The 10th Industrial Fluid Properties Simulation Challenge
The Pressure-Viscosity Relation

p / MPa	η / mPa·s	
0	0.640	
25	0.844	
50	1.101	
100	1.71	
150	2.54	
250	5.31	<===5.13
350	10.67	
400	15.0	
500	30.9	
600	62.9	
700	126.9	
800	264	
900	558	
1000	1187	

$$\alpha^* = \left[\int_0^\infty \frac{\eta(p=0)\,dp}{\eta(p)} \right]^{-1}$$

$$\alpha^* \approx \left[\frac{\eta_0}{\alpha_N \eta_N} + \sum_{i=1}^{N} \frac{\eta_0}{\alpha_i} \frac{\eta_i - \eta_{i-1}}{\eta_i \eta_{i-1}} \right]^{-1} = 8.85 \text{ GPa}^{-1}$$

$$\alpha(p = 0.9 \text{ GPa}) = \left. \frac{d(\ln \eta)}{dp} \right|_{p=0.9 \text{ GPa}}$$

$$\alpha\left(p = \frac{p_i + p_{i-1}}{2}\right) \approx \frac{\ln(\eta_i / \eta_{i-1})}{(p_i - p_{i-1})}$$

$$\alpha(p = 0.9 \text{ GPa}) \approx 7.5 \text{ GPa}^{-1}$$

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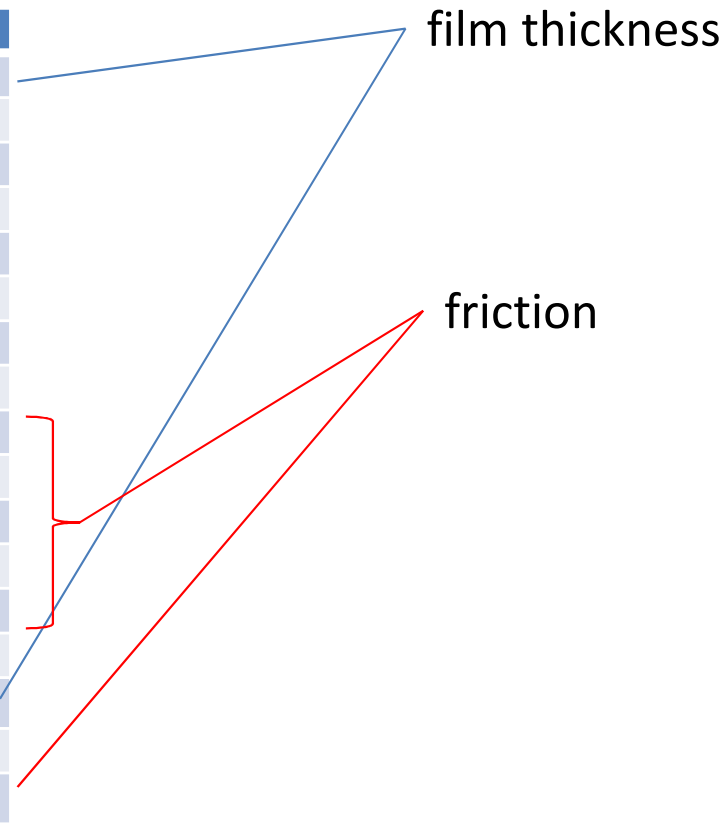
Maximum total points = 100

p / MPa	Category	Tolerance	Full Points
0	Viscosity	4.9%	15
25	Viscosity	4.9%	2
50	Viscosity	4.8%	2
100	Viscosity	4.7%	3
150	Viscosity	4.7%	3
250	Viscosity	4.9%	3
400	Viscosity	5.5%	3
500	Viscosity	6.0%	3
600	Viscosity	6.4%	4
700	Viscosity	6.9%	4
800	Viscosity	7.5%	4
900	Viscosity	8.0%	6
1000	Viscosity	8.5%	8
	α*	11.3%	20
	α(p=900)	13.3%	20



Relative Error is defined as $\varepsilon = \frac{X_{MD}}{X_{\exp}} - 1$ Full points are awarded for $|\varepsilon| < t$

The tolerance on viscosity is the greatest relative error expected in the experimental measurement if the error in viscosity, temperature and pressure are all equal to the estimated uncertainty. The tolerance on pressure-viscosity coefficient is simply based on error of 1 GPa^{-1}. The points awarded for each of the 15 categories is F × Full Points .

If $|\varepsilon| < t$, then $E = 0$. Else if $\varepsilon > t$, then $E = \varepsilon - t$ and if $\varepsilon < t$, then $E = \varepsilon + t$.

$$F = \frac{1}{\exp(sE)} \text{ where } s = 3.$$

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