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COMMITTEE OF EXPERTS ON THE TRANSPORT OF
DANGEROUS GOODS AND ON THE GLOBALLY
HARMONIZED SYSTEM OF CLASSIFICATION
AND LABELLING OF CHEMICALS

Sub-Committee of Experts on the
Transport of Dangerous Goods
(Twenty-third session, 30 June-4 July 2003,
agenda item 2)

TRANSPORT OF GASES

Miscellaneous proposals relative to pressure receptacles for Class 2

Transmitted by the expert from the United States of America

Introduction

Based on discussions concerning filling limits for pressure receptacles the expert from the United States of America agreed to sponsor a study by the National Institute for Standardization and Technology. The results of the study and a comparison of the NIST values and the P200 values are provided in the table provided as annex to this document.

Annex

Side-by-side comparison of filling ratio values from UN and DOT with the values calculated by NIST

UN#	Name	Tc (C) ISO1622	Ptest(bar) UN, abs.	Filling Ratio			Percentage Difference		
				UN	49 CFR	NIST	UN VS NIST	NIST VS DOT	UN VS DOT
3159	1,1,1,1,2-tetrafluoroethane (R134a)	101.1	23	1.04		1.06	1.71	N/A	N/A
2035	1,1,1-trifluoroethane (R143a)	73.1	36	0.75		0.79	5.66	N/A	N/A
1030	1,1-difluoroethane (R152a)	113.5	19	0.79	0.82	0.79	0.51	0.51	0.00
1959	1,1-difluoroethylene	29.7	251	0.77	0.80	0.77	0.18	5.37	5.19
1010	1,2-butadiene	176.1	11	0.59		0.58	-1.06	N/A	N/A
1958	1,2-dichloro-1,1,2,2-tetrafluoroethane (R114)	145.7	11	1.30		1.31	0.81	N/A	N/A
1010	1,3-butadiene	152	11	0.55		0.55	0.78	N/A	N/A
1012	1-butylene	146.4	11	0.53		0.53	-0.51	N/A	N/A
2517	1-chloro-1,1-difluoroethane (R142b)	137.1	11	0.99	1.04	0.99	0.31	-0.70	-1.01
1021	1-chloro-1,2,2,2-tetrafluoroethane (R124)	na	13	1.20		1.21	0.43	N/A	N/A
1983	1-chloro-2,2,2-trifluoroethane	150	11	1.18		1.19	0.84	N/A	N/A
2044	2,2-dimethylpropane	160.6	11	0.53		0.53	-0.06	N/A	N/A
1001	acetylene	na	61	na		0.08	na	N/A	N/A
1001	acetylene	na	53	na		0.07	na	N/A	N/A
3374	acetylene	na	53	na		0.07	na	N/A	N/A
3374	acetylene	na	61	na		0.08	na	N/A	N/A
1005	Ammonia, Anhydrous	132.4	34	0.53	0.56	0.55	4.07	2.10	-1.89
2188	arsine	99.9	43	1.10		1.17	5.97	N/A	N/A
1741	boron trichloride	178.8	11	1.19		1.20	0.83	N/A	N/A
1008	boron trifluoride, BF3	-12.2	226	0.72		0.76	6.56	N/A	N/A
1008	boron trifluoride, BF3	-12.2	301	0.86		0.89	3.77	N/A	N/A
2901	bromine chloride	na	11	1.50		0.00	na	N/A	N/A
1745	bromine pentafluoride	na	11	na		2.26	na	N/A	N/A
1746	bromine trifluoride	na	11	na		2.49	na	N/A	N/A
2419	bromotrifluoroethylene	184.8	11	1.19		1.64	37.97	N/A	N/A

UN#	Name	Tc (C) ISO11622	Ptest(bar) UN, abs.	Filling Ratio			Percentage Difference		
				UN	49 CFR	NIST	UN VS NIST	NIST VS DOT	UN VS DOT
1009	Bromotrifluoromethane	66.8	121	1.44		1.47	1.98	N/A	N/A
1009	Bromotrifluoromethane	66.8	251	1.60		1.59	-0.39	N/A	N/A
1009	Bromotrifluoromethane (R13B1)	66.8	43	1.13	1.35	1.31	15.66	5.12	-9.73
1011	Butane	152	11	0.51		0.52	1.36	N/A	N/A
1013	Carbon Dioxide	30.1	191	0.66	0.77	0.68	2.28	-0.74	-3.03
1013	Carbon Dioxide	30.1	251	0.75	0.80	0.76	1.83	10.96	9.33
2417	carbonyl fluoride	14.7	201	0.47		0.72	52.98	N/A	N/A
2417	carbonyl fluoride	14.7	301	0.70		0.83	18.28	N/A	N/A
2204	carbonyl sulphide	102	27	0.84		0.89	5.87	N/A	N/A
1017	chlorine	144	23	1.25	1.32	1.25	0.17	0.17	0.00
2548	chlorine pentafluoride	142.6	14	1.49		1.61	7.78	N/A	N/A
1749	chlorine trifluoride	153.7	31	1.40		1.57	11.98	N/A	N/A
1974	chlorodifluorobromomethane	153.7	11	1.61		1.63	1.36	N/A	N/A
1018	Chlorodifluoromethane (R22)	96.2	30	1.03	1.07	1.04	0.97	-0.97	-1.94
1020	Chloropentafluoroethane (R115)	80	26	1.08	1.14	1.11	2.51	0.64	-1.85
1022	Chlorotrifluoromethane (R13)	28.8	101	0.83		0.82	-0.89	N/A	N/A
1022	Chlorotrifluoromethane (R13)	28.8	121	0.90		0.90	-0.15	N/A	N/A
1022	Chlorotrifluoromethane (R13)	28.8	191	1.04	1.11	1.04	-0.11	3.74	3.85
1022	Chlorotrifluoromethane (R13)	28.8	251	1.10		1.11	0.73	N/A	N/A
1012	cis-2-butylene	162.4	11	0.55		0.56	1.70	N/A	N/A
1026	cyanogen	126.6	101	0.70		0.79	13.04	N/A	N/A
1589	cyanogen chloride	215	21	1.03		1.06	3.37	N/A	N/A
2601	cyclobutane	186.8	11	0.63		0.63	0.23	N/A	N/A
1027	cyclopropane	125.2	21	0.53	0.58	0.55	4.07	0.28	-3.77
1911	diborane	16	251	0.07		0.30	323.28	N/A	N/A
1028	Dichlorodifluoromethane (R12)	112	19	1.15	1.21	1.16	0.86	-2.60	-3.48

UN#	Name	Tc (C) ISO1622	Ptest(bar) UN, abs.	Filling Ratio			Percentage Difference		
				UN	49 CFR	NIST	UN VS NIST	NIST VS DOT	UN VS DOT
1029	dichlorofluoromethane (R21)	178.5	11	1.23		1.24	0.98	N/A	N/A
2189	dichlorosilane	176.3	11	0.90		1.10	22.53	N/A	N/A
3252	Difluoromethane (R32)	78	49	0.78		0.82	5.20	N/A	N/A
1033	dimethyl ether	126.9	19	0.58		0.58	0.71	N/A	N/A
1032	dimethylamine	164.6	11	0.59	0.62	0.59	0.07	0.07	0.00
1035	Ethane	32.3	96	0.25		0.25	1.20	N/A	N/A
1035	Ethane	32.3	121	0.29	0.38	0.30	4.08	-18.61	-23.45
1035	Ethane	32.3	301	0.39	0.39	0.40	2.59	8.03	5.64
1037	ethyl chloride	187.2	11	0.80		0.81	1.14	N/A	N/A
2453	ethyl fluoride	102.2	31	0.57		0.63	10.59	N/A	N/A
1039	ethyl methyl ether	164.7	11	0.64		0.63	-1.81	N/A	N/A
2452	ethyl acetyle	190.5	11	0.57		0.59	2.89	N/A	N/A
1036	ethylamine	183.4	11	0.61		0.61	0.58	N/A	N/A
1962	Ethylene	9.2	226	0.34	0.35	0.34	1.34	10.02	8.82
1962	Ethylene	9.2	301	0.37	0.39	0.38	2.66	6.54	4.05
1040	ethylene oxide	195.8	16	0.78		0.79	1.38	N/A	N/A
2192	germane	34.8	251	1.02		1.00	-2.05	N/A	N/A
3296	heptafluoropropane (R227ea)	100	16	1.20		1.22	1.62	N/A	N/A
2420	hexafluoroacetone	84.1	23	1.08		1.14	5.78	N/A	N/A
2193	Hexafluoroethane (R116)	19.7	201	1.10		1.13	2.95	N/A	N/A
1858	hexafluoropropylene	86.2	23	1.11		1.13	1.93	N/A	N/A
1048	hydrogen bromide	89.9	61	1.54		1.52	-1.17	N/A	N/A
1050	hydrogen chloride	51.5	101	0.30		0.38	25.88	N/A	N/A
1050	hydrogen chloride	51.5	121	0.56		0.59	5.61	N/A	N/A
1050	hydrogen chloride	51.5	151	0.67		0.66	-0.79	N/A	N/A
1050	hydrogen chloride	51.5	201	0.74	0.78	0.72	-2.35	10.05	12.16
1051	hydrogen cyanide	183.5	101	0.55		0.61	11.56	N/A	N/A
1052	hydrogen fluoride	na	11	0.84		0.83	-0.72	N/A	N/A
2197	hydrogen iodide	150.8	24	2.25		2.28	1.19	N/A	N/A
2202	hydrogen selenide	138	32	1.60		1.57	-1.91	N/A	N/A
1053	hydrogen sulphide	100	56	0.67	0.70	0.68	1.69	8.27	6.72
2495	iodine pentafluoride	na	11	na		2.95	na	N/A	N/A

UN#	Name	Tc (C) ISO11622	Ptest(bar) UN, abs.	Filling Ratio			Percentage Difference		
				UN	49 CFR	NIST	UN VS NIST	NIST VS DOT	UN VS DOT
1969	Isobutane	134.9	11	0.49		0.49	0.38	N/A	N/A
1055	isobutylene	144.7	11	0.52		0.53	1.49	N/A	N/A
1062	methyl bromide	194	11	1.51		1.51	0.26	N/A	N/A
1063	methyl chloride	143	18	0.81	0.85	0.82	0.98	-2.70	-3.70
2454	Methyl Fluoride (R41)	na	301	0.36		0.63	74.95	N/A	N/A
1064	methyl mercaptan	196.8	11	0.78	0.83	0.79	0.89	N/A	N/A
1061	methylamine	156.9	14	0.58	0.62	0.59	1.74	-1.68	-3.45
1067	nitrogen dioxide	158	11	1.30		1.31	0.48	N/A	N/A
2451	Nitrogen Trifluoride	-39.3	201	0.50		0.63	26.79	N/A	N/A
2451	Nitrogen Trifluoride	-39.3	301	0.75		0.82	9.80	N/A	N/A
1069	nitrosyl chloride	167.5	14	1.10	1.21	1.15	4.27	4.09	0.00
1070	nitrous oxide	36.4	181	0.68		0.66	-2.23	N/A	N/A
1070	nitrous oxide	36.4	226	0.74	0.77	0.73	-1.16	7.03	8.11
1070	nitrous oxide	36.4	251	0.75		0.76	1.01	N/A	N/A
2422	octafluorobut-2-ene	98.3	13	1.34		1.31	-1.92	N/A	N/A
1976	Octafluorocyclobutane (RC318)	115.3	12	1.34		1.33	-0.94	N/A	N/A
2424	Octafluoropropane (R218)	71.9	26	1.09		1.13	3.70	N/A	N/A
3220	Pentafluoroethane (R125)	66.3	50	0.95		1.03	8.63	N/A	N/A
3220	Pentafluoroethane (R125)	66.3	37	0.72		1.00	38.63	N/A	N/A
3083	perchloryl fluoride	95.2	34	1.21		1.23	1.49	N/A	N/A
3154	perfluoroethylvinylether	132.8	11	0.98		1.22	24.22	N/A	N/A
3153	perfluoromethylvinylether	87	21	0.75		1.05	40.16	N/A	N/A
1076	phosgene	182.3	21	1.23		1.24	1.10	N/A	N/A
2199	phosphine	51.9	226	0.30	0.00	0.50	67.15	N/A	N/A
2199	phosphine	51.9	251	0.45		0.51	13.80	N/A	N/A
2198	phosphorous pentafluoride	19	201	0.90		1.12	24.45	N/A	N/A
2198	phosphorous pentafluoride	19	301	1.34		1.25	-6.94	N/A	N/A
2200	propadiene	120.7	23	0.50		0.51	2.66	N/A	N/A
1978	Propane	96.8	26	0.42		0.43	2.62	N/A	N/A
1077	Propylene	92.4	31	0.43		0.44	2.25	N/A	N/A
3337	R404A	na	37	0.82		0.89	8.56	N/A	N/A

UN#	Name	Tc (C) ISO11622	Ptest(bar) UN, abs.	Filling Ratio			Percentage Difference		
				UN	49 CFR	NIST	UN VS NIST	NIST VS DOT	UN VS DOT
3338	R407A	na	37	0.94		0.99	4.81	N/A	N/A
3339	R407B	na	39	0.93		1.00	7.53	N/A	N/A
3340	R407C	na	36	0.95		0.98	3.49	N/A	N/A
2602	R500	na	23	1.01		1.00	-0.77	N/A	N/A
1973	R502	na	32	1.05		1.05	-0.22	N/A	N/A
2599	R503	na	32	0.11		0.12	8.90	N/A	N/A
2599	R503	na	43	0.20		0.17	-12.71	N/A	N/A
2599	R503	na	101	0.66		0.64	-3.37	N/A	N/A
2194	selenium hexafluoride	na	37	1.46		1.77	21.22	N/A	N/A
2203	silane	-3.5	226	0.32		0.33	3.84	N/A	N/A
2203	silane	-3.5	251	0.36		0.35	-4.03	N/A	N/A
1859	silicon tetrafluoride	-14.2	201	0.74		0.96	30.31	N/A	N/A
1859	silicon tetrafluoride	-14.2	301	1.10		1.17	6.62	N/A	N/A
2676	stibine	173	21	1.20		1.94	61.47	N/A	N/A
1079	Sulphur Dioxide	157.5	15	1.23	1.28	1.23	-0.04	-1.66	-1.63
1080	Sulphur Hexafluoride	45.6	71	1.04		1.06	2.23	N/A	N/A
1080	Sulphur Hexafluoride	45.6	141	1.33	1.36	1.34	0.62	10.33	9.77
1080	Sulphur Hexafluoride	45.6	161	1.37		1.38	0.39	N/A	N/A
2418	sulphur tetrafluoride	91	31	0.91		1.37	50.59	N/A	N/A
2191	sulphuryl fluoride	91	51	1.10		1.12	2.13	5.64	3.64
2195	tellurium hexafluoride	83.2	21	1.00		2.37	137.02	N/A	N/A
1081	tetrafluoroethylene	33.3	201	na	1.10	1.04	na	13.83	N/A
1982	Tetrafluoromethane (R14)	-45.7	201	0.62		0.71	14.76	N/A	N/A
1982	Tetrafluoromethane (R14)	-45.7	301	0.94		0.90	-4.76	N/A	N/A
1012	trans-2-butylene	155.5	11	0.54		0.54	0.18	N/A	N/A
3057	trifluoroacetylchloride	109	18	1.17		1.21	3.41	N/A	N/A
1082	trifluorochloroethylene	105.8	20	1.13	1.17	1.12	-1.20	-3.00	-1.77
1984	Trifluoromethane (R23)	26	191	0.87		0.88	1.19	N/A	N/A
1984	Trifluoromethane (R23)	26	251	0.95		0.96	1.02	N/A	N/A
1083	trimethylamine	160.2	11	0.56	0.59	0.57	1.40	-0.38	-1.79
2196	tungsten hexafluoride	170	11	2.70		3.13	15.74	N/A	N/A
1085	vinyl bromide	198	11	1.37		1.38	0.79	N/A	N/A

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1086	vinyl chloride	156.5	13	0.81	0.85	0.82	0.79	-2.89	-3.70
1860	vinyl fluoride	54.7	251	0.64	0.65	0.65	1.27	4.34	3.13
1087	vinyl methyl ether	171.6	11	0.67	0.71	0.67	0.68	-0.81	-1.49
2036	Xenon	16.6	131	1.24		1.28	3.13	N/A	N/A

Note: Colors indicate approximate level of uncertainty in density calculation.

Yellow: these fluids have dedicated equations of state; uncertainty less than 1%

Blue: estimated with extended corresponding states model using experimental data to obtain parameters; uncertainty less than 3%

Green: estimated with extended corresponding states model with estimated parameters and limited data; uncertainty greater than 3%

na = Data Not Available

N/A = DOT Data Not Available

NIST = National Institute of Standards and Technology

DOT = U.S. Department of Transportation

UN = United Nations Model Regulations (See Table P200 for Filling Ratios)