

Air Conditioning and Ventilation Technologies for Performing Arts and Public Assembly Facilities



Air Distribution Solutions for

Performing Arts Centers
Theatres and Cinemas
Museums and Galleries
Libraries
Educational Facilities
Houses of Worship
Sports Arenas

Focus on the Future

TROX[®] **TECHNIK**
the art of handling air

World Class Facilities: World Class Air Distribution Solutions



*Vancouver Public Library
Vancouver, BC*



*Sidney Opera House
Sidney, Australia*

For over 50 years, Trox has been reknowned as the world leader in the delivery of engineered air distribution solutions. Trox products and technologies have been used in many of the world's most prestigious buildings, some of which are illustrated on these pages.

Performing arts facilities require air distribution systems that provide superior patron comfort while maintaining space noise levels that do not interfere with the patrons' enjoyment of the performance. At the same time, these systems should be aesthetically appealing.

Museums and galleries require air conditioning systems that provide precise control of temperature and humidity in order to preserve the contents of their collections. At the same time these systems should provide acceptable levels of comfort for visitors and staff.

Public use buildings, such as libraries, courtrooms, theatres, sports and religious facilities often have high ceilings or obstacles that can prevent proper air distribution by conventional means.

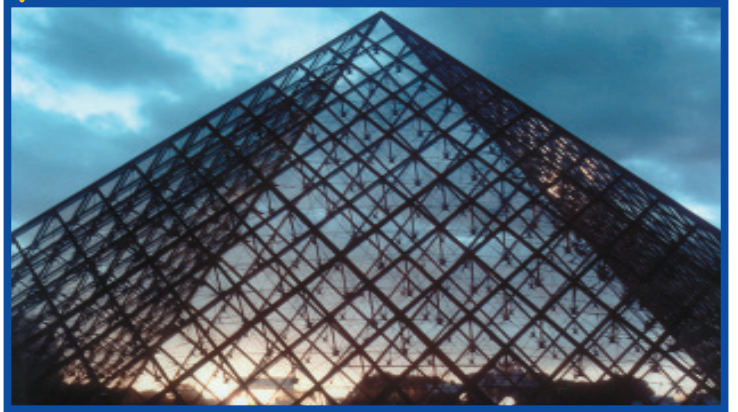
High ceilings are also commonly found in educational facilities, such as auditoriums and lecture halls. As the occupied levels comprise only a small percentage of the space, floor based distribution systems can effectively isolate overhead heat sources such as lighting.

Trox engineers have done extensive research in developing air distribution systems tailored to these applications. This publication highlights a few of these.

*National Theatre
Barcelona, Spain*



*The Louvre
Paris, France*



World Class Air Distribution Solutions for Performing Arts Facilities



*National Theatre
Barcelona, Spain*



*Opera House
Frankfurt, Germany*

As once was said of children, air diffusers in performing arts facilities should be seen and not heard. TROX has applied this adage in its design of air diffusion solutions for performing arts applications.

Extensive acoustical research and project mock-up testing has enabled the development of a series of floor and riser based products that conform to strict acoustical requirements. TROX engineers have worked closely with most of the world's leading acoustical consultants to tailor project specific solutions. TROX products have been installed in many of the world's most prestigious concert and opera facilities.

This cooperation between consultant and supplier is responsible for the development of products that allow maintenance of space sound levels of NC15 and lower. In addition, these products are aesthetically appealing and blend well with most architectural and interior design schemes.

TROX staircase, displacement and floor diffusers can be selected to mount below the occupants' seats and comfortably deliver conditioned air. Our research facilities are equipped to allow testing of these devices under actual project operational conditions.

*Opera House
Vienna, Austria*



*Opera House
Frankfurt, Germany*

World Class Air Distribution Solutions for World Class Museums and Galleries



• State Cultural Museum
• Copenhagen, Denmark



• National Gallery
• London, UK

Air conditioning systems for museums and art galleries are required to maintain precise control of temperature and humidity within the space while assuring the comfort of patrons and staff.

Displacement air distribution has been successfully employed to condition many of the world's greatest treasures. Visitors to the Louvre in Paris may note that the galleries which house the precious works of Picasso, daVinci, Rembrandt and others are supplied by these systems.

TROX has engineered solutions for many of the world's most famous galleries and museums. Among these facilities are the ones depicted on these pages. TROX engineers can, and have, tailored solutions specific to comfort and humidity constraints of the space in order to assure preservation of the world's most precious art and cultural treasures.

FB series floor diffusers are ideal for use in exhibit galleries where large fluctuations in occupancy levels might be expected. Their rugged construction and attractive appearance satisfy the needs of engineers and architects alike. Their superior room air induction capabilities assure that high levels of comfort are maintained.

TROX also manufactures a wide range of displacement diffusers which can be integrated into walls or structural columns. These outlets can be designed to complement and highlight the architectural design or to simply remain unobtrusive or hidden.

Guggenheim Museum
Bilbao, Spain



The Louvre
Paris, France

World Class Air Distribution Solutions for Government and Public Use Facilities



••• Cinema
••• Dusseldorf, Germany



••• Les Miserables
••• Dusseldorf, Germany



••• Maastricht University
••• Netherlands

TROX also manufactures floor and riser based solutions for the conditioning of public assembly facilities.

Many of these facilities use high ceilings and stage lighting. The efficient conditioning of the space often involves stratification by design to isolate these overhead heat gains while maintaining comfortable conditions at the occupied levels of the space. Floor and riser based air diffusers are ideal for such applications. These include theatres, sports arenas, educational and worship facilities.

TROX products have been successfully used to provide high levels of occupant comfort while maximizing the efficiency of the air conditioning system.

TROX floor and displacement diffusers are also installed in a variety of governmental facilities around the world. Courtrooms, libraries and other places of assembly require high degrees of occupant comfort.

Olympic Athletic Center
Athens, Greece



Vancouver Public Library
Vancouver, BC



Parliament of the Czech Republic
Prague, Czech Republic

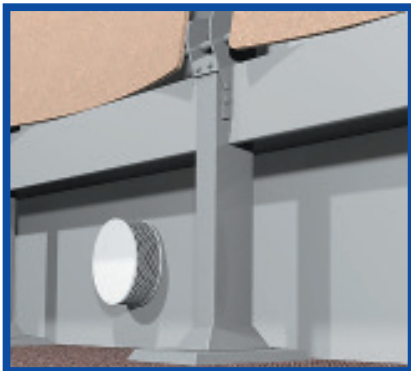
Air Distribution Solutions Engineered for Public Assembly Applications

SD Series Staircase Swirl Diffusers



SD staircase diffusers are high induction outlets which mount on the riser below stadium type seats. These diffusers are constructed of steel and are furnished in a variety of colors. They are ideal for use in sports facilities, theatres, and lecture halls. For additional information, see product leaflet 1/9/EN/4.

QSP Series Displacement Diffusers



QSP series displacement cylinders can be mounted in the floor or on the riser below stadium type seats. These are constructed of steel and can be furnished in a variety of colors. Their low noise characteristics make them ideal for use in performing arts facilities and theatres.

FB Series Floor Diffusers



FB Series floor outlets are high induction diffusers that mount in the floor below the seat. Available in plastic or aluminum, FB diffusers can be provided in a variety of colors. They are ideal for use in museums, court rooms, religious and performing arts facilities. For additional information see product leaflet 1/8/US/2.

Performance Information

Acoustical and Comfort Data

Outlet Type	Airflow (cfm)	ΔP_T (in.w.g.)	Local Velocity (fpm)		Sound Power Level, dB Octave Band Center Frequency, Hz							Maximum Airflow for Specified NC Levels		
			L = 16"	L = 24"	63	125	250	500	1K	2K	4K	NC15	NC25	MAX
SD-Q-LQ No Filter	30	.046	<40	<40	26	22	22	21	16	9	-	30	50	60
	45	.103	45	<40	31	27	28	26	22	19	12			
	60	.184	50	<40	37	35	34	33	31	29	23			
SD-Q-LQ with F721 Acoustic Filter	20	.033	<40	<40	27	18	7	-	-	-	-	40	50	60
	40	.134	40	<40	30	26	23	22	11	-	-			
	60	.301	50	<40	33	28	30	31	29	25	20			
QSP-200 48% FA H = 50 mm No Filter	45	.012	40	<40	8	6	-	-	-	-	-	45	85	60
	60	.020	50	<40	26	21	19	17	15	12	10			
	75	.032	60	50	34	29	26	23	21	19	16			
QSP-200 48% FA H = 50 mm with F721 Acoustic Filter	20	.049	<40	<40	8	-	-	-	-	-	-	50	90	60
	40	.195	<40	<40	18	12	10	6	-	-	-			
	60	.440	50	<40	28	23	21	19	18	16	14			
FB 200 No Filter	30	.007	<40	<40	13	12	-	-	-	-	-	60	100	50
	45	.017	40	<40	18	17	7	-	-	-	-			
	60	.030	55	45	27	20	20	19	6	-	-			
FB 200 with F721 Acoustic Filter	30	.052	<40	<40	19	12	6	-	-	-	-	60	100	50
	45	.117	40	<40	24	18	14	6	-	-	-			
	60	.208	55	45	29	25	23	20	13	6	-			

Performance data for the outlets shown on the previous page are tabulated above.

The referenced acoustical filters are designed to impose additional pressure losses on the outlet without appreciably increasing noise levels. Use of these filters is advised when outlets are selected for very low flows, as the outlet pressure loss is often insufficient for maintaining balanced air distribution.

The columns on the right side of the table indicate the maximum outlet airflow for specified NC levels. The far right column indicates the maximum recommended flow rate for applications which require high comfort levels.

Red values in the NC15 and NC25 indicate airflow rates that exceed those specified for high comfort levels. Such airflows should be restricted to applications like sports facilities or those of short occupancy duration.

Performance Notes:

1. Sound power levels shown are dB per octave band.
2. Local velocities represent the maximum predicted velocity (fpm) at the specified radial distance (L) from the outlet.
3. NC values are based on sound power levels shown and include no corrections for room absorption.
4. (-) indicates sound power levels less than 5dB

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