Ground Run-up Enclosures for Commercial, General Aviation & Military Aircraft

GRE

BDI
Blast Deflectors

Reducing Airport Noise and Improving Safety Since 1957

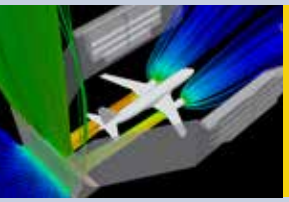
"BDI's extensive knowledge of acoustics and aerodynamics, along with an extraordinary commitment during the design and construction phases, were critical factors in the overall success of the project." - Airbus Group

Martin Tzschichhold | Project Manager

BDI pioneered a cost-effective, technologically-advanced solution for ground run-up noise attenuation. We offer ground run-up enclosure (GRE) facilities that use patented components, proven designs and a spotless track record of successful installations. BDI's philosophy is to balance project requirements with practical solutions.

Planning & Design Support

- Ground run-up noise assessments
- Photorealistic renderings for communicating concepts to stakeholders
- Support for FAA Part 150 studies, airspace studies, obstacle free conflicts, aerodynamic usability, etc.



Engineering

- Continuous innovation using computational fluid dynamics (CFD) and finite element (FE)
- Computer aided design (CAD) and 3D structural models for BIM integration
- Local code compliance of concrete foundations, anchoring systems and structural design

Fabrication & Supply

- ISO 9001:2015 certification ensures that the highest quality standards are followed
- Global manufacturing capability offering the highest quality materials and production techniques
- Custom-manufactured solutions to meet unique project requirements

Delivery

- GRE material delivered to any location in the world via truck, rail, ocean or air freight
- All material is professionally packed in easily-handled bundles
- Project management team oversees design, delivery and construction to meet schedules and deadlines

Installation

- BDI's staff of field technicians provide site assistance to ensure a smooth and efficient installation
- Our diverse capabilities enable BDI to offer turnkey installation service
- All BDI projects are backed by a performance guarantee and material warranty

Performance Verification

- Upon completion of an installation, BDI can assist with field validation of the GRE performance
- Field measurements of jet blast exhaust, air flow and acoustic performance are compiled into a report
- BDI's R&D department uses field data to develop new products and solutions

Support

- Spare parts and replacement components are stocked at various BDI facilities around the world
- Refurbishment program to evaluate and repair older facilities to extend service life
- Archives of documentation and details from more than 1,500 past projects available

A RUN-UP NOISE SOLUTION

BDI's approach is based on providing our customers with the highest quality products and services that match our international reputation of performance and value earned over the last 60 years. This reputation includes technically-sound designs, timely deliveries, professional installation and outstanding post-project customer service.

The combination of the aerodynamically advanced Stabile Flow™ design with the effectiveness of Noise Blotter™ acoustic panels provide an aerodynamically efficient GRE with very high usability and outstanding noise reduction.

BDI can design and build ground run-up enclosures for any aircraft mix including commercial, general aviation and military.

BDI utilizes the latest aerodynamic, acoustical and structural software packages, combined with scale modeling and field measurements, to ensure project requirements are met.

Let us assist you with your project by providing a complimentary analysis demonstrating how BDI's GRE technology can mitigate a specific ground run-up noise challenge.

St. Louis (USA)

Bangkok (Thailand)

Bogotá (Colombia)

Dubai (UAE)

Albany (USA)

EXTRACT OF BDI PROJECTS AROUND THE WORLD

AMERICAS

Argentina
Buenos Aires

Brazil
Goiania

Canada
Abbotsford
Calgary
Cold Lake
Edmonton
Josephburg
Montreal, Dorval
Montreal, Trudeau
Ottawa
Puvirnituq
St. John's
Toronto, Billy Bishop
Toronto, Pearson
Vancouver
Waterloo
Winnipeg

Chile
Santiago

Colombia
Bogotá

Ecuador
Manta
Quito

Cayman Islands
Grand Cayman

Panama
Panama City

Trinidad & Tobago
Trinidad

USA
Akron
Albany
Albuquerque
Altus AFB
Anchorage
Andrews AFB
Atlanta
Atlantic City
Austin
Baltimore
Bangor
Barksdale AFB
Battle Creek
Beale AFB
Beaufort, MCAS
Birmingham
Boca Raton
Bradley
Buffalo-Niagara
Burbank
Carlsbad
Cecil Field, NAS
Charleston
Charlotte
Chennault/Lake Charles
Cherry Point, MCAS
Chesterfield
Chicago, Midway
Chicago, O'Hare
China Lake
Chino
Cleveland
Colorado Springs
Columbus
Dallas, DFW
Dallas, Love Field
Deer Valley
Denver
Des Moines
Detroit
Dobbins AFB
Dyess AFB
Edwards AFB
Eglin AFB
Eielson AFB
Ellsworth AFB
Elmendorf AFB
Fairbanks
Fairchild AFB
Fallon, NAS
Flint
Fort Bliss
Fort Dix
Fort Worth
Glendale
Grand Forks AFB
Grand Junction
Grand Rapids
Greensboro
Greenville
Grissom ARB
Harrisburg
Hawthorne
Hickam AFB
Hill AFB
Holloman AFB
Honolulu
Houston, Bush
Houston, Hobby
Huntsville
Independence
Indianapolis
Jacksonville, Cecil
Jacksonville, Int'l
Jacksonville, NAS
Kaneohe Bay, MCAS
Kansas City
Killeen
Knoxville
Kodiak
Kona
Kulis
Lafayette
Las Vegas
Laurel
Leigh Valley
Lemoore, NAS
Lexington
Lihue
Little Rock
Long Beach
Long Island
Los Angeles
Louisville
Madison
March ARB
Marietta
Martinsburg
McAllen
McConnell AFB
McGuire AFB
Melbourne
Memphis
Mercedita
Miami
Milwaukee
Minneapolis
Mobile Brookley
Moffett Field
Mojave
Monterey
Montgomery
Moody AFB
Morristown
Mountain Home AFB
Naples
Nashville
Nellis AFB
Nevada Test Site
New Orleans
New York, JFK
New York, LaGuardia
Newark
Newcastle
Norfolk
Oakland
Oceana, NAS
Omaha
Onslow
Ontario
Oscoda
Palmdale
Patuxent River, NAS
Pensacola
Philadelphia
Phoenix
Pittsburgh
Point Mugu, NAS
Pontiac
Portland (Maine)
Portland (Oregon)
Providence
Portsmouth
Randolph AFB
Reno
Republic
Roanoke
Robins AFB
Rochester
Sacramento
Saginaw
Salt Lake City
San Antonio, Int'l
San Antonio, Kelly
San Diego
San Francisco
San Jose
Santa Monica
Sarasota
Savannah
Scott AFB
Scottsdale
Scranton
Seattle, Boeing Field
Seattle, Everett
Seattle, Renton
Seymour Johnson AFB
Shaw AFB
Sikorsky
South Bend
St. Augustine
St. Joseph
St. Louis
Stewart
Tallahassee
Tampa
Tinker AFB
Tonopah
Travis AFB
Truckee
Tucson
Tulsa
Tyndall AFB
Van Nuys
Victorville
Washington, Dulles
Washington, Reagan
West Palm Beach
Westchester
Westfield-Barnes
Whidbey Island, NAS
Wichita
Wilmington
Wright-Patterson AFB
Yuma, MCAS

GRE Locations

GLOBAL PRESENCE IN OVER 55 COUNTRIES

EUROPE

Austria
Vienna

Bulgaria
Sofia

Czech Republic
Prague

Estonia
Ämari Air Base

France
Bordeaux
Paris, CDG
Toulouse

Germany
Augsburg
Berlin Schönefeld
Berlin Tegel
Dortmund
Finkenwerder
Frankfurt
Friedrichshafen
Hannover
Köln
Munich
Ramstein AB
Saarbuecken

Hungary
Budapest

Iceland
Reykjavík

Ireland
Dublin
Shannon

Italy
Aviano AB
Bologna
Cameri AB
Naples

Latvia
Lielvārde AB
Riga

Lithuania
Zokniai AB

Luxembourg
Luxembourg

Netherlands
Schiphol

Norway
Oslo

Portugal
Lisbon
Porto

Romania
Camp Turzii AB
MK Air Base

Russia
Moscow Sheremetyevo

Spain
Almeria
Barajas
Granada
Ibiza
La Coruna
Lanzarote
Madrid
Moron AB
Murcia
Seville
Tenerife
Zaragoza

Switzerland
Basel
Bern
Stans
Zurich

United Kingdom
Birmingham
Brough
Broughton
Cambridge
Exeter
Lakenheath, RAF
Liverpool
London, Luton
London, Stansted
Manchester
Mildenhall, RAF
Norwich
Warton

MIDDLE EAST / AFRICA

Algeria
Algiers

Afghanistan
Bagram
Kandahar

Bahrain
Manama

Djibouti
Camp Lemonnier

Egypt
Beni Suef AB
Cairo
Fayid AB
Helwan AB

Ethiopia
Addis Ababa

Iraq
Al Asad AB
Balad AB

Jordan
Amman

Kuwait
Al Jaber AB
Kuwait

Morocco
Ben Guerir AB

Oman
Adam AB
Al Musannah AB
Thumrait AB

Qatar
Al Udeid AB
Doha

Saudi Arabia
Dhahran AB
Dammam
Jeddah
King Faisal AB
Medina
Riyadh

Turkey
Incirlik AB
Istanbul, Ataturk
Istanbul, Grand Airport
Istanbul, Sabiha Gokcen

United Arab Emirates
Abu Dhabi
Al Ain
Al Dhafra AB
Dubai, DWC
Dubai, DXB

ASIA / OCEANIA

Afghanistan
Bagram
Kandahar

Australia
Amberley, RAAF
Darwin, RAAF
Hobart
Melbourne
Newcastle-Williamtown
Sydney
Tindal, RAAF

China
Hong Kong

India
Hindon
Mumbai
Nagpur

Diego Garcia

Japan
Iwakuni AB
Kadena AB
Komaki
Misawa AB

Korea
Kunsan AB
Osan AB
Sacheon
Seoul
Suwon AB

Malaysia
Kuala Lumpur
Labuan
Subang

Pakistan
Lahore
Karachi

Philippines
Manila

Singapore
Changi
Paya Lebar
Seletar
Sudong
Tengah

Sri Lanka
Colombo

Taiwan
Taipei

Thailand
Bangkok

Turkmenistan
Ashgabat

GRE Locations

THE AERODYNAMIC CHALLENGE

Running aircraft engines at high power settings while stationary can be challenging for various reasons:

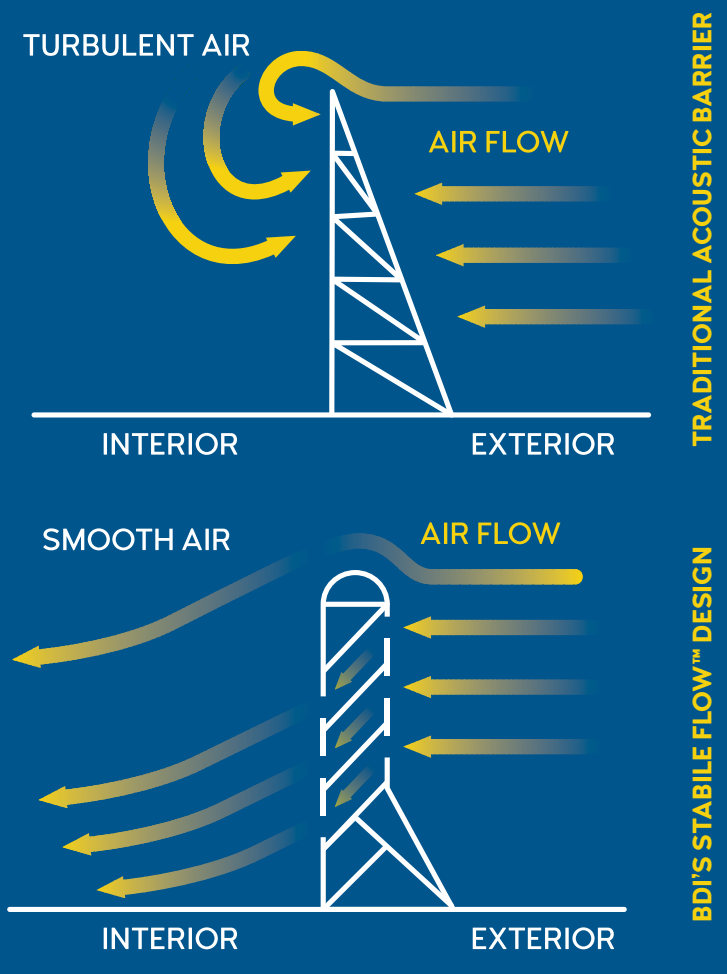
- Aircraft engines require smooth and turbulence-free air
- Modern aircraft are efficient and powerful, and the latest turbofan engines use high bypass ratios with larger fan diameters that are closer to the ground than previous generation aircraft, which can create significant aerodynamic challenges
- Ground-running aircraft in a GRE is more complicated than open-field conditions due to the fixed facility orientation, tall acoustic walls, and atmospheric conditions
- Successful ground-running of aircraft engines requires avoiding turbulence at the nacelle (inlet)

BDI'S SOLUTION

Through the use of scale model testing, computational fluid dynamics (CFD) and field evaluation of more than 30 completed facilities, BDI's GRE facilities have innovative aerodynamic features that maximize facility usability.

"Users of the Billy Bishop Toronto City Airport are able to successfully test aircraft inside the BDI GRE in almost all wind conditions ensuring excellent facility usability." - PortsToronto

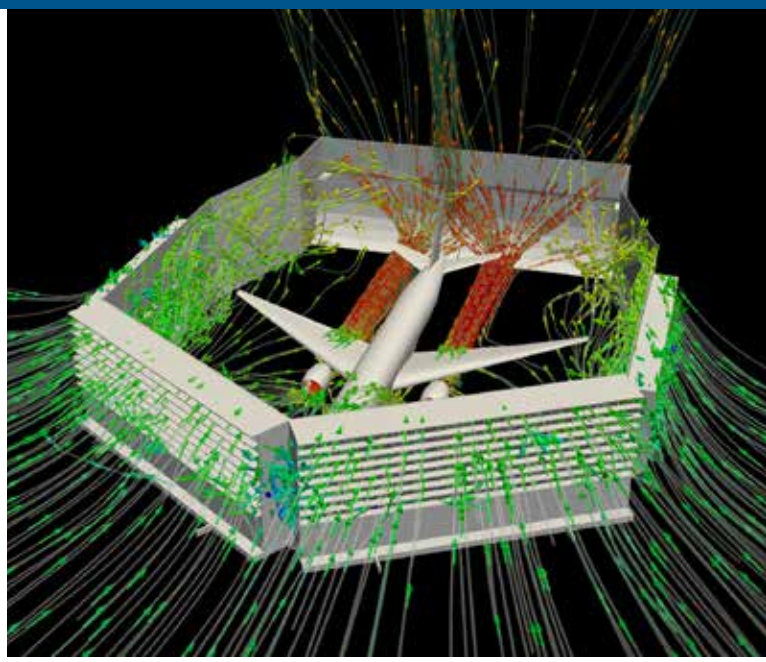
Bojan Drakul | Manager – Infrastructure, Planning and Environment



GRE aerodynamic design is a critical factor in usability. An aerodynamically efficient, curved jet blast deflector at the rear of the GRE redirects the jet blast vertically and maintains the jet efflux momentum to drive the flow inside the facility.

Our 3-sided GRE design starts with sloped entry walls with a rolled top to improve airflow into the facility and eliminate vortex formation, due to separation, at the front and top of the side walls.

Our 4-sided GRE design uses large, vented front gates with sufficient open area to supply the necessary air into the facility. The side walls of our GRE facilities use large, acoustically-treated vents to provide engine entrainment air and to improve usability in cross-wind conditions.



BDI's patented, vented rear-wall, the Vertivent™, directs entrainment air to the discharge lip of the jet blast deflector. The Vertivent™ improves the jet blast discharge angle, reduces high intensity turbulence due to the jet blast discharge, and dramatically improves usability in tail wind conditions. BDI GREs are designed to use the momentum of aircraft engines to smoothly drive air with minimal turbulence generation, not only through the jet engines but through the entirety of the facility. Our aerodynamic know how and the outstanding performance of our facilities is one reason BDI builds the best GREs on the market.

Sloped entry for high usability in quartering head winds

Acoustically treated side walls with aerodynamic vents

Curved Vertivent™ jet blast deflector incorporated into the rear wall system for high usability in tail winds

Rolled top for improved performance in crosswind conditions

St. Augustine (USA)

Indianapolis (USA)

Winnipeg (Canada)

Milwaukee (USA)

Detroit (USA)

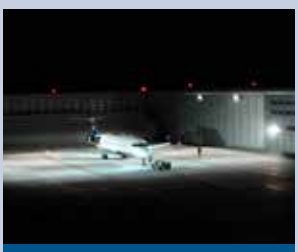
NOISE ATTENUATING TECHNOLOGY

Engine run-ups typically occur at night, precisely when communities near airports are most sensitive to noise. With over 30 successful GREs constructed to date, BDI understands that the primary reason to build a GRE is the acoustic benefits such a facility brings to airports and communities. BDI works with all stakeholders to develop a solution that, first and foremost, meets the project's acoustic requirements.

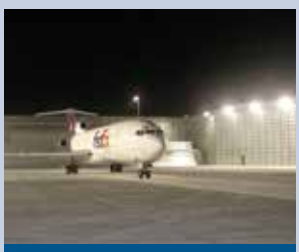
Example of noise contour without GRE

Example of noise contour with GRE

50-60 dBA	60-70 dBA	70-80 dBA	80-90 dBA	90+ dBA



Norfolk (USA)

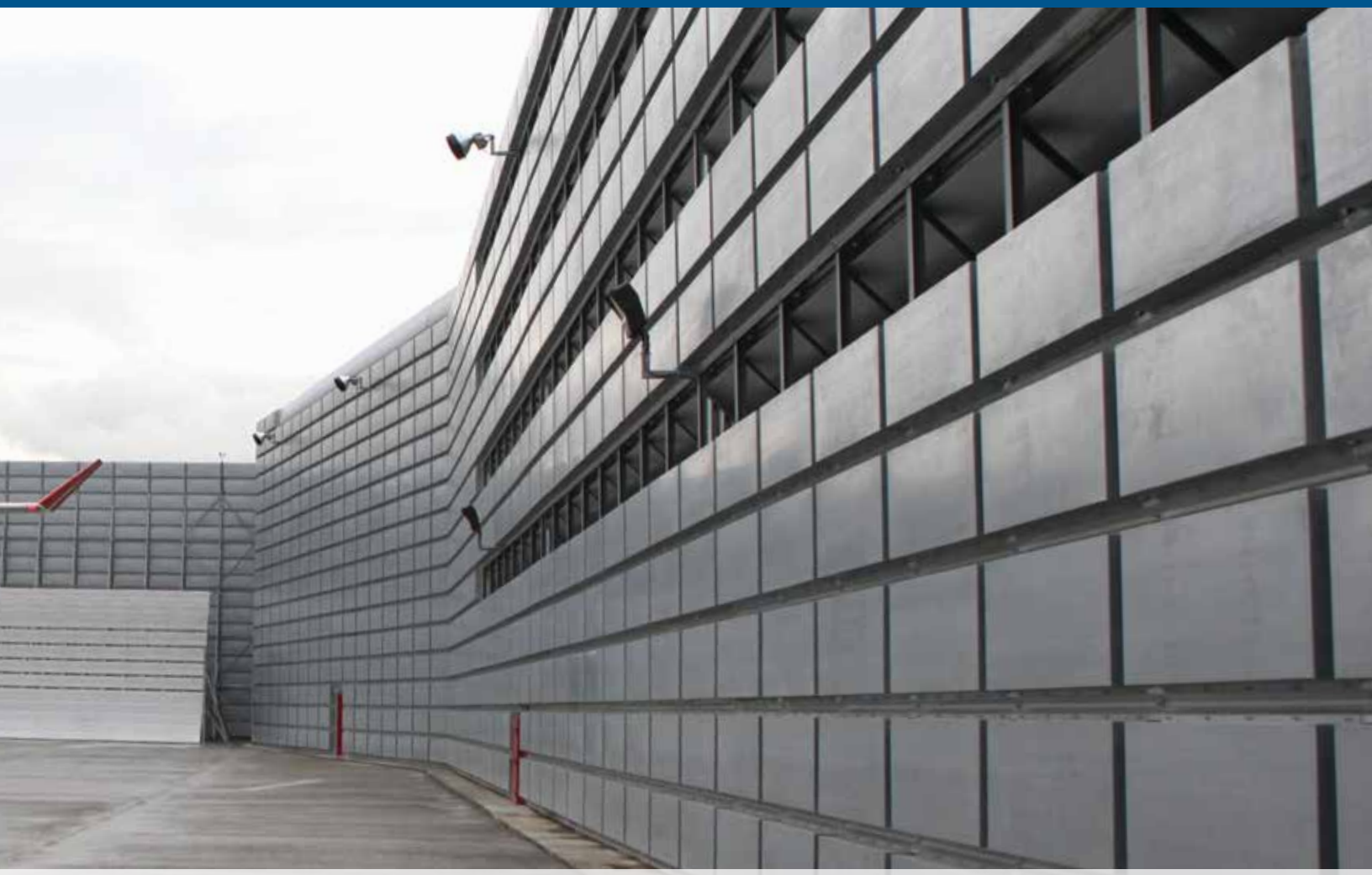


Oakland (USA)

Chicago (USA)

Portsmouth (USA)

Sofia (Bulgaria)



BDI uses the latest computer noise modeling programs and truly understands the complex issues and regulations involved in analyzing aircraft noise challenges. BDI's GREs incorporate high-performance materials and designs in our patented Noise Blotter™ acoustic panel, which were designed specifically for control of the low frequency noise generally associated with aircraft ground run-ups.

These panels feature a high transmission loss (STC) of 36 and effectively absorb low frequency noise. These panels have demonstrated a noise reduction coefficient (NRC) of 1.25 and maintain an absorption coefficient of 1.0 at 100Hz. The use of hydrophobic materials and acoustically-transparent wrap materials ensure that the panels will provide a long, maintenance-free service life.

Ashgabat (Turkmenistan)

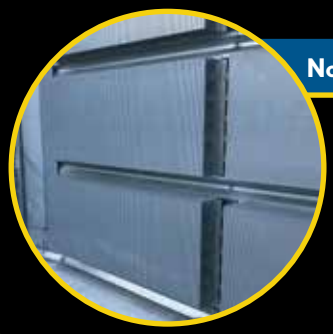
Everett (USA)

Tampa (USA)

Subang (Malaysia)

Al Ain (UAE)

FEATURES OF A BDI 3-SIDED GRE



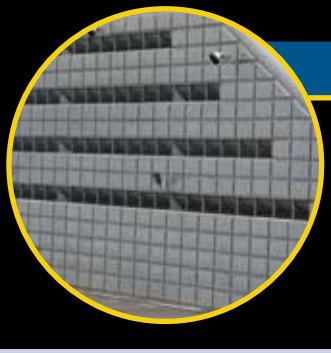
Noise Blotter™ Acoustic Panels

Optional Vented Rear Wall (not shown)

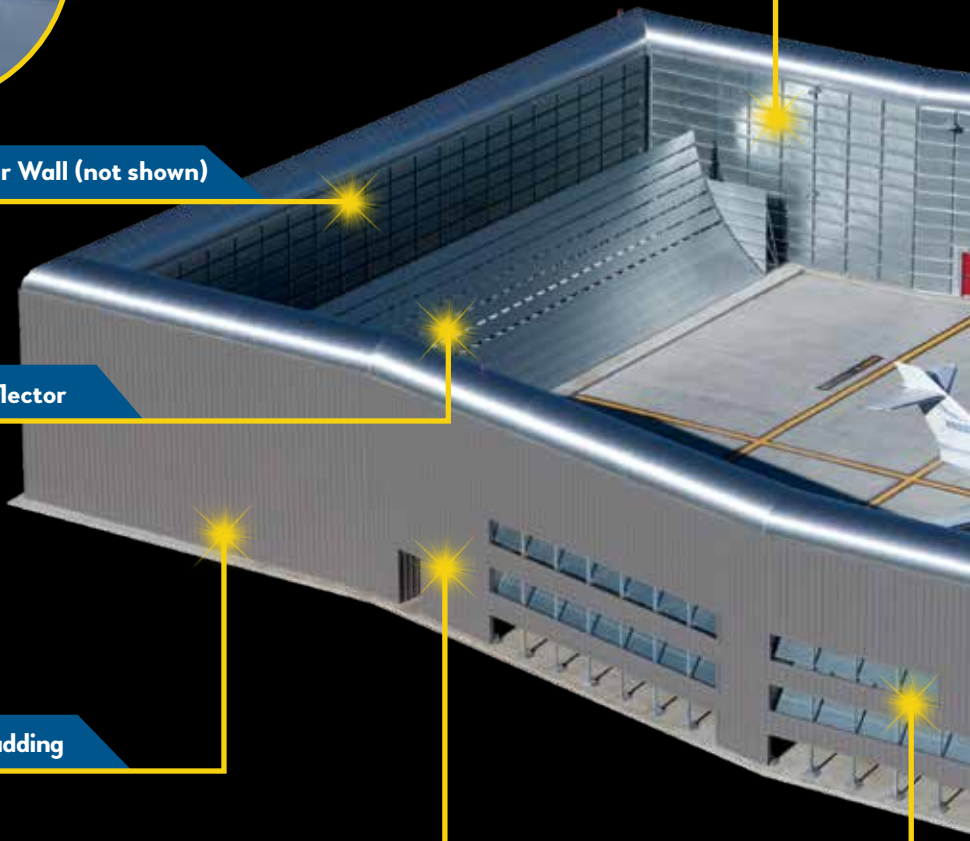
Curved Jet Blast Deflector

Optional Aesthetic Cladding

Access/ Egress Doors



Acoustically-Treated Aero Vents



Pontiac (USA)

Memphis (USA)

Budapest (Hungary)

Kuala Lumpur (Malaysia)

BDI's line of 3-sided GREs provides the optimal balance of acoustic performance, aerodynamic usability and budget considerations. Having completed more than 30 such facilities, BDI can design the ideal solution to accommodate any commercial or military aircraft.

Safety Features

Interior Work Lights

Wind Condition Display

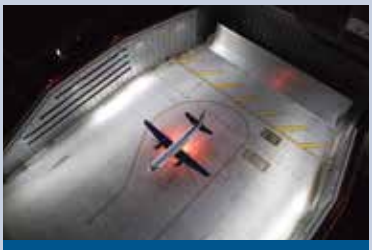
Ingress/Egress Guides

Observation Cabin

Weather Monitoring Station

Aerial Photo: Spirit of St. Louis (USA)

Seletar (Singapore)



Vancouver (Canada)

Portland (USA)

Zurich (Switzerland)

FEATURES OF A BDI 4-SIDED GRE

Acoustically Treated Front Gates

Control Room

Motorized Gates

Emergency Vehicle Access

Airbus Finkenwerder (Germany)

BDI's line of 4-sided GREs provides 360 degrees of acoustic protection, which is ideal for projects in highly congested areas or when stringent acoustic performance is required. The patented Vertivent design delivers smooth, turbulence-free air that results in a facility with very high aerodynamic usability.

Safety Features

Vented Rear Wall

Curved Jet Blast Deflector

Optional Aesthetic Cladding (not shown)

Aerial Photo: Marshall of Cambridge (UK)

Marshall of Cambridge (UK)

THE ORIGINAL EXPERTS

Founded in 1957 in San Francisco, Blast Deflectors, Inc. is a world leader in jet blast deflectors and aircraft acoustic enclosure technology. Our innovative solutions have set the standard for the jet blast deflector industry for more than 60 years. We safeguard our reputation for excellence through a focus on research and development combined with state-of-the-art manufacturing. The result is a complete range of jet blast deflectors suitable for all applications.

BDI works with aircraft manufacturers, civil aviation authorities and airport consultants to analyze the potential jet blast impacts of aircraft. That, coupled with our years of experience and thousands of successful installations across the world, allows us to plan, design and implement the most cost effective and practical solutions. BDI's commitment for customer service and continuous improvement is evidenced by our ISO 9001:2015 certification.

A FOCUS ON QUALITY

BDI has a long history of consistently providing quality blast deflectors and ground run-up enclosures that meet project requirements. This commitment has been reinforced by receiving registration to ISO 9001:2015 standards.

"After more than ten years of service, Emirates Airline continues to be very happy with the GRE facility by BDI, which is used on a daily basis for ground run-ups." - Emirates Engineering

Robert Aiken | Senior Manager Eng. Facilities

Step 1: Site Preparation

Step 2: Civil Construction

Step 3: Steel Erection

Step 4: Acoustic Panels Installed

Step 5: Aerodynamic Features Installed

Step 6: Aesthetic Cladding Installed

Step 7: Acceptance Testing

Step 8: Facility Put Into Service

BDI closely controls the construction activities for each GRE project site using both on-site personnel and remote web-based monitoring in order to ensure optimal quality standards are followed.

Featured Facility: Toronto City Airport

LET BDI'S 60+ YEARS OF EXPERIENCE BENEFIT YOUR PROJECT

AMERICAS
us.sales@bdi.aero

EUROPE, MIDDLE EAST AND AFRICA
emea.sales@bdi.aero

ASIA-PACIFIC
ap.sales@bdi.aero

- **Jet Blast Deflectors**
- **Ground Run-up Enclosures**
- **Visual Screens**
- **FOD Barriers**
- **Acoustic Barriers**

Blast Deflectors, Inc.
8620 Technology Way
Reno NV 89521 USA
+1 775.856.1928
www.bdi.aero

BDI
Blast Deflectors