

Determination of derived volumetric properties and heat capacities at high pressures using two density scaling based equations of state. Application to dipentaerythritol hexa(3,5,5-trimethylhexanoate)

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SUPPLEMENTARY INFORMATION

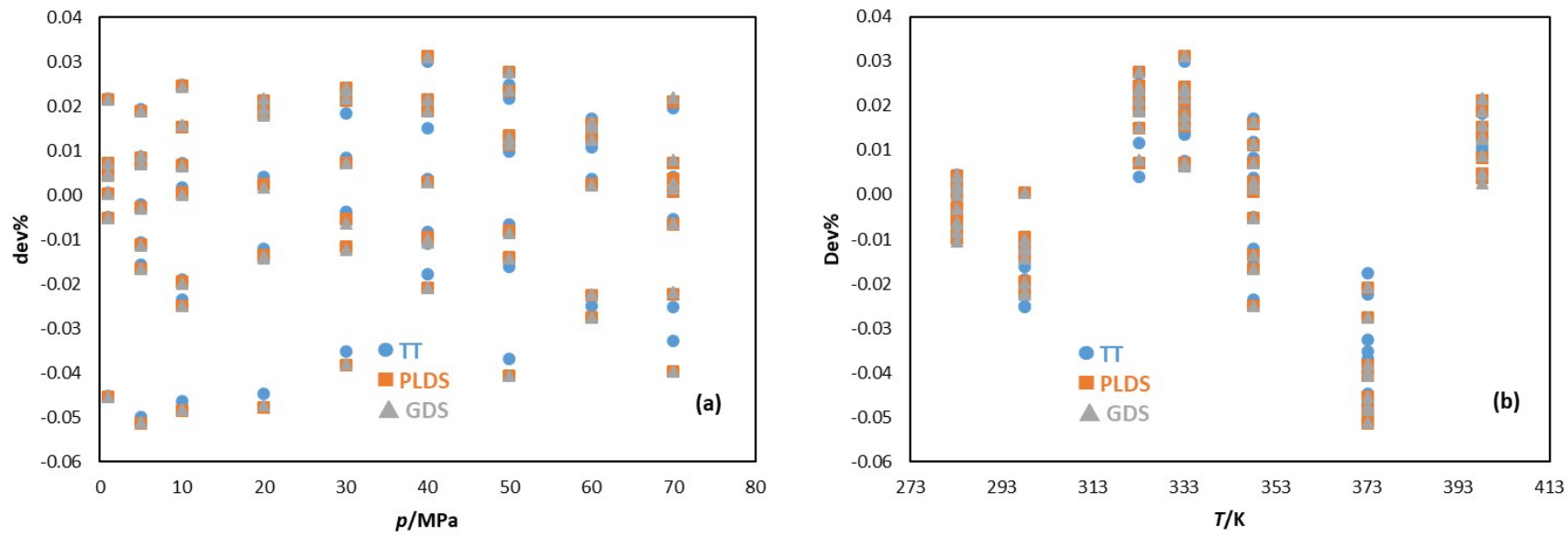


Fig. 1. Deviations between the densities reported in Table 1 and those obtained from the EoS. (a) versus pressure and (b) versus temperature

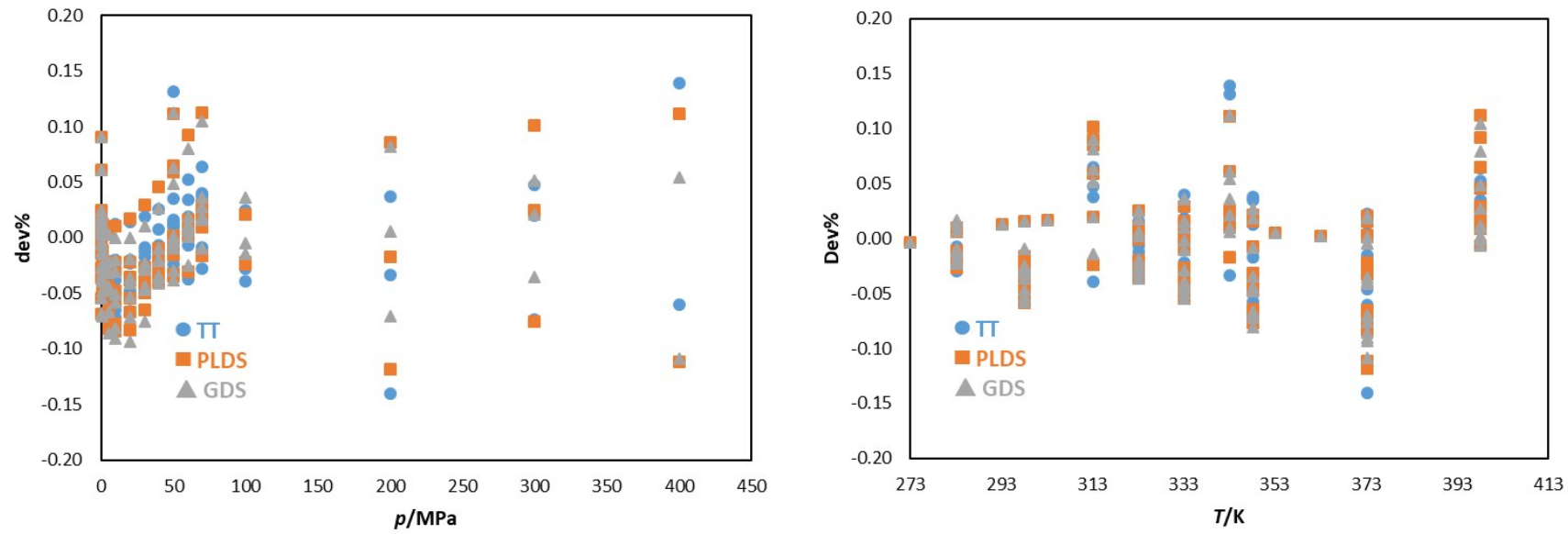


Fig. 2. Deviations between the densities from the database and those obtained from the EoS. (a) versus pressure and (b) versus temperature

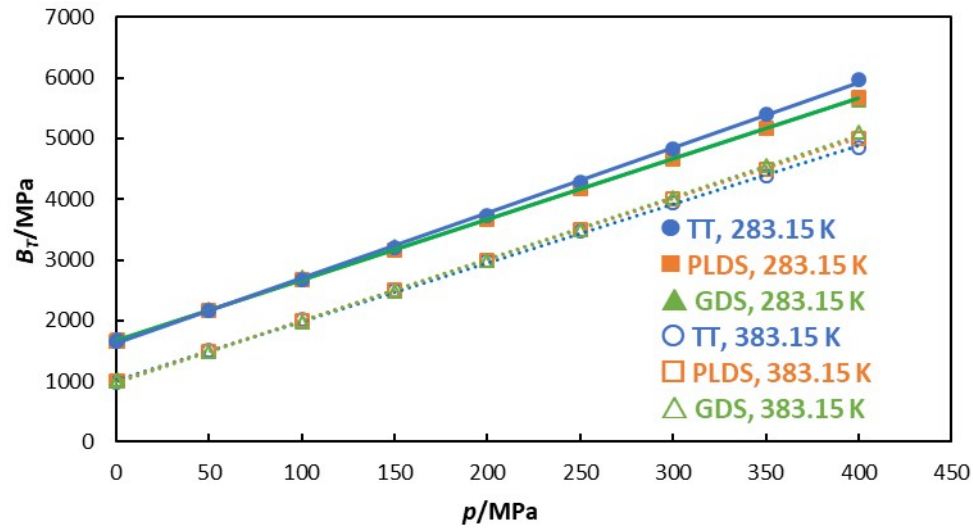


Fig. 3. Bulk modulus versus pressure at two different temperatures, 283.15 K (filled symbols) and 383.15 K (unfilled symbols) obtained from TT equation, eqn (20), PLDS equation, eqn (7) and GDS equation, eqn (18)).

Table 1. $10^{10} \kappa_T/\text{Pa}^{-1}$ from TT equation, Eqn (20). Global fit

ρ/MPa	T/K											
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15	398.15
1	6.00	6.32	6.67	7.04	7.42	7.82	8.25	8.68	9.13	9.60	10.06	10.76
50	4.57	4.76	4.95	5.15	5.36	5.57	5.78	5.99	6.21	6.42	6.63	6.93
100	3.70	3.82	3.95	4.07	4.20	4.33	4.46	4.59	4.72	4.84	4.96	5.13
150	3.11	3.20	3.29	3.38	3.47	3.56	3.65	3.74	3.82	3.90	3.98	4.10
200	2.69	2.76	2.83	2.90	2.96	3.03	3.10	3.16	3.22	3.28	3.34	3.42
250	2.38	2.43	2.49	2.54	2.59	2.64	2.69	2.74	2.79	2.84	2.89	2.95
300	2.13	2.18	2.22	2.26	2.31	2.35	2.39	2.43	2.47	2.51	2.54	2.59
350	1.94	1.97	2.01	2.04	2.08	2.12	2.15	2.18	2.22	2.25	2.28	2.32

Table 2. $10^{10} \kappa_T/\text{Pa}^{-1}$ from PLDS equation, Eqn (7). Global fit

ρ/MPa	T/K											
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15	398.15
1	5.97	6.28	6.61	6.95	7.32	7.70	8.10	8.52	8.97	9.44	9.93	10.72
50	4.62	4.80	4.99	5.19	5.38	5.59	5.80	6.01	6.23	6.45	6.68	7.02
100	3.75	3.87	3.99	4.12	4.24	4.37	4.49	4.62	4.75	4.88	5.01	5.20
150	3.16	3.24	3.33	3.41	3.50	3.58	3.67	3.75	3.84	3.92	4.00	4.13
200	2.73	2.79	2.85	2.92	2.98	3.04	3.10	3.16	3.22	3.28	3.34	3.42
250	2.40	2.45	2.50	2.54	2.59	2.64	2.68	2.73	2.77	2.82	2.86	2.92
300	2.14	2.18	2.22	2.26	2.29	2.33	2.37	2.40	2.43	2.47	2.50	2.55
350	1.93	1.97	2.00	2.03	2.06	2.09	2.12	2.14	2.17	2.20	2.22	2.26

Table 3. $10^{10} \kappa_T/\text{Pa}^{-1}$ from GDS equation, Eqn (18). Global fit

ρ/MPa	T/K											
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15	398.15
1	5.98	6.28	6.60	6.94	7.29	7.67	8.06	8.47	8.90	9.35	9.82	10.58
50	4.62	4.81	5.00	5.20	5.40	5.61	5.83	6.04	6.26	6.49	6.71	7.06
100	3.74	3.86	3.99	4.12	4.25	4.39	4.52	4.66	4.79	4.92	5.06	5.26
150	3.13	3.22	3.31	3.40	3.49	3.59	3.68	3.77	3.86	3.95	4.04	4.17
200	2.68	2.75	2.82	2.88	2.95	3.02	3.09	3.16	3.22	3.29	3.35	3.45
250	2.34	2.39	2.44	2.50	2.55	2.60	2.66	2.71	2.76	2.81	2.86	2.93
300	2.07	2.11	2.16	2.20	2.24	2.28	2.32	2.36	2.41	2.44	2.48	2.54
350	1.85	1.89	1.93	1.96	1.99	2.03	2.06	2.10	2.13	2.16	2.19	2.24

Table 4. $10^4 \alpha_p/\text{K}^{-1}$ from TT equation, Eqn (20). Global fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	7.06	7.10	7.14	7.17	7.21	7.24	7.27	7.31	7.34	7.37
1	7.03	7.07	7.10	7.14	7.17	7.20	7.23	7.27	7.29	7.32
50	5.79	5.77	5.76	5.74	5.73	5.73	5.73	5.74	5.77	5.81
100	5.01	4.98	4.95	4.93	4.91	4.90	4.91	4.93	4.97	5.03
150	4.49	4.45	4.41	4.39	4.37	4.37	4.38	4.42	4.47	4.56
200	4.10	4.06	4.03	4.00	3.99	3.99	4.01	4.06	4.12	4.22
250	3.80	3.76	3.73	3.71	3.70	3.71	3.73	3.78	3.86	3.97
300	3.56	3.52	3.49	3.47	3.47	3.48	3.51	3.57	3.66	3.78
350	3.36	3.32	3.29	3.28	3.27	3.29	3.33	3.39	3.49	3.62
400	3.19	3.16	3.13	3.11	3.11	3.13	3.18	3.25	3.35	3.48

Table 5. $10^4 \alpha_p/K^{-1}$ from PLDS equation, Eqn (7). Global fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	7.06	7.10	7.14	7.17	7.21	7.24	7.27	7.31	7.34	7.37
1	7.03	7.07	7.10	7.14	7.17	7.20	7.24	7.27	7.29	7.32
50	5.83	5.82	5.81	5.79	5.78	5.76	5.74	5.71	5.69	5.66
100	5.08	5.05	5.03	5.00	4.97	4.94	4.91	4.87	4.84	4.80
150	4.57	4.54	4.51	4.48	4.45	4.42	4.39	4.36	4.32	4.29
200	4.20	4.17	4.15	4.12	4.09	4.06	4.03	4.01	3.98	3.95
250	3.92	3.90	3.87	3.85	3.83	3.80	3.78	3.75	3.73	3.70
300	3.71	3.68	3.66	3.64	3.62	3.60	3.58	3.56	3.54	3.52
350	3.53	3.51	3.50	3.48	3.46	3.44	3.43	3.41	3.39	3.38
400	3.39	3.37	3.36	3.35	3.33	3.32	3.30	3.29	3.28	3.26

Table 6. $10^4 \alpha_p/K^{-1}$ from GDS equation, Eqn (18). Global fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	7.06	7.10	7.14	7.17	7.21	7.24	7.27	7.31	7.34	7.37
1	7.03	7.07	7.11	7.14	7.17	7.21	7.24	7.27	7.30	7.32
50	5.84	5.83	5.82	5.80	5.79	5.77	5.75	5.74	5.72	5.70
100	5.06	5.04	5.01	4.98	4.95	4.92	4.90	4.87	4.85	4.82
150	4.52	4.49	4.46	4.43	4.40	4.37	4.34	4.32	4.30	4.28
200	4.13	4.09	4.06	4.03	4.00	3.97	3.95	3.93	3.91	3.90
250	3.82	3.79	3.76	3.73	3.70	3.68	3.66	3.64	3.63	3.63
300	3.58	3.55	3.52	3.49	3.47	3.45	3.43	3.42	3.41	3.41
350	3.38	3.35	3.33	3.30	3.28	3.26	3.25	3.24	3.24	3.24
400	3.22	3.19	3.17	3.14	3.12	3.11	3.10	3.09	3.09	3.10

Table 7. $C_p/J \cdot kg^{-1} \cdot K^{-1}$ from TT equation, Eqn (20). Global fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	1910	1946	1980	2012	2044	2074	2102	2129	2155	2180
1	1910	1945	1980	2012	2043	2073	2102	2129	2155	2179
50	1903	1939	1972	2005	2035	2064	2092	2117	2141	2164
100	1903	1938	1972	2003	2032	2060	2085	2107	2128	2146
150	1905	1940	1973	2003	2031	2056	2077	2096	2112	2125
200	1908	1943	1975	2004	2029	2051	2069	2084	2095	2101
250	1912	1947	1977	2004	2027	2046	2061	2071	2076	2076
300	1916	1950	1979	2005	2025	2041	2051	2056	2056	2049
350	1921	1953	1981	2005	2023	2035	2041	2041	2035	2021
400	1925	1957	1983	2004	2020	2028	2031	2025	2013	1992

Table 8. $C_p/\text{J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$ from PLDS equation, Eqn (7). Global fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	1910	1946	1980	2012	2044	2074	2102	2129	2155	2180
1	1910	1945	1980	2012	2043	2073	2102	2129	2155	2179
50	1902	1938	1972	2005	2036	2066	2095	2122	2148	2173
100	1901	1936	1971	2004	2036	2066	2095	2123	2149	2174
150	1901	1937	1972	2005	2037	2068	2097	2125	2152	2177
200	1902	1938	1973	2007	2039	2070	2099	2128	2155	2180
250	1903	1940	1975	2008	2041	2072	2101	2130	2157	2183
300	1904	1941	1976	2010	2042	2073	2103	2131	2158	2184
350	1905	1942	1977	2011	2043	2074	2104	2132	2160	2185
400	1905	1942	1977	2011	2044	2075	2105	2133	2160	2186

Table 9. $C_p/J \cdot kg^{-1} \cdot K^{-1}$ from GDS equation, Eqn (18). Global fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	1910	1946	1980	2012	2044	2074	2102	2129	2155	2180
1	1910	1945	1980	2012	2043	2073	2102	2129	2155	2179
50	1902	1938	1972	2005	2036	2066	2094	2121	2147	2172
100	1901	1936	1971	2004	2035	2065	2094	2121	2146	2170
150	1901	1938	1972	2005	2036	2066	2094	2121	2146	2170
200	1903	1940	1974	2007	2038	2068	2096	2122	2146	2168
250	1906	1942	1977	2009	2040	2069	2097	2122	2145	2166
300	1908	1945	1979	2012	2042	2071	2097	2122	2144	2164
350	1911	1947	1982	2014	2044	2072	2098	2121	2142	2160
400	1913	1950	1984	2016	2045	2073	2097	2120	2139	2156

Table 10. $10^{10} \kappa_3/\text{Pa}^{-1}$ from TT equation, Eqn (20). Global fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	5.54	5.86	6.20	6.56	6.93	7.32	7.73	8.15	8.58	9.02
50	4.24	4.43	4.62	4.81	5.01	5.21	5.41	5.61	5.81	5.99
100	3.44	3.56	3.69	3.81	3.93	4.06	4.17	4.29	4.39	4.49
150	2.90	2.99	3.08	3.16	3.25	3.33	3.41	3.48	3.55	3.61
200	2.51	2.58	2.65	2.71	2.78	2.84	2.89	2.94	2.98	3.02
250	2.22	2.28	2.33	2.38	2.43	2.47	2.51	2.55	2.58	2.60
300	2.00	2.04	2.08	2.12	2.16	2.20	2.23	2.25	2.27	2.29
350	1.81	1.85	1.89	1.92	1.95	1.98	2.00	2.02	2.04	2.04

Table 11. $10^{10} \kappa_3/\text{Pa}^{-1}$ from PLDS equation, Eqn (7). Global fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	5.49	5.80	6.11	6.45	6.81	7.18	7.57	7.99	8.43	8.89
50	4.27	4.45	4.64	4.83	5.03	5.23	5.43	5.64	5.86	6.08
100	3.48	3.60	3.72	3.84	3.96	4.08	4.21	4.33	4.46	4.59
150	2.93	3.01	3.10	3.18	3.26	3.35	3.43	3.51	3.60	3.68
200	2.53	2.59	2.65	2.71	2.77	2.83	2.89	2.95	3.01	3.06
250	2.23	2.27	2.32	2.36	2.41	2.45	2.50	2.54	2.58	2.62
300	1.98	2.02	2.06	2.09	2.13	2.16	2.20	2.23	2.26	2.29
350	1.79	1.82	1.85	1.88	1.90	1.93	1.96	1.98	2.01	2.03

Table 12. $10^{10} \kappa_3/\text{Pa}^{-1}$ from GDS equation, Eqn (18). Global fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	5.50	5.79	6.10	6.43	6.77	7.13	7.51	7.92	8.34	8.78
50	4.28	4.46	4.65	4.85	5.05	5.25	5.46	5.67	5.89	6.11
100	3.47	3.60	3.73	3.85	3.98	4.11	4.24	4.38	4.51	4.64
150	2.91	3.00	3.09	3.18	3.27	3.36	3.45	3.54	3.63	3.72
200	2.50	2.56	2.63	2.70	2.77	2.83	2.90	2.96	3.03	3.09
250	2.18	2.23	2.29	2.34	2.39	2.44	2.49	2.54	2.59	2.63
300	1.93	1.97	2.01	2.06	2.10	2.14	2.18	2.21	2.25	2.28
350	1.73	1.76	1.80	1.83	1.87	1.90	1.93	1.96	1.99	2.01

Table 13. $u/\text{m}\cdot\text{s}^{-1}$ from TT equation, Eqn (20). Global fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	1367	1334	1302	1270	1240	1210	1182	1155	1130	1107
50	1542	1514	1486	1460	1435	1411	1388	1368	1348	1331
100	1694	1669	1645	1622	1600	1579	1561	1544	1529	1516
150	1829	1805	1783	1762	1743	1725	1709	1695	1682	1673
200	1949	1928	1907	1888	1870	1854	1840	1828	1818	1812
250	2060	2039	2020	2002	1986	1971	1959	1949	1941	1937
300	2161	2142	2123	2107	2092	2078	2067	2059	2054	2052
350	2256	2237	2220	2204	2190	2178	2168	2161	2158	2159

Table 14. $u/\text{m}\cdot\text{s}^{-1}$ from PLDS equation, Eqn (7). Global fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	1373	1341	1311	1281	1251	1223	1195	1167	1141	1115
50	1536	1509	1483	1457	1433	1409	1386	1364	1342	1322
100	1684	1660	1638	1615	1594	1574	1554	1535	1517	1500
150	1819	1797	1777	1758	1739	1721	1704	1687	1672	1656
200	1943	1923	1905	1888	1871	1855	1840	1825	1811	1798
250	2058	2041	2024	2008	1993	1979	1965	1952	1940	1928
300	2167	2151	2136	2121	2108	2095	2083	2071	2060	2049
350	2270	2255	2241	2228	2216	2204	2193	2183	2173	2163

Table 15. $u/\text{m}\cdot\text{s}^{-1}$ from GDS equation, Eqn (18). Global fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	1373	1342	1312	1283	1254	1226	1199	1173	1147	1122
50	1534	1507	1480	1455	1430	1406	1383	1360	1339	1319
100	1685	1660	1636	1612	1590	1568	1548	1528	1509	1492
150	1825	1801	1779	1757	1736	1717	1698	1680	1663	1647
200	1956	1934	1913	1892	1873	1854	1837	1821	1805	1791
250	2080	2059	2039	2020	2001	1984	1968	1952	1938	1925
300	2199	2178	2159	2141	2123	2107	2092	2077	2064	2052
350	2312	2292	2274	2256	2240	2224	2210	2196	2184	2173

Table 16. $10^{10} \kappa_T/\text{Pa}^{-1}$ from TT equation, Eqn (20). Present data fit

ρ/MPa	T/K											
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15	398.15
1	6.08	6.40	6.73	7.09	7.46	7.86	8.28	8.72	9.18	9.67	10.17	10.96
5	5.91	6.20	6.51	6.83	7.18	7.54	7.92	8.32	8.74	9.18	9.63	10.42
10	5.72	5.99	6.27	6.57	6.89	7.22	7.57	7.94	8.32	8.72	9.13	9.82
20	5.37	5.60	5.85	6.11	6.39	6.67	6.97	7.28	7.60	7.93	8.27	8.82
30	5.06	5.27	5.49	5.72	5.96	6.20	6.46	6.72	7.00	7.28	7.56	8.00
40	4.78	4.97	5.17	5.37	5.58	5.80	6.02	6.25	6.49	6.73	6.97	7.33
50	4.54	4.71	4.88	5.06	5.25	5.44	5.64	5.84	6.05	6.26	6.47	6.77
60	4.32	4.47	4.63	4.79	4.96	5.13	5.31	5.49	5.67	5.85	6.04	6.29

Table 17. $10^{10} \kappa_T/\text{Pa}^{-1}$ from PLDS equation, Eqn (7). Present data fit

ρ/MPa	T/K											
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15	398.15
1	6.07	6.39	6.72	7.08	7.45	7.84	8.26	8.69	9.15	9.63	10.14	10.95
5	5.90	6.20	6.52	6.85	7.20	7.57	7.96	8.36	8.78	9.22	9.69	10.42
10	5.71	5.99	6.28	6.59	6.92	7.25	7.61	7.97	8.36	8.76	9.17	9.83
20	5.35	5.60	5.86	6.13	6.41	6.69	6.99	7.30	7.62	7.95	8.30	8.83
30	5.04	5.26	5.49	5.72	5.97	6.21	6.47	6.74	7.01	7.29	7.57	8.02
40	4.77	4.96	5.16	5.37	5.58	5.80	6.02	6.25	6.48	6.72	6.96	7.34
50	4.52	4.69	4.87	5.06	5.24	5.44	5.63	5.83	6.03	6.24	6.45	6.76
60	4.29	4.45	4.61	4.78	4.94	5.11	5.29	5.46	5.64	5.82	6.00	6.28

Table 18. $10^{10} \kappa_T/\text{Pa}^{-1}$ from GDS equation, Eqn (18). Present data fit

ρ/MPa	T/K											
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15	398.15
1	6.06	6.38	6.72	7.07	7.45	7.84	8.26	8.69	9.15	9.64	10.15	10.96
5	5.89	6.20	6.51	6.85	7.20	7.57	7.95	8.36	8.78	9.23	9.69	10.43
10	5.70	5.98	6.28	6.59	6.91	7.25	7.61	7.97	8.36	8.76	9.18	9.83
20	5.35	5.60	5.86	6.13	6.41	6.69	6.99	7.30	7.62	7.95	8.30	8.83
30	5.04	5.26	5.49	5.72	5.97	6.22	6.47	6.74	7.01	7.28	7.57	8.01
40	4.77	4.96	5.17	5.37	5.58	5.80	6.02	6.25	6.48	6.72	6.96	7.33
50	4.52	4.70	4.88	5.06	5.25	5.44	5.63	5.83	6.03	6.24	6.44	6.76
60	4.30	4.46	4.62	4.78	4.95	5.12	5.29	5.47	5.64	5.82	6.00	6.30

Table 19. $10^4 \alpha_p/K^{-1}$ from TT equation, Eqn (20). Present data fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	6.96	7.03	7.09	7.15	7.21	7.27	7.33	7.39	7.44	7.49
1	6.93	7.00	7.06	7.12	7.18	7.23	7.29	7.34	7.39	7.44
5	6.81	6.86	6.92	6.97	7.02	7.07	7.12	7.16	7.20	7.25
10	6.66	6.71	6.75	6.80	6.84	6.88	6.92	6.95	6.99	7.03
20	6.39	6.43	6.46	6.49	6.52	6.54	6.57	6.59	6.62	6.65
30	6.16	6.18	6.21	6.22	6.24	6.26	6.28	6.29	6.31	6.34
40	5.95	5.97	5.98	5.99	6.00	6.01	6.02	6.04	6.05	6.07
50	5.77	5.78	5.79	5.79	5.79	5.80	5.81	5.81	5.83	5.85
60	5.60	5.61	5.61	5.61	5.61	5.61	5.61	5.62	5.63	5.65
70	5.45	5.45	5.45	5.45	5.44	5.44	5.44	5.45	5.46	5.48

Table 20. $10^4 \alpha_p/\text{K}^{-1}$ from PLDS equation, Eqn (7). Present data fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	6.96	7.03	7.09	7.15	7.21	7.27	7.33	7.39	7.44	7.49
1	6.93	7.00	7.06	7.12	7.18	7.23	7.29	7.34	7.39	7.44
5	6.80	6.86	6.92	6.97	7.02	7.07	7.12	7.16	7.21	7.25
10	6.66	6.71	6.75	6.80	6.84	6.88	6.92	6.96	6.99	7.02
20	6.38	6.42	6.46	6.49	6.52	6.55	6.58	6.60	6.62	6.64
30	6.15	6.18	6.21	6.23	6.25	6.27	6.29	6.30	6.31	6.32
40	5.94	5.96	5.98	6.00	6.02	6.03	6.04	6.05	6.05	6.05
50	5.75	5.77	5.78	5.80	5.81	5.82	5.82	5.83	5.83	5.83
60	5.58	5.60	5.61	5.62	5.63	5.63	5.63	5.64	5.63	5.63
70	5.43	5.44	5.45	5.46	5.47	5.47	5.47	5.47	5.46	5.46

Table 21. $10^4 \alpha_p/K^{-1}$ from GDS equation, Eqn (18). Present data fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	6.96	7.03	7.09	7.15	7.21	7.27	7.33	7.39	7.44	7.49
1	6.93	7.00	7.06	7.12	7.18	7.23	7.29	7.34	7.39	7.44
5	6.80	6.86	6.92	6.97	7.02	7.07	7.12	7.16	7.20	7.24
10	6.65	6.70	6.75	6.80	6.84	6.88	6.92	6.96	6.99	7.02
20	6.38	6.42	6.46	6.49	6.52	6.55	6.58	6.60	6.62	6.64
30	6.15	6.18	6.20	6.23	6.25	6.27	6.29	6.30	6.31	6.32
40	5.94	5.96	5.98	6.00	6.01	6.03	6.04	6.05	6.05	6.05
50	5.75	5.77	5.78	5.80	5.81	5.82	5.82	5.83	5.83	5.83
60	5.58	5.59	5.61	5.62	5.63	5.63	5.64	5.64	5.64	5.63
70	5.43	5.44	5.45	5.46	5.47	5.47	5.47	5.47	5.47	5.46

Table 22. $C_p/J \cdot \text{kg}^{-1} \cdot \text{K}^{-1}$ from TT equation, Eqn (20). Present data fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	1910	1946	1980	2012	2044	2074	2102	2129	2155	2180
1	1910	1945	1979	2012	2043	2073	2102	2129	2155	2179
5	1908	1944	1978	2011	2042	2072	2100	2127	2153	2178
10	1907	1942	1976	2009	2040	2070	2098	2126	2151	2176
20	1904	1940	1974	2006	2038	2067	2096	2123	2148	2172
30	1902	1938	1972	2004	2035	2065	2093	2120	2145	2170
40	1901	1936	1970	2003	2034	2063	2091	2118	2143	2167
50	1899	1935	1969	2001	2032	2062	2090	2116	2141	2165
60	1898	1934	1968	2000	2031	2060	2088	2115	2139	2163
70	1897	1933	1967	1999	2030	2059	2087	2113	2137	2160

Table 23. $C_p/J \cdot kg^{-1} \cdot K^{-1}$ from PLDS equation, Eqn (7). Present data fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	1910	1946	1980	2012	2044	2074	2102	2129	2155	2180
1	1910	1945	1979	2012	2043	2073	2102	2129	2155	2179
5	1908	1944	1978	2011	2042	2072	2100	2127	2153	2178
10	1907	1942	1976	2009	2040	2070	2098	2126	2151	2176
20	1904	1940	1974	2006	2037	2067	2096	2123	2148	2173
30	1902	1937	1971	2004	2035	2065	2093	2120	2146	2171
40	1900	1936	1970	2002	2033	2063	2092	2119	2144	2169
50	1898	1934	1968	2000	2032	2061	2090	2117	2143	2168
60	1897	1932	1966	1999	2030	2060	2089	2116	2142	2166
70	1896	1931	1965	1998	2029	2059	2088	2115	2141	2165

Table 24. $C_p/J \cdot \text{kg}^{-1} \cdot \text{K}^{-1}$ from GDS equation, Eqn (18). Present data fit

p/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1	1910	1946	1980	2012	2044	2074	2102	2129	2155	2180
1	1910	1945	1979	2012	2043	2073	2102	2129	2155	2179
5	1908	1944	1978	2011	2042	2072	2100	2127	2153	2178
10	1907	1942	1976	2009	2040	2070	2098	2126	2151	2176
20	1904	1940	1974	2006	2037	2067	2096	2123	2148	2173
30	1902	1937	1971	2004	2035	2065	2093	2120	2146	2171
40	1900	1936	1970	2002	2033	2063	2092	2119	2144	2169
50	1898	1934	1968	2000	2032	2061	2090	2117	2143	2168
60	1897	1932	1966	1999	2030	2060	2089	2116	2142	2166
70	1896	1931	1965	1998	2029	2059	2087	2115	2141	2165

Table 25. $10^{10} \kappa_3/\text{Pa}^{-1}$ from TT equation, Eqn (20). Present data fit

ρ/MPa	T/K										
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	5.35	5.63	5.94	6.26	6.60	6.96	7.35	7.75	8.18	8.63	9.09
5	5.21	5.48	5.76	6.06	6.38	6.72	7.08	7.46	7.85	8.26	8.69
10	5.04	5.29	5.56	5.84	6.13	6.45	6.78	7.12	7.48	7.85	8.23
20	4.73	4.95	5.19	5.43	5.69	5.96	6.24	6.53	6.83	7.14	7.45
30	4.46	4.66	4.87	5.08	5.31	5.54	5.78	6.03	6.29	6.55	6.81
40	4.22	4.40	4.59	4.78	4.97	5.18	5.39	5.61	5.83	6.05	6.27
50	4.01	4.17	4.34	4.51	4.68	4.86	5.05	5.24	5.43	5.62	5.81
60	3.82	3.96	4.11	4.27	4.42	4.59	4.75	4.92	5.09	5.26	5.42

Table 26. $10^{10} \kappa_3/\text{Pa}^{-1}$ from PLDS equation, Eqn (7). Present data fit

ρ/MPa	T/K										
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	5.33	5.62	5.93	6.25	6.59	6.95	7.33	7.73	8.15	8.59	9.06
5	5.19	5.47	5.76	6.06	6.38	6.72	7.07	7.44	7.83	8.24	8.67
10	5.03	5.29	5.56	5.84	6.14	6.45	6.77	7.11	7.46	7.84	8.22
20	4.73	4.96	5.20	5.44	5.70	5.96	6.24	6.53	6.82	7.13	7.45
30	4.47	4.67	4.88	5.09	5.32	5.55	5.79	6.03	6.28	6.55	6.81
40	4.23	4.41	4.60	4.79	4.98	5.18	5.39	5.60	5.82	6.04	6.27
50	4.02	4.18	4.34	4.51	4.69	4.86	5.05	5.23	5.42	5.61	5.81
60	3.82	3.97	4.12	4.27	4.42	4.58	4.74	4.91	5.07	5.24	5.41

Table 27. $10^{10} \kappa_S/\text{Pa}^{-1}$ from GDS equation, Eqn (18). Present data fit

ρ/MPa	T/K										
	283.15	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	5.33	5.62	5.92	6.25	6.59	6.95	7.33	7.73	8.15	8.60	9.07
5	5.19	5.46	5.75	6.06	6.38	6.72	7.07	7.44	7.83	8.24	8.67
10	5.03	5.29	5.56	5.84	6.13	6.44	6.77	7.11	7.47	7.84	8.23
20	4.73	4.96	5.20	5.44	5.70	5.96	6.24	6.53	6.82	7.13	7.45
30	4.47	4.67	4.88	5.09	5.32	5.55	5.79	6.03	6.28	6.54	6.81
40	4.23	4.41	4.60	4.79	4.98	5.19	5.39	5.60	5.82	6.04	6.27
50	4.02	4.18	4.35	4.52	4.69	4.87	5.05	5.23	5.42	5.61	5.81
60	3.83	3.97	4.12	4.27	4.43	4.59	4.74	4.91	5.07	5.24	5.41

Table 28. $u/\text{m}\cdot\text{s}^{-1}$ from TT equation, Eqn (20). Present data fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	1356	1325	1295	1266	1237	1208	1180	1153	1127	1102
5	1373	1343	1314	1285	1257	1229	1202	1175	1150	1125
10	1395	1366	1337	1309	1281	1254	1227	1202	1177	1153
20	1437	1409	1381	1354	1328	1302	1277	1253	1229	1207
30	1478	1451	1424	1398	1372	1348	1324	1301	1279	1258
40	1517	1491	1465	1440	1415	1391	1369	1347	1326	1306
50	1555	1529	1504	1480	1456	1433	1411	1390	1370	1351
60	1591	1566	1542	1519	1496	1474	1453	1432	1413	1395

Table 29. $u/\text{m}\cdot\text{s}^{-1}$ from PLDS equation, Eqn (7). Present data fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	1357	1326	1296	1267	1238	1210	1182	1156	1129	1104
5	1374	1344	1314	1285	1257	1230	1203	1177	1151	1126
10	1395	1366	1337	1308	1281	1254	1228	1203	1178	1154
20	1437	1408	1380	1353	1327	1302	1277	1253	1229	1207
30	1477	1449	1423	1397	1372	1347	1324	1301	1279	1257
40	1515	1489	1463	1439	1415	1391	1369	1347	1326	1306
50	1553	1528	1503	1479	1456	1434	1412	1392	1371	1352
60	1590	1565	1542	1519	1496	1475	1454	1435	1415	1397

Table 30. $u/\text{m}\cdot\text{s}^{-1}$ from GDS equation, Eqn (18). Present data fit

ρ/MPa	T/K									
	293.15	303.15	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
1	1358	1327	1296	1267	1238	1210	1182	1155	1129	1104
5	1375	1344	1315	1286	1257	1230	1203	1177	1151	1126
10	1396	1366	1337	1309	1281	1254	1228	1203	1178	1154
20	1437	1408	1380	1353	1327	1302	1277	1253	1229	1207
30	1476	1449	1422	1397	1372	1347	1324	1301	1279	1257
40	1515	1489	1463	1438	1414	1391	1369	1347	1326	1306
50	1553	1527	1503	1479	1456	1434	1412	1391	1372	1352
60	1589	1565	1541	1518	1496	1475	1454	1434	1415	1397