Mechanism for bromine containing species:

Reaction	k $[(\text{molec. cm}^{-3})^{1-n}\text{s}^{-1}]$	Reaction order n	Reference	Reaction No.
$O_3 + h\nu \rightarrow O + O_2$	$4.70\ 10^{-7}$	1	Lehrer et al. (2004)	(R1)
$C_2H_5 + O_2(+M) \rightarrow C_2H_5O_2(+M)$	$7.12\ 10^{-12}$	2	Atkinson et al. (2006)	(R2)
$O + O_2 \rightarrow O_3$	$4.20\ 10^{-11}$	2	Atkinson et al. (2006)	(R3)
$O + H_2O \rightarrow 2OH$	$2.30\ 10^{-10}$	2	Atkinson et al. (2006)	(R4)
$Br + O_3 \rightarrow BrO + O_2$	$7.65\ 10^{-13}$	2	Atkinson et al. (2006)	(R5)
$Br_2 + h\nu \rightarrow 2Br$	0.021	1	Lehrer et al. (2004)	(R6)
$BrO + h\nu \xrightarrow{O_2} Br + O_3$	0.014	1	Lehrer et al. (2004)	(R7)
$BrO + BrO \rightarrow 2Br + O_2$	$1.92\ 10^{-12}$	2	Atkinson et al. (2006)	(R8)
$BrO + BrO \rightarrow Br_2 + O_2$	$5.42\ 10^{-13}$	2	Atkinson et al. (2006)	(R9)
$BrO + HO_2 \rightarrow HOBr + O_2$	$4.31\ 10^{-11}$	2	Atkinson et al. (2006)	(R10)
$HOBr + h\nu \rightarrow Br + OH$	$3.00\ 10^{-4}$	1	Lehrer et al. (2004)	(R11)
$CO + OH \xrightarrow{O_2} HO_2 + CO_2$	$2.40\ 10^{-13}$	2	Atkinson et al. (2006)	(R12)
$Br + HO_2 \rightarrow HBr + O_2$	$1.42\ 10^{-12}$	2	Atkinson et al. (2006)	(R13)
$HOBr + HBr \xrightarrow{\text{aerosol}} Br_2 + H_2O$	See text			(R14)
$HOBr + H^+ + Br^- \xrightarrow{\text{snow/ice}} Br_2 + H_2O$	See text			(R15)
$Br + HCHO \xrightarrow{O_2} HBr + CO + HO_2$	$7.65\ 10^{-13}$	2	Atkinson et al. (2006)	(R16)
$Br + CH_3CHO \xrightarrow{O_2} HBr + CH_3CO_3$	$3.22\ 10^{-12}$	2	Atkinson et al. (2006)	(R17)
$Br_2 + OH \rightarrow HOBr + Br$	$5.66\ 10^{-11}$	2	Atkinson et al. (2006)	(R18)
$HBr + OH \rightarrow H_2O + Br$	$1.23\ 10^{-11}$	2	Atkinson et al. (2006)	(R19)
$Br + C_2H_2 \xrightarrow{3O_2} 2CO + 2HO_2 + Br$	$4.20\ 10^{-14}$	2	Borken (1996)	(R20)
$Br + C_2H_2 \xrightarrow{2O_2} 2CO + HO_2 + HBr$	$8.92\ 10^{-14}$	2	Borken (1996)	(R21)
$Br + C_2H_4 \xrightarrow{3.5O_2} 2CO + 2HO_2 + Br + H_2O$	$2.53\ 10^{-13}$	2	Barnes et al. (1993)	(R22)
$Br + C_2H_4 \xrightarrow{2.5O_2} 2CO + HO_2 + HBr + H_2O$	$5.34\ 10^{-13}$	2	Barnes et al. (1993)	(R23)
$CH_4 + OH \xrightarrow{O_2} CH_3O_2 + H_2O$	$2.46\ 10^{-15}$	2	Atkinson et al. (2006)	(R24)
$BrO + CH_3O_2 \rightarrow Br + HCHO + HO_2$	$1.60\ 10^{-12}$	2	Aranda et al. (1997)	(R25)
$BrO + CH_3O_2 \rightarrow HOBr + HCHO + 0.5O_2$	$4.10\ 10^{-12}$	2	Aranda et al. (1997)	(R26)
$OH + O_3 \rightarrow HO_2 + O_2$	$3.94\ 10^{-14}$	2	Atkinson et al. (2006)	(R27)
$OH + HO_2 \rightarrow H_2O + O_2$	$1.26\ 10^{-10}$	2	Atkinson et al. (2006)	(R28)
$OH + H_2O_2 \rightarrow HO_2 + H_2O$	$1.56\ 10^{-12}$	2	Atkinson et al. (2006)	(R29)
$OH + OH \xrightarrow{O_2} H_2O + O_3$	$2.12\ 10^{-12}$	2	Atkinson et al. (2006)	(R30)
$HO_2 + O_3 \rightarrow OH + 2O_2$	$1.37\ 10^{-15}$	2	Atkinson et al. (2006)	(R31)
$HO_2 + HO_2 \rightarrow O_2 + H_2O_2$	$4.65\ 10^{-12}$	2	Atkinson et al. (2006)	(R32)
$C_2H_6 + OH \rightarrow C_2H_5 + H_2O$	$1.46\ 10^{-13}$	2	Atkinson et al. (2006)	(R33)
$C_2H_5 + O_2 \rightarrow C_2H_4 + HO_2$	$3.80\ 10^{-15}$	2	Atkinson et al. (2006)	(R34)
$C_2H_4 + OH \xrightarrow{1.5O_2} CH_3O_2 + CO + H_2O$	$8.20\ 10^{-12}$	2	Atkinson et al. (2006)	(R35)
$C_2H_4 + O_3 \rightarrow HCHO + CO + H_2O$	$4.33\ 10^{-19}$	2	Sander et al. (1997)	(R36)
$C_2H_2 + OH \xrightarrow{1.5O_2} HCHO + CO + HO_2$	$7.50\ 10^{-13}$	2	Atkinson et al. (2006)	(R37)
$C_3H_8 + OH \xrightarrow{2O_2} C_2H_5O_2 + CO + 2H_2O$	$8.13\ 10^{-13}$	2	Atkinson et al. (2006)	(R38)
$HCHO + OH \xrightarrow{O_2} CO + H_2O + HO_2$	$9.29\ 10^{-12}$	2	Atkinson et al. (2006)	(R39)
$CH_3CHO + OH \xrightarrow{O_2} CH_3CO_3 + H_2O$	$1.86\ 10^{-11}$	2	Atkinson et al. (2006)	(R40)
$CH_3O_2 + HO_2 \rightarrow CH_3O_2H + O_2$	$7.81\ 10^{-12}$	2	Atkinson et al. (2006)	(R41)
$CH_3OOH + OH \rightarrow CH_3O_2 + H_2O$	$3.97\ 10^{-12}$	2	Atkinson et al. (2006)	(R42)
$CH_3OOH + OH \rightarrow HCHO + OH + H_2O$	$2.09\ 10^{-12}$	2	Atkinson et al. (2006)	(R43)
$CH_3OOH + Br \rightarrow CH_3O_2 + HBr$	$5.19\ 10^{-15}$	2	Atkinson et al. (2006)	(R44)
$CH_3O_2 + CH_3O_2 \rightarrow CH_3OH + HCHO + O_2$	$3.06\ 10^{-13}$	2	Atkinson et al. (2006)	(R45)
$CH_3O_2 + CH_3O_2 \xrightarrow{O_2} 2HCHO + 2HO_2$	$1.50\ 10^{-13}$	2	Atkinson et al. (2006)	(R46)
$CH_3OH + OH \xrightarrow{O_2} HCHO + HO_2 + H_2O$	$7.68\ 10^{-13}$	2	Atkinson et al. (2006)	(R47)
$C_2H_5O_2 + C_2H_5O_2 \rightarrow C_2H_5O + C_2H_5O + O_2$	$6.80\ 10^{-14}$	2	Atkinson et al. (2006)	(R48)
$C_2H_5O + O_2 \rightarrow CH_3CHO + HO_2$	$7.44\ 10^{-15}$	2	Sander et al. (1997)	(R49)
$C_2H_5O + O_2 \rightarrow CH_3O_2 + HCHO$	$7.51\ 10^{-17}$	2	Sander et al. (1997)	(R50)
$C_2H_5O_2 + HO_2 \rightarrow C_2H_5OOH + O_2$	$1.31\ 10^{-11}$	2	Atkinson et al. (2006)	(R51)
$C_2H_5OOH + OH \rightarrow C_2H_5O_2 + H_2O$	$8.21\ 10^{-12}$	2	Sander et al. (1997)	(R52)
$C_2H_5OOH + Br \rightarrow C_2H_5O_2 + HBr$	$5.19\ 10^{-15}$	2	Sander et al. (1997)	(R53)
$OH + OH(+M) \xrightarrow{O_2} H_2O + O_3(+M)$	$5.21\ 10^{-12}$	2	Atkinson et al. (2006)	(R54)
$H_2O_2 + h\nu \rightarrow 2OH$	$2.00\ 10^{-6}$	1	Lehrer et al. (2004)	(R55)

Mechanism for nitrogen containing species:

Reaction	k $[(\text{molec. cm}^{-3})^{1-n}\text{s}^{-1}]$	Reaction order n	Reference	Reaction No.
$NO + O_3 \rightarrow NO_2 + O_2$	$8.89\ 10^{-15}$	2	Atkinson et al. (2006)	(R56)
$NO + HO_2 \rightarrow NO_2 + OH$	$9.38\ 10^{-12}$	2	Atkinson et al. (2006)	(R57)
$NO_2 + O_3 \rightarrow NO_3 + O_2$	$9.02\ 10^{-18}$	2	Atkinson et al. (2006)	(R58)
$NO_2 + OH \rightarrow HNO_3$	$1.62\ 10^{-11}$	2	Atkinson et al. (2006)	(R59)
$NO + NO_3 \rightarrow 2NO_2$	$2.76\ 10^{-11}$	2	Atkinson et al. (2006)	(R60)
$HONO + OH \rightarrow NO_2 + H_2O$	$7.40\ 10^{-12}$	2	Atkinson et al. (2006)	(R61)
$HO_2 + NO_2 \rightarrow HNO_4$	$1.61\ 10^{-12}$	2	Atkinson et al. (2006)	(R62)
$HNO_4 \rightarrow NO_2 + HO_2$	$4.02\ 10^{-4}$	1	Atkinson et al. (2006)	(R63)
$HNO_4 + OH \rightarrow NO_2 + H_2O + O_2$	$6.05\ 10^{-12}$	2	Atkinson et al. (2006)	(R64)
$NO + OH \rightarrow HONO$	$1.36\ 10^{-11}$	2	Atkinson et al. (2006)	(R65)
$OH + NO_3 \rightarrow NO_2 + HO_2$	$2.00\ 10^{-11}$	2	Atkinson et al. (2006)	(R66)
$HNO_3 + h\nu \rightarrow NO_2 + OH$	$4.40\ 10^{-8}$	1	Lehrer et al. (2004)	(R67)
$NO_2 + h\nu \xrightarrow{O_2} NO + O_3$	$3.50\ 10^{-3}$	1	Lehrer et al. (2004)	(R68)
$NO_3 + h\nu \rightarrow NO_2 + O$	$1.40\ 10^{-1}$	1	Lehrer et al. (2004)	(R69)
$NO_3 + h\nu \rightarrow NO + O_2$	$1.70\ 10^{-2}$	1	Lehrer et al. (2004)	(R70)
$NO + CH_3O_2 \xrightarrow{O_2} HCHO + HO_2 + NO_2$	$8.44\ 10^{-12}$	2	Atkinson et al. (2006)	(R71)
$NO_3 + CH_3OH \xrightarrow{O_2} HCHO + HO_2 + HNO_3$	$6.38\ 10^{-17}$	2	Atkinson et al. (2006)	(R72)
$NO_3 + HCHO \xrightarrow{O_2} CO + HO_2 + HNO_3$	$5.80\ 10^{-16}$	2	Atkinson et al. (2006)	(R73)
$NO + C_2H_5O_2 \xrightarrow{O_2} CH_3CHO + NO_2 + HO_2$	$8.70\ 10^{-12}$	2	Atkinson et al. (2006)	(R74)
$NO + CH_3CO_3 \xrightarrow{O_2} CH_3O_2 + NO_2 + CO_2$	$2.00\ 10^{-11}$	2	Atkinson et al. (2006)	(R75)
$NO_2 + CH_3CO_3 \rightarrow PAN$	$1.33\ 10^{-12}$	2	Atkinson et al. (2006)	(R76)
$Br + NO_2 \rightarrow BrNO_2$	$5.03\ 10^{-12}$	2	Atkinson et al. (2006)	(R77)
$Br + NO_3 \rightarrow BrO + NO_2$	$1.60\ 10^{-11}$	2	Atkinson et al. (2006)	(R78)
$BrO + NO_2 \rightarrow BrONO_2$	$3.89\ 10^{-12}$	2	Atkinson et al. (2006)	(R79)
$BrO + NO \rightarrow Br + NO_2$	$2.38\ 10^{-11}$	2	Atkinson et al. (2006)	(R80)
$BrONO_2 + h\nu \rightarrow NO_3 + Br$	$3.40\ 10^{-4}$	1	Lehrer et al. (2004)	(R81)
$BrNO_2 + h\nu \rightarrow NO_2 + Br$	$9.30\ 10^{-5}$	1	Lehrer et al. (2004)	(R82)
$BrONO_2 + H_2O \xrightarrow{\text{aerosol}} HOBr + HNO_3$	See text			(R83)
$PAN + h\nu \rightarrow NO_2 + CH_3CO_3$	$3.03\ 10^{-7}$	1	DeMore et al. (1997)	(R84)
$HNO_3 + h\nu \xrightarrow{\text{aerosol}} OH + NO_2$	See text			(R85)
$BrONO_2 + H_2O \xrightarrow{\text{ice/snow}} HOBr + HNO_3$	See text			(R86)

Mechanism for chlorine containing species:

Reaction	k $[(\text{molec. cm}^{-3})^{1-n}\text{s}^{-1}]$	Reaction order n	Reference	Reaction No.
$CH_3OOH + Cl \rightarrow CH_3O_2 + HCl$	$5.70\ 10^{-11}$	2	Atkinson et al. (2006)	(R87)
$C_2H_5O_2H + Cl \rightarrow C_2H_5O_2 + HCl$	$5.70\ 10^{-11}$	2	Sander et al. (1997)	(R88)
$HO_2 + Cl \rightarrow O_2 + HCl$	$3.48\ 10^{-11}$	2	Atkinson et al. (2006)	(R89)
$HO_2 + Cl \rightarrow OH + ClO$	$7.17\ 10^{-12}$	2	Atkinson et al. (2006)	(R90)
$H_2O_2 + Cl \rightarrow HO_2 + HCl$	$2.46\ 10^{-13}$	2	Atkinson et al. (2006)	(R91)
$O_3 + Cl \rightarrow O_2 + ClO$	$1.06\ 10^{-11}$	2	Atkinson et al. (2006)	(R92)
$CH_4 + Cl \xrightarrow{O_2} CH_3O_2 + HCl$	$5.13\ 10^{-14}$	2	Atkinson et al. (2006)	(R93)
$C_2H_2 + Cl \xrightarrow{3O_2} 2CO + 2HO_2 + Cl$	$2.00\ 10^{-11}$	2	Borken (1996)	(R94)
$C_2H_2 + Cl \xrightarrow{2O_2} 2CO + HO_2 + HCl$	$4.24\ 10^{-11}$	2	Borken (1996)	(R95)
$C_2H_4 + Cl \xrightarrow{3.5O_2} 2CO + 2HO_2 + Cl + H_2O$	$3.92\ 10^{-11}$	2	Atkinson et al. (2006)	(R96)
$C_2H_4 + Cl \xrightarrow{2.5O_2} 2CO + HO_2 + HCl + H_2O$	$8.32\ 10^{-11}$	2	Atkinson et al. (2006)	(R97)
$C_2H_6 + Cl \rightarrow C_2H_5 + HCl$	$5.60\ 10^{-11}$	2	Atkinson et al. (2006)	(R98)
$C_3H_8 + Cl \xrightarrow{2.5O_2} C_2H_5O_2 + CO_2 + HCl + H_2O$	$1.40\ 10^{-10}$	2	Atkinson et al. (2006)	(R99)
$HCHO + Cl \xrightarrow{O_2} CO + HCl + HO_2$	$7.19\ 10^{-11}$	2	Atkinson et al. (2006)	(R100)
$CH_3CHO + Cl \xrightarrow{O_2} HCl + CH_3CO_3$	$7.20\ 10^{-11}$	2	Atkinson et al. (2006)	(R101)
$OH + Cl_2 \rightarrow Cl + HOCl$	$4.28\ 10^{-14}$	2	Atkinson et al. (2006)	(R102)
$OH + HCl \rightarrow Cl + H_2O$	$6.68\ 10^{-13}$	2	Atkinson et al. (2006)	(R103)
$OH + HOCl \rightarrow ClO + H_2O$	$4.32\ 10^{-13}$	2	Atkinson et al. (2006)	(R104)
$OH + ClO \rightarrow Cl + HO_2$	$1.72\ 10^{-11}$	2	Atkinson et al. (2006)	(R105)
$OH + ClO \rightarrow HCl + O_2$	$3.50\ 10^{-13}$	2	Atkinson et al. (2006)	(R106)
$ClO + ClO \rightarrow Cl_2 + O_2$	$2.11\ 10^{-15}$	2	Atkinson et al. (2006)	(R107)
$ClO + ClO \rightarrow 2Cl + O_2$	$2.25\ 10^{-15}$	2	Atkinson et al. (2006)	(R108)
$ClO + ClO \rightarrow Cl + OClO$	$1.73\ 10^{-15}$	2	Atkinson et al. (2006)	(R109)
$ClO + ClO(+M) \rightarrow Cl_2O_2(+M)$	$4.42\ 10^{-13}$	2	Atkinson et al. (2006)	(R110)
$Cl_2O_2(+M) \rightarrow ClO + ClO(+M)$	$4.81\ 10^{-1}$	1	Atkinson et al. (2006)	(R111)
$ClO + HO_2 \rightarrow HOCl + O_2$	$7.21\ 10^{-12}$	2	Atkinson et al. (2006)	(R112)
$ClO + CH_3O_2 \rightarrow Cl + HCHO + HO_2$	$1.36\ 10^{-12}$	2	Atkinson et al. (2006)	(R113)
$ClO + NO \rightarrow Cl + NO_2$	$1.94\ 10^{-11}$	2	Atkinson et al. (2006)	(R114)
$ClO + NO_2(+M) \rightarrow ClONO_2(+M)$	$2.77\ 10^{-12}$	2	Atkinson et al. (2006)	(R115)
$Cl + ClONO_2 \rightarrow Cl_2 + NO_3$	$1.26\ 10^{-11}$	2	Atkinson et al. (2006)	(R116)
$OClO + NO \rightarrow ClO + NO_2$	$2.44\ 10^{-13}$	2	DeMore et al. (1997)	(R117)
$ClONO_2 + OH \rightarrow HOCl + NO_3$	$3.34\ 10^{-13}$	2	Atkinson et al. (2006)	(R118)
$ClO + BrO \rightarrow Br + OClO$	$8.47\ 10^{-12}$	2	Atkinson et al. (2006)	(R119)
$ClO + BrO \rightarrow Br + Cl + O_2$	$6.80\ 10^{-12}$	2	Atkinson et al. (2006)	(R120)
$ClO + BrO \rightarrow BrCl + O_2$	$1.12\ 10^{-12}$	2	Atkinson et al. (2006)	(R121)
$Br + OClO \rightarrow BrO + ClO$	$1.69\ 10^{-13}$	2	Atkinson et al. (2006)	(R122)
$Br + Cl_2O_2 \rightarrow BrCl + ClOO$	$3.00\ 10^{-12}$	2	Atkinson et al. (2006)	(R123)
$Br_2 + Cl \rightarrow BrCl + Br$	$1.20\ 10^{-10}$	2	Sander et al. (1997)	(R124)
$BrCl + Br \rightarrow Br_2 + Cl$	$3.30\ 10^{-15}$	2	Sander et al. (1997)	(R125)
$Br + Cl_2 \rightarrow BrCl + Cl$	$1.10\ 10^{-15}$	2	Sander et al. (1997)	(R126)
$BrCl + Cl \rightarrow Br + Cl_2$	$1.50\ 10^{-11}$	2	Sander et al. (1997)	(R127)
$HOBr + HCl \xrightarrow{\text{aerosol}} BrCl + H_2O$	See text			(R128)
$HOBr + H^+ + Cl^- \xrightarrow{\text{snow/ice}} BrCl + H_2O$	See text			(R129)
$BrCl + h\nu \rightarrow Br + Cl$	$5.70\ 10^{-3}$	1	Lehrer et al. (2004)	(R130)
$Cl_2 + h\nu \rightarrow 2Cl$	$8.50\ 10^{-4}$	1	Lehrer et al. (2004)	(R131)
$ClO + h\nu \xrightarrow{O_2} Cl + O_3$	$5.00\ 10^{-7}$	1	Lehrer et al. (2004)	(R132)
$HOCl + h\nu \rightarrow Cl + OH$	$8.60\ 10^{-5}$	1	Lehrer et al. (2004)	(R133)
$ClONO_2 + h\nu \rightarrow Cl + NO_3$	$1.30\ 10^{-2}$	1	Lehrer et al. (2004)	(R134)
$OClO + h\nu \rightarrow ClO + O$	$3.60\ 10^{-2}$	1	Lehrer et al. (2004)	(R135)