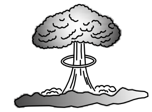
(ENGINEERS)
SUBMITTAL DATA



Shock Tube Tested

(see data)

Ventilation Damper "Blast Resistance"

ICBL-20 (up to 75 psi)
G-ICBL-20 (up to 75 psi)

Application and Design

The ICBL-20 is designed for protection against sudden blasts and instantaneous pressure changes. The blast damper was designed using the RISA 3D structural program with a rod strength of 36,000 psi and a maximum deflection ratio of L / 180. The G-ICBL-20 includes a High Frequency Wave Equalizing Grid and Debris Screen.

STANDARD CONSTRUCTION:

FRAME:
3"(76.2mm) x 10"(254mm) x 3"(76.2mm), 10 ga. Carbon Steel Channel with 10"(254mm) wide x 1/4"(6.35mm) Faceplate (ASTM A1011 CS Type B & A569CQ)

BLADES:
10 ga carbon steel double skin airfoil (ASTM A1011 CS Type B & A569CQ)

BLADE LOCK:
Latch mechanism to lock blades in close position after Blast (exothermic reaction)

AXLES:
Ø 1" solid A36 steel on 6" centers (G)-ICBL-20)

LINKAGE:
3/16" thick x 3/4" wide bars

BEARINGS:
Two hole flange ball bearing (type III)

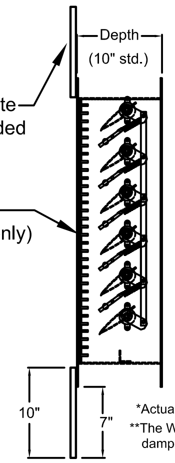
FINISH:
Zinc Rich Gray Primer

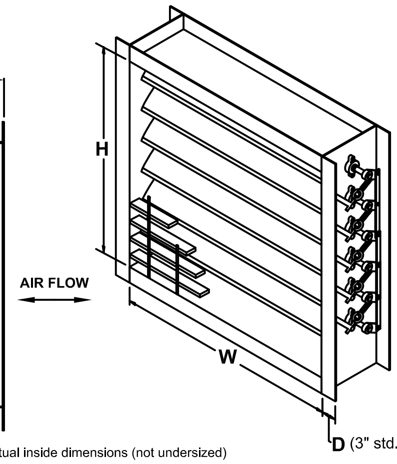
SIZE LIMITATIONS:
Mininmum size: 8"w x 8"h
Maximum single section: 48"w x 60" (see graph for psi limitations)
For factory assembled multi-section size limitations, consult factory

Note: Equalizing Grid provided with G-ICBL -20 only

10" wide, 1/4" plate factory stitch welded to damper frame (typ. 4 sides)

Equalizing Grid (G-ICBL Series only)





*Actual inside dimensions (not undersized)
**The W dimension is ALWAYS parallel with the damper blade length.

(BLAST #1 ARRANGEMENT SHOWN)

Optional: Damper above is shown without flange for induct mounting.

Max. Free Area Velocity: 4000 FPM

Required Specifications:

Blast Arrangement / Airflow

☐ #1
☐ Intake ☐ Exhaust
Air Volume ________cfm
☐ #2 (normally closed)
☐ #3 (normally closed)
☐ #4
☐ Intake ☐ Exhaust
Air Volume ________cfm

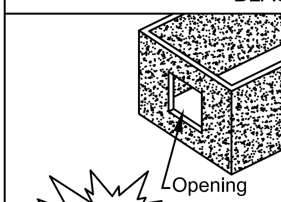
Blast Criteria

Reflective Pressure________psi
Duration________msecs
Impulse________psi-msecs

Adjustable Spring Tensioner location

☐ Accessible from Interior (Side A) -Standard
☐ Accessible from Exterior (Side B) -Optional

BLAST #1 ARRANGEMENT



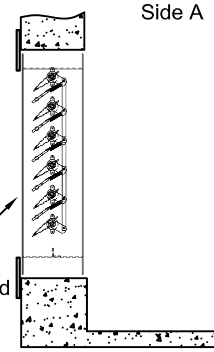
Outside Containment

Side B

AIRFLOW
(exhaust) (intake)

CONCUSSION DIRECTION

Blast Damper (open)



Side A

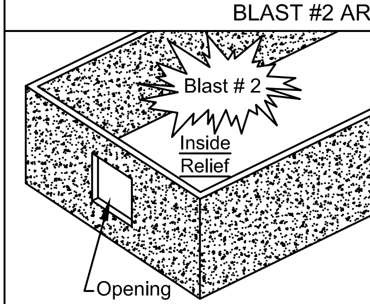
Maintain wall integrity and protect against internal concussion

BLAST #1 ARRANGEMENT

VARIATIONS:

☐ Blade seals (EDPM)
☐ Blade seals (silicone)
☐ 304 Stainless Steel construction (ASTM-A240,SA240,AMS 5513)
☐ 316 Stainless Steel frame and blades (some parts may not be 316 ss) (ASTM-A240,SA240,AMS 5513)
☐ Powder Coating, select color
☐ Blast deflector on jambs
☐ Equalizing Grid (G-ICBL-10 & 20)
☐ Omit Flange (in duct mount)

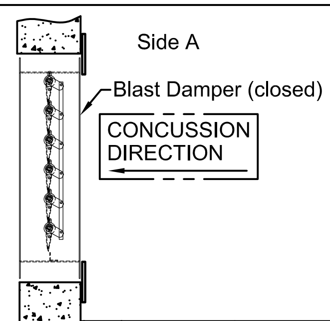
BLAST #2 ARRANGEMENT



Side B

BLAST #2 ARRANGEMENT

Maintain wall integrity and internal concussion relief

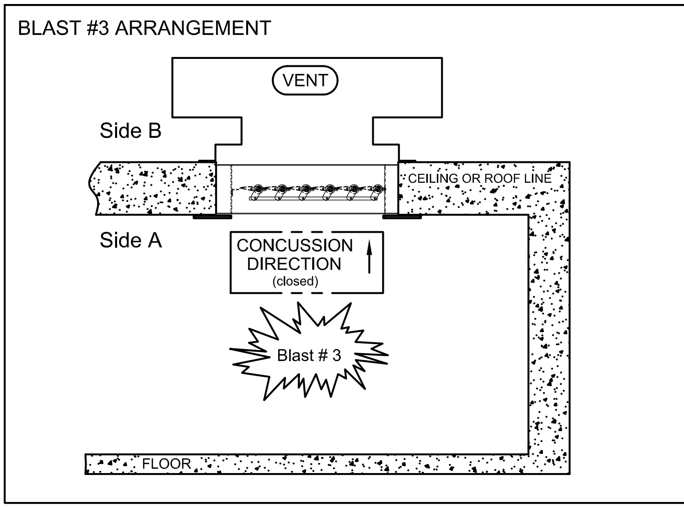


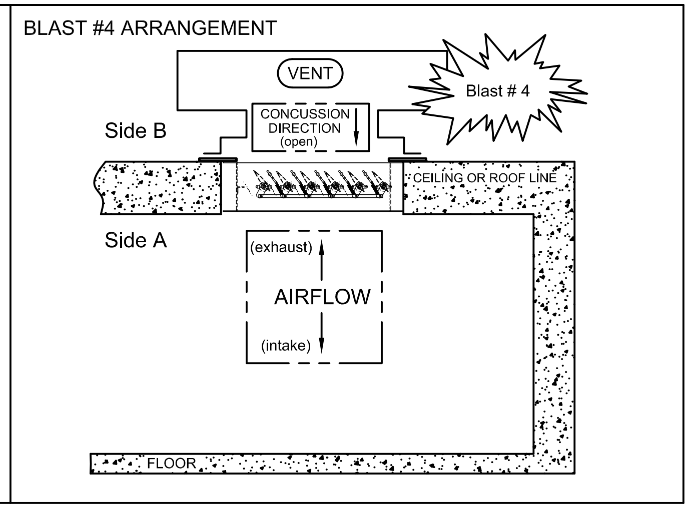
Side A

Blast Damper (closed)

CONCUSSION DIRECTION

Job Name:	☐ **ICBL-20** ☐ **G-ICBL-20**		
Location:			
Architect:	DRAWN BY: CLJ	DATE: 10-4-06	REV. DATE: 4-21-15
Engineer:			
Contractor:	REV.NO.: 29	APPROVED BY: MDD	DWG NO.: **C-29**



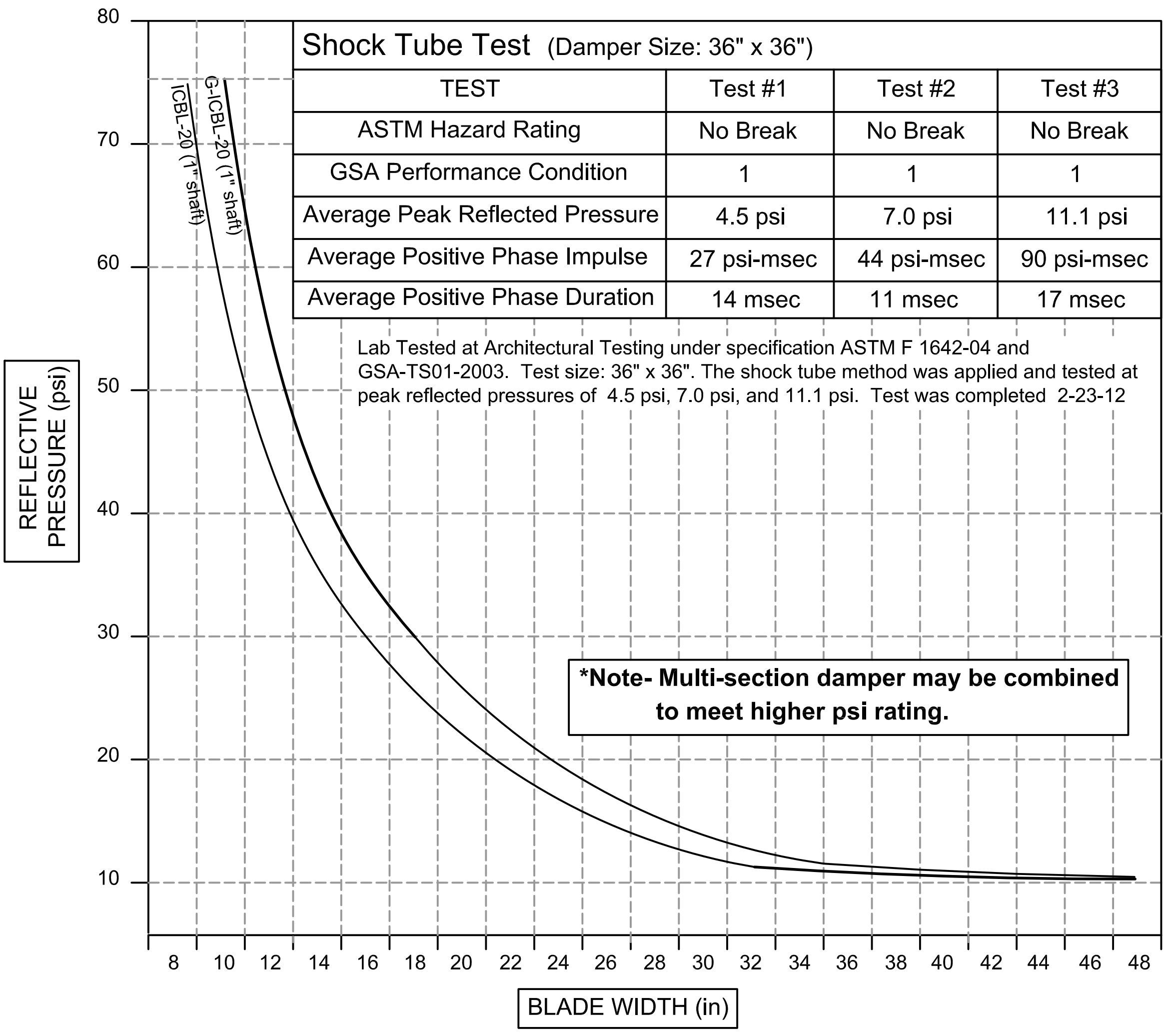


Energy released from a bomb is part in the form of thermal radiation, plus air blast, and ground shock. Air blast is the primary mechanism producing the potential for damage and casualties.

Example of Blast Force: The peak pressure in a blast pulse produced by 10 lbs. of TNT at a range of about 50 ft. is approximately 2.4 psi (or 348 psf) with a duration of the positive phase of 7.7 ms.
1 bar = 14.5 psi

At the Oklahoma City event, the yield of the weapon was equivalent to approximately 4,000 lbs of TNT. The truck containing the explosive was positioned approximately 10 ft. from the building. The peak pressure at the face of the building was approximately 1900 psi and the duration of the positive phase was approximately 3 ms. The air blast (shock wave) was the primary damage mechanism and ground shock was secondary.

BLAST DAMPERS (ICBL SERIES)
DESIGN PRESSURES VS. WIDTH



Shock Tube Test (Damper Size: 36" x 36")

TEST	Test #1	Test #2	Test #3
ASTM Hazard Rating	No Break	No Break	No Break
GSA Performance Condition	1	1	1
Average Peak Reflected Pressure	4.5 psi	7.0 psi	11.1 psi
Average Positive Phase Impulse	27 psi-msec	44 psi-msec	90 psi-msec
Average Positive Phase Duration	14 msec	11 msec	17 msec

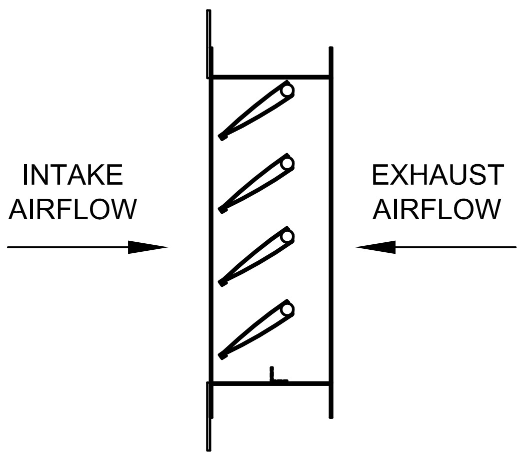
Lab Tested at Architectural Testing under specification ASTM F 1642-04 and GSA-TS01-2003. Test size: 36" x 36". The shock tube method was applied and tested at peak reflected pressures of 4.5 psi, 7.0 psi, and 11.1 psi. Test was completed 2-23-12

***Note- Multi-section damper may be combined to meet higher psi rating.**

AMCA LAB TESTED

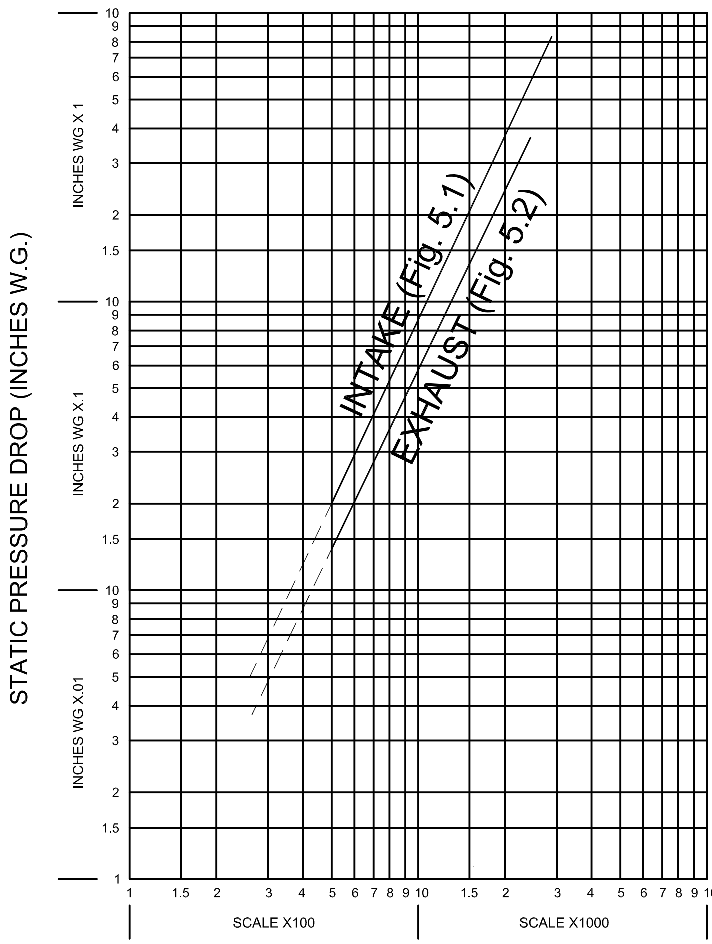
Tested per AMCA Standard 500-D (fig. 5.1, & fig. 5.2)
Ductwork upstream or downstream

DIRECTION OF AIRFLOW
(SEE CHART FOR PRESSURE DROP)



D = $\sqrt{4ab/\pi}$ for Rectangular Ducts, 'a' is width, 'b' is height
D = Duct Diameter for round duct

PRESSURE DROP



FACE AREA / DUCT VELOCITY (FT/MIN)

Based on STANDARD AIR- .075 lb. per cubic foot

TEST SIZE: 24" X 24"

Intake Application

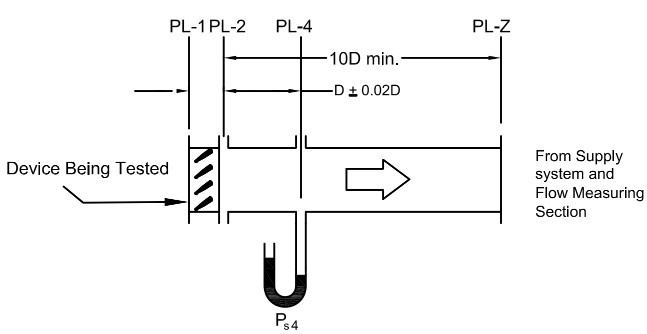


Figure 5.1- Test Device Setup with Outlet Duct

TEST SIZE: 24" X 24"

Exhaust Application

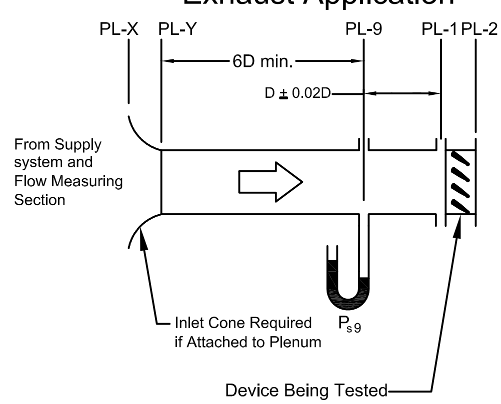


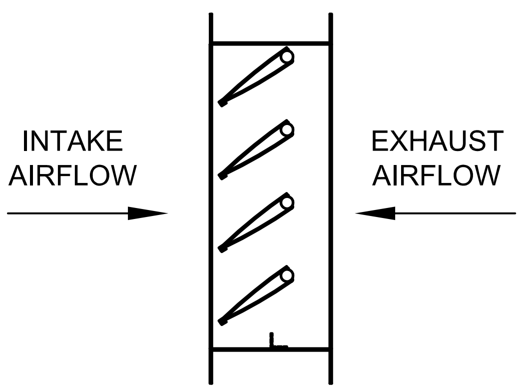
Figure 5.2- Test Device Setup with Inlet Duct

TEST SIZE: 24" X 24"

AMCA LAB TESTED

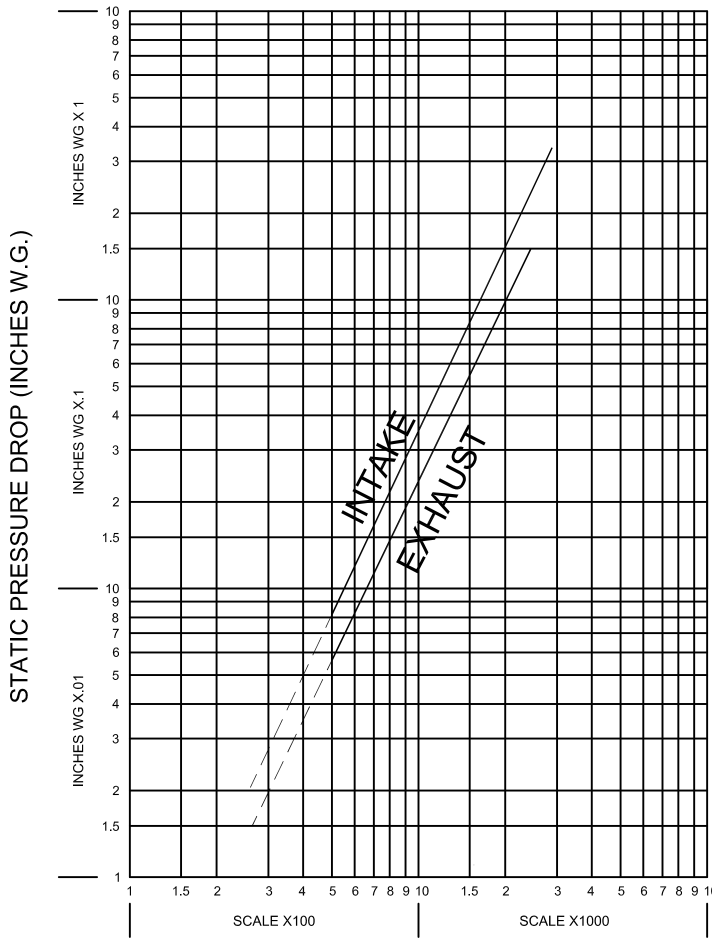
Tested per AMCA Standard 500-D fig. 5.3, with ductwork installed both upstream and downstream.

DIRECTION OF AIRFLOW
(SEE CHART FOR PRESSURE DROP)



$D = \sqrt{4ab/\pi}$ for Rectangular Ducts, 'a' is width, 'b' is height
D = Duct Diameter for round duct

PRESSURE DROP



FACE AREA / DUCT VELOCITY (FT/MIN)

Based on STANDARD AIR- .075 lb. per cubic foot

TEST SIZE: 24" X 24"

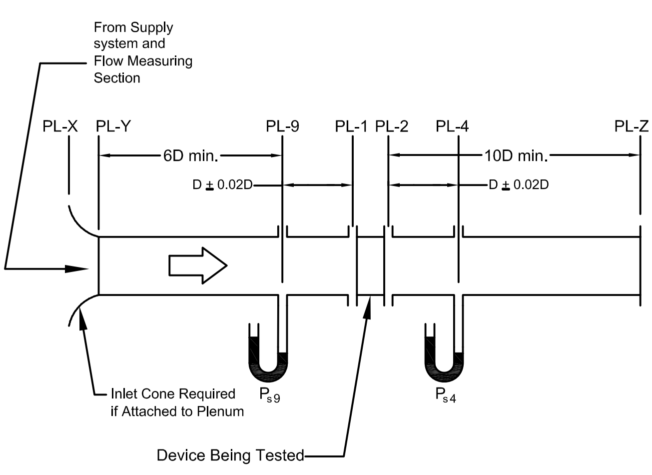


Figure 5.3- Test Device Setup with Inlet and Outlet Ducts

TEST SIZE: 24" X 24"

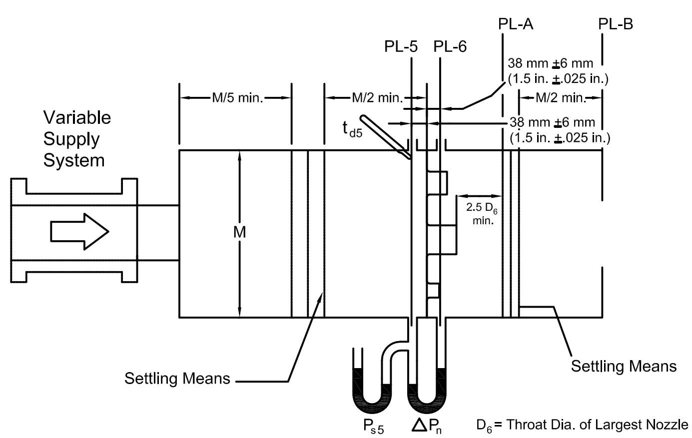


Figure 6.5- Airflow Rate Measurement Setup- Multiple Nozzle Chamber on Fan Outlet

ICBL-SERIES INSTALLATION INSTRUCTIONS

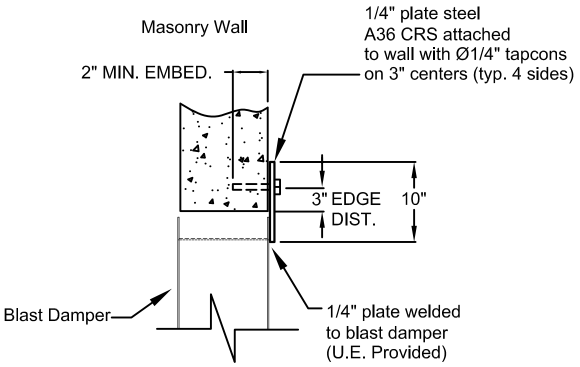


PLATE STRESS (ksi) 1" AXLE = 16.4 ksi

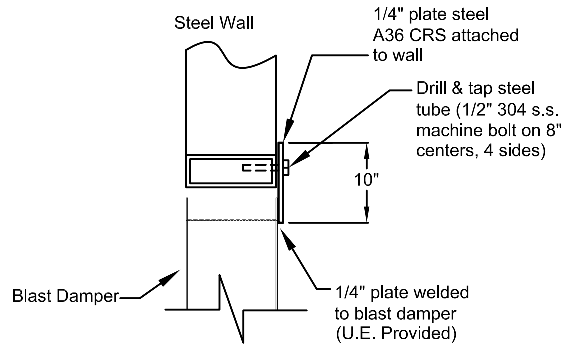
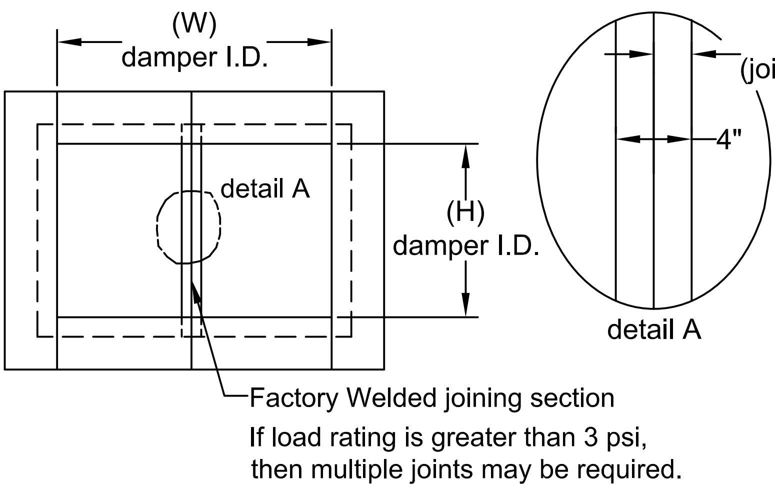


PLATE STRESS (ksi) 1" AXLE = 16.4 ksi

Note: Attachment is to be made on the same side as the blast
Substrates may vary from above application; site specific engineering may be required.

FACTORY ASSEMBLED MULTIPLE SECTION DAMPERS



NOTES:

1) For openings larger than 48”w x 60”h, contractor must divide the width of the opening into two or more sections with the substrate dividing the sections designed to maintain the integrity and load ratings of the wall.

2) Dampers with widths larger than 48” and heights less than 60” may be eligible for more than 2 or more factory supplied sections (this may occur if psi is over 3). Consult factory if conditions exist.

3) Maximum factory assembled multi-section size is 48”w x 60”h (if psi is over 3, two or more sections may occur) Consult factory if condition exists.

4) When more than one partition / mullion exists as mentioned above, field supplied reinforcement may be necessary behind the mullions depending on load rating and height of the opening.

SUGGESTED SPECIFICATION

Furnish and install, at locations shown in plans or in accordance with schedules, industrial grade blast dampers meeting the following construction standards. Frame shall be 8" to 12" deep (10" std.) x 3" flanged 10 gage carbon steel channel. Sleeve or channel with inner frame is not acceptable. The blades shall be maximum 7" wide, minimum 10 ga carbon steel airfoil shaped double-skin. Front flange to be 10" wide x 1/4" thick plate steel. Axles shall be continuous (not axle pins) 3/4" diameter (ICBL-10) and 1" diameter (ICBL-20) steel rod welded to blade. Finish shall be zinc rich primer. Linkage shall be minimum 3/16" thick 3/4" bar located on side of damper out of airstream. Pivot pins in linkage shall be stainless steel. Linkage shall include externally mounted release springs and adjustable tension to keep damper open until blast of specified pressure forces blades closed. Damper shall include blade locks for delayed exothermic reaction (a moving flame front). Damper shall be independent lab tested by the shock tube method under classification of ASTM F1642-04 and GSA TS01-2003. Damper shall be designed to withstand blast of *________psi with blades closed. Submittal must include leakage, and maximum pressure data based on AMCA publication 500-D testing. Damper must be installed per manufacturer's installation instructions. Damper shall be United Enertech ICBL-Series blast damper. Add pre-fix (G) for equalizing grid. *See graph for width and design pressures (psi).

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Chattanooga, TN 37407
(423) 698-7715
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www.unitedenertech.com

BLAST RESISTANT DESIGN with STRUCTURAL STEEL

COMMON QUESTIONS ANSWERED

Anatol Longinow, Ph.D. and
Farid Alfawakhiri, Ph.D.

Strategies for blast protection have become an important consideration for structural designers as global terrorist attacks continue at an alarming rate. Conventional structures, particularly those above grade, normally are not designed to resist blast loads; and because the magnitudes of design loads are significantly lower than those produced by most explosions, conventional structures are susceptible to damage from explosions. With this in mind, developers, architects and engineers increasingly are seeking solutions for potential blast situations, to protect building occupants and the structures themselves. The questions and answers that follow offer some explanation of explosions and the potential dangers they present to steel-framed buildings. The authors take a look at the historical response of steel-framed structures to blast situations and which types of structural frames, connections and steel shapes best resist blast loads. They also examine strategies designers can use to implement heightened building security and greater structural resistance to blast threats. Design specifications, code requirements, progressive collapse, seismic requirements and composite construction also are considered. Lastly, a list of references on the topic of blast protection is provided, along with information about computer software programs that can aid designers.

Complete Print-out of article:
Google search: Modern Steel Construction, October 2003

Blast-resistant design considerations for precast, prestressed concrete structures

Sanaa Alaoui and Charles Oswald

Blast-resistant design is becoming more common in the precast concrete industry as more blast-resistant buildings are constructed with precast/prestressed concrete components. This is occurring primarily because many large government and U.S. Department of Defense buildings now require some level of blast-resistant design. Blast design has been performed for many years for the chemical and petrochemical industry and explosive storage and manufacturing facilities, which have inherent accidental explosion hazards. Based on both theoretical analysis and testing, blast design guidelines and methods have been developed for many common types of building components, including steel members, concrete masonry unit walls, and reinforced concrete members.1,2 Much of this blast design guidance is applicable to precast/prestressed concrete components, though it is not widely understood by designers within the precast concrete industry. Some of the design guidance is restricted to official government use only or is based on proprietary research, but most of this information resides in the public domain. This paper presents prevalent blast-resistant design information that can be used for precast/prestressed concrete elements and structures. It is part of work in progress of the newly formed PCI Blast Resistance and Structural Integrity Committee.

Complete Print-out of article:
Google search: PCI Journal, November - December 2007

Where Are Blast Dampers Being Used?

- Chemical, paint or hazardous material storage rooms
- Pharmaceutical facilities, college laboratories and other R & D areas
- Bioscience and nanotechnology research buildings
- Refineries, petrochemical and other industrial complexes
- Nuclear power stations
- Engine test cells
- Ammunition depots, munitions storage facilities and arsenals
- Missile tests and launch sites

Now Added to the List are:

- All new federal government facilities within the US and overseas
- Some Fed. & State agencies are also being required to update their existing and leased facilities
- Data Storage facilities
- Medical facilities
- Major Sporting Venues

Blast Forces or Loads

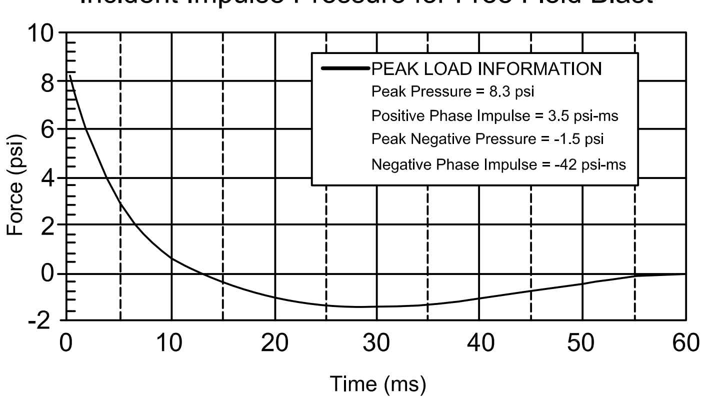
- Free Field Blast - 360° Blast
- Reflective Blast - Restrictions around it

The amount of damage usually depends on many things like: Charge Weight, Distance, Shape, Height Above Ground, Level of Confinement.

Mostly weighted on Charge Weight and Distance

- Reflective Pressure - The pressure from an explosion which is reflected from a solid object or surface, rather than dissapated in the air.

Incident Impulse Pressure for Free Field Blast



What is an Explosion?

Definition: It is a rapid release of stored energy characterized by a bright flash and an audible blast.

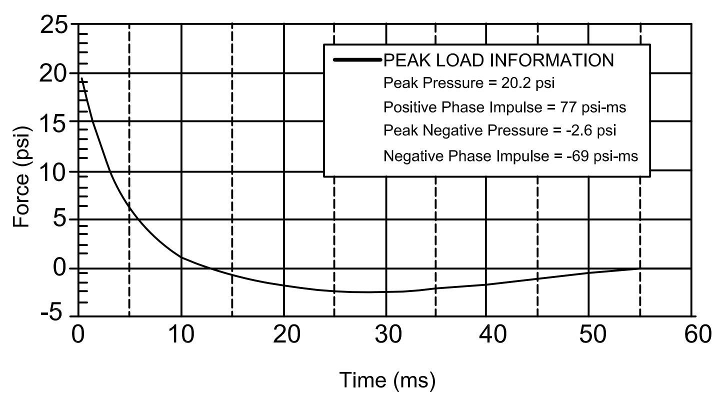
- Part of the energy is released as thermal radiation.
- Part is coupled into the air as airblast (waves) and part into ground as shock waves.

Deflagration is an exothermic reaction (a moving flame front), which propagates from the burning gases to the unreacted material by conduction, convection, and radiation. It travels slower than the speed of sound. Gases, mist or dust suspended in the air will burn when ignited under the proper conditions.

Detonation is an exothermic reaction characterized by the presence of a shock wave in the material that establishes and maintains the reaction. It travels at a speed greater than the speed of sound.

Reflective Pressure and Impulse:

Actual Blast load of 100 lbs. of TNT at 50 ft away. Note 20 psi Peak Load. (18"x60"=21,600 lbs of force)



ICBL-20 Free Area Chart (square feet):

Damper I.D. Height in Inches	*Damper I.D. Width in Inches*							
	8	12	18	24	30	36	42	48
8	0.13	0.20	0.30	0.40	0.5	0.60	0.70	0.80
12	0.20	0.46	0.69	0.92	1.15	1.38	1.60	1.84
18	0.50	0.76	1.15	1.53	1.91	2.29	2.98	3.06
24	0.71	1.07	1.61	2.14	2.68	3.21	3.75	4.28
30	0.91	1.34	2.07	2.75	3.44	4.13	4.85	5.5
36	1.01	1.65	2.53	3.36	4.2	5.05	5.95	6.72
42	1.21	1.96	2.99	3.97	4.96	5.97	7.05	7.94
48	1.41	2.27	3.45	4.58	5.72	6.89	8.15	9.16
54	1.62	2.58	3.91	5.19	6.48	7.81	9.25	10.38
60	1.82	2.89	4.37	5.8	7.24	8.73	10.16	11.6