

THEATRICAL SMOKE AND HAZE TESTING CALIBRATION FACTORS

ENVIRON has developed a protocol for using a MIE PDR-1000AN aerosol monitor to measure concentrations of theatrical smoke and haze. The monitor measures the light scattering produced by particles in the air, and reports the results in terms of mass concentration (milligrams per cubic meter, or mg/m^3) with the assumption that the particles in the air are a fine dust. Because different types of particles have different light scattering properties, the readings from the monitor need to be adjusted (or calibrated) when measuring something other than dust (such as fog droplets). The user converts the dust readings to the correct mg/m^3 readings for the fog droplets by multiplying the dust readings by a *calibration factor* for the particular fog fluid/fog machine combination being used for the fog, smoke, or haze effect.

The following calibration factors have been developed and approved by Equity and the League for use in measuring theatrical smoke and haze:

Approved Calibration Factors for Monitoring Theatrical Smoke and Haze (updated May 2006)					
Manufacturer	Machine	Fluid	Fluid Type	Calibration Factor	Ref
CITC	Fog Max	Natural Fogging Fluid	glycol	0.663	(4)
	Haze Max	Water Vapor Haze Fluid	glycerol	0.108	(4)
	Starhazer	High Performance Fluid	oil	0.867	(4)
High End Systems	F-100	Atmosphere HQ Fluid	glycol	1.21	(10)
		Atmosphere Stage Formula	glycol	0.253	(1)
		Atmosphere Cold Flow Formula	glycol	2.41	(1)
Le Maitre Special Effects	G100	Directors Choice	glycol	4.17	(1,9)
		Extra Quick Dissipating	glycol	3.17	(1)
		Quick Dissipating	glycol	3.45	(1)
		Regular Fog Fluid	glycol	4.17	(1)
	G150	Directors Choice	glycol	4.17	(1,9)
		Extra Quick Dissipating	glycol	3.17	(1)
		Molecular Fog Fluid	glycol	2.58	(1)
		Pro Beam (Long Lasting)	glycol	1.42	(4)
		Quick Dissipating	glycol	3.45	(1)
		Regular Fog Fluid	glycol	4.17	(1)
	G300	Directors Choice	glycol	0.304	(4,9)
		Molecular Fog Fluid	glycol	0.533	(4)
		Pro Beam (Long Lasting)	glycol	0.667	(4)
		Quick Dissipating	glycol	2.65	(4)
		Regular Fog Fluid	glycol	0.304	(4)
		Regular Haze Fluid	glycerol	0.09	(10)
	G300/LSG or equivalent chiller	Molecular Fog Fluid	glycol	4.95*	(7)
Power Fog Industrial (PFI) 9D/LSG or equivalent chiller	Molecular Fog Fluid	glycol	4.95*	(11)	

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Manufacturer	Machine	Fluid	Fluid Type	Calibration Factor	Ref
Le Maitre Special Effects (cont.)	Mini Mist	Regular Fog Fluid	glycol	2.24	(10)
	Neutron XS	Neutron Haze Fluid	glycerol	0.12	(2)
	Opti Mist Ranger	Mini Mist Canister	glycol	3.01	(1)
	Power Fog Industrial (PFI) or PFI 9D	Directors Choice	glycol	0.995	(4,9,11)
		Molecular Fog Fluid	glycol	2.77	(4,11)
		Pro Beam (Long Lasting)	glycol	1.36	(4,11)
		Quick Dissipating	glycol	1.37	(4,11)
	Show Fogger Pro	Regular Fog Fluid	glycol	0.995	(4,11)
		Directors Choice	glycol	0.444	(4,9)
		Pro Beam (Long Lasting)	glycol	0.436	(4)
		Quick Dissipating	glycol	2.56	(4)
	Stage Fogger DMX	Regular Fog Fluid	glycol	0.444	(4)
		Directors Choice	glycol	0.995	(4,9)
		Molecular Fog Fluid	glycol	2.77	(4)
		Pro Beam (Long Lasting)	glycol	1.36	(4)
	Look Solutions / Theatre Effects	Quick Dissipating	glycol	1.37	(4)
Regular Fog Fluid		glycol	0.995	(4)	
Orka		Regular-Fog Fluid	glycol	0.23	(8)
Tiny Fogger		Tiny Fogger Fluid	glycol	0.761	(4)
Martin Professional	Unique/Unique2 Hazer	Unique Fluid	glycol	0.299	(4,12)
	Viper II (NT)	Regular-Fog Fluid	glycol	1.46	(4,12)
MDG Fog Generators	Jem Glaciator	Jem B2 Heavy Fog Fluid	glycol	3.41	(4)
	Jem ZR12-DMX	Jem Pro-Smoke Super Fluid	glycol	1.12	(4)
	Jem ZR24/7 Hazer	Jem Pro-Haze Fluid	glycol	0.76	(5)
Reel EFX, Inc.	Mini-Max	MDG Dense Fluid	glycol	3.21	(1)
	Atmosphere APS	MDG Neutral Fluid	oil	0.784	(1)
	MAX 3000 APS	MDG Neutral Fluid	oil	0.784	(1)
	MDG MAX 3000 APS through accumulator box	MDG Neutral Fluid	oil	0.27	(6)
Rosco Laboratories	DF-50	Diffusion Fluid	oil	0.784	(1)
	1500 / 1600	Rosco Clear Fog Fluid	glycol	1.82	(1)
		Rosco Fog Fluid	glycol	1.27	(1)
		Rosco Light Fog Fluid	glycol	1.375	(1)
		Rosco Stage & Studio Fluid	glycol	1.56	(1)
	Alpha 900	Rosco Clear Fog Fluid	glycol	1.82	(1)
		Rosco Fog Fluid	glycol	1.27	(1)
		Rosco Light Fog Fluid	glycol	1.375	(1)
		Rosco Stage & Studio Fluid	glycol	1.56	(1)
	Delta 3000	Rosco Clear Fog Fluid	glycol	1.43	(4)
		Rosco Fog Fluid	glycol	1.00	(4)
		Rosco Light Fog Fluid	glycol	1.35	(4)
		Rosco Stage & Studio Fluid	glycol	1.97	(4)

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Rosco Laboratories (cont.)	PF-1000	Rosco Clear Fog Fluid	glycol	1.82	(1)
		Rosco Fog Fluid	glycol	1.27	(1)
		Rosco Light Fog Fluid	glycol	1.375	(1)
		Rosco Stage & Studio Fluid	glycol	1.56	(1)
SFX	Fog Master FM-1	Aquafof Fluid	glycol	0.19	(3)
Smoke Factory	Tour Hazer	Tour Hazer Fog Fluid	glycol	0.299	(4)

Notes:

* Due to monitor overloading during the calibration testing for the Le Maitre G300/LSG-Molecular Fog Fluid combination, the resulting calibration factor of 4.95 is known to be overestimated. This value can be used as a conservative (i.e., health protective) screening value. If monitoring results using this calibration factor result in exposures exceeding the guidance levels, it is recommended that additional testing to refine this calibration factor be conducted.

References:

- (1) Equipment-Based Guidelines for the Use of Theatrical Smoke and Haze, prepared by ENVIRON International Corporation for the Equity-League Pension and Health Trust Funds, June 8, 2001.
- (2) Theatrical Haze and Fog Testing for Mamma Mia! Winter Garden Theatre, prepared by ENVIRON International Corporation for Mamma Mia! Broadway and Nina Lannan Associates, November 12, 2001.
- (3) Theatrical Smoke and Haze Testing for The Phantom of the Opera, Majestic Theatre, prepared by ENVIRON International Corporation for Alan Wasser Associates, July 2002.
- (4) Calibration Factors for Monitoring Theatrical Smoke and Haze, prepared by ENVIRON International Corporation for Entertainment Services and Technology Association, November 11, 2002.
- (5) Development of Calibration Factors for Monitoring Theatrical Smoke and Haze: Jem 24/7 Hazer with Pro-Haze Fluid, prepared by ENVIRON International Corporation for Martin Professional, August 2003.
- (6) Theatrical Smoke and Haze Testing, Wicked the Musical, Gershwin Theatre, prepared by ENVIRON International Corporation for Stone Productions, July 2004.
- (7) Theatrical Smoke Testing at Bombay Dreams, prepared by ENVIRON International Corporation for Bombay Dreams NY L.L.C., July 30, 2004.
- (8) Development of Calibration Factors for Monitoring Theatrical Smoke and Haze: Look Solutions Orka with Regular-Fog Fluid, prepared by ENVIRON International Corporation for Look Solutions, April 1, 2005.
- (9) Letter from Le Maitre Special Effects to ENVIRON International Corporation regarding name change of Regular Fog Fluid to Directors Choice, December 5, 2005.
- (10) Theatrical Smoke and Haze Testing for The Phantom of the Opera, Forrest Theatre, prepared by ENVIRON International Corporation for Alan Wasser Associates, January 2003.
- (11) Letter from Le Maitre Special Effects to ENVIRON International Corporation regarding Stage Fogger DMX, Power Fog Industrial, and Power Fog Industrial 9D, April 12, 2006.

Approved Calibration Factors for Monitoring Theatrical Smoke and Haze (updated May 2006)					
Manufacturer	Machine	Fluid	Fluid Type	Calibration Factor	Ref
(12) Letter from Look Solutions to ENVIRON International Corporation regarding Viper Fluid, Unique2 Hazer, and Viper II/NT, May 5, 2006.					

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