

2.6 Haloalkanes of General Formula $C_nH_{2n+2-(k+l+m)}A_kB_lE_m$ (A,B,E - elements of halogen series)

Bromochlorodifluoromethane**[353-59-3]****CBrClF₂****MW = 165.36****583**

Table 1. Coefficients of the polynomial expansion equation. Standard deviations (see introduction): $\sigma_{c,w} = 9.8106 \cdot 10^{-1}$ (combined temperature ranges, weighted), $\sigma_{c,uw} = 2.7210 \cdot 10^{-1}$ (combined temperature ranges, unweighted).

| Coefficient | $T = 233.15 \text{ to } 393.15 \text{ K}$ $\rho = A + BT + CT^2 + DT^3 + \dots$ |
|-------------|--|
| A | $2.57395 \cdot 10^3$ |
| B | $-1.11086 \cdot 10^{-4}$ |
| C | $-2.27845 \cdot 10^{-2}$ |
| D | $7.67205 \cdot 10^{-5}$ |
| E | $-9.92952 \cdot 10^{-8}$ |

Table 2. Experimental values with uncertainties and deviation from calculated values.

| $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{\rho_{\text{exp}} - \rho_{\text{calc}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. (Symbol in Fig. 1) | $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{\rho_{\text{exp}} - \rho_{\text{calc}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. (Symbol in Fig. 1) |
|---------------|--|--|-------------------------|---------------|--|--|-------------------------|
| 233.15 | 2013.00 ± 1.00 | -1.32 | 1973-per/ale(□) | 323.15 | 1700.00 ± 1.00 | -0.78 | 1973-per/ale(□) |
| 243.15 | 1983.00 ± 1.00 | 0.32 | 1973-per/ale(□) | 333.15 | 1658.00 ± 1.00 | -0.73 | 1973-per/ale(□) |
| 253.15 | 1951.00 ± 1.00 | 0.37 | 1973-per/ale(□) | 343.15 | 1614.00 ± 1.00 | -0.22 | 1973-per/ale(□) |
| 263.15 | 1919.00 ± 1.00 | 0.96 | 1973-per/ale(□) | 353.15 | 1567.00 ± 1.00 | 0.07 | 1973-per/ale(□) |
| 273.15 | 1886.00 ± 1.00 | 1.25 | 1973-per/ale(□) | 363.15 | 1517.00 ± 1.00 | 0.53 | 1973-per/ale(□) |
| 283.15 | 1851.00 ± 1.00 | 0.41 | 1973-per/ale(□) | 373.15 | 1464.00 ± 1.00 | 1.54 | 1973-per/ale(□) |
| 293.15 | 1815.00 ± 1.00 | -0.35 | 1973-per/ale(□) | 383.15 | 1406.00 ± 1.00 | 1.53 | 1973-per/ale(□) |
| 303.15 | 1778.00 ± 1.00 | -0.81 | 1973-per/ale(□) | 393.15 | 1340.00 ± 1.00 | -2.07 | 1973-per/ale(□) |
| 313.15 | 1740.00 ± 1.00 | -0.71 | 1973-per/ale(□) | | | | |

Further references: [1952-eis].**Table 3.** Recommended values (fit to the reliable experimental values according to the equations

$$\rho = A + BT + CT^2 + DT^3 + \dots \text{ or } \rho = [1 + 1.75(1 - T/T_c)^{1/3} + 0.75(1 - T/T_c)][\rho_c + A(T_c - T) + B(T_c - T)^2 + C(T_c - T)^3 + D(T_c - T)^4].$$

| $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ |
|---------------|--|---------------|--|---------------|--|
| 230.00 | 2024.22 ± 1.44 | 293.15 | 1815.35 ± 1.01 | 350.00 | 1582.15 ± 1.01 |
| 240.00 | 1992.68 ± 1.28 | 298.15 | 1797.26 ± 0.99 | 360.00 | 1532.73 ± 1.07 |
| 250.00 | 1960.78 ± 1.19 | 300.00 | 1790.47 ± 0.98 | 370.00 | 1479.88 ± 1.15 |
| 260.00 | 1928.37 ± 1.14 | 310.00 | 1752.89 ± 0.95 | 380.00 | 1423.19 ± 1.29 |
| 270.00 | 1895.32 ± 1.11 | 320.00 | 1713.57 ± 0.93 | 390.00 | 1362.23 ± 1.53 |
| 280.00 | 1861.46 ± 1.07 | 330.00 | 1672.22 ± 0.94 | 400.00 | 1296.54 ± 1.93 |
| 290.00 | 1826.58 ± 1.03 | 340.00 | 1628.53 ± 0.97 | | |

cont.

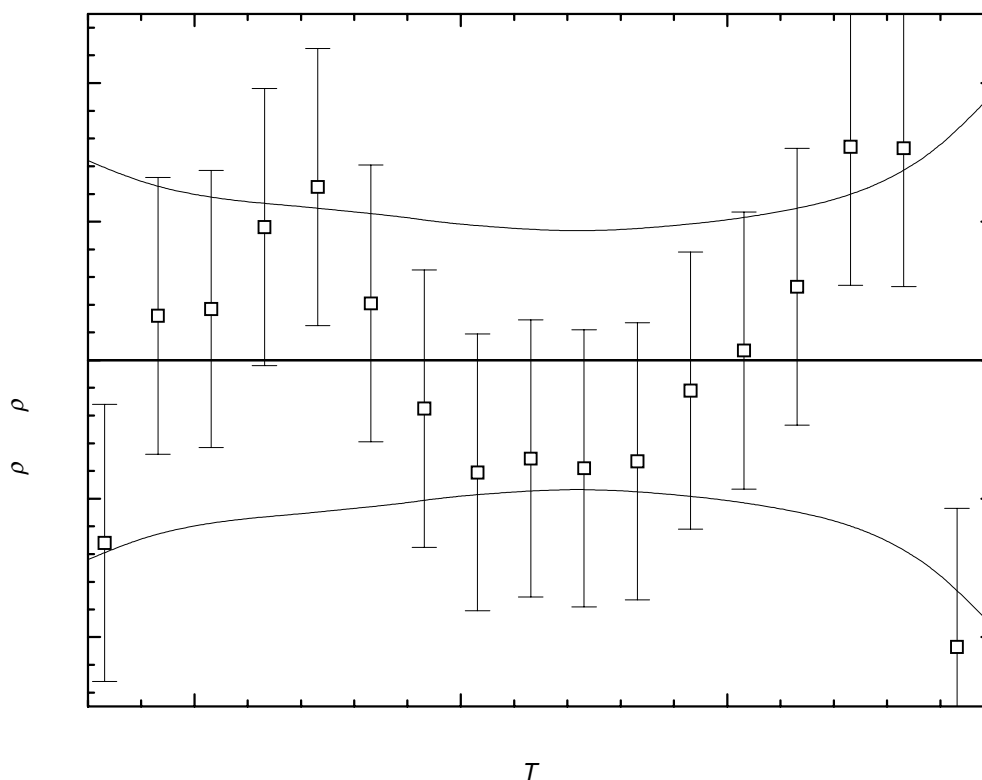
Bromochlorodifluoromethane (cont.)

Fig. 1. The symbols show the deviation of the calculated from the experimental values from Table 2. The curves above and below the zero line indicate the calculated error region of the recommended values given in Table 3. The error bars represent the experimental errors. (Error bars smaller than the symbols are omitted for clarity of the figure.)

Bromochlorofluoromethane**[593-98-6]****CHBrClF****MW = 147.37****584****Table 1.** Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|--------------|
| 273.15 | 1977.10 ± 2.00 | 1942-ber/stu |

1,2-Dibromo-2-chloro-1,1,2-trifluoroethane

[354-51-8]

 $C_2Br_2ClF_3$

MW = 276.28

585

Table 1. Coefficients of the polynomial expansion equation. Standard deviations (see introduction): $\sigma_{c,w} = 4.7085 \cdot 10^{-1}$ (combined temperature ranges, weighted), $\sigma_{c,uw} = 1.4392 \cdot 10^{-1}$ (combined temperature ranges, unweighted).

| Coefficient | $T = 213.15 \text{ to } 323.15 \text{ K}$ $\rho = A + BT + CT^2 + DT^3 + \dots$ |
|-------------|--|
| <i>A</i> | $2.96037 \cdot 10^3$ |
| <i>B</i> | -2.14521 |
| <i>C</i> | $-9.79274 \cdot 10^{-4}$ |

Table 2. Experimental values with uncertainties and deviation from calculated values.

| $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{\rho_{\text{exp}} - \rho_{\text{calc}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. (Symbol in Fig. 1) | $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{\rho_{\text{exp}} - \rho_{\text{calc}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. (Symbol in Fig. 1) |
|---------------|--|--|----------------------------|---------------|--|--|-------------------------|
| 293.15 | 2247.80 ± 1.50 | 0.45 | 1948-hen/ruh(○) | 263.15 | 2327.60 ± 1.00 | -0.45 | 1969-gel/nik(□) |
| 293.15 | 2247.80 ± 2.00 | 0.45 | 1952-eis(Δ) | 273.15 | 2302.20 ± 1.00 | 0.85 | 1969-gel/nik(□) |
| 213.15 | 2459.00 ± 1.00 | 0.37 | 1969-gel/nik(□) | 283.15 | 2274.80 ± 1.00 | 0.35 | 1969-gel/nik(□) |
| 223.15 | 2432.50 ± 1.00 | -0.41 | 1969-gel/nik(□) | 293.15 | 2246.50 ± 1.00 | -0.85 | 1969-gel/nik(□) |
| 233.15 | 2406.60 ± 1.00 | -0.39 | 1969-gel/nik(□) | 303.15 | 2219.50 ± 1.00 | -0.56 | 1969-gel/nik(□) |
| 243.15 | 2380.90 ± 1.00 | 0.03 | 1969-gel/nik(□) | 313.15 | 2192.60 ± 1.00 | 0.03 | 1969-gel/nik(□) |
| 253.15 | 2352.60 ± 1.00 | -1.96 | 1969-gel/nik ¹⁾ | 323.15 | 2165.00 ± 1.00 | 0.11 | 1969-gel/nik(□) |

¹⁾ Not included in Fig. 1.

Further references: [1934-loc/bro].

Table 3. Recommended values (fit to the reliable experimental values according to the equations

$$\rho = A + BT + CT^2 + DT^3 + \dots \text{ or } \rho = [1 + 1.75(1 - T/T_c)^{1/3} + 0.75(1 - T/T_c)][\rho_c + A(T_c - T) + B(T_c - T)^2 + C(T_c - T)^3 + D(T_c - T)^4].$$

| $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ |
|---------------|--|---------------|--|---------------|--|
| 210.00 | 2466.69 ± 1.44 | 260.00 | 2336.42 ± 1.06 | 298.15 | 2233.73 ± 1.24 |
| 220.00 | 2441.03 ± 1.24 | 270.00 | 2309.78 ± 1.08 | 300.00 | 2228.68 ± 1.26 |
| 230.00 | 2415.17 ± 1.12 | 280.00 | 2282.94 ± 1.12 | 310.00 | 2201.25 ± 1.40 |
| 240.00 | 2389.12 ± 1.06 | 290.00 | 2255.91 ± 1.17 | 320.00 | 2173.63 ± 1.61 |
| 250.00 | 2362.87 ± 1.05 | 293.15 | 2247.35 ± 1.19 | 330.00 | 2145.81 ± 1.89 |

cont.

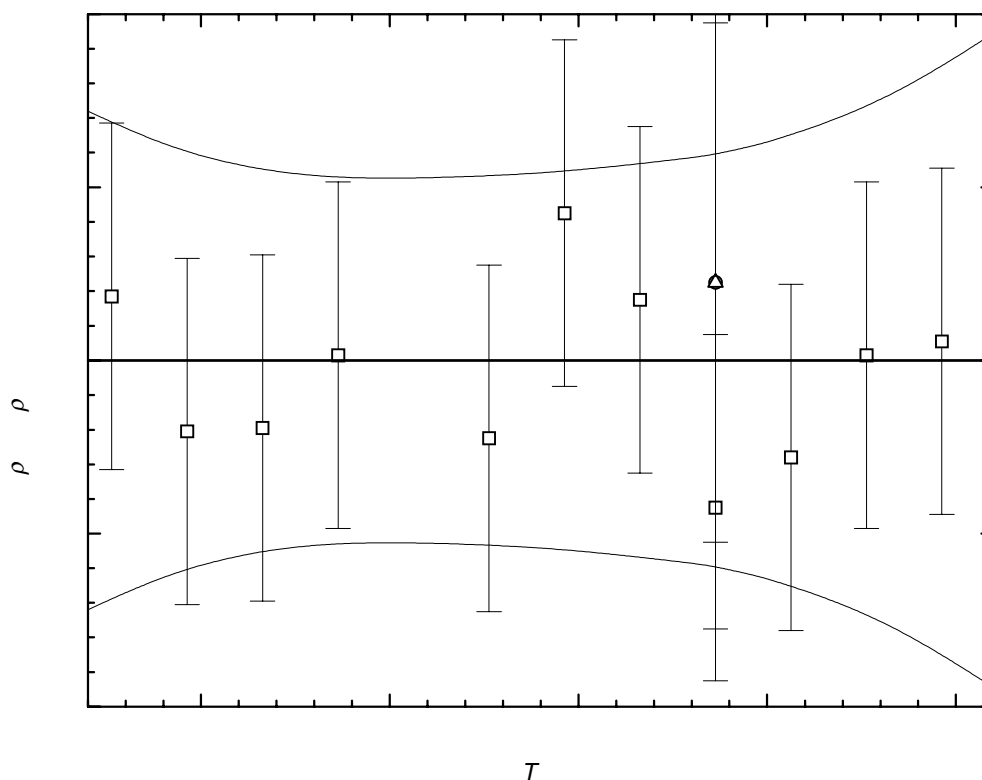
1,2-Dibromo-2-chloro-1,1,2-trifluoroethane (cont.)

Fig. 1. The symbols show the deviation of the calculated from the experimental values from Table 2. The curves above and below the zero line indicate the calculated error region of the recommended values given in Table 3. The error bars represent the experimental errors. (Error bars smaller than the symbols are omitted for clarity of the figure.)

1-Bromo-1-chloro-2,2,2-trifluoroethane [151-67-7]

$C_2HBrClF_3$ MW = 197.38 586

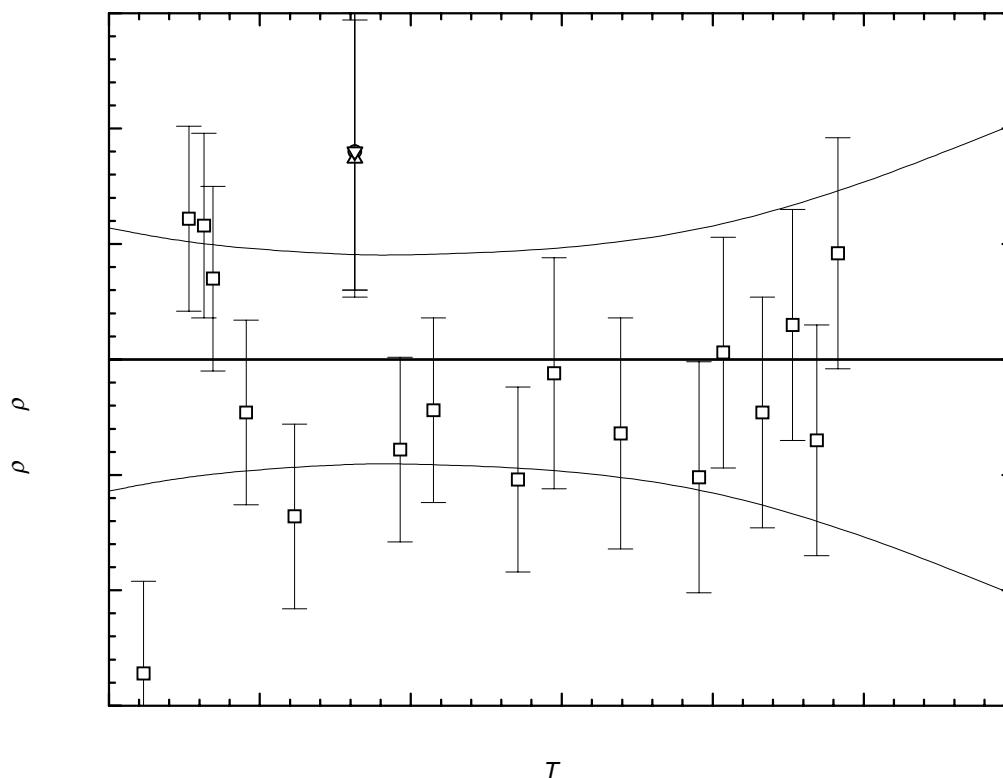
Table 1. Coefficients of the polynomial expansion equation. Standard deviations (see introduction): $\sigma_{c,w} = 5.4842 \cdot 10^{-1}$ (combined temperature ranges, weighted), $\sigma_{c,uw} = 1.3783 \cdot 10^{-1}$ (combined temperature ranges, unweighted).

| Coefficient | $T = 291.15 \text{ to } 314.15 \text{ K}$ |
|-------------|---|
| | $\rho = A + BT + CT^2 + DT^3 + \dots$ |
| A | $1.63202 \cdot 10^3$ |
| B | 4.15770 |
| C | $-1.14319 \cdot 10^{-2}$ |

cont.

Table 2. Experimental values with uncertainties and deviation from calculated values.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | $\rho_{\text{exp}} - \rho_{\text{calc}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. (Symbol in Fig. 1) | T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | $\rho_{\text{exp}} - \rho_{\text{calc}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. (Symbol in Fig. 1) |
|----------|---|---|----------------------------|----------|---|---|----------------------------|
| 298.15 | 1856.31 ± 0.60 | 0.90 | 1986-hne/cib(∇) | 300.75 | 1848.20 ± 0.40 | -0.22 | 1990-fra/com(□) |
| 298.15 | 1856.31 ± 0.60 | 0.90 | 1987-hne/doh(○) | 303.55 | 1840.20 ± 0.40 | -0.52 | 1990-fra/com(□) |
| 298.15 | 1856.28 ± 0.60 | 0.87 | 1990-fen/doh(Δ) | 304.75 | 1837.30 ± 0.50 | -0.06 | 1990-fra/com(□) |
| 291.15 | 1872.10 ± 0.40 | -1.36 | 1990-fra/com(□) | 306.95 | 1830.80 ± 0.50 | -0.32 | 1990-fra/com(□) |
| 292.65 | 1870.30 ± 0.40 | 0.61 | 1990-fra/com(□) | 309.55 | 1823.10 ± 0.50 | -0.51 | 1990-fra/com(□) |
| 293.15 | 1869.00 ± 0.40 | 0.58 | 1990-fra/com(□) | 310.35 | 1821.30 ± 0.50 | 0.03 | 1990-fra/com(□) |
| 293.45 | 1868.00 ± 0.40 | 0.35 | 1990-fra/com(□) | 311.65 | 1817.20 ± 0.50 | -0.23 | 1990-fra/com(□) |
| 294.55 | 1864.60 ± 0.40 | -0.23 | 1990-fra/com(□) | 312.65 | 1814.60 ± 0.50 | 0.15 | 1990-fra/com(□) |
| 296.15 | 1860.00 ± 0.40 | -0.68 | 1990-fra/com(□) | 313.45 | 1811.70 ± 0.50 | -0.35 | 1990-fra/com(□) |
| 298.65 | 1852.10 ± 0.40 | -1.98 | 1990-fra/com ¹⁾ | 314.15 | 1810.40 ± 0.50 | 0.46 | 1990-fra/com(□) |
| 299.65 | 1851.00 ± 0.40 | -0.39 | 1990-fra/com(□) | | | | |

¹⁾ Not included in Fig. 1.**Further references:** [1980-maj/svo].**Fig. 1.** The symbols show the deviation of the calculated from the experimental values from Table 2. The curves above and below the zero line indicate the calculated error region of the recommended values given in Table 3. The error bars represent the experimental errors. (Error bars smaller than the symbols are omitted for clarity of the figure.)

cont.

1-Bromo-1-chloro-2,2,2-trifluoroethane (cont.)**Table 3.** Recommended values (fit to the reliable experimental values according to the equations

$$\rho = A + BT + CT^2 + DT^3 + \dots \text{ or } \rho = [1 + 1.75(1 - T/T_c)^{1/3} + 0.75(1 - T/T_c)][\rho_c + A(T_c - T) + B(T_c - T)^2 + C(T_c - T)^3 + D(T_c - T)^4]$$

| $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ | $\frac{T}{K}$ | $\frac{\rho \pm \sigma_{\text{fit}}}{\text{kg} \cdot \text{m}^{-3}}$ |
|---------------|--|---------------|--|---------------|--|
| 290.00 | 1876.32 ± 0.57 | 298.15 | 1855.41 ± 0.45 | 310.00 | 1822.29 ± 0.50 |
| 293.15 | 1868.42 ± 0.49 | 300.00 | 1850.45 ± 0.45 | 320.00 | 1791.85 ± 1.02 |

1-Bromo-2-chloro-1,1,2-trifluoroethane [354-06-3]**C₂HBrClF₃** MW = 197.38 587**Table 1.** Experimental value with uncertainty.

| $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. |
|---------------|--|--------------|
| 298.15 | 1857.38 ± 0.20 | 1990-fen/doh |

1,2-Dibromo-2-chloro-1,1-difluoroethane

[421-36-3]

C₂HBr₂ClF₂ MW = 258.29 588**Table 1.** Experimental value with uncertainty.

| $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. |
|---------------|--|--------------|
| 298.15 | 2231.90 ± 1.50 | 1936-hen/lad |

1,2-Dibromo-1,2-dichloro-1-fluoroethane

[421-33-0]

C₂HBr₂Cl₂F MW = 274.74 589**Table 1.** Experimental value with uncertainty.

| $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. |
|---------------|--|--------------|
| 296.15 | 2283.30 ± 1.50 | 1936-hen/lad |

1-Bromo-1-chloro-2,2-difluoroethane [430-89-7]**C₂H₂BrClF₂** MW = 179.39 590**Table 1.** Experimental value with uncertainty.

| $\frac{T}{K}$ | $\frac{\rho_{\text{exp}} \pm 2\sigma_{\text{est}}}{\text{kg} \cdot \text{m}^{-3}}$ | Ref. |
|---------------|--|----------------|
| 293.15 | 1879.00 ± 2.00 | 1936-hen/ren-1 |

1-Bromo-2-chloro-2,2-difluoroethane [421-01-2] $C_2H_2BrClF_2$ MW = 179.39 591

Table 1. Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|--------------|
| 293.15 | 1830.00 ± 1.00 | 1948-hen/ruh |

1-Bromo-1,2-dichloro-2-fluoroethane [430-88-6] $C_2H_2BrCl_2F$ MW = 195.85 592

Table 1. Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|----------------|
| 293.15 | 1932.00 ± 2.00 | 1936-hen/ren-1 |

2-Bromo-1-chloro-1-fluoroethane [430-54-6] C_2H_3BrClF MW = 161.4 593

Table 1. Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|--------------|
| 293.15 | 1829.13 ± 2.00 | 1936-hen/ren |

2-Bromo-2-chloro-1,1,1-trifluoropropane [500043-70-9] $C_3H_3BrClF_3$ MW = 211.41 594

Table 1. Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|--------------|
| 298.15 | 1708.00 ± 1.00 | 1947-mcb/has |

2-Bromo-1-chloro-1,1-difluoropropane [500043-69-6] $C_3H_4BrClF_2$ MW = 193.42 595

Table 1. Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|--------------|
| 298.15 | 1662.00 ± 1.00 | 1947-mcb/has |

3-Bromo-1-chloro-1,1-difluoropropane [460-29-7] $C_3H_4BrClF_2$ MW = 193.42 596

Table 1. Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|--------------|
| 297.15 | 1726.00 ± 1.00 | 1947-mcb/has |

1-Chloro-2-iodo-4,4,5,5,6,6,6-heptafluorohexane

[10011-04-8]

$C_6H_5ClF_7I$

MW = 372.45

597

Table 1. Experimental value with uncertainty.

| T K | $\rho_{\text{exp}} \pm 2\sigma_{\text{est}}$ $\text{kg} \cdot \text{m}^{-3}$ | Ref. |
|----------|---|----------|
| 293.15 | 1974.00 ± 1.00 | 1964-moo |