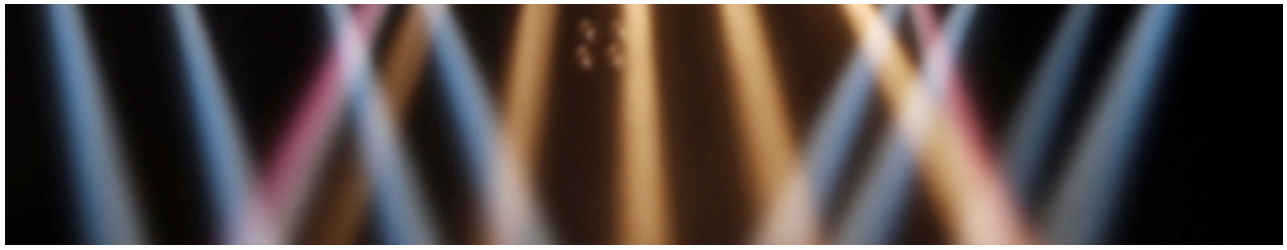

Calibration Factors And Time-and-Distance Guidelines For Use of Theatrical Fog Equipment

Bog Fog, K-razy Haze, Training Smoke XD, Backwood Bay, Faze Haze, Training Smoke FR, Amusement Park Fluid, Velocity, Cryo Freeze, Quick Blast, Training Smoke Q, Techno Fog, Beam Splitter, Neutronic Haze, DaFiddy, Base-H

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ENVIRON

1 Introduction

In 1997-99, at the request of Actors' Equity Association (AEA) and the League of American Theaters and Producers (LATP) and with the support of the Equity-League Pension and Health Trust Funds, investigators from the Mount Sinai School of Medicine (Mt. Sinai) and ENVIRON International Corporation (ENVIRON) conducted a study to evaluate whether the use of smoke, fog, haze, and pyrotechnics special effects in theatrical musical productions is associated with a negative health impact in actors. This effort was initiated in response to ongoing concerns by actors that the use of these theatrical effects may have an impact on their health. The results of this study were presented in the report *Health Effects Evaluation of Theatrical Smoke, Haze, and Pyrotechnics* (Mt. Sinai and ENVIRON 2000).

The results of the Mt. Sinai/ENVIRON study indicate that there are certain health effects associated with actors exposed to elevated or peak levels of glycol smoke/fog and mineral oil. However, as long as peak exposures are avoided, actors' health, vocal abilities, and careers should not be harmed. Pyrotechnics as used on Broadway at the time of the study did not have an observable effect on actors' health.

Mt. Sinai and ENVIRON recommended the following peak guidance levels with respect to glycols and mineral oil:

- The use of glycols should be such that an actor's exposure does not exceed **40 milligrams per cubic meter (mg/m^3)**.
- Mineral oil should be used in a manner such that an actor's exposure does not exceed a peak concentration of **25 mg/m^3**.
- For chronic exposures to mineral oil, the existing standards established for oil mists (**5 mg/m^3** as an eight-hour time-weighted average) should also be protective for actors in theatrical productions.

Comparable guidance levels were developed for glycerol in a subsequent study (ENVIRON 2001b):

- Glycerol should be used in a manner such that an actor's exposure does not exceed a peak concentration of **50 mg/m^3**.
- For chronic exposures to glycerol, the existing standards established for glycerin mists (**10 mg/m^3** as an eight-hour TWA) should also be protective for actors in theatrical productions.

To ensure that peak smoke, fog, and haze levels are below these guidelines, one option available to productions is to conduct show-specific testing at their theatres using an aerosol monitor. In order to conduct this testing, calibration data must be developed for each equipment/fluid combination. These calibration data are necessary to convert the readings of the aerosol monitor to glycol, mineral oil, or glycerol concentrations. A compilation of calibration factors approved for use in evaluating compliance with the peak guidance levels is provided on the Actors Equity web site (http://www.actorsequity.org/library/library.asp?cat=33).

ENVIRON was retained by Froggy's Fog to develop calibration factors and time-and-distance guidelines for the following equipment-fluid combinations listed in Appendix A.

2 Testing Methodology

2.1 Sampling Equipment and Materials

Monitoring of short-term concentrations was performed using portable real-time aerosol monitors (*personal* DataRAM Model PDR-1000) manufactured by Thermo Scientific. The PDR-1000 is a high sensitivity (i.e., photometric) monitor that uses a light scattering sensing chamber to measure the concentration of airborne particulate matter (liquid or solid), providing a direct and continuous readout as well as electronic logging of the data.

The PDR-1000 aerosol monitors as obtained are calibrated to Arizona road dust over a measurement range of 0.001 to 400 mg/m^3. In order to be utilized to measure short-term glycol, oil mist, or glycerol concentrations, the monitors were first calibrated for the smoke or haze machines and fluids being used. Calibration of the aerosol monitors was conducted by collecting simultaneous measurements with a series of sampling pumps and PDR-1000 aerosol monitors, mounted on tripods.

Gilian BDX-II and Gilian GilAir 3 sampling pumps were used to draw air through collection media. The calibration sampling was conducted in conjunction with operating the PDR-1000 aerosol monitor.

For fluids containing glycols, OSHA Versatile Sampler (OVS) traps were used as the collection media, each containing two sections of XAD-7 resin (200-mg front section, 100-mg back section, separated by a polyurethane foam [PUF] plug). The XAD-7 resin was used to collect both the particulate and vapor phase of the glycol aerosol. A 13-mm glass fiber filter (GFF) plug precedes the front section and a PUF plug follows the back section. This sampling is based on a variation of NIOSH Method 5523 (NIOSH 1996; Pendergrass 1999). Bulk fluid samples are also collected and submitted for laboratory analysis to determine which species of glycols are present.

For fluids containing glycerols, air samples were collected on 37 mm 2-piece cassettes containing tared 5µm polyvinyl chloride (PVC) filters. The sampling method is based on NIOSH Method 0500.

For fluids containing mineral oil, air samples were collected on 37 mm 2-piece cassettes containing tared 5µm polyvinyl chloride (PVC) filters. Bulk fluid samples are also collected and submitted for laboratory analysis to be used as a calibration standard. The sampling method is based on NIOSH Method 5026.

The testing was performed at a rented industrial space in Columbia, Tennessee.

2.2 Aerosol Monitor Calibration Procedure

A series of tripod assemblies was used for calibrating the aerosol monitors, each consisting of a sampling pump, flexible tubing, sampling media, and an aerosol monitor. The height of the tripod was approximately five feet, corresponding with the breathing zone of a typical actor. For low fog machines, testing assemblies were placed at floor level. The room ventilation fans were

turned off during each run; no major movement occurred in the testing room during each run that would affect fog dispersion.

a. The sampling pumps were calibrated to 2 liters per minute (LPM) (OVS traps) or 3 LPM (cassettes) using a BIOS Defender pump calibrator. The aerosol monitor was zeroed, the data logging function of the aerosol monitor was turned on, and the data logging time for the aerosol monitors were synchronized.

b. The fog machines were positioned on a table to allow a release of fog at a height of four feet. Low fog machines and the Martin K-1 hazer were positioned on the floor. The tripods were placed at various distances from the smoke machine release nozzle to achieve a range of exposure concentrations.

c. The sampling pumps were turned on, followed by the fog machines, allowing sustained fog generation to occur. After a period of approximately five to twenty minutes, the machines and pumps were simultaneously turned off.

d. The sampling media were capped and labeled to identify the type of fog machine and fluid, sampling location, and other sampling specifics. After being capped and labeled, OVS traps were placed in a freezer.

e. Various fans and ceiling vents were used between runs to clear residual aerosols from the testing area air by room ventilation.

The collection media and bulk fluid samples, along with appropriate field blanks, were submitted for analysis to Analytics Laboratory of Richmond, Virginia, an American Industrial Hygiene Association (AIHA) accredited laboratory.

2.3 Laboratory Analysis

All sample analyses were conducted by using validated analytical methodologies, as described in the ENVIRON Air Sampling Protocol (ENVIRON 2001a).

Samples were analyzed for glycols using a variation of NIOSH Method 5523, which involves the use of a gas chromatograph with a flame ionization detector (GC/FID). The NIOSH Method 5523 was extended to a validated level of quantification (LOQ) of 5.0 to 15.0 micrograms (μg) of each individual glycol per sample.

Samples were analyzed gravimetrically for glycerols using NIOSH Method 0500. A LOQ of 10 μg per sample was used.

Samples were analyzed by infrared spectrophotometry for mineral oil using NIOSH Method 5026. A LOQ of 50 μg per sample was used.

2.4 Time-and-Distance Monitoring Procedure

To measure the levels of glycol, glycerol, or mineral oil present at different distances from the release point, a series of five tripods equipped with aerosol monitors positioned at breathing height (approximately 5 ft above ground) were used. Each fog or haze machine was turned on for durations ranging from 5 to 120 seconds, allowing sustained fog generation to occur, and

then turned off. The aerosol monitors collected logged data on the fog levels as the concentrations gradually dissipated. For low fog machines, tripods were also placed at various heights off of the floor at a set distance from the smoke machine to represent breathing heights of actors in various positions (e.g. lying down, sitting, kneeling, and standing).

3 Results and Discussion

3.1 Aerosol Monitor Calibration

Total glycol, glycerol, and mineral oil concentrations were calculated from the analytical data. For glycols, only the glycol species measured in the bulk solution were included. For glycol species that were measured in the bulk solution, and were detected in the air sample but not above the LOQ, one half of the LOQ for that glycol species was conservatively used in calculating the total glycol concentration. To develop a calibration curve for each fluid, the average aerosol monitor readings during the period of time in which air was drawn through the sampling media for each air sample were calculated and plotted against the total glycol, glycerol, or mineral oil concentration data.

The calibration curves for the fifty equipment-fluid combinations tested are shown in Appendix C. First order regression curves are also shown on these figures. The calibration factors, calculated from the slopes of these regressions, are summarized in Appendix B.

For determining the calibration factor for any fluid containing two or more distinct chemical constituents, the calibration factors were initially determined for each constituent, and the most conservative calibration factor was used when conducting time and distance testing for the fluid as a whole.

3.2 Use of Calibration Factors

The real-time aerosol monitor readings can be converted to glycol concentrations using the appropriate calibration factor for the fluid, as follows:

$$CONC = C \times PDR$$

where:

CONC = air concentration of total glycols, mg/m^3

C = aerosol monitor calibration factor (mg/m^3)/ (mg/m^3 aerosol)

PDR = aerosol monitor reading, mg/m^3 aerosol

For example, an uncalibrated reading of 100 mg/m^3 on the aerosol monitor would correspond to a glycol concentration of 107 mg/m^3 for the Chauvet 1800 Flex/Bog Fog combination. These calculated concentrations can then be compared with the peak guidance levels. The peak guidance level for glycols of 40 mg/m^3 would correspond to an uncalibrated aerosol monitor reading of 37.4 mg/m^3 for the Chauvet 1800 Flex/Bog Fog combination.

3.3 Time-and-Distance Guidelines

For various distances from the cue release point, Appendix C provides the average time (in seconds) after the end of the cue release after which the glycol, glycerol, or oil mist concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the fog release point until the amount of

time listed in Appendix C has elapsed following the end of the cue. For example, if a production is using the Chauvet 1800 Flex/Bog Fog combination at full output with 15-second cue duration, an actor should not be situated within five to 25 feet from the front of the cue release point until at least 70 seconds following the end of the cue release.

It should be reiterated that the Time-and-Distance Guidelines provided in Appendix C are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Tables in Appendix C are based on the fog machine being positioned approximately four feet above the ground, and being operated to achieve 5 to 120 seconds of continuous fog generation. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate fog for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to determine whether peak exposure may occur.

4 References

ENVIRON International Corporation (ENVIRON). 2001a. Evaluation of short-term exposures to theatrical smoke and haze: Air sampling protocol. Prepared for Equity-League Pension and Health Trust Funds. May 14.

ENVIRON International Corporation (ENVIRON). 2001b. Theatrical Haze and Fog Testing for Mamma Mia!, Winter Garden Theatre. Prepared for Mamma Mia! Broadway and Nina Lannan Associates. November 12.

Mount Sinai School of Medicine and ENVIRON International Corporation (Mt. Sinai and ENVIRON). 2000. Health effects evaluation of theatrical smoke, haze, and pyrotechnics. Prepared for Equity-League Pension and Health Trust Funds. June 6.

National Institute for Occupational Safety and Health (NIOSH). 1996. Method 5523: Glycols, Issue 1. NIOSH Manual of Analytical Methods (NMAM). Fourth Edition. May 15.

Pendergrass, S.M. 1999. Determination of glycols in air: Development of sampling and analytical methodology and application to theatrical smokes. AIHA Journal, 60:452-457.

Appendix C: Calibration Factor and Time and Distance Testing Results for Each Equipment/Fluid Combination

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M1500 with Training Smoke FR Fluid – Fire Rescue Formula

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke FR fluid – Fire Rescue Formula in a FireBase SG-M1500 smoke generator.

Training Smoke FR is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-M1500.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

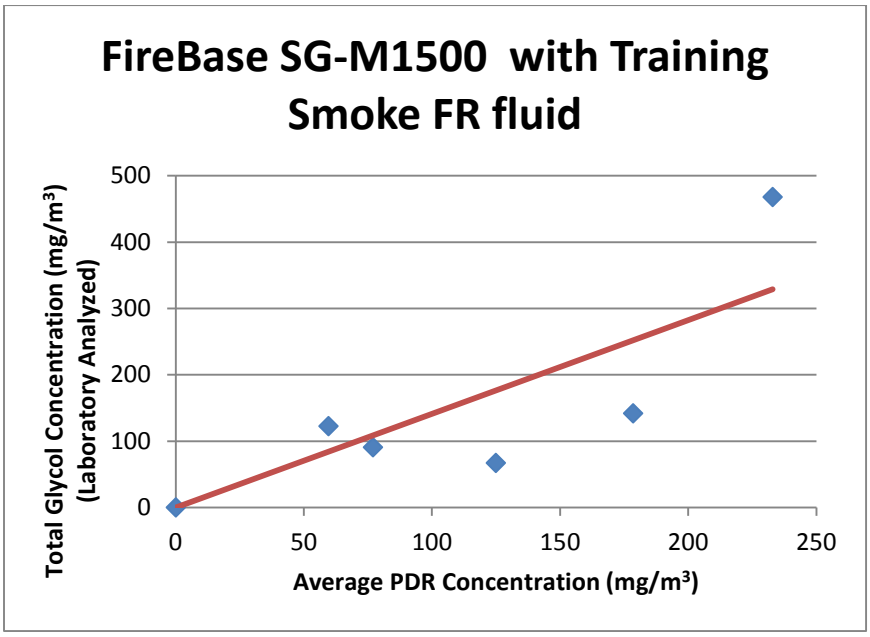


Figure 1. Calibration curve for FireBase SG-M1500 with Training Smoke FR fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 1.41 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M1500	Training Smoke FR	Glycol	1.41

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the fog release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M1500/Training Smoke FR combination at 100% output with 15-second cue duration, an actor should not be situated within five to 25 feet from the front of the cue release point until at least 90 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Fog Generation FireBase SG-M1500 with Training Smoke FR Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	100%	90	90	90	90	90
15	100%	90	90	90	90	90
30*	100%	90	90	90	90	90
30†	65%	60	60	60	50	0
60†	65%	70	70	60	50	10
60	25%	50	0	0	0	0

*Machine shuts off after 20 seconds

†Machine runs at reduced output volume after 15 seconds

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate fog for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M1500 with Training Smoke XD Fluid – Extreme Density

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke XD fluid in a FireBase SG-M1500 smoke generator.

Training Smoke XD is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the FireBase SG-M1500.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

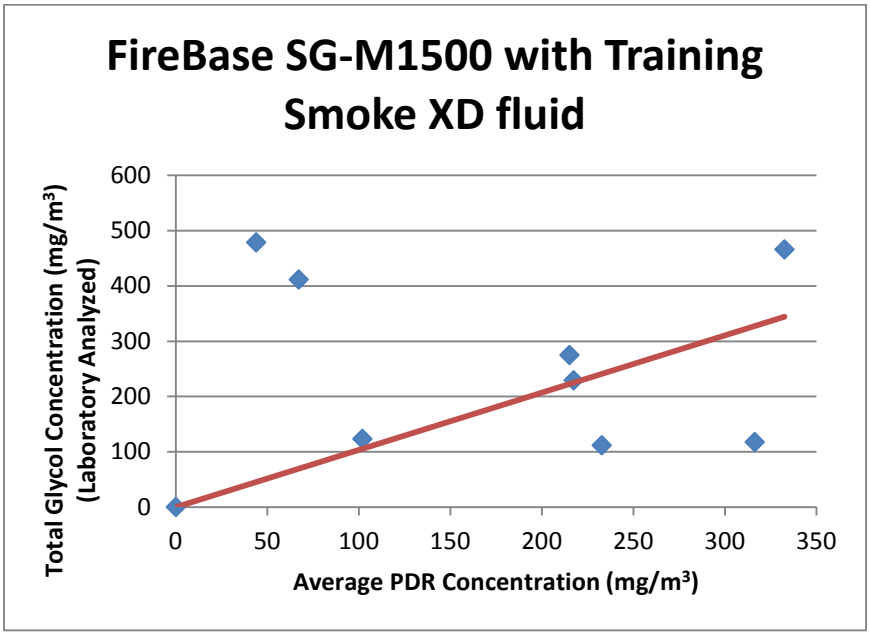


Figure 1. Calibration curve for FireBase SG-M1500 with Training Smoke XD fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 1.03 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M1500	Training Smoke XD	Glycol	1.03

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the fog release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M1500/Training Smoke XD combination at 100% output with 15-second cue duration, an actor should not be situated within five to 10 feet from the front of the cue release point until at least 90 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Fog Generation FireBase SG-M1500 with Training Smoke XD Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	100%	90	90	50	30	0
15	100%	90	90	60	60	60
30	100%	100	100	60	60	60
30	65%	100	30	0	0	0
60	65%	110	40	0	0	0
60	25%	110	0	0	0	0

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate fog for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M1500 with Training Smoke Q Fluid – Quick Dissipating

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke Q fluid in a FireBase SG-M1500 smoke generator.

Training Smoke Q is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-M1500.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

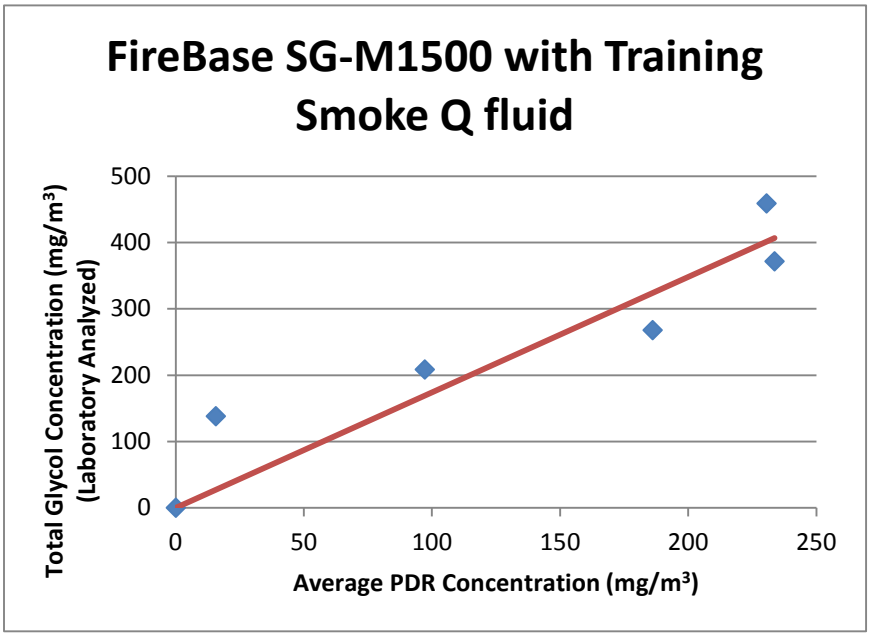


Figure 1. Calibration curve for FireBase SG-M1500 with Training Smoke Q fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 1.74 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M1500	Training Smoke Q	Glycol	1.74

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M1500/Training Smoke Q combination at 100% output with 15-second cue duration, an actor should not be situated within five to 15 feet from the front of the cue release point until at least 20 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-M1500 with Training Smoke Q Fluid						
Release Duration (secs)	**Output Setting**	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**				
		5 ft	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	100%	20	20	0	0	0
15	100%	20	20	20	10	0
30*	100%	20	20	20	10	0
15	65%	10	10	0	0	0
30	65%	10	10	0	0	0
60	65%	20	20	0	0	0
60	25%	20	0	0	0	0

*Machine shuts off after 20 seconds

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M1800 with Training Smoke FR Fluid – Fire Rescue Formula

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke FR fluid in a FireBase SG-M1800 smoke generator.

Training Smoke FR is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-M1800.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

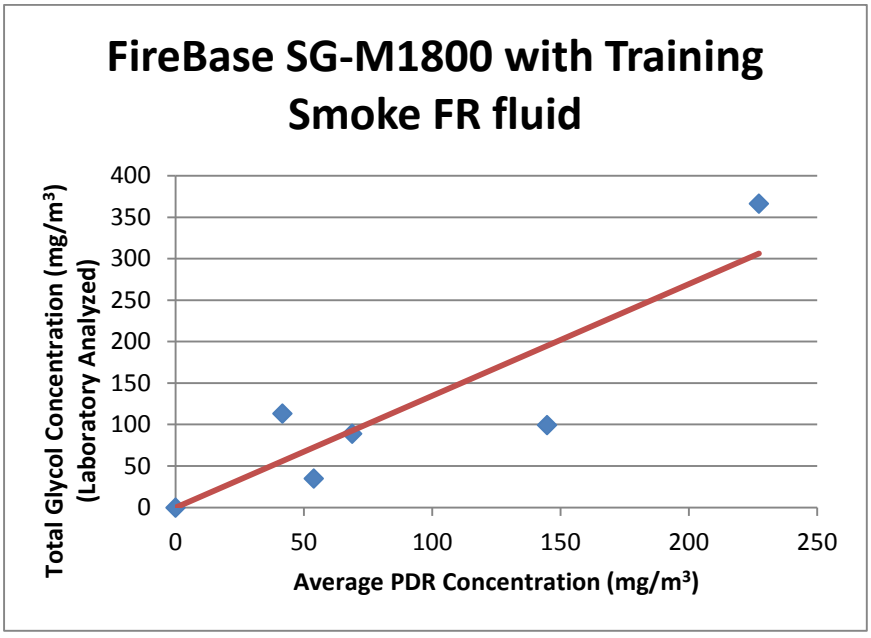


Figure 1. Calibration curve for FireBase SG-M1800 with Training Smoke FR fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 1.35 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M1800	Training Smoke FR	Glycol	1.35

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M1800/Training Smoke FR combination at high output with 15-second cue duration, an actor should not be situated within five to 20 feet from the front of the cue release point until at least 80 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-M1800 with Training Smoke FR Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	High	80	80	80	80	70
15	High	80	80	80	80	70
30	High	80	80	80	80	70
30	Medium	50	50	50	50	40
60	Medium	60	60	60	60	50
120*	Medium	70	70	60	60	50
60	Low†	60	60	60	60	50
120	Low†	70	70	60	60	50

*Machine shuts off after 52 seconds

†Machine pulses every 5 seconds at low setting

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M1800 with Training Smoke XD Fluid – Extreme Density

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke XD fluid in a FireBase SG-M1800 smoke generator.

Training Smoke XD is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-M1800.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

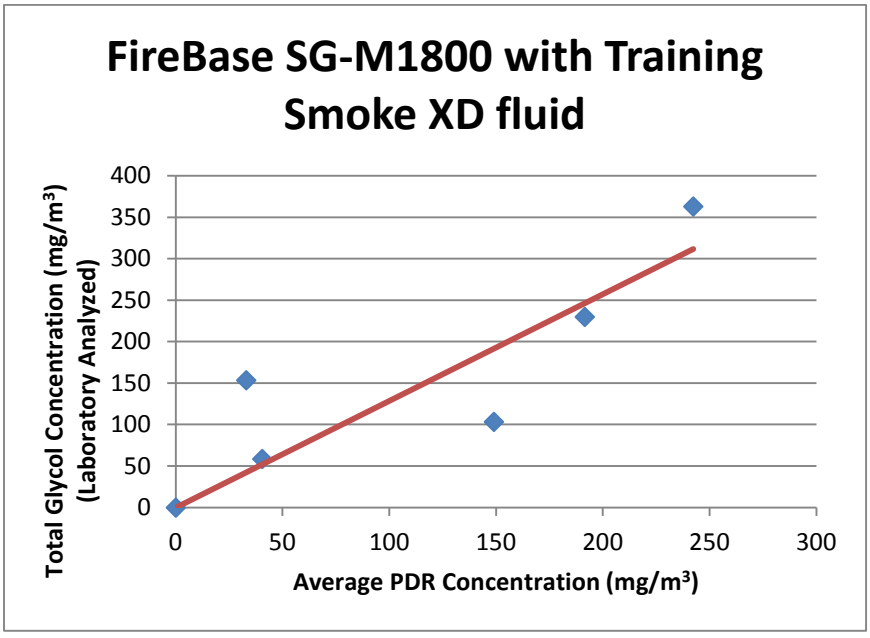


Figure 1. Calibration curve for FireBase SG-M1800 with Training Smoke XD fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 1.29 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M1800	Training Smoke XD	Glycol	1.29

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M1800/Training Smoke XD combination at high output with 15-second cue duration, an actor should not be situated within five to 10 feet from the front of the cue release point until at least 70 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-M1800 with Training Smoke XD Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	High	40	40	30	20	0
15	High	70	70	60	60	60
30	High	70	70	60	60	60
15	Med	60	60	60	60	60
30	Med	60	60	60	60	60
60*	Med	110	110	60	60	60
60	Low	110	110	10	0	0
120†	Low	110	110	10	0	0

*Machine shuts off after 40 seconds

†Machine shuts off after 90 seconds

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M1800 with Training Smoke Q Fluid – Quick Dissipating

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke Q fluid in a FireBase SG-M1800 smoke generator.

Training Smoke Q is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-M1800.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

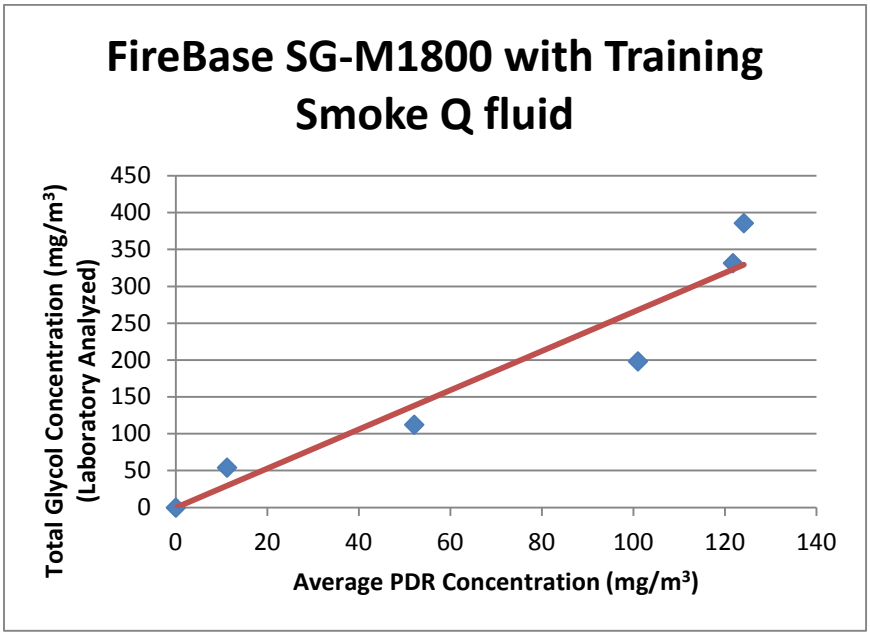


Figure 1. Calibration curve for FireBase SG-M1800 with Training Smoke Q fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 2.65 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M1800	Training Smoke Q	Glycol	2.65

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M1800/Training Smoke Q combination at high output with 15-second cue duration, an actor should not be situated within five to 10 feet from the front of the cue release point until at least 40 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-M1800 with Training Smoke Q Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	High	30	30	30	30	0
15	High	40	40	30	30	30
30*	High	40	40	30	30	30
15	Med	30	30	30	30	0
30†	Med	30	30	30	30	10
60‡	Med	30	30	30	30	10
60	Low	30	30	0	0	0
120	Low	30	30	0	0	0

*Machine runs at reduced output volume after 10 seconds

†Machine runs at reduced output volume after 20 seconds

‡Machine shuts off after 49 seconds

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M3000 with Training Smoke XD Fluid – Extreme Density

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke XD fluid in a FireBase SG-M3000 smoke generator.

Training Smoke XD is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-M3000.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

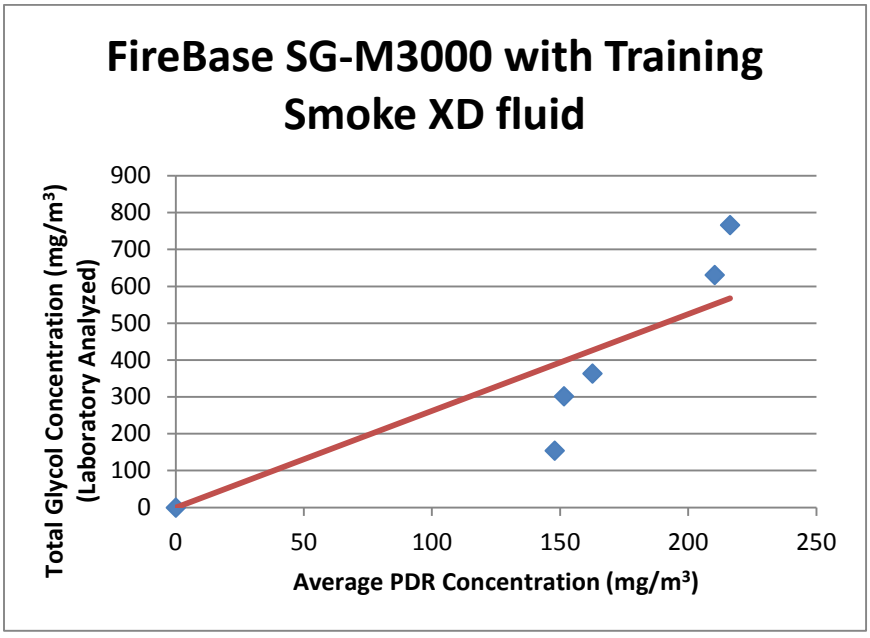


Figure 1. Calibration curve for FireBase SG-M3000 with Training Smoke XD fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 2.62 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M3000	Training Smoke XD	Glycol	2.62

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M3000/Training Smoke XD combination at 100% output with 15-second cue duration, an actor should not be situated within five to 10 feet from the front of the cue release point until at least 100 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-M3000 with Training Smoke XD Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	100%	90	90	90	70	70
15	100%	100	100	90	70	70
30	100%	120	120	100	100	70
15	65%	90	60	50	40	30
30	65%	120	120	70	70	60
60*	65%	120	120	70	70	60
60	25%	60	0	0	0	0
120	25%	60	30	0	0	0

*Machine shuts off after 48 seconds

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-M3000 with Training Smoke Q Fluid – Quick Dissipating

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke Q fluid in a FireBase SG-M3000 smoke generator.

Training Smoke Q is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-M3000.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

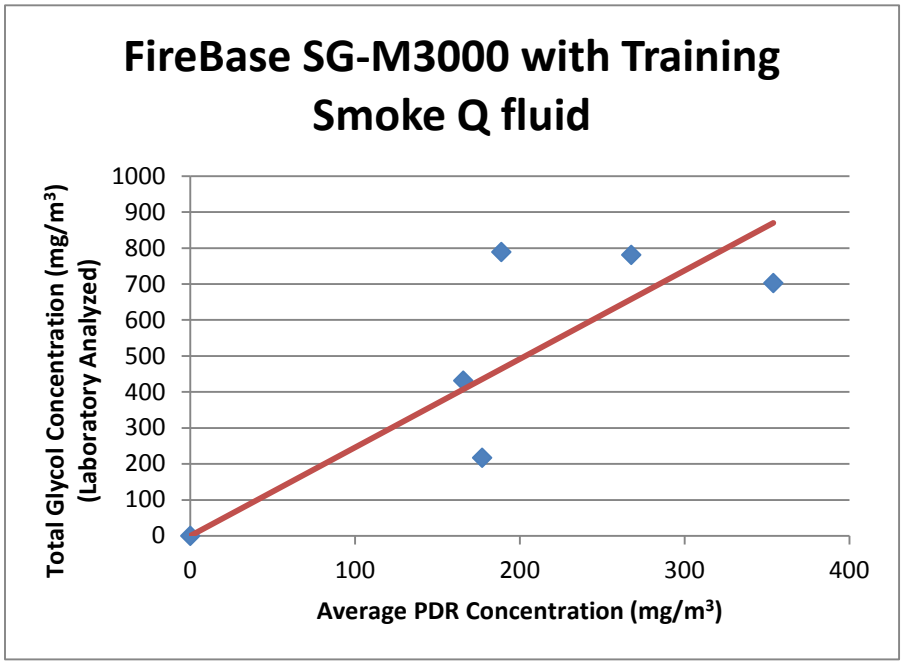


Figure 1. Calibration curve for FireBase SG-M3000 with Training Smoke Q fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 2.46 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-M3000	Training Smoke Q	Glycol	2.46

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-M3000/Training Smoke Q combination at 100% output with 15-second cue duration, an actor should not be situated within five to 20 feet from the front of the cue release point until at least 30 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-M3000 with Training Smoke Q Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	100%	30	30	30	30	20
15	100%	30	30	30	30	20
30	100%	30	30	30	30	20
15	65%	30	20	20	0	0
30	65%	30	30	30	0	0
60	65%	30	30	30	0	0
60	25%	0	0	0	0	0
120	25%	0	0	0	0	0

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-1300 with Training Smoke FR Fluid – Fire Rescue Formula

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke FR fluid in a FireBase SG-1300 smoke generator.

Training Smoke FR is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-1300.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

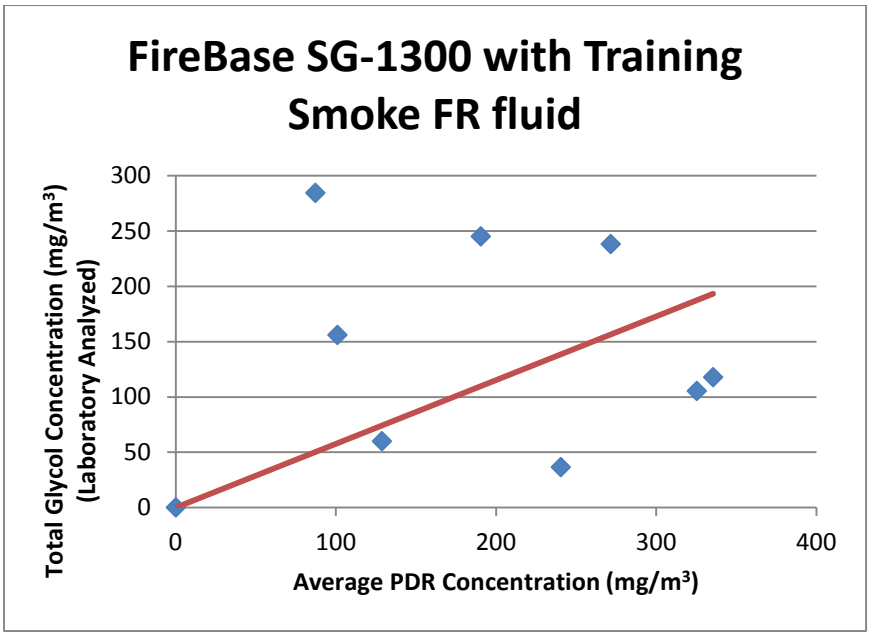


Figure 1. Calibration curve for FireBase SG-1300 with Training Smoke FR fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 0.58 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-1300	Training Smoke FR	Glycol	0.58

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-1300/Training Smoke FR combination at 99% output with 15-second cue duration, an actor should not be situated within five to 25 feet from the front of the cue release point until at least 30 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-1300 with Training Smoke FR Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	99%	30	30	30	30	30
15	99%	30	30	30	30	30
30*	99%	50	40	30	30	30
30	65%	50	10	0	0	0
60	65%	50	10	0	0	0
120	65%	50	10	0	0	0
60	25%	40	0	0	0	0
120	25%	40	0	0	0	0

*Machine had reduced output volume after 20 seconds

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-1300 with Training Smoke XD Fluid – Extreme Density

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke XD fluid in a FireBase SG-1300 smoke generator.

Training Smoke XD is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-1300.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

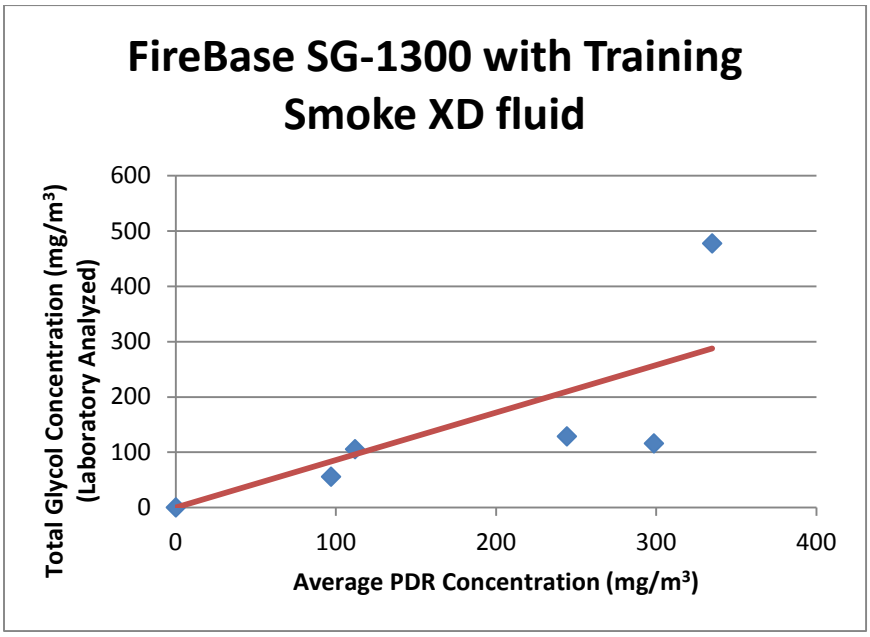


Figure 1. Calibration curve for FireBase SG-1300 with Training Smoke XD fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 0.86 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-1300	Training Smoke XD	Glycol	0.86

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-1300/Training Smoke XD combination at 99% output with 15-second cue duration, an actor should not be situated within five to 25 feet from the front of the cue release point until at least 50 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-1300 with Training Smoke XD Fluid						
Release Duration (secs)	**Output Setting**	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**				
		5 ft	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	99%	40	40	40	30	30
15	99%	50	50	50	50	50
30	99%	70	50	50	50	50
30	65%	70	0	0	0	0
60	65%	70	0	0	0	0
120	65%	70	0	0	0	0
60	25%	0	0	0	0	0
120	25%	0	0	0	0	0

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-1300 with Training Smoke Q Fluid – Quick Dissipating

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke Q fluid in a FireBase SG-1300 smoke generator.

Training Smoke Q is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-1300.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

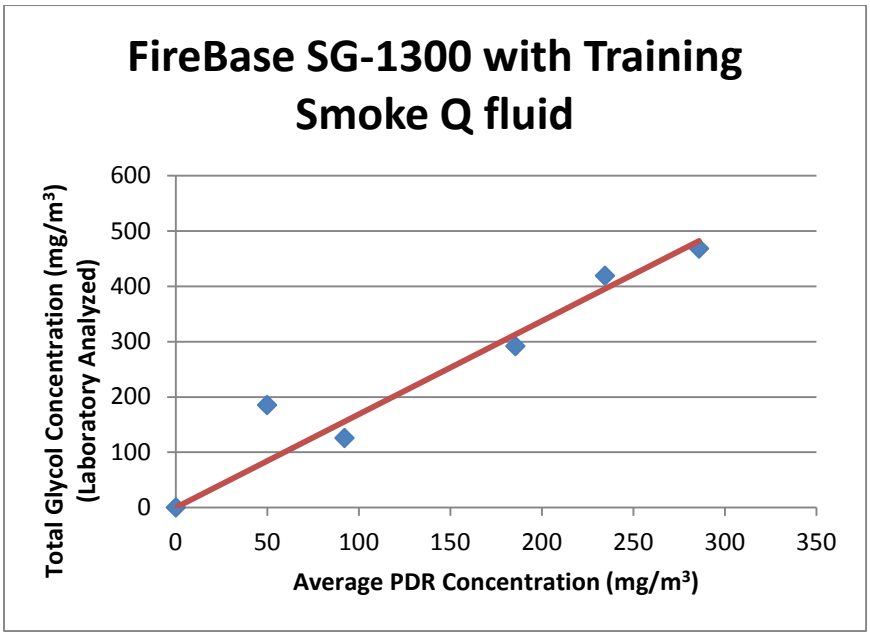


Figure 1. Calibration curve for FireBase SG-1300 with Training Smoke Q fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 1.69 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-1300	Training Smoke Q	Glycol	1.69

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-1300/Training Smoke Q combination at 99% output with 15-second cue duration, an actor should not be situated within five to 25 feet from the front of the cue release point until at least 20 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-1300 with Training Smoke Q Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	99%	0	0	0	0	0
15	99%	20	20	20	20	20
30	99%	30	20	20	20	20
30	65%	30	0	0	0	0
60	65%	30	10	0	0	0
120	65%	30	10	0	0	0
60	25%	0	0	0	0	0
120	25%	0	0	0	0	0

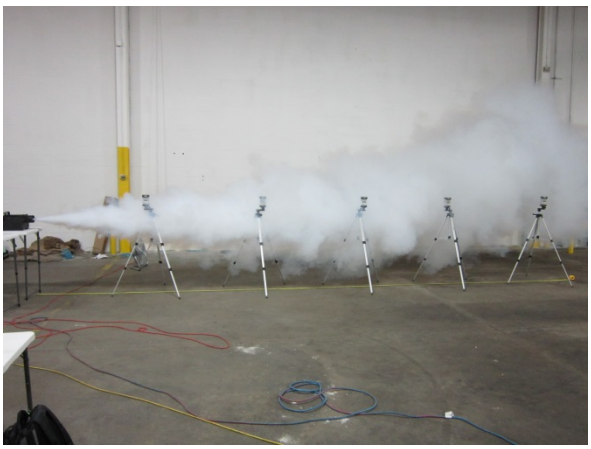
It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-2600 with Training Smoke FR Fluid – Fire Rescue Formula

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke FR fluid in a FireBase SG-2600 smoke generator.



Training Smoke FR is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-2600.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

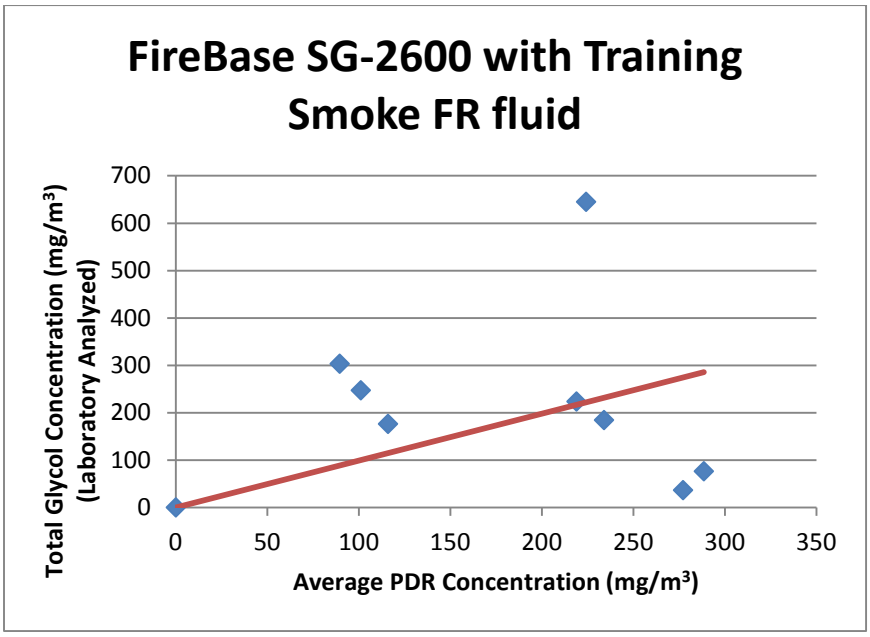


Figure 1. Calibration curve for FireBase SG-2600 with Training Smoke FR fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 0.99 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-2600	Training Smoke FR	Glycol	0.99

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-2600/Training Smoke FR combination at 99% output with 15-second cue duration, an actor should not be situated within five to 25 feet from the front of the cue release point until at least 40 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-2600 with Training Smoke FR Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	99%	40	40	40	40	40
15	99%	40	40	40	40	40
30*	99%	50	50	40	40	40
30	65%	20	0	0	0	0
60	65%	20	0	0	0	0
120	65%	>180	0	0	0	0
60	25%	0	0	0	0	0
120	25%	0	0	0	0	0

*Machine had reduced output volume after 20 seconds

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.

Calibration Factor and Time-and-Distance Guidelines

FireBase SG-2600 with Training Smoke XD Fluid – Extreme Density

Prepared for Froggy's Fog by ENVIRON International Corporation

ENVIRON developed calibration factors and Time-and-Distance guidelines for the use of Froggy's Fog Training Smoke XD fluid in a FireBase SG-2600 smoke generator.

Training Smoke XD is a glycol-based smoke fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the SG-2600.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

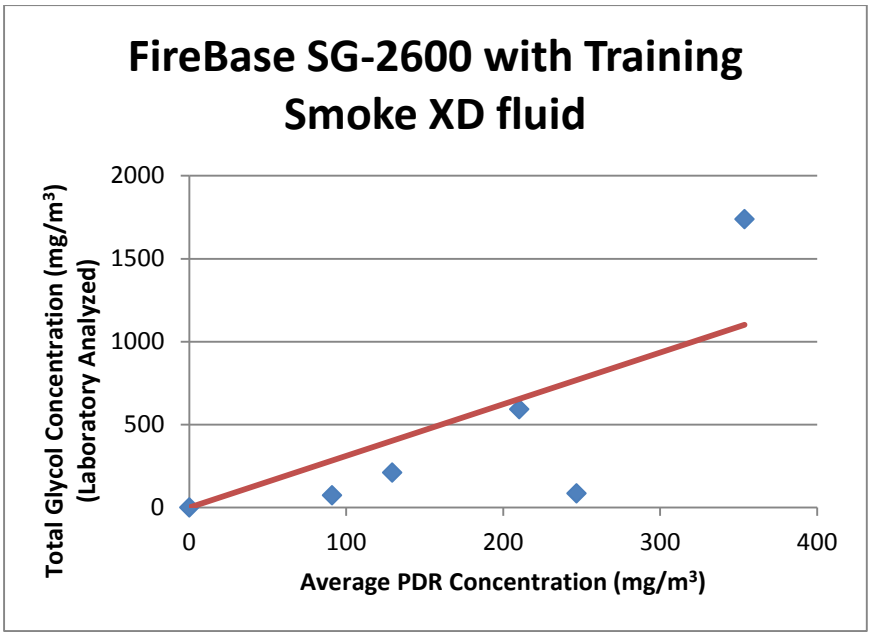


Figure 1. Calibration curve for FireBase SG-2600 with Training Smoke XD fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 3.11 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
FireBase	SG-2600	Training Smoke XD	Glycol	3.11

Time and Distance Guidelines. For various distances from the cue release point, the following table provides the average time (in seconds) after the end of the cue release after which the glycol concentrations will have fallen below the guidance levels. Thus, in order to prevent peak exposures to actors, the blocking and choreography should be arranged such that actors are not situated within a particular distance from the front of the smoke release point until the amount of time listed in this table has elapsed following the end of the cue. For example, if a production is using the FireBase SG-2600/Training Smoke XD combination at 99% output with 15-second cue duration, an actor should not be situated within five feet from the front of the cue release point until at least 90 seconds following the end of the cue release.

Summary of Time-and-Distance Guidelines for Smoke Generation FireBase SG-2600 with Training Smoke XD Fluid						
Release Duration (secs)	**Time (in sec) After Which Air Concentrations Are Below Guidance Level (40 mg/m^3)**					
	Machine Setting	**5 ft**	**10 ft**	**15 ft**	**20 ft**	**25 ft**
5	99%	90	50	40	40	40
15	99%	90	50	40	40	40
30	99%	90	70	40	40	40
30	65%	60	0	0	0	0
60	65%	60	0	0	0	0
120	65%	60	0	0	0	0
60	25%	0	0	0	0	0
120	25%	0	0	0	0	0

It should be reiterated that the Time-and-Distance Guidelines provided above are intended to allow a production to use the tested equipment and fluid combinations without conducting monitoring. However, these Guidelines may not be appropriate for all productions. Productions may want to use different configurations for positioning the machine (e.g., different heights), provide on-stage ventilation, or generate smoke for a shorter or longer period of time. In addition, many productions may have other stage-specific conditions (e.g., on-stage activities and props that enhance dispersion) that would allow actors to be present in areas that are restricted under these Guidelines but which, in fact, do not exceed the guidance levels. In those cases, production-specific monitoring would be recommended to evaluate whether peak exposure may occur.