$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{77} \quad -\mathrm{k}^{\mathrm{bi}}_{78}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{39}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{40} \quad -\mathrm{k}^{\mathrm{bi}}_{45} \quad -\mathrm{k}^{\mathrm{bi}}_{75}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{CH_3Br}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{76}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{CF_2Cl_2}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{63}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{N_2O}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{37} \quad -\mathrm{k}^{\mathrm{bi}}_{61}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{32}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{O(^1D)}]} = +2\mathrm{k}^{\mathrm{bi}}_{78}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{77} \quad -\mathrm{k}^{\mathrm{bi}}_{78}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{N_2O}]\,\partial[\mathrm{O(^1D)}]} = +2\mathrm{k}^{\mathrm{bi}}_{37}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{CF_2Cl_2}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{63}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{CF_2Cl_2}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{63}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{CH_3Br}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{76}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{39}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{45}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{39}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{75}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{39}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{40}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{O(^1D)}]} = +2\mathrm{k}^{\mathrm{bi}}_{32}$$

$$\frac{\partial^2[\mathrm{CH_3}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{40}$$

$$\frac{\partial^2[\mathrm{CH_3O}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{75}$$

$$\frac{\partial^2[\mathrm{CH_3O}]}{\partial[\mathrm{CH_3Br}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{76}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = +\mathrm{k}^{\mathrm{bi}}_{45}$$

$$\frac{\partial^2[\mathrm{CH_4}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{40} \quad -\mathrm{k}^{\mathrm{bi}}_{45} \quad -\mathrm{k}^{\mathrm{bi}}_{75}$$

$$\frac{\partial^2[\mathrm{CH_3Br}]}{\partial[\mathrm{CH_3Br}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{76}$$

$$\frac{\partial^2[\mathrm{CF_2Cl_2}]}{\partial[\mathrm{CF_2Cl_2}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{63}$$

$$\frac{\partial^2[\mathrm{N_2O}]}{\partial[\mathrm{N_2O}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}^{\mathrm{bi}}_{37} \quad -\mathrm{k}^{\mathrm{bi}}_{61}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{O(^1D)}]} = -\mathrm{k}_{32}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{O(^3P)}]} = -4\mathrm{k}_{93}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{1}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{91}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{36}^{\mathrm{bi}} \quad -\mathrm{k}_{88}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{21}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{28}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{74}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{34}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{35}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{27}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{CO}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{96}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{1}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = -\mathrm{k}_{91}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{36}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{91}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = -\mathrm{k}_{36}^{\mathrm{bi}} \quad -\mathrm{k}_{88}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{88}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{28}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{21}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = -\mathrm{k}_{21}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{28}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = -\mathrm{k}_{28}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{74}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = -\mathrm{k}_{74}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = +\mathrm{k}_{34}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{O}(^3\mathrm{P})]} = -\mathrm{k}_{34}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{O(^3P)}]} = +\mathrm{k}_{35}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{O(^3P)}]} = +\mathrm{k}_{27}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{O(^3P)}]} = +\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{35}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{O(^3P)}]} = +\mathrm{k}_{27}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O_2}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{27}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{O(^3P)}]} = +\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CO}]}{\partial[\mathrm{CO}]\,\partial[\mathrm{O(^3P)}]} = -\mathrm{k}_{96}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{CO_2}]}{\partial[\mathrm{CO}]\,\partial[\mathrm{O(^3P)}]} = +\mathrm{k}_{96}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{77}^{\mathrm{bi}} \quad -\mathrm{k}_{78}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{O_3}]} = +2\mathrm{k}_{78}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{1}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{77}^{\mathrm{bi}} \quad -\mathrm{k}_{78}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_1^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_8^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_9^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{20}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{65}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{H}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{10}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_2^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_3^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_8^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{O_3}]} = +\mathrm{k}_8^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_9^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{O_3}]} = +\mathrm{k}_9^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{20}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{O_3}]} = +\mathrm{k}_{20}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{65}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{O_3}]} = +\mathrm{k}_{65}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{H}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{10}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H}]\,\partial[\mathrm{O_3}]} = +\mathrm{k}_{10}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{2}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{O_3}]} = +\mathrm{k}_{3}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{O_3}]} = +\mathrm{k}_{2}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{O_3}]} = -\mathrm{k}_{3}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{NO}]\,\partial[\mathrm{N}]} = +\mathrm{k}_{38}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{N}]} = +\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{N}]} = -\mathrm{k}_{38}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{N}]} = -\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{N}]} = -\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{N}]} = -\mathrm{k}_{38}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{N}]} = +\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{N}]} = -\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{N}]} = +\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{N}]} = -\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N_2O}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{N}]} = +\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{91}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{N}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{38}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{8}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N}]}{\partial[\mathrm{N}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{38}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{91}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{8}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{N}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{38}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO_3}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{60}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{53}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{91}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{8}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_3}]\,\partial[\mathrm{NO}]} = +2\mathrm{k}_{60}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{53}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{NO_3}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{60}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{53}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{53}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{NO}]} = +\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{NO}]} = -\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{36}^{\mathrm{bi}} \quad -\mathrm{k}_{88}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{N}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{9}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N}]}{\partial[\mathrm{N}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{36}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{H}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{36}^{\mathrm{bi}} \quad -\mathrm{k}_{88}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{9}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{N}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_3}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{89}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{86}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{94}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{H}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{85}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{87}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{88}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{9}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{NO_3}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{89}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{N_2O_5}]}{\partial[\mathrm{NO_3}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{89}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{85}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{HO_2NO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{87}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{86}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{86}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{94}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{94}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{H}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{85}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{NO_2}]} = -\mathrm{k}_{87}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{N_2O}]}{\partial[\mathrm{N}]\,\partial[\mathrm{NO_2}]} = +\mathrm{k}_{64}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{NO_3}]} = -\mathrm{k}_{60}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{NO_3}]} = +2\mathrm{k}_{60}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{NO_3}]} = -\mathrm{k}_{89}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{NO_3}]} = -\mathrm{k}_{60}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{NO_3}]} = -\mathrm{k}_{89}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{N_2O_5}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{NO_3}]} = +\mathrm{k}_{89}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{N_2O_5}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{N_2O_5}]} = -\mathrm{k}_{157}^{\mathrm{h}} \quad -\mathrm{k}_{158}^{\mathrm{h}}$$

$$\frac{\partial^2[N_2O_5]}{\partial[HBr]\,\partial[N_2O_5]} = -k^h_{182} \quad -k^h_{183}$$

$$\frac{\partial^2[N_2O_5]}{\partial[H_2O]\,\partial[N_2O_5]} = -k^{bi}_{62} \quad -k^h_{154} \quad -k^h_{155} \quad -k^h_{156}$$

$$\frac{\partial^2[HNO_3]}{\partial[HCl]\,\partial[N_2O_5]} = +k^h_{157} \quad +k^h_{158}$$

$$\frac{\partial^2[HNO_3]}{\partial[HBr]\,\partial[N_2O_5]} = +k^h_{182} \quad +k^h_{183}$$

$$\frac{\partial^2[HNO_3]}{\partial[H_2O]\,\partial[N_2O_5]} = +2k^{bi}_{62} \quad +2k^h_{154} \quad +2k^h_{155} \quad +2k^h_{156}$$

$$\frac{\partial^2[ClNO_2]}{\partial[HCl]\,\partial[N_2O_5]} = +k^h_{157} \quad +k^h_{158}$$

$$\frac{\partial^2[HCl]}{\partial[HCl]\,\partial[N_2O_5]} = -k^h_{157} \quad -k^h_{158}$$

$$\frac{\partial^2[BrONO]}{\partial[HBr]\,\partial[N_2O_5]} = +k^h_{182} \quad +k^h_{183}$$

$$\frac{\partial^2[HBr]}{\partial[HBr]\,\partial[N_2O_5]} = -k^h_{182} \quad -k^h_{183}$$

$$\frac{\partial^2[H_2O]}{\partial[H_2O]\,\partial[N_2O_5]} = -k^{bi}_{62} \quad -k^h_{154} \quad -k^h_{155} \quad -k^h_{156}$$

$$\frac{\partial^2[NO_3]}{\partial[OH]\,\partial[HNO_3]} = +k^{bi}_{30}$$

$$\frac{\partial^2[HNO_3]}{\partial[OH]\,\partial[HNO_3]} = -k^{bi}_{30}$$

$$\frac{\partial^2[OH]}{\partial[OH]\,\partial[HNO_3]} = -k^{bi}_{30}$$

$$\frac{\partial^2[H_2O]}{\partial[OH]\,\partial[HNO_3]} = +k^{bi}_{30}$$

$$\frac{\partial^2[NO_2]}{\partial[OH]\,\partial[HO_2NO_2]} = +k_{44}^{bi}$$

$$\frac{\partial^2[HO_2NO_2]}{\partial[OH]\,\partial[HO_2NO_2]} = -k_{44}^{bi}$$

$$\frac{\partial^2[OH]}{\partial[OH]\,\partial[HO_2NO_2]} = -k_{44}^{bi}$$

$$\frac{\partial^2[H_2O]}{\partial[OH]\,\partial[HO_2NO_2]} = +k_{44}^{bi}$$

$$\frac{\partial^2[O_3]}{\partial[O_3]\,\partial[Cl]} = -k_{20}^{bi}$$

$$\frac{\partial^2[Cl]}{\partial[O_3]\,\partial[Cl]} = -k_{20}^{bi}$$

$$\frac{\partial^2[Cl]}{\partial[H_2]\,\partial[Cl]} = -k_{19}^{bi}$$

$$\frac{\partial^2[Cl]}{\partial[HO_2]\,\partial[Cl]} = -k_{43}^{bi} \quad -k_{54}^{bi}$$

$$\frac{\partial^2[Cl]}{\partial[H_2O_2]\,\partial[Cl]} = -k_{5}^{bi}$$

$$\frac{\partial^2[Cl]}{\partial[HCHO]\,\partial[Cl]} = -k_{51}^{bi}$$

$$\frac{\partial^2[Cl]}{\partial[CH_4]\,\partial[Cl]} = -k_{22}^{bi}$$

$$\frac{\partial^2[ClO]}{\partial[O_3]\,\partial[Cl]} = +k_{20}^{bi}$$

$$\frac{\partial^2[ClO]}{\partial[HO_2]\,\partial[Cl]} = +k_{54}^{bi}$$

$$\frac{\partial^2[HCl]}{\partial[H_2]\,\partial[Cl]} = +k_{19}^{bi}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{43}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{5}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{51}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{22}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{Cl}]} = -\mathrm{k}_{19}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{19}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{54}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{Cl}]} = -\mathrm{k}_{43}^{\mathrm{bi}} \quad -\mathrm{k}_{54}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{5}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O_2}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{Cl}]} = -\mathrm{k}_{5}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{22}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{Cl}]} = +\mathrm{k}_{51}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{Cl}]} = -\mathrm{k}_{51}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_4}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{Cl}]} = -\mathrm{k}_{22}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{21}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{86}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{21}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{48}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{81}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{21}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{24}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{86}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{ClO}]} = -4\mathrm{k}_{95}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{70}^{\mathrm{bi}} \quad -\mathrm{k}_{71}^{\mathrm{bi}} \quad -\mathrm{k}_{72}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{48}^{\mathrm{bi}} \quad -\mathrm{k}_{49}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_4^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{81}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClOO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{71}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OClO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{70}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl_2O_2}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{ClO}]} = +2\mathrm{k}_{95}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{86}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{49}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_4^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{70}^{\mathrm{bi}} \quad +\mathrm{k}_{71}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{70}^{\mathrm{bi}} \quad -\mathrm{k}_{71}^{\mathrm{bi}} \quad -\mathrm{k}_{72}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{72}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_{48}^{\mathrm{bi}} \quad -\mathrm{k}_{49}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{ClO}]} = +\mathrm{k}_{48}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{ClO}]} = -\mathrm{k}_4^{\mathrm{bi}}$$

$$\frac{\partial^2[CH_3O]}{\partial[CH_3O_2]\,\partial[ClO]} = +k_{81}^{bi}$$

$$\frac{\partial^2[CH_3O_2]}{\partial[CH_3O_2]\,\partial[ClO]} = -k_{81}^{bi}$$

$$\frac{\partial^2[O(^3P)]}{\partial[O(^3P)]\,\partial[ClONO_2]} = -k_{28}^{bi}$$

$$\frac{\partial^2[NO_3]}{\partial[O(^3P)]\,\partial[ClONO_2]} = +k_{28}^{bi}$$

$$\frac{\partial^2[NO_3]}{\partial[OH]\,\partial[ClONO_2]} = +k_{11}^{bi}$$

$$\frac{\partial^2[HNO_3]}{\partial[HCl]\,\partial[ClONO_2]} = +k_{148}^{h} +k_{149}^{h} +k_{150}^{h}$$

$$\frac{\partial^2[HNO_3]}{\partial[HBr]\,\partial[ClONO_2]} = +k_{171}^{h} +k_{177}^{h} +k_{178}^{h}$$

$$\frac{\partial^2[HNO_3]}{\partial[H_2O]\,\partial[ClONO_2]} = +k_{151}^{h} +k_{152}^{h} +k_{153}^{h}$$

$$\frac{\partial^2[Cl_2]}{\partial[HCl]\,\partial[ClONO_2]} = +k_{148}^{h} +k_{149}^{h} +k_{150}^{h}$$

$$\frac{\partial^2[ClO]}{\partial[O(^3P)]\,\partial[ClONO_2]} = +k_{28}^{bi}$$

$$\frac{\partial^2[ClONO_2]}{\partial[O(^3P)]\,\partial[ClONO_2]} = -k_{28}^{bi}$$

$$\frac{\partial^2[ClONO_2]}{\partial[HCl]\,\partial[ClONO_2]} = -k_{148}^{h} -k_{149}^{h} -k_{150}^{h}$$

$$\frac{\partial^2[ClONO_2]}{\partial[HBr]\,\partial[ClONO_2]} = -k_{171}^{h} -k_{177}^{h} -k_{178}^{h}$$

$$\frac{\partial^2[ClONO_2]}{\partial[OH]\,\partial[ClONO_2]} = -k_{11}^{bi}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{ClONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{151} \quad -\mathrm{k}^{\mathrm{h}}_{152} \quad -\mathrm{k}^{\mathrm{h}}_{153}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{ClONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{148} \quad -\mathrm{k}^{\mathrm{h}}_{149} \quad -\mathrm{k}^{\mathrm{h}}_{150}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{ClONO_2}]} = +\mathrm{k}^{\mathrm{bi}}_{11}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{ClONO_2}]} = +\mathrm{k}^{\mathrm{h}}_{151} \quad +\mathrm{k}^{\mathrm{h}}_{152} \quad +\mathrm{k}^{\mathrm{h}}_{153}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{ClONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{171} \quad -\mathrm{k}^{\mathrm{h}}_{177} \quad -\mathrm{k}^{\mathrm{h}}_{178}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{ClONO_2}]} = +\mathrm{k}^{\mathrm{h}}_{171} \quad +\mathrm{k}^{\mathrm{h}}_{177} \quad +\mathrm{k}^{\mathrm{h}}_{178}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{ClONO_2}]} = -\mathrm{k}^{\mathrm{bi}}_{11}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{ClONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{151} \quad -\mathrm{k}^{\mathrm{h}}_{152} \quad -\mathrm{k}^{\mathrm{h}}_{153}$$

$$\frac{\partial^2[\mathrm{N_2O_5}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{157} \quad -\mathrm{k}^{\mathrm{h}}_{158}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{157} \quad +\mathrm{k}^{\mathrm{h}}_{158}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{148} \quad +\mathrm{k}^{\mathrm{h}}_{149} \quad +\mathrm{k}^{\mathrm{h}}_{150}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{174} \quad +\mathrm{k}^{\mathrm{h}}_{175} \quad +\mathrm{k}^{\mathrm{h}}_{176}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{bi}}_{23}$$

$$\frac{\partial^2[\mathrm{Cl_2}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{148} \quad +\mathrm{k}^{\mathrm{h}}_{149} \quad +\mathrm{k}^{\mathrm{h}}_{150}$$

$$\frac{\partial^2[\mathrm{Cl_2}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{159} \quad +\mathrm{k}^{\mathrm{h}}_{160} \quad +\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{ClNO_2}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{157} \quad +\mathrm{k}^{\mathrm{h}}_{158}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{148} \quad -\mathrm{k}^{\mathrm{h}}_{149} \quad -\mathrm{k}^{\mathrm{h}}_{150}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{157} \quad -\mathrm{k}^{\mathrm{h}}_{158}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{148} \quad -\mathrm{k}^{\mathrm{h}}_{149} \quad -\mathrm{k}^{\mathrm{h}}_{150}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{159} \quad -\mathrm{k}^{\mathrm{h}}_{160} \quad -\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{174} \quad -\mathrm{k}^{\mathrm{h}}_{175} \quad -\mathrm{k}^{\mathrm{h}}_{176}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{165} \quad -\mathrm{k}^{\mathrm{h}}_{166} \quad -\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{bi}}_{23}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{159} \quad -\mathrm{k}^{\mathrm{h}}_{160} \quad -\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{174} \quad -\mathrm{k}^{\mathrm{h}}_{175} \quad -\mathrm{k}^{\mathrm{h}}_{176}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{h}}_{165} \quad -\mathrm{k}^{\mathrm{h}}_{166} \quad -\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{174} \quad +\mathrm{k}^{\mathrm{h}}_{175} \quad +\mathrm{k}^{\mathrm{h}}_{176}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{165} \quad +\mathrm{k}^{\mathrm{h}}_{166} \quad +\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCl}]} = -\mathrm{k}^{\mathrm{bi}}_{23}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{159} +\mathrm{k}^{\mathrm{h}}_{160} +\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{h}}_{165} +\mathrm{k}^{\mathrm{h}}_{166} +\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCl}]} = +\mathrm{k}^{\mathrm{bi}}_{23}$$

$$\frac{\partial^2[\mathrm{Cl_2}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOCl}]} = +\mathrm{k}^{\mathrm{h}}_{159} +\mathrm{k}^{\mathrm{h}}_{160} +\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HOCl}]} = +\mathrm{k}^{\mathrm{bi}}_{50}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOCl}]} = -\mathrm{k}^{\mathrm{h}}_{159} -\mathrm{k}^{\mathrm{h}}_{160} -\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOCl}]} = -\mathrm{k}^{\mathrm{h}}_{159} -\mathrm{k}^{\mathrm{h}}_{160} -\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOCl}]} = -\mathrm{k}^{\mathrm{h}}_{168} -\mathrm{k}^{\mathrm{h}}_{169} -\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HOCl}]} = -\mathrm{k}^{\mathrm{bi}}_{50}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOCl}]} = -\mathrm{k}^{\mathrm{h}}_{168} -\mathrm{k}^{\mathrm{h}}_{169} -\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOCl}]} = +\mathrm{k}^{\mathrm{h}}_{168} +\mathrm{k}^{\mathrm{h}}_{169} +\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HOCl}]} = -\mathrm{k}^{\mathrm{bi}}_{50}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOCl}]} = +\mathrm{k}^{\mathrm{h}}_{159} +\mathrm{k}^{\mathrm{h}}_{160} +\mathrm{k}^{\mathrm{h}}_{161}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOCl}]} = +\mathrm{k}^{\mathrm{h}}_{168} +\mathrm{k}^{\mathrm{h}}_{169} +\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HOCl}]} = +\mathrm{k}^{\mathrm{bi}}_{50}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{Br}]} = -\mathrm{k}^{\mathrm{bi}}_{65}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{Br}]} = -\mathrm{k}^{\mathrm{bi}}_{65}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{Br}]} = -\mathrm{k}^{\mathrm{bi}}_{66}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{Br}]} = -\mathrm{k}^{\mathrm{bi}}_{56}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{Br}]} = +\mathrm{k}^{\mathrm{bi}}_{65}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{Br}]} = +\mathrm{k}^{\mathrm{bi}}_{66}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{Br}]} = +\mathrm{k}^{\mathrm{bi}}_{56}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{Br}]} = -\mathrm{k}^{\mathrm{bi}}_{66}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{Br}]} = +\mathrm{k}^{\mathrm{bi}}_{56}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{Br}]} = -\mathrm{k}^{\mathrm{bi}}_{56}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{BrO}]} = -\mathrm{k}^{\mathrm{bi}}_{74}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{BrO}]} = -\mathrm{k}^{\mathrm{bi}}_{53}$$

$$\frac{\partial^2[NO_2]}{\partial[NO]\,\partial[BrO]} = +k_{53}^{bi}$$

$$\frac{\partial^2[NO_2]}{\partial[NO_2]\,\partial[BrO]} = -k_{94}^{tri}$$

$$\frac{\partial^2[ClO]}{\partial[ClO]\,\partial[BrO]} = -k_{70}^{bi} \quad -k_{71}^{bi} \quad -k_{72}^{bi}$$

$$\frac{\partial^2[ClOO]}{\partial[ClO]\,\partial[BrO]} = +k_{71}^{bi}$$

$$\frac{\partial^2[OClO]}{\partial[ClO]\,\partial[BrO]} = +k_{70}^{bi}$$

$$\frac{\partial^2[Br]}{\partial[O(^3P)]\,\partial[BrO]} = +k_{74}^{bi}$$

$$\frac{\partial^2[Br]}{\partial[NO]\,\partial[BrO]} = +k_{53}^{bi}$$

$$\frac{\partial^2[Br]}{\partial[ClO]\,\partial[BrO]} = +k_{70}^{bi} \quad +k_{71}^{bi}$$

$$\frac{\partial^2[Br]}{\partial[BrO]\,\partial[BrO]} = +4k_{67}^{bi}$$

$$\frac{\partial^2[Br]}{\partial[CH_3O_2]\,\partial[BrO]} = +k_{80}^{bi}$$

$$\frac{\partial^2[BrO]}{\partial[O(^3P)]\,\partial[BrO]} = -k_{74}^{bi}$$

$$\frac{\partial^2[BrO]}{\partial[NO]\,\partial[BrO]} = -k_{53}^{bi}$$

$$\frac{\partial^2[BrO]}{\partial[NO_2]\,\partial[BrO]} = -k_{94}^{tri}$$

$$\frac{\partial^2[BrO]}{\partial[ClO]\,\partial[BrO]} = -k_{70}^{bi} \quad -k_{71}^{bi} \quad -k_{72}^{bi}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{BrO}]} = -4\mathrm{k}_{67}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{BrO}]} = -\mathrm{k}_{73}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{BrO}]} = -\mathrm{k}_{80}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{BrO}]} = +\mathrm{k}_{94}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{BrO}]} = +\mathrm{k}_{73}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{BrO}]} = +\mathrm{k}_{72}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{BrO}]} = -\mathrm{k}_{73}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{BrO}]} = +\mathrm{k}_{80}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{CH_3O_2}]\,\partial[\mathrm{BrO}]} = -\mathrm{k}_{80}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{BrONO_2}]} = +\mathrm{k}_{174}^{\mathrm{h}} \quad +\mathrm{k}_{175}^{\mathrm{h}} \quad +\mathrm{k}_{176}^{\mathrm{h}}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{BrONO_2}]} = +\mathrm{k}_{172}^{\mathrm{h}} \quad +\mathrm{k}_{173}^{\mathrm{h}}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{BrONO_2}]} = +\mathrm{k}_{179}^{\mathrm{h}} \quad +\mathrm{k}_{180}^{\mathrm{h}} \quad +\mathrm{k}_{181}^{\mathrm{h}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{BrONO_2}]} = -\mathrm{k}_{174}^{\mathrm{h}} \quad -\mathrm{k}_{175}^{\mathrm{h}} \quad -\mathrm{k}_{176}^{\mathrm{h}}$$

$$\frac{\partial^2[\mathrm{Br_2}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{BrONO_2}]} = +\mathrm{k}_{172}^{\mathrm{h}} \quad +\mathrm{k}_{173}^{\mathrm{h}}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{BrONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{174} \quad -\mathrm{k}^{\mathrm{h}}_{175} \quad -\mathrm{k}^{\mathrm{h}}_{176}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{BrONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{172} \quad -\mathrm{k}^{\mathrm{h}}_{173}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{BrONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{179} \quad -\mathrm{k}^{\mathrm{h}}_{180} \quad -\mathrm{k}^{\mathrm{h}}_{181}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{BrONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{172} \quad -\mathrm{k}^{\mathrm{h}}_{173}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{BrONO_2}]} = +\mathrm{k}^{\mathrm{h}}_{179} \quad +\mathrm{k}^{\mathrm{h}}_{180} \quad +\mathrm{k}^{\mathrm{h}}_{181}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{BrONO_2}]} = +\mathrm{k}^{\mathrm{h}}_{174} \quad +\mathrm{k}^{\mathrm{h}}_{175} \quad +\mathrm{k}^{\mathrm{h}}_{176}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{H_2O}]\,\partial[\mathrm{BrONO_2}]} = -\mathrm{k}^{\mathrm{h}}_{179} \quad -\mathrm{k}^{\mathrm{h}}_{180} \quad -\mathrm{k}^{\mathrm{h}}_{181}$$

$$\frac{\partial^2[\mathrm{N_2O_5}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{182} \quad -\mathrm{k}^{\mathrm{h}}_{183}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{182} \quad +\mathrm{k}^{\mathrm{h}}_{183}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{171} \quad +\mathrm{k}^{\mathrm{h}}_{177} \quad +\mathrm{k}^{\mathrm{h}}_{178}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{172} \quad +\mathrm{k}^{\mathrm{h}}_{173}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{171} \quad -\mathrm{k}^{\mathrm{h}}_{177} \quad -\mathrm{k}^{\mathrm{h}}_{178}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{168} \quad -\mathrm{k}^{\mathrm{h}}_{169} \quad -\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{bi}}_{68}$$

$$\frac{\partial^2[\mathrm{Br_2}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{172} \quad +\mathrm{k}^{\mathrm{h}}_{173}$$

$$\frac{\partial^2[\mathrm{Br_2}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{162} \quad +\mathrm{k}^{\mathrm{h}}_{163} \quad +\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{172} \quad -\mathrm{k}^{\mathrm{h}}_{173}$$

$$\frac{\partial^2[\mathrm{BrONO}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{182} \quad +\mathrm{k}^{\mathrm{h}}_{183}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{182} \quad -\mathrm{k}^{\mathrm{h}}_{183}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{171} \quad -\mathrm{k}^{\mathrm{h}}_{177} \quad -\mathrm{k}^{\mathrm{h}}_{178}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{168} \quad -\mathrm{k}^{\mathrm{h}}_{169} \quad -\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{172} \quad -\mathrm{k}^{\mathrm{h}}_{173}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{162} \quad -\mathrm{k}^{\mathrm{h}}_{163} \quad -\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{bi}}_{68}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{h}}_{162} \quad -\mathrm{k}^{\mathrm{h}}_{163} \quad -\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{171} \quad +\mathrm{k}^{\mathrm{h}}_{177} \quad +\mathrm{k}^{\mathrm{h}}_{178}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{168} \quad +\mathrm{k}^{\mathrm{h}}_{169} \quad +\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HBr}]} = -\mathrm{k}^{\mathrm{bi}}_{68}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{168} +\mathrm{k}^{\mathrm{h}}_{169} +\mathrm{k}^{\mathrm{h}}_{170}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HOBr}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{h}}_{162} +\mathrm{k}^{\mathrm{h}}_{163} +\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HBr}]} = +\mathrm{k}^{\mathrm{bi}}_{68}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOBr}]} = -\mathrm{k}^{\mathrm{h}}_{165} -\mathrm{k}^{\mathrm{h}}_{166} -\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{Br_2}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOBr}]} = +\mathrm{k}^{\mathrm{h}}_{162} +\mathrm{k}^{\mathrm{h}}_{163} +\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOBr}]} = -\mathrm{k}^{\mathrm{h}}_{162} -\mathrm{k}^{\mathrm{h}}_{163} -\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOBr}]} = -\mathrm{k}^{\mathrm{h}}_{165} -\mathrm{k}^{\mathrm{h}}_{166} -\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOBr}]} = -\mathrm{k}^{\mathrm{h}}_{162} -\mathrm{k}^{\mathrm{h}}_{163} -\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{BrCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOBr}]} = +\mathrm{k}^{\mathrm{h}}_{165} +\mathrm{k}^{\mathrm{h}}_{166} +\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{HOBr}]} = +\mathrm{k}^{\mathrm{h}}_{165} +\mathrm{k}^{\mathrm{h}}_{166} +\mathrm{k}^{\mathrm{h}}_{167}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{HOBr}]} = +\mathrm{k}^{\mathrm{h}}_{162} +\mathrm{k}^{\mathrm{h}}_{163} +\mathrm{k}^{\mathrm{h}}_{164}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{H_2}]} = -\mathrm{k}^{\mathrm{bi}}_{39}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2}]} = -\mathrm{k}^{\mathrm{bi}}_{19}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2}]} = +\mathrm{k}^{\mathrm{bi}}_{19}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{H_2}]} = -\mathrm{k}_{39}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2}]} = -\mathrm{k}_{19}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2}]} = -\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{H_2}]} = +\mathrm{k}_{39}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2}]} = +\mathrm{k}_{19}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2}]} = +\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{H_2}]} = +\mathrm{k}_{39}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2}]} = -\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2}]} = +\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{H}]} = +\mathrm{k}_{58}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{H}]} = -\mathrm{k}_{10}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{H}]} = +\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{H}]} = -\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{H}]} = +\mathrm{k}_{57}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{H}]} = -\mathrm{k}_{10}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{H}]} = -\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{H}]} = -\mathrm{k}_{57}^{\mathrm{bi}} \quad -\mathrm{k}_{58}^{\mathrm{bi}} \quad -\mathrm{k}_{59}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{H}]} = +\mathrm{k}_{10}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{H}]} = +\mathrm{k}_{79}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{H}]} = +2\mathrm{k}_{59}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{H}]} = -\mathrm{k}_{57}^{\mathrm{bi}} \quad -\mathrm{k}_{58}^{\mathrm{bi}} \quad -\mathrm{k}_{59}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{H}]} = +\mathrm{k}_{58}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{34}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{OH}]\,\partial[\mathrm{OH}]} = +2\mathrm{k}_{47}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{2}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N}]}{\partial[\mathrm{N}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{N}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{85}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{HO_2NO_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{44}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{HNO_3}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{30}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_3}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{11}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{85}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{HNO_3}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{30}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2NO_2}]}{\partial[\mathrm{HO_2NO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{44}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{48}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{23}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{48}^{\mathrm{bi}} \quad -\mathrm{k}_{49}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{50}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{11}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{49}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{23}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{11}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{50}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{68}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{CH_3Br}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{69}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{68}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{34}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{N}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{CO}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{34}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{2}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{N}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{55}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{85}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HNO_3}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{30}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HO_2NO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{44}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{48}^{\mathrm{bi}} \quad -\mathrm{k}_{49}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{11}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{23}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{50}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{68}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{OH}]} = -4\mathrm{k}_{47}^{\mathrm{bi}} \quad -4\mathrm{k}_{84}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{33}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{CH_3OOH}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{12}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{CH_3Br}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{69}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{CO}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{2}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{48}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{33}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{OH}]} = +2\mathrm{k}_{84}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{H_2O_2}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{12}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{CH_3OOH}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3OOH}]}{\partial[\mathrm{CH_3OOH}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_4}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{12}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3Br}]}{\partial[\mathrm{CH_3Br}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{69}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CO}]}{\partial[\mathrm{CO}]\,\partial[\mathrm{OH}]} = -\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CO_2}]}{\partial[\mathrm{CO}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HNO_3}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{30}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HO_2NO_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{44}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HCl}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{23}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HOCl}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{50}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HBr}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{68}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{H_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{26}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{OH}]} = +2\mathrm{k}_{47}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{33}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{H_2O_2}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{CH_3OOH}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{HCHO}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{CH_4}]\,\partial[\mathrm{OH}]} = +\mathrm{k}_{12}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{35}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{H}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{58}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O_3}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{3}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{87}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{HO_2NO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{87}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{43}^{\mathrm{bi}} \quad -\mathrm{k}_{54}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{54}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{4}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{43}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{4}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{66}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{73}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{66}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{73}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{H}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{57}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{H}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{57}^{\mathrm{bi}} \quad -\mathrm{k}_{58}^{\mathrm{bi}} \quad -\mathrm{k}_{59}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{35}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{3}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HO_2}]} = +\mathrm{k}_{54}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{H}]\,\partial[\mathrm{HO_2}]} = +2\mathrm{k}_{59}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{33}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{35}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{O_3}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{3}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{31}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{NO_2}]\,\partial[\mathrm{HO_2}]} = -\mathrm{k}_{87}^{\mathrm{tri}}$$

$$\frac{\partial^2[HO_2]}{\partial[Cl]\,\partial[HO_2]} = -k_{43}^{bi} \quad -k_{54}^{bi}$$

$$\frac{\partial^2[HO_2]}{\partial[ClO]\,\partial[HO_2]} = -k_{4}^{bi}$$

$$\frac{\partial^2[HO_2]}{\partial[Br]\,\partial[HO_2]} = -k_{66}^{bi}$$

$$\frac{\partial^2[HO_2]}{\partial[BrO]\,\partial[HO_2]} = -k_{73}^{bi}$$

$$\frac{\partial^2[HO_2]}{\partial[H]\,\partial[HO_2]} = -k_{57}^{bi} \quad -k_{58}^{bi} \quad -k_{59}^{bi}$$

$$\frac{\partial^2[HO_2]}{\partial[OH]\,\partial[HO_2]} = -k_{33}^{bi}$$

$$\frac{\partial^2[HO_2]}{\partial[HO_2]\,\partial[HO_2]} = -4k_{15}^{bi} \quad -4k_{52}^{bi}$$

$$\frac{\partial^2[HO_2]}{\partial[CH_3O_2]\,\partial[HO_2]} = -k_{18}^{bi}$$

$$\frac{\partial^2[H_2O_2]}{\partial[HO_2]\,\partial[HO_2]} = +2k_{15}^{bi} \quad +2k_{52}^{bi}$$

$$\frac{\partial^2[CH_3O_2]}{\partial[CH_3O_2]\,\partial[HO_2]} = -k_{18}^{bi}$$

$$\frac{\partial^2[CH_3OOH]}{\partial[CH_3O_2]\,\partial[HO_2]} = +k_{18}^{bi}$$

$$\frac{\partial^2[H_2O]}{\partial[H]\,\partial[HO_2]} = +k_{58}^{bi}$$

$$\frac{\partial^2[H_2O]}{\partial[OH]\,\partial[HO_2]} = +k_{33}^{bi}$$

$$\frac{\partial^2[O(^3P)]}{\partial[O(^3P)]\,\partial[H_2O_2]} = -k_{27}^{bi}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2O_2}]} = -\mathrm{k}_5^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2O_2}]} = +\mathrm{k}_5^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{H_2O_2}]} = +\mathrm{k}_{27}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2O_2}]} = -\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{H_2O_2}]} = +\mathrm{k}_{27}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2O_2}]} = +\mathrm{k}_5^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2O_2}]} = +\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O_2}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{H_2O_2}]} = -\mathrm{k}_{27}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O_2}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{H_2O_2}]} = -\mathrm{k}_5^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2O_2}]} = -\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{H_2O_2}]} = +\mathrm{k}_{25}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{CH_3O_2}]} = +\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{CH_3O_2}]} = +\mathrm{k}_{81}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{81}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{CH_3O_2}]} = +\mathrm{k}_{80}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{BrO}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{80}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HO_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{18}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{CH_3O_2}]} = +\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{CH_3O_2}]} = +\mathrm{k}_{81}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{CH_3O_2}]} = +\mathrm{k}_{80}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{NO}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{13}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{ClO}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{81}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{BrO}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{80}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{CH_3O_2}]} = -\mathrm{k}_{18}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3OOH}]}{\partial[\mathrm{HO_2}]\,\partial[\mathrm{CH_3O_2}]} = +\mathrm{k}_{18}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CH_3OOH}]} = -\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3O_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CH_3OOH}]} = +\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3OOH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CH_3OOH}]} = -\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CH_3OOH}]} = +\mathrm{k}_{46}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^3P)}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{51}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{51}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Br}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{56}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HBr}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{56}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{51}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{56}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCO}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{O(^3P)}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{17}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{51}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{Br}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{56}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCHO}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCHO}]} = -\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{HCHO}]} = +\mathrm{k}_{41}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O(^1D)}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{CH_4}]} = -\mathrm{k}_{40}^{\mathrm{bi}} \quad -\mathrm{k}_{45}^{\mathrm{bi}} \quad -\mathrm{k}_{75}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{CH_4}]} = -\mathrm{k}_{22}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{HCl}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{CH_4}]} = +\mathrm{k}_{22}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H_2}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{CH_4}]} = +\mathrm{k}_{45}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{CH_4}]} = +\mathrm{k}_{75}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{CH_4}]} = +\mathrm{k}_{40}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CH_4}]} = -\mathrm{k}_{12}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{CH_4}]} = +\mathrm{k}_{40}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3}]}{\partial[\mathrm{Cl}]\,\partial[\mathrm{CH_4}]} = +\mathrm{k}_{22}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CH_3}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CH_4}]} = +\mathrm{k}_{12}^{\mathrm{bi}}$$

$$\frac{\partial^2[CH_3O]}{\partial[O(^1D)]\,\partial[CH_4]} = +k_{75}^{bi}$$

$$\frac{\partial^2[HCHO]}{\partial[O(^1D)]\,\partial[CH_4]} = +k_{45}^{bi}$$

$$\frac{\partial^2[CH_4]}{\partial[O(^1D)]\,\partial[CH_4]} = -k_{40}^{bi} \quad -k_{45}^{bi} \quad -k_{75}^{bi}$$

$$\frac{\partial^2[CH_4]}{\partial[Cl]\,\partial[CH_4]} = -k_{22}^{bi}$$

$$\frac{\partial^2[CH_4]}{\partial[OH]\,\partial[CH_4]} = -k_{12}^{bi}$$

$$\frac{\partial^2[H_2O]}{\partial[OH]\,\partial[CH_4]} = +k_{12}^{bi}$$

$$\frac{\partial^2[O(^1D)]}{\partial[O(^1D)]\,\partial[CH_3Br]} = -k_{76}^{bi}$$

$$\frac{\partial^2[Br]}{\partial[O(^1D)]\,\partial[CH_3Br]} = +k_{76}^{bi}$$

$$\frac{\partial^2[Br]}{\partial[OH]\,\partial[CH_3Br]} = +k_{69}^{bi}$$

$$\frac{\partial^2[OH]}{\partial[OH]\,\partial[CH_3Br]} = -k_{69}^{bi}$$

$$\frac{\partial^2[CH_3O]}{\partial[O(^1D)]\,\partial[CH_3Br]} = +k_{76}^{bi}$$

$$\frac{\partial^2[CH_3Br]}{\partial[O(^1D)]\,\partial[CH_3Br]} = -k_{76}^{bi}$$

$$\frac{\partial^2[CH_3Br]}{\partial[OH]\,\partial[CH_3Br]} = -k_{69}^{bi}$$

$$\frac{\partial^2[O(^1D)]}{\partial[O(^1D)]\,\partial[CF_2Cl_2]} = -k_{63}^{bi}$$

$$\frac{\partial^2[\mathrm{Cl}]}{\partial[\mathrm{O}(^1\mathrm{D})]\,\partial[\mathrm{CF_2Cl_2}]} = +\mathrm{k}_{63}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{ClO}]}{\partial[\mathrm{O}(^1\mathrm{D})]\,\partial[\mathrm{CF_2Cl_2}]} = +\mathrm{k}_{63}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CF_2Cl_2}]}{\partial[\mathrm{O}(^1\mathrm{D})]\,\partial[\mathrm{CF_2Cl_2}]} = -\mathrm{k}_{63}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^3\mathrm{P})]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{CO}]} = -\mathrm{k}_{96}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{H}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CO}]} = +\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CO}]} = -\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CO}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{CO}]} = -\mathrm{k}_{96}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{CO}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CO}]} = -\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{CO_2}]}{\partial[\mathrm{O}(^3\mathrm{P})]\,\partial[\mathrm{CO}]} = +\mathrm{k}_{96}^{\mathrm{tri}}$$

$$\frac{\partial^2[\mathrm{CO_2}]}{\partial[\mathrm{OH}]\,\partial[\mathrm{CO}]} = +\mathrm{k}_{29}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^1\mathrm{D})]}{\partial[\mathrm{O}(^1\mathrm{D})]\,\partial[\mathrm{N_2O}]} = -\mathrm{k}_{37}^{\mathrm{bi}} \quad -\mathrm{k}_{61}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{NO}]}{\partial[\mathrm{O}(^1\mathrm{D})]\,\partial[\mathrm{N_2O}]} = +2\mathrm{k}_{37}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N_2O}]}{\partial[\mathrm{O}(^1\mathrm{D})]\,\partial[\mathrm{N_2O}]} = -\mathrm{k}_{37}^{\mathrm{bi}} \quad -\mathrm{k}_{61}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{O}(^1\mathrm{D})]}{\partial[\mathrm{O}(^1\mathrm{D})]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}_{32}^{\mathrm{bi}}$$

$$\frac{\partial^2[\mathrm{N_2O_5}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}^{\mathrm{bi}}_{62} \quad -\mathrm{k}^{\mathrm{h}}_{154} \quad -\mathrm{k}^{\mathrm{h}}_{155} \quad -\mathrm{k}^{\mathrm{h}}_{156}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{H_2O}]} = +2\mathrm{k}^{\mathrm{bi}}_{62} \quad +2\mathrm{k}^{\mathrm{h}}_{154} \quad +2\mathrm{k}^{\mathrm{h}}_{155} \quad +2\mathrm{k}^{\mathrm{h}}_{156}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{H_2O}]} = +\mathrm{k}^{\mathrm{h}}_{151} \quad +\mathrm{k}^{\mathrm{h}}_{152} \quad +\mathrm{k}^{\mathrm{h}}_{153}$$

$$\frac{\partial^2[\mathrm{HNO_3}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{H_2O}]} = +\mathrm{k}^{\mathrm{h}}_{179} \quad +\mathrm{k}^{\mathrm{h}}_{180} \quad +\mathrm{k}^{\mathrm{h}}_{181}$$

$$\frac{\partial^2[\mathrm{ClONO_2}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}^{\mathrm{h}}_{151} \quad -\mathrm{k}^{\mathrm{h}}_{152} \quad -\mathrm{k}^{\mathrm{h}}_{153}$$

$$\frac{\partial^2[\mathrm{HOCl}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{H_2O}]} = +\mathrm{k}^{\mathrm{h}}_{151} \quad +\mathrm{k}^{\mathrm{h}}_{152} \quad +\mathrm{k}^{\mathrm{h}}_{153}$$

$$\frac{\partial^2[\mathrm{BrONO_2}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}^{\mathrm{h}}_{179} \quad -\mathrm{k}^{\mathrm{h}}_{180} \quad -\mathrm{k}^{\mathrm{h}}_{181}$$

$$\frac{\partial^2[\mathrm{HOBr}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{H_2O}]} = +\mathrm{k}^{\mathrm{h}}_{179} \quad +\mathrm{k}^{\mathrm{h}}_{180} \quad +\mathrm{k}^{\mathrm{h}}_{181}$$

$$\frac{\partial^2[\mathrm{OH}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{H_2O}]} = +2\mathrm{k}^{\mathrm{bi}}_{32}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{O(^1D)}]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}^{\mathrm{bi}}_{32}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{N_2O_5}]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}^{\mathrm{bi}}_{62} \quad -\mathrm{k}^{\mathrm{h}}_{154} \quad -\mathrm{k}^{\mathrm{h}}_{155} \quad -\mathrm{k}^{\mathrm{h}}_{156}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{ClONO_2}]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}^{\mathrm{h}}_{151} \quad -\mathrm{k}^{\mathrm{h}}_{152} \quad -\mathrm{k}^{\mathrm{h}}_{153}$$

$$\frac{\partial^2[\mathrm{H_2O}]}{\partial[\mathrm{BrONO_2}]\,\partial[\mathrm{H_2O}]} = -\mathrm{k}^{\mathrm{h}}_{179} \quad -\mathrm{k}^{\mathrm{h}}_{180} \quad -\mathrm{k}^{\mathrm{h}}_{181}$$