4)} \\
M_{xyyz} &= -M_{dxz}^{(5)} - T_{fay}^{(2)} - T_{fbz}^{(2)} + T_{py}^{(4)} \\
M_{xyzx} &= M_{dyz}^{(5)} - T_{fax}^{(2)} + T_{fbx}^{(2)} + T_{px}^{(4)} \\
M_{xyxy} &= 2M_{dv}^{(5)} + T_{f3}^{(2)}
\end{aligned}$$

\* Rank 4 tensor (as).

$$\begin{bmatrix} M_{yzxx} & M_{yzyy} & M_{yzzz} & M_{yzyz} & M_{yzzx} & M_{yzxy} \\ M_{zxxx} & M_{zxyy} & M_{zxzz} & M_{zxyz} & M_{zxzx} & M_{zxxz} \\ M_{xyxx} & M_{xyyy} & M_{xyzz} & M_{xyyz} & M_{xyzx} & M_{xyxy} \end{bmatrix}$$

$$\begin{aligned}
M_{yzxx} &= 2T_{fax}^{(3)} + T_{px}^{(5)} + 2T_{px}^{(6)} \\
M_{yzyy} &= -2M_{dyz}^{(6)} - T_{fax}^{(3)} + T_{fbx}^{(3)} + T_{px}^{(5)} \\
M_{yzzz} &= 2M_{dyz}^{(6)} - T_{fax}^{(3)} - T_{fbx}^{(3)} + T_{px}^{(5)} \\
M_{yzyz} &= -3M_{du}^{(6)} - M_{dv}^{(6)} + T_{f3}^{(3)} \\
M_{yzzx} &= M_{dxy}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} + T_{pz}^{(6)} \\
M_{yzxy} &= -M_{dxz}^{(6)} - T_{fay}^{(3)} - T_{fbz}^{(3)} + T_{py}^{(6)} \\
M_{zxxx} &= 2M_{dxz}^{(6)} - T_{fay}^{(3)} - T_{fbz}^{(3)} + T_{py}^{(5)} \\
M_{zxyy} &= 2T_{fay}^{(3)} + T_{py}^{(5)} + 2T_{py}^{(6)} \\
M_{zxzz} &= -2M_{dxy}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} + T_{py}^{(5)} \\
M_{zxyz} &= -M_{dxy}^{(6)} - T_{faz}^{(3)} - T_{fbz}^{(3)} + T_{pz}^{(6)} \\
M_{zxzx} &= 3M_{du}^{(6)} - M_{dv}^{(6)} + T_{f3}^{(3)} \\
M_{zxxxy} &= M_{dyz}^{(6)} - T_{fax}^{(3)} + T_{fbx}^{(3)} + T_{px}^{(6)} \\
M_{xyxx} &= -2M_{dxy}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} + T_{pz}^{(5)} \\
M_{xyyy} &= 2M_{dxy}^{(6)} - T_{faz}^{(3)} - T_{fbz}^{(3)} + T_{pz}^{(5)} \\
M_{xyzz} &= 2T_{faz}^{(3)} + T_{pz}^{(5)} + 2T_{pz}^{(6)} \\
M_{xyyz} &= M_{dxy}^{(6)} - T_{fay}^{(3)} + T_{fbz}^{(3)} + T_{py}^{(6)} \\
M_{xyzx} &= -M_{dyz}^{(6)} - T_{fax}^{(3)} - T_{fbx}^{(3)} + T_{px}^{(6)} \\
M_{xyxy} &= 2M_{dv}^{(6)} + T_{f3}^{(3)}
\end{aligned}$$

\* Rank 4 tensor (s).

$$\begin{bmatrix} M_{xxxx} & M_{xxyy} & M_{xxzz} & M_{xxyz} & M_{xxzx} & M_{xxxy} & M_{xxzy} & M_{xxxz} & M_{xxyx} \\ M_{yyxx} & M_{yyyy} & M_{yyzz} & M_{yyyz} & M_{yyzx} & M_{yyxy} & M_{yyzy} & M_{yyxz} & M_{yyyx} \\ M_{zzxx} & M_{zzyy} & M_{zzzz} & M_{zzyz} & M_{zzzx} & M_{zzxy} & M_{zzzy} & M_{zzxz} & M_{zzyx} \\ M_{yzxx} & M_{yzyy} & M_{yzzz} & M_{yzyz} & M_{yzzx} & M_{yzxy} & M_{yzzy} & M_{yzxz} & M_{zyyx} \\ M_{zxxx} & M_{zxyy} & M_{zxzz} & M_{zxyz} & M_{zxzx} & M_{zxxy} & M_{zxzy} & M_{zxzz} & M_{zxyx} \\ M_{xyxx} & M_{xyyy} & M_{xyzz} & M_{xyyz} & M_{xyzx} & M_{xyxy} & M_{xyzy} & M_{xyxz} & M_{xyyx} \end{bmatrix}$$

$$M_{xxxx} = -2M_{du}^{(1)} - 4M_{du}^{(2)} + 2M_{dv}^{(1)} + 4M_{dv}^{(2)} - M_{gu}^{(1)} + M_{gv}^{(1)} + 2M_g^{(1)} + M_s^{(1)} + 2M_s^{(2)}$$

$$M_{xxyy} = -2M_{du}^{(1)} - 2M_{dv}^{(3)} + 2M_{gu}^{(1)} - M_g^{(1)} + M_s^{(1)} + 4T_{f3}^{(1)}$$

$$M_{xxzz} = M_{du}^{(1)} + 3M_{du}^{(3)} + M_{dv}^{(1)} - M_{dv}^{(3)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} - 4T_{f3}^{(1)}$$

$$M_{xxyz} = M_{dyz}^{(1)} + M_{dyz}^{(3)} + 2M_{gbx}^{(1)} + 2T_{fax}^{(2)} - 4T_{fbx}^{(1)} + T_{px}^{(3)} + 2T_{px}^{(4)}$$

$$M_{xxzx} = M_{dxx}^{(1)} + 2M_{dxx}^{(2)} + M_{dxx}^{(3)} + 2M_{dxx}^{(5)} - M_{gax}^{(1)} - M_{gbx}^{(1)} + 2T_{fay}^{(1)} - T_{fay}^{(2)} + 2T_{fbx}^{(1)} - T_{fbx}^{(2)} - 2T_{py}^{(1)} + T_{py}^{(3)}$$

$$M_{xxxz} = M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{dxy}^{(3)} - 2M_{dxy}^{(5)} + M_{gaz}^{(1)} - M_{gbz}^{(1)} - 2T_{faz}^{(1)} - T_{faz}^{(2)} + 2T_{fbz}^{(1)} + T_{fbz}^{(2)} + 2T_{pz}^{(1)} + T_{pz}^{(3)}$$

$$M_{xxzy} = M_{dyz}^{(1)} + M_{dyz}^{(3)} + 2M_{gbx}^{(1)} - 2T_{fax}^{(2)} - 4T_{fbx}^{(1)} - T_{px}^{(3)} - 2T_{px}^{(4)}$$

$$M_{xxxz} = M_{dxx}^{(1)} + 2M_{dxx}^{(2)} + M_{dxx}^{(3)} - 2M_{dxx}^{(5)} - M_{gax}^{(1)} - M_{gbx}^{(1)} + 2T_{fay}^{(1)} + T_{fay}^{(2)} + 2T_{fbx}^{(1)} + T_{fbx}^{(2)} - 2T_{py}^{(1)} - T_{py}^{(3)}$$

$$M_{xxyx} = M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{dxy}^{(3)} + 2M_{dxy}^{(5)} - M_{gaz}^{(1)} - M_{gbz}^{(1)} - 2T_{faz}^{(1)} + T_{faz}^{(2)} + 2T_{fbz}^{(1)} - T_{fbz}^{(2)} + 2T_{pz}^{(1)} - T_{pz}^{(3)}$$

$$M_{yyxx} = -2M_{du}^{(1)} + 2M_{dv}^{(3)} + 2M_{gu}^{(1)} - M_g^{(1)} + M_s^{(1)} - 4T_{f3}^{(1)}$$

$$M_{yyyy} = -2M_{du}^{(1)} - 4M_{du}^{(2)} - 2M_{dv}^{(1)} - 4M_{dv}^{(2)} - M_{gu}^{(1)} - M_{gv}^{(1)} + 2M_g^{(1)} + M_s^{(1)} + 2M_s^{(2)}$$

$$M_{yyzz} = M_{du}^{(1)} + 3M_{du}^{(3)} - M_{dv}^{(1)} + M_{dv}^{(3)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} + 4T_{f3}^{(1)}$$

$$M_{yyyz} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{dyz}^{(3)} - 2M_{dyz}^{(5)} + M_{gax}^{(1)} - M_{gbx}^{(1)} - 2T_{fax}^{(1)} - T_{fax}^{(2)} + 2T_{fbx}^{(1)} + T_{fbx}^{(2)} + 2T_{px}^{(1)} + T_{px}^{(3)}$$

$$M_{yyzx} = M_{dxx}^{(1)} + M_{dxx}^{(3)} + 2M_{gbx}^{(1)} + 2T_{fay}^{(2)} - 4T_{fbx}^{(1)} + T_{py}^{(3)} + 2T_{py}^{(4)}$$

$$M_{yyxy} = M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{dxy}^{(3)} - 2M_{dxy}^{(5)} - M_{gaz}^{(1)} - M_{gbz}^{(1)} + 2T_{faz}^{(1)} - T_{faz}^{(2)} + 2T_{fbz}^{(1)} - T_{fbz}^{(2)} - 2T_{pz}^{(1)} + T_{pz}^{(3)}$$

$$M_{yyzy} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{dyz}^{(3)} + 2M_{dyz}^{(5)} + M_{gax}^{(1)} - M_{gbx}^{(1)} - 2T_{fax}^{(1)} + T_{fax}^{(2)} + 2T_{fbx}^{(1)} - T_{fbx}^{(2)} + 2T_{px}^{(1)} - T_{px}^{(3)}$$

$$M_{yyxz} = M_{dxx}^{(1)} + M_{dxx}^{(3)} + 2M_{gbx}^{(1)} - 2T_{fay}^{(2)} - 4T_{fbx}^{(1)} - T_{py}^{(3)} - 2T_{py}^{(4)}$$

$$M_{yyyx} = M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{dxy}^{(3)} - 2M_{dxy}^{(5)} - M_{gaz}^{(1)} - M_{gbx}^{(1)} + 2T_{faz}^{(1)} + T_{faz}^{(2)} + 2T_{fbz}^{(1)} + T_{fbz}^{(2)} - 2T_{pz}^{(1)} - T_{pz}^{(3)}$$

$$M_{zzxx} = M_{du}^{(1)} - 3M_{du}^{(3)} + M_{dv}^{(1)} + M_{dv}^{(3)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} + 4T_{f3}^{(1)}$$

$$M_{zzxy} = M_{du}^{(1)} - 3M_{du}^{(3)} - M_{dv}^{(1)} - M_{dv}^{(3)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} - 4T_{f3}^{(1)}$$

$$M_{zzzz} = 4M_{du}^{(1)} + 8M_{du}^{(2)} + 2M_{gu}^{(1)} + 2M_g^{(1)} + M_s^{(1)} + 2M_s^{(2)}$$

$$M_{zzyz} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{dyz}^{(3)} + 2M_{dyz}^{(5)} - M_{gax}^{(1)} - M_{gbx}^{(1)} + 2T_{fax}^{(1)} - T_{fax}^{(2)} + 2T_{fbx}^{(1)} - T_{fbx}^{(2)} - 2T_{px}^{(1)} + T_{px}^{(3)}$$

$$M_{zzzx} = M_{dxx}^{(1)} + 2M_{dxx}^{(2)} + M_{dxx}^{(3)} - 2M_{dxx}^{(5)} + M_{gax}^{(1)} - M_{gbx}^{(1)} - 2T_{fay}^{(1)} - T_{fay}^{(2)} + 2T_{fbx}^{(1)} + T_{fbx}^{(2)} + 2T_{py}^{(1)} + T_{py}^{(3)}$$

$$M_{zzxy} = M_{dxy}^{(1)} + M_{dxy}^{(3)} + 2M_{gbx}^{(1)} + 2T_{fax}^{(2)} - 4T_{fbx}^{(1)} + T_{pz}^{(3)} + 2T_{pz}^{(4)}$$

$$M_{zzzy} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{dyz}^{(3)} - 2M_{dyz}^{(5)} - M_{gax}^{(1)} - M_{gbx}^{(1)} + 2T_{fax}^{(1)} + T_{fax}^{(2)} + 2T_{fbx}^{(1)} + T_{fbx}^{(2)} - 2T_{px}^{(1)} - T_{px}^{(3)}$$

$$M_{zzxz} = M_{dxx}^{(1)} + 2M_{dxx}^{(2)} + M_{dxx}^{(3)} + 2M_{dxx}^{(5)} + M_{gax}^{(1)} - M_{gbx}^{(1)} - 2T_{fay}^{(1)} + T_{fay}^{(2)} + 2T_{fbx}^{(1)} - T_{fbx}^{(2)} + 2T_{py}^{(1)} - T_{py}^{(3)}$$

$$M_{zzyx} = M_{dxy}^{(1)} + M_{dxy}^{(3)} + 2M_{gbx}^{(1)} - 2T_{faz}^{(2)} - 4T_{fbz}^{(1)} - T_{pz}^{(3)} - 2T_{pz}^{(4)}$$

$$M_{yzxx} = M_{dyz}^{(1)} - M_{dyz}^{(3)} + 2M_{gbx}^{(1)} + 4T_{fbx}^{(1)}$$

$$M_{yzyy} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} - M_{dyz}^{(3)} + M_{gax}^{(1)} - M_{gbx}^{(1)} + 2T_{fax}^{(1)} - 2T_{fbx}^{(1)} - 2T_{px}^{(1)}$$

$$M_{yzzz} = M_{dyz}^{(1)} + 2M_{dyz}^{(2)} - M_{dyz}^{(3)} - M_{gax}^{(1)} - M_{gbx}^{(1)} - 2T_{fax}^{(1)} - 2T_{fbx}^{(1)} + 2T_{px}^{(1)}$$

$$M_{yzyz} = M_{du}^{(2)} - 3M_{du}^{(5)} - M_{dv}^{(2)} - M_{dv}^{(5)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} + T_{f3}^{(2)}$$

$$M_{yzzx} = M_{dxy}^{(2)} - M_{dxy}^{(5)} + 2M_{gbx}^{(1)} - 4T_{faz}^{(1)} - T_{faz}^{(2)} - T_{fbz}^{(1)} - T_{fbz}^{(2)} + T_{pz}^{(1)} + T_{pz}^{(4)}$$

$$M_{yzxy} = M_{dxx}^{(2)} + M_{dxx}^{(5)} + 2M_{gbx}^{(1)} + 4T_{fay}^{(1)} - T_{fay}^{(2)} + T_{fbx}^{(2)} + T_{py}^{(1)} + T_{py}^{(4)}$$

$$M_{yzzy} = M_{du}^{(2)} + 3M_{du}^{(5)} - M_{dv}^{(2)} + M_{dv}^{(5)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} - T_{f3}^{(2)}$$

$$M_{yzxz} = M_{dyz}^{(2)} + M_{dyz}^{(5)} + 2M_{gbx}^{(1)} - 4T_{faz}^{(1)} + T_{faz}^{(2)} + T_{fbz}^{(1)} - T_{fbz}^{(2)} - T_{pz}^{(1)} - T_{pz}^{(4)}$$

$$M_{yzyx} = M_{dxx}^{(2)} - M_{dxx}^{(5)} + 2M_{gbx}^{(1)} + 4T_{fay}^{(1)} + T_{fay}^{(2)} - T_{fbx}^{(2)} + T_{py}^{(1)} - T_{py}^{(4)}$$

$$M_{zxxx} = M_{dxx}^{(1)} + 2M_{dxx}^{(2)} - M_{dxx}^{(3)} - M_{gax}^{(1)} - M_{gbx}^{(1)} - 2T_{fay}^{(1)} - 2T_{fbx}^{(1)} + 2T_{py}^{(1)}$$

$$M_{zxyy} = M_{dxx}^{(1)} - M_{dxx}^{(3)} + 2M_{gbx}^{(1)} + 4T_{fbx}^{(1)}$$

$$M_{zxzz} = M_{dxx}^{(1)} + 2M_{dxx}^{(2)} - M_{dxx}^{(3)} + M_{gax}^{(1)} - M_{gbx}^{(1)} + 2T_{fay}^{(1)} - 2T_{fbx}^{(1)} - 2T_{py}^{(1)}$$

$$M_{zxyz} = M_{dyz}^{(2)} + M_{dyz}^{(5)} + 2M_{gbx}^{(1)} + 4T_{faz}^{(1)} - T_{faz}^{(2)} + T_{fbz}^{(2)} + T_{pz}^{(1)} + T_{pz}^{(4)}$$

$$M_{zxzx} = M_{du}^{(2)} + 3M_{du}^{(5)} + M_{dv}^{(2)} - M_{dv}^{(5)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} + T_{f3}^{(2)}$$

$$M_{zxyy} = M_{dyz}^{(2)} - M_{dyz}^{(5)} + 2M_{gbx}^{(1)} - 4T_{faz}^{(1)} - T_{faz}^{(2)} - T_{fbx}^{(2)} - T_{px}^{(1)} + T_{px}^{(4)}$$

$$M_{zxzy} = M_{dyz}^{(2)} - M_{dyz}^{(5)} + 2M_{gbx}^{(1)} + 4T_{faz}^{(1)} + T_{faz}^{(2)} - T_{fbz}^{(2)} + T_{pz}^{(1)} - T_{pz}^{(4)}$$

$$M_{zxxz} = M_{du}^{(2)} - 3M_{du}^{(5)} + M_{dv}^{(2)} + M_{dv}^{(5)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} - T_{f3}^{(2)}$$

\* Rank 4 tensor (a).

$$\begin{bmatrix} M_{yzxx} & M_{yzyy} & M_{yzzz} & M_{yzyz} & M_{yzxx} & M_{yzxy} & M_{yzyy} & M_{yzxz} & M_{yzyx} \\ M_{zxxy} & M_{zxyy} & M_{zxzz} & M_{zxyz} & M_{zxzx} & M_{zxxz} & M_{zxyy} & M_{zxzz} & M_{zxyx} \\ M_{xyxx} & M_{xyyy} & M_{xyzz} & M_{xyyz} & M_{xyzx} & M_{xyxy} & M_{xyzz} & M_{xyxz} & M_{xyyx} \end{bmatrix}$$

$$\begin{aligned} M_{yzxx} &= 2T_{fax}^{(3)} + T_{px}^{(5)} + 2T_{px}^{(6)} \\ M_{yzyy} &= -2M_{dyz}^{(6)} - T_{fax}^{(3)} + T_{fbx}^{(3)} + T_{px}^{(5)} \\ M_{yzzz} &= 2M_{dyz}^{(6)} - T_{fax}^{(3)} - T_{fbx}^{(3)} + T_{px}^{(5)} \\ M_{yzyz} &= -2M_{du}^{(4)} - 3M_{du}^{(6)} + 2M_{dv}^{(4)} - M_{dv}^{(6)} + M_s^{(3)} + T_{f3}^{(3)} \\ M_{yzxx} &= 2M_{dxy}^{(4)} + M_{dxy}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} - T_{pz}^{(2)} + T_{pz}^{(6)} \\ M_{yzxy} &= 2M_{dxz}^{(4)} - M_{dxz}^{(6)} - T_{fay}^{(3)} - T_{fbz}^{(3)} + T_{py}^{(2)} + T_{py}^{(6)} \\ M_{yzyy} &= 2M_{du}^{(4)} - 3M_{du}^{(6)} - 2M_{dv}^{(4)} - M_{dv}^{(6)} - M_s^{(3)} + T_{f3}^{(3)} \\ M_{yzxx} &= -2M_{dxy}^{(4)} + M_{dxy}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} + T_{pz}^{(2)} + T_{pz}^{(6)} \\ M_{yzyx} &= -2M_{dxz}^{(4)} - M_{dxz}^{(6)} - T_{fay}^{(3)} - T_{fbz}^{(3)} - T_{py}^{(2)} + T_{py}^{(6)} \\ M_{zxxy} &= 2M_{dxz}^{(6)} - T_{fay}^{(3)} - T_{fbz}^{(3)} + T_{py}^{(5)} \\ M_{zxyy} &= 2T_{fay}^{(3)} + T_{py}^{(5)} + 2T_{py}^{(6)} \\ M_{zxzz} &= -2M_{dxz}^{(6)} - T_{fay}^{(3)} + T_{fbz}^{(3)} + T_{py}^{(5)} \\ M_{zxyz} &= 2M_{dxy}^{(4)} - M_{dxy}^{(6)} - T_{faz}^{(3)} - T_{fbz}^{(3)} + T_{pz}^{(2)} + T_{pz}^{(6)} \\ M_{zxzx} &= -2M_{du}^{(4)} + 3M_{du}^{(6)} - 2M_{dv}^{(4)} - M_{dv}^{(6)} + M_s^{(3)} + T_{f3}^{(3)} \\ M_{zxxxy} &= 2M_{dyz}^{(4)} + M_{dyz}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} - T_{px}^{(2)} + T_{px}^{(6)} \\ M_{zxzy} &= -2M_{dxy}^{(4)} - M_{dxy}^{(6)} - T_{faz}^{(3)} - T_{fbz}^{(3)} - T_{pz}^{(2)} + T_{pz}^{(6)} \\ M_{zxzz} &= 2M_{du}^{(4)} + 3M_{du}^{(6)} + 2M_{dv}^{(4)} - M_{dv}^{(6)} - M_s^{(3)} + T_{f3}^{(3)} \\ M_{zxyx} &= -2M_{dyz}^{(4)} + M_{dyz}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} + T_{px}^{(2)} + T_{px}^{(6)} \\ M_{xyxx} &= -2M_{dxy}^{(6)} - T_{faz}^{(3)} + T_{fbz}^{(3)} + T_{pz}^{(5)} \\ M_{xyyy} &= 2M_{dyz}^{(6)} - T_{faz}^{(3)} - T_{fbz}^{(3)} + T_{pz}^{(5)} \\ M_{xyzz} &= 2T_{faz}^{(3)} + T_{pz}^{(5)} + 2T_{pz}^{(6)} \\ M_{xyyz} &= 2M_{dxz}^{(4)} + M_{dxz}^{(6)} - T_{fay}^{(3)} + T_{fbz}^{(3)} - T_{py}^{(2)} + T_{py}^{(6)} \\ M_{xyzx} &= 2M_{dyz}^{(4)} - M_{dyz}^{(6)} - T_{faz}^{(3)} - T_{fbz}^{(3)} + T_{px}^{(2)} + T_{px}^{(6)} \\ M_{xyxy} &= 4M_{du}^{(4)} + 2M_{dv}^{(6)} + M_s^{(3)} + T_{f3}^{(3)} \\ M_{xyzy} &= -2M_{dxz}^{(4)} + M_{dxz}^{(6)} - T_{fay}^{(3)} + T_{fbz}^{(3)} + T_{py}^{(2)} + T_{py}^{(6)} \\ M_{xyxz} &= -2M_{dyz}^{(4)} - M_{dyz}^{(6)} - T_{faz}^{(3)} - T_{fbz}^{(3)} - T_{px}^{(2)} + T_{px}^{(6)} \\ M_{xyyx} &= -4M_{du}^{(4)} + 2M_{dv}^{(6)} - M_s^{(3)} + T_{f3}^{(3)} \end{aligned}$$

\* Rank 4 tensor (t).

$$\left[ \begin{array}{ccc} M_{xxxx} & M_{xxyy} & M_{xxxz} \\ M_{yyyx} & M_{yyyy} & M_{yyyz} \\ M_{zzzx} & M_{zzzy} & M_{zzzz} \\ M_{yyzx} & M_{yyzy} & M_{yyzz} \\ M_{zzxx} & M_{zzxy} & M_{zzzz} \\ M_{xxxy} & M_{xxyy} & M_{xxyz} \\ M_{yzxx} & M_{yzyy} & M_{yzzz} \\ M_{zxzx} & M_{zxxy} & M_{zxzz} \\ M_{xyyy} + M_{yyzz} - M_{yzyy} - M_{zxzx} + M_{zzxx} & M_{xyyz} & M_{xyyz} \\ -\frac{M_{yyyz}}{2} + \frac{M_{yuzu}}{2} + M_{zxyy} & M_{xyyz} + \frac{M_{zxxz}}{2} - \frac{M_{zxxz}}{2} - \frac{M_{xxxy}}{2} + M_{xyyy} - M_{yyyz} + M_{zzxy} \end{array} \right]$$

$$\begin{aligned}
M_{xxxx} &= -2M_{du}^{(1)} - 4M_{du}^{(2)} + 2M_{dv}^{(1)} + 4M_{dv}^{(2)} - M_{gu}^{(1)} + M_{gv}^{(1)} + 2M_g^{(1)} + 3M_s^{(1)} \\
M_{xxyy} &= M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{dxy}^{(3)} - 2M_{dxy}^{(5)} + M_{gaz}^{(1)} - M_{gbz}^{(1)} \\
M_{xxxz} &= M_{dxz}^{(1)} + 2M_{dxz}^{(2)} + M_{dxz}^{(3)} - 2M_{dxz}^{(5)} - M_{gay}^{(1)} - M_{gby}^{(1)} \\
M_{yyxx} &= M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{dxy}^{(3)} - 2M_{dxy}^{(5)} - M_{gaz}^{(1)} - M_{gbz}^{(1)} \\
M_{yyyy} &= -2M_{du}^{(1)} - 4M_{du}^{(2)} - 2M_{dv}^{(1)} - 4M_{dv}^{(2)} - M_{gu}^{(1)} - M_{gv}^{(1)} + 2M_g^{(1)} + 3M_s^{(1)} \\
M_{yyyz} &= M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{dyz}^{(3)} - 2M_{dyz}^{(5)} + M_{gax}^{(1)} - M_{gbx}^{(1)} \\
M_{zzzx} &= M_{daz}^{(1)} + 2M_{daz}^{(2)} + M_{daz}^{(3)} - 2M_{daz}^{(5)} + M_{gay}^{(1)} - M_{gby}^{(1)} \\
M_{zzzy} &= M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{dyz}^{(3)} - 2M_{dyz}^{(5)} - M_{gax}^{(1)} - M_{gbx}^{(1)} \\
M_{zzzz} &= 4M_{du}^{(1)} + 8M_{du}^{(2)} + 2M_{gu}^{(1)} + 2M_g^{(1)} + 3M_s^{(1)} \\
M_{yyzx} &= M_{daz}^{(1)} + M_{daz}^{(3)} + 2M_{gbz}^{(1)} \\
M_{yyzy} &= M_{dyz}^{(1)} + 2M_{dyz}^{(2)} + M_{dyz}^{(3)} + 2M_{dyz}^{(5)} + M_{gax}^{(1)} - M_{gbx}^{(1)} \\
M_{yyzz} &= M_{du}^{(1)} + 3M_{du}^{(3)} - M_{dv}^{(1)} + M_{dv}^{(3)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} \\
M_{zzxx} &= M_{du}^{(1)} - 3M_{du}^{(3)} + M_{dv}^{(1)} + M_{dv}^{(3)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} \\
M_{zzxy} &= M_{dxy}^{(1)} + M_{dxy}^{(3)} + 2M_{gbz}^{(1)} \\
M_{zzxz} &= M_{daz}^{(1)} + 2M_{daz}^{(2)} + M_{daz}^{(3)} + 2M_{daz}^{(5)} + M_{gay}^{(1)} - M_{gby}^{(1)} \\
M_{xxyx} &= M_{dxy}^{(1)} + 2M_{dxy}^{(2)} + M_{dxy}^{(3)} + 2M_{dxy}^{(5)} + M_{gaz}^{(1)} - M_{gbz}^{(1)} \\
M_{xxyy} &= -2M_{du}^{(1)} - 2M_{dv}^{(3)} + 2M_{gu}^{(1)} - M_g^{(1)} + M_s^{(1)} \\
M_{xxyz} &= M_{dyz}^{(1)} + M_{dyz}^{(3)} + 2M_{gbx}^{(1)} \\
M_{yzzx} &= M_{dxy}^{(2)} - M_{dxy}^{(5)} + 2M_{gbz}^{(1)} \\
M_{yzyy} &= M_{du}^{(2)} + 3M_{du}^{(5)} - M_{dv}^{(2)} + M_{dv}^{(5)} - M_{gu}^{(1)} + M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} \\
M_{yzzz} &= M_{dyz}^{(1)} + 2M_{dyz}^{(2)} - M_{dyz}^{(3)} - M_{gax}^{(1)} - M_{gbx}^{(1)} \\
M_{zxxx} &= M_{daz}^{(1)} + 2M_{daz}^{(2)} - M_{daz}^{(3)} - M_{gay}^{(1)} - M_{gby}^{(1)} \\
M_{zxxz} &= M_{dyz}^{(2)} - M_{dyz}^{(5)} + 2M_{gbx}^{(1)} \\
M_{zxxz} &= M_{du}^{(2)} - 3M_{du}^{(5)} + M_{dv}^{(2)} + M_{dv}^{(5)} - M_{gu}^{(1)} - M_{gv}^{(1)} - M_g^{(1)} + M_s^{(1)} \\
M_{xyyy} &= M_{dxy}^{(1)} + 2M_{dxy}^{(2)} - M_{dxy}^{(3)} - M_{gaz}^{(1)} - M_{gbz}^{(1)} \\
M_{xyyz} &= M_{daz}^{(2)} - M_{daz}^{(5)} + 2M_{gbz}^{(1)}
\end{aligned}$$