

Viscosity Measurements of Rocket Propellant RP-2 Over Wide Ranges of Temperature and Pressure

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Table S1. Detailed composition of rocket grade kerosene RP-2A and RP-2B used in this study, and RP-2 (POSF 12810) used in the work reported by Laesecke and Cousins³. Composition determined using two-dimensional gas chromatography (GCxGC) with simultaneous mass spectral (MS) and flame ionization detection (FID) as described in Reference 9

Hydrocarbon Type	RP-2A (POSF 12427)		RP-2B (POSF 13205)		RP-2 (POSF 12810)	
	Weight %	Volume %	Weight %	Volume %	Weight %	Volume %
Aromatics						
Alkylbenzenes						
benzene (C06)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
toluene (C07)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C2-benzene (C08)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C3-benzene (C09)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C4-benzene (C10)	0.05	0.05	<0.01	<0.01	0.04	0.03

C5-benzene (C11)	0.06	0.05	<0.01	<0.01	0.03	0.03
C6-benzene (C12)	<0.01	<0.01	0.03	0.03	<0.01	<0.01
C7-benzene (C13)	0.04	0.04	0.04	0.04	0.04	0.04
C8-benzene (C14)	0.04	0.04	<0.01	<0.01	<0.01	<0.01
C9+-benzene (C15+)	0.08	0.07	0.03	0.02	0.03	0.03
Total Alkylbenzenes	0.28	0.26	0.11	0.10	0.16	0.15
Diaromatics (Naphthalenes, Biphenyl, etc.)						
diaromatic-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
diaromatic-C11	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
diaromatic-C12	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
diaromatic-C13	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
diaromatic-C14+	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Alkylnaphthalenes	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Cycloaromatics (Indans, Tetralins, etc.)						
cycloaromatic-C09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
cycloaromatic-C10	0.02	0.01	<0.01	<0.01	<0.01	<0.01
cycloaromatic-C11	0.03	0.03	<0.01	<0.01	0.01	0.01
cycloaromatic-C12	0.04	0.04	0.06	0.05	0.07	0.06
cycloaromatic-C13	0.16	0.14	0.10	0.09	0.09	0.08
cycloaromatic-C14	0.16	0.14	0.09	0.08	0.06	0.05
cycloaromatics-C15+	0.08	0.07	0.03	0.02	0.02	0.02
Total Cycloaromatics	0.49	0.42	0.28	0.25	0.26	0.23
Total Aromatics	0.80	0.70	0.39	0.35	0.42	0.38

Paraffins

iso-Paraffins

C07 and lower-iso	0.04	0.05	<0.01	<0.01	0.03	0.04
C08-isoparaffins	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C09-isoparaffins	<0.01	<0.01	0.02	0.02	<0.01	<0.01
C10-isoparaffins	0.11	0.12	2.09	2.30	1.18	1.30
C11-isoparaffins	5.65	6.02	5.52	5.96	7.36	7.91
C12-isoparaffins	9.54	10.19	6.38	6.91	8.24	8.87
C13-isoparaffins	4.98	5.20	6.97	7.38	7.74	8.15
C14-isoparaffins	4.29	4.45	6.65	6.99	6.66	6.96
C15-isoparaffins	9.36	9.64	4.78	4.99	3.59	3.73
C16-isoparaffins	2.42	2.48	1.00	1.04	1.18	1.22
C17-isoparaffins	0.57	0.58	0.25	0.26	0.42	0.43
C18-isoparaffins	0.18	0.19	0.03	0.03	0.15	0.15
C19-isoparaffins	0.03	0.03	0.06	0.06	0.05	0.05
C20-isoparaffins	<0.01	<0.01	<0.01	<0.01	0.01	0.01
C21-isoparaffins	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C22-isoparaffins	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C23-isoparaffins	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C24-isoparaffins	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total iso-Paraffins	37.18	38.95	33.75	35.94	36.63	38.82
n-Paraffins						
n-C07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-C08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-C09	0.01	0.01	0.04	0.05	<0.01	<0.01
n-C10	0.42	0.45	0.08	0.09	0.03	0.03
n-C11	5.84	6.24	0.08	0.09	0.07	0.08
n-C12	4.46	4.70	0.08	0.09	0.14	0.15
n-C13	0.50	0.52	0.03	0.03	0.15	0.16
n-C14	0.05	0.05	0.02	0.02	0.14	0.15

n-C15	0.01	0.01	0.01	0.01	0.08	0.08
n-C16	<0.01	<0.01	<0.01	<0.01	0.04	0.04
n-C17	<0.01	<0.01	<0.01	<0.01	0.02	0.02
n-C18	<0.01	<0.01	<0.01	<0.01	0.01	0.01
n-C19	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-C20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-C21	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-C22	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-C23	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total n-Paraffins	11.29	12.00	0.35	0.38	0.69	0.73
Total Paraffins (iso- + n-)	48.47	50.95	34.1	36.32	37.32	39.55

Cycloparaffins

Monocycloparaffins

C1-monocyclo (C07)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C2-monocyclo (C08)	<0.01	<0.01	0.15	0.16	0.08	0.08
C3-monocyclo (C09)	0.01	0.01	2.08	2.10	1.36	1.37
C4-monocyclo (C10)	0.97	0.94	6.53	6.39	7.64	7.44
C5-monocyclo (C11)	5.69	5.65	8.30	8.35	10.36	10.36
C6-monocyclo (C12)	3.56	3.51	7.10	7.10	8.23	8.19
C7-monocyclo (C13)	3.88	3.78	6.75	6.68	6.43	6.33
C8-monocyclo (C14)	7.10	6.95	4.75	4.72	3.90	3.85
C9-monocyclo (C15)	4.82	4.70	1.91	1.89	1.27	1.25
C10-monocyclo (C16)	0.97	0.95	0.54	0.53	0.35	0.35
C11-monocyclo (C17)	0.21	0.20	0.07	0.07	0.12	0.12
C12-monocyclo (C18)	0.03	0.03	0.01	0.01	0.03	0.03
C13+-monocyclo (C19+)	<0.01	<0.01	<0.01	<0.01	0.01	0.01

Total Monocycloparaffins	27.25	26.72	38.19	37.99	39.80	39.38
Dicycloparaffins (Decalins, Bihexyls, etc.)						
C08-dicycloparaffins	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C09-dicycloparaffins	<0.01	<0.01	0.38	0.34	0.17	0.15
C10-dicycloparaffins	1.04	0.92	2.24	2.01	2.57	2.28
C11-dicycloparaffins	2.73	2.53	5.76	5.41	4.72	4.41
C12-dicycloparaffins	2.74	2.56	6.02	5.69	5.32	5.00
C13-dicycloparaffins	5.81	5.41	5.78	5.45	4.75	4.46
C14-dicycloparaffins	4.69	4.37	2.28	2.15	1.41	1.32
C15-dicycloparaffins	4.76	4.43	2.03	1.91	1.28	1.20
C16-dicycloparaffins	0.10	0.09	0.04	0.04	0.03	0.02
C17+-dicycloparaffins	0.03	0.03	0.01	0.01	0.02	0.02
Total Dicycloparaffins	21.92	20.35	24.55	23.03	20.26	18.86
Tricycloparaffins						
C10-tricycloparaffins	0.06	0.04	0.10	0.08	0.09	0.08
C11-tricycloparaffins	0.07	0.06	0.43	0.35	0.40	0.33
C12-tricycloparaffins	0.46	0.38	0.99	0.83	1.06	0.88
C13-tricycloparaffins	0.71	0.59	1.15	0.96	0.56	0.47
C14-tricycloparaffins	0.19	0.15	0.07	0.06	0.04	0.04
C15-tricycloparaffins	0.03	0.02	0.01	0.01	<0.01	<0.01
C16-tricycloparaffins	0.03	0.02	<0.01	<0.01	0.02	0.02
C17-tricycloparaffins	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Tricycloparaffins	1.55	1.28	2.77	2.31	2.20	1.82
Total Cycloparaffins	50.72	48.36	65.51	63.33	62.25	60.07

CALIBRATION RESULTS

The calibration results of the rolling-ball viscometer are shown in Figure S1. The calibration constant values, k , are presented as a function of pressure for each isotherm.

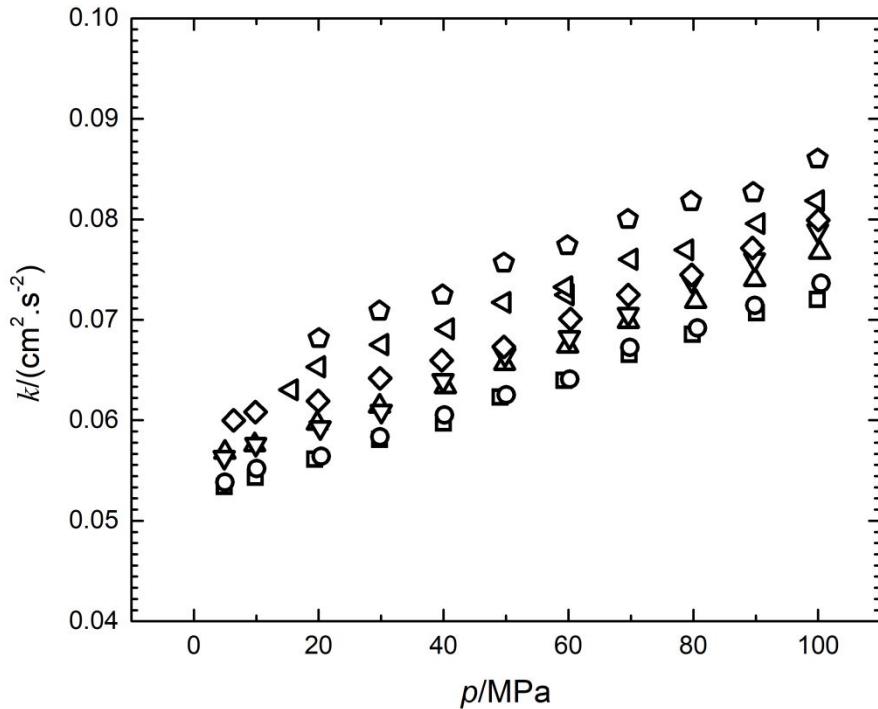


Figure S1. Rolling-ball viscometer calibration constant, k , at different pressures, p , measured with n-dodecane at a tilt angle of 7° : □ 298 K, ○ 324 K, △ 373 K, ▽ 423 K, ◇ 473 K, ▲ 524 K, ▨ 573 K.