Understanding Special Purpose Doors and Windows

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Description: Provides an overview of special purpose doors and windows, including fire, acoustical, blast and pressure, bullet-resistant, radio frequency, stainless steel, and thermal applications.

DHI Info: Course No: 04-1018; 6 points

Other Info: This program qualifies for Health Safety and Wellness credit.

How to use this Online Learning Course

- You will need approximately 1.5 hours to read through the 80+ slides of this course.
- When you are finished reading the slides, you will need to complete the multiple-choice exam, located on the same page as you downloaded this presentation from.
- You will need to fill in all your contact information asked for on the first page of the exam.
- You will then fax your completed exam to the fax number provided on your exam.
- You must pass with a score of at least 80% accuracy or better in order to qualify for 6 DHI points.
- When you pass your exam, we will notify you and fax you a certificate of completion for you to keep in your records and report to DHI
- If you do not pass the exam, you will have an opportunity to review the slides again and re-take the exam.
- Please note that it make take us up to 5 days to return your exam results.

Learning Objectives

Upon completing this course, you will have a better understanding of:

- The various types of applications and clients that utilize special purpose doors and windows.
- The range of manufacturer capabilities and products available on the market today.
- Common mistakes made when specifying special purpose doors and windows.
- The important questions to ask when evaluating manufacturers and their products.

Special Purpose Doors and Windows

- Definition
  - An assembly of proprietary components, designed to function as a system and perform to a level beyond that of a commodity door or window.

- Characteristics
  - Tested products with reproducible performance under both laboratory and field conditions, with documentation and affirmations that confirm their performance as an assembly.
  - Products that meet specifications for unique needs, such as acoustic resistance, blast and bullet resistance, thermal barriers, radio frequency barriers, stainless steel, etc.

Special Purpose Doors and Windows

- What needs do special purpose products serve**?**
  - Acoustic: Noise Barriers, Privacy Guards, Radio Frequency Barriers
  - Security: Crime Deterrents, Property Guards, Damage Prevention
  - Health: Disease Control & Sterilization, Hazardous Waste Storage
  - Safety: Detonation Guards, Fire & Smoke Barriers, Climate Barriers

- Where are special purpose products used?
  - Blast-resistant, bullet-resistant, acoustical, and lead lined doors are used in a wide variety of applications, including banking facilities, petroleum plants, schools, studios, heavy industry, ship production, etc.

Special Purpose Doors and Windows

- What impacts the use of special purpose openings?
  - Local Building Codes
  - American Disability Act (ADA)
  - Group and Division Occupancy (NFPA)

- What dictates the use of special purpose openings?
  - Insurance liability and specific environmental and/or performance needs
  - Occupational Safety and Hazards Agency (OHSA) standards
  - Federal, state or local regulatory requirements, such as the Defense Intelligence Agency (DIAM 50-3)

Demand for Special Purpose Doors and Windows

- Security
  - Increasing crime and threats have resulted in blast, bullet, and fire resistant doors and windows being required in locations where they were not previously necessary (e.g. schools, shopping malls, hospitals, post offices, retail operations, private homes, etc.).
- Health & Safety
  - Escalating insurance costs and liability claims have brought on increasingly stringent building requirements that provide for health and safety contingencies for an ever increasing list of threats.
- Science & Technology
  - Both fields demand doors and windows that meet unique sanitation, equipment sensitivity, explosion, hazardous material containment, and air infiltration requirements.
- Entertainment
  - Increasing demand for high quality acoustics in entertainment have increased the demand for acoustical (i.e. sound barrier) doors and windows.
- Defense
  - Increasing concerns regarding homeland security and worldwide volatility have increased the demand for many types of special purpose doors and windows.

Understanding Fire Rated

Doors and Windows

Fire Rated Doors and Windows

- Introduction

  - Fire rated doors and windows are used wherever they are required by local Building Codes based on use and occupancy classifications.

  - Fire ratings are determined by the length of time that the door or window assembly satisfactorily withstands a standard fire and hose test.

  - Fire rated doors and windows are currently available with fire ratings ranging from 20 minutes up to 3 hours.

  - The fire rating for an entire assembly is determined by the lowest rated door component (e.g. an assembly with a 3 hour door and a 45 minute glass component will only have a 45 minute rating).

Fire Rated Doors and Windows

Opening	Wall Rating	Door/Frame Rating
In walls which separate buildings or divide a single building into fire areas.	4 hour	3 hour
In enclosures of vertical communications (stairwells or elevator shafts)or in exterior walls subject to severe fire exposure from outside the building.	2 hour	1.5 hour
In walls between occupancies.	1 hour	1 hour
In corridors and room partitions or in exterior walls subject to moderate or light fire exposure from from outside the building.	1 hour	3/4 hour
Where smoke control is a primary concern for partitions between a habitable room and a corridor when the wall is constructed to have a fire resistance of more than 1 hour or across corridors where a smoke partition is required.	1 hour	1/3 hour (no hose stream)

NOTE: The local authority, having jurisdiction (AHJ) over the local building code, will specify the acceptable hourly rating for any location.

Fire Rated Doors and Windows

- Fire Rating Standards
  - NFPA 101
    - Deals with life safety and means of egress from fire emergencies and covers the construction, protection and occupancy features concerned with minimizing danger to life from fires, smoke, fumes, and panic.
  - NFPA 80
    - Provides standards for fire doors and windows and regulates the use of openings in walls in order to prevent spread of fire and smoke within, into, or out of buildings.

Fire Rated Doors and Windows

- Positive Pressure Testing
  - Positive pressure testing has been in use since 1997. Earlier negative pressure testing methods did not simulate actual fire conditions. Instead, heat and gasses were vented away from openings, similar to a fireplace flue.
  - Positive pressure testing subjects specimens to positive pressure at heights above 40" AFF in order to simulate actual fire conditions - where combustible material ignites, heat and gas rises, and air is drawn in through gaps at the bottom of the door assembly - with the positive pressure of the fire being applied to the upper portions of the fire door assembly.
  - The majority of steel stiffened, hollow metal doors have been able to pass new positive pressure testing, however most wood doors cannot pass without modifications.
  - Important to know:
    - UBC 7-2 (1997) Part I is the fire test standard for door and frame
    - UBC 7-2 (1997) Part II is the test for smoke and draft control "S" label
    - UBC 7-4 (1997) is the test for window frames

Fire Rated Doors and Windows

- Fire Rated Glass
  - In contrast to wire glass, the majority of fire rated glass on the market today meets the CPSC 16CFR1201 (Category II) impact rating.
  - Transparent ceramic glass is available in ratings up to 3 hours.
  - Transparent wall units composed of multiple layers of glass with intumescent material in between can be used where heat transfer must be minimized, allowing for unlimited amount of glazing in a wall and making it possible to design with floor-to-ceiling glass.
  - In Insulated Glass Units (IGUs), the second piece of glass can be tinted or mirrored in order to offer sound control, hurricane resistance, security protection and even energy efficiency.
  - Previously popular wire glass is being used less and less due to limitations and risks associated with dangerous break patterns that result from the wire used to hold the glass together.

Specifying Fire Rated Doors and Windows

- Points to Remember
  - Fire doors and frames of a specific rating also qualify for all lower ratings.
  - All of the components of an assembly, including the frame, door, latch, hinge, glass, and threshold, must be fire rated.
  - Fire rated doors serving as a "required means of egress" from places having an occupancy of 100 or more must be equipped with fire exit hardware.
  - Power operated fire doors must be equipped with detection devices that cut power to the operator and cause the door to close and latch in case of fire.
  - Doors must be self closing and self latching in order to be fire rated.
  - Due to their size, weight and configuration, some special purpose doors cannot be self closing and self latching, and so cannot be fire rated.
  - For more information, refer to NAAMM's Third Edition Hollow Metal Manual and Steel Door Institute (SDI) 118-01.

Understanding Acoustical

Doors and Windows

Acoustical Doors and Windows

- Introduction

  - Soundproof and acoustical doors and windows, in wood or metal, are used in premiere live performance venues and industrial applications where sound containment is of primary concern.

  - Acoustical doors are available in flush designs or with vision lights, as singles or pairs, including single or bi-parting horizontal sliding doors, and as manual or power operated assemblies.

  - Acoustical door and window products are rated on a Sound Transmission Class scale: an STC 55 door is capable of reducing the sound of a jet engine (130 dBA) to that of a typical office (60 dBA).

Acoustical Doors and Windows

- Typical Uses and Applications

  - Live Performance Venues
  - Radio & TV Broadcast Studios
  - Recording Studios
  - Theme Park Entertainment
  - School Music Facilities
  - Movie Theaters
  - Post Production Studios
  - Museums
  - Sensitive Compartmented Information Facilities (SCIF)
  - Laboratories
  - Testing Facilities
  - Courtrooms
  - Government Offices
  - Refineries
  - Power Plants
  - Machine Rooms
  - Factories
  - Facilities where high levels of mechanical noise are present

Acoustical Doors and Windows

- Sound Transmission Class (STC) Scale
  - STC ratings are derived from measured values of sound transmission loss using ASTM E90 "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".
  - STC ratings are E calculated based on the relationship between sound levels, absorption levels, room size and test specimen size, in accordance with ASTM E413 "Classification for Rating Sound Insulation".

- Examples of Various Sound Levels

Level (dbA)	0 10 20	30 40	50 60	70 80	90 100	110 120	130
Source	Rustle of Leaves Whisper Soundproof Room	Quiet Home Private Office Empty Auditorium Quiet Conversation	Noisy Home Inside Office Conversation Quiet Radio	Cocktail Party Nosiy Office Street Noise Average Radio Average Factory	Loud Street Noisy Factory Truck Unmuffled Police Whistle	Thunder, Artillery Nearby Riveter Elevated Train Discotheque	Jet Aircraft at 100' Bass Drum at 3' Auto Horn at 3"
Sensation	Very Faint	Faint	Moderate	Loud	Very Loud	Deafening	Physical Pain

Acoustical Doors and Windows

- How is an STC rating determined?
  - Measurements are typically conducted using two adjacent, highly reverberant rooms, presenting a diffuse sound field, and requiring walls with acoustical properties far superior to the test specimen.
  - The test specimen is installed in an opening between the two rooms, after which a calibrated noise source and frequency spectrum is activated.
  - Rotating or multiple microphones in each room transmit measured sound levels to an analyzer, which then determines the transmission loss (TL) in decibels (dB) at each of the 18 one-third octave bands between 100 and 5000 cycles per second.
  - Finally, the readings are plotted against a standard contour curve as established by ASTM E413, resulting in a single number STC rating.

Acoustical Doors and Windows

- How is certification of an STC rating obtained?
  - To receive a Sound Transmission Loss test report, a manufacturer must arrange for a testing session in an acoustical laboratory.
  - The laboratory must be NVLAP accredited by the US Department of Commerce to perform the required test in accordance with ASTM E90 and E413 standards.
  - A certified laboratory test is the only way to ensure that a door or window will perform to the specified STC rating.

Acoustical Doors and Windows

- What should an STC lab report contain?
  - The name of the manufacturer ordering the test, a report number, and an introduction indicating which test method was used and whether the laboratory is accredited.
  - A description of the test specimen, including model number, which indicates the essential details of the product and the results of the test measurement.
  - An accompanying graph, indicating the standard STC contour to which the transmission loss curve was compared.
  - The lab report should be printed on the laboratory's stationary, and signed and dated by a certifying technician and a laboratory official.

Acoustical Doors and Windows

- Laboratory Testing vs. Field Testing

  – Lab tests do not guaranty that manufacturers are building doors and windows to the same standards as the tested specimen, and currently there are no inspections or check points in place.

  – Field testing should be used to confirm the ratings of acoustical doors and windows once they are installed - it is the only way to guaranty that they will meet the specified STC ratings.

  – Field test results are expressed in terms of Noise Isolation Class (NIC) and are conducted according to ASTM E336 standards.

Specifying Acoustical Doors and Windows

- What is available on the market today?
  - STC Ratings
    - Metal doors are available in ratings from STC 53 (standard 1¾" door) to STC 62 (thicker, oversized door), however auto-operation may be required depending on door size and weight.
    - Wood veneer, human operable doors are available in ratings up to STC 53.
    - Windows are available in ratings up to STC 58.

Specifying Acoustical Doors and Windows

- What is available on the market today?
  - Combination Performance
    - You can specify doors with combination performance, such as a stainless steel, acoustical door that is also bullet resistant.
  - Tested Assemblies
    - It is possible to specify complete tested assemblies that include the door, frame, gasketing, hinging, and threshold.
  - Fire Ratings
    - You can specify acoustical doors with fire ratings of up to 3 hours.
  - Vision Lights
    - It is possible to specify acoustical STC rated doors with vision lights.
  - Finishes
    - Products are available in a variety of wood, metallic and plastic laminate finishes.

Specifying Acoustical Doors and Windows

- What about custom or oversized doors?
  - Once a door of specific construction and design is tested and certified at a specific STC rating, it retains the same certification regardless of its size.

- Can an acoustical door have vision lights?
  - Existing test reports of custom glass sizes and configurations can be used to estimate the STC value of a door with other custom glass size configurations.
  - For example, given that a laboratory tested STC 46 door can have up to 900 sq. in. of glass, other glass sizes can be provided based on calculations from the tested door.
  - Reputable manufacturers should be able to provide multiple test reports for a variety of vision lights to support their particular door construction.

Specifying Acoustical Doors and Windows

- What about pairs of acoustical doors?
  - Laboratory tests and STC ratings that are based on single doors may not correlate with pairs of doors, therefore it is important to insist on data from tests conducted on pairs of doors.
  - Depending on their design, pairs of doors will require either a mullion, or single or double acoustical astragals at the meeting stile.

- Should acoustical door frames be grouted?
  - Most acoustical consultants and manufacturers highly recommend grouting acoustical pressed steel door frames in order to minimize voids between the wall and the door.
  - When grouting, it is important to use top quality products from well-established manufacturers with a proven track-record of use.
  - It is important to note that bituminous under-coatings have a high potential to cause flaming on unexposed surfaces.

Specifying Acoustical Doors and Windows

- Points to Consider
  - It is important to depend on expert acoustical consultants in order to identify the proper STC rating - a higher STC rating is not necessarily better.
  - The higher the STC rating, the more difficult it is for the human ear to perceive a difference.
  - Lower frequency sounds may be abated using doors with lower STC ratings.
  - Current louver designs do not provide optimum sound reduction and are therefore not recommended.
  - It is important to specify a complete assembly (i.e. door, frame, gasketing, hinging, and threshold) from one manufacturer, and to insist on a manufacturer that can provide laboratory certified data.

Specifying Acoustical Doors and Windows

- Common Mistakes
  - Under-specifying the walls and over-specifying the doors.
  - Only extending the wall above the suspended ceiling, rather than slab to slab.
  - Walls that are not structurally able to carry the weight of the acoustical door.
  - Allowing electrical boxes to be mounted back to back in an acoustical wall.
  - Allowing HVAC and electrical conduit penetrations in an acoustical wall.
  - Failing to provide for sound traps in room-to-room HVAC ducts.
  - Failing to provide for sound walls to have fully caulked joints at the floor.
  - Failing to provide for sound frames to be grout filled (high STC doors).
  - Failing to provide for thresholds where carpet occurs.
  - Failing to consider special hardware requirements for pairs of doors.

Understanding Blast and Pressure

Doors and Windows

Blast and Pressure Doors and Windows

- Introduction

  - Blast and pressure doors and windows are used in commercial and industrial installations designed to protect personnel and property from explosions and explosion borne missiles.

  - Doors are typically constructed using formed, heavy gauge, steel face sheets around a custom engineered, steel rib core with interior armor plating as required to protect against a specified blast level.

  - Doors are available in flush designs or with vision lights, as singles or pairs of hinged doors, including single or bi-parting horizontal sliding doors, and as manual or power operated assemblies.

Blast and Pressure Doors and Windows

- Typical Uses and Applications
  - Refineries
  - Aerospace
  - Defense
  - Test Cells
  - Facilities used for the protection of personnel or sensitive equipment
  - Research labs
  - Retail Operations
  - Banking Facilities
  - Government Offices
  - Facilities used for the containment of hazardous materials

Blast and Pressure Doors and Windows

- Pressure Resistance vs. Blast Resistance

  - Pressure Resistance
    - Refers to a pressure load applied over a relatively long duration (i.e. seconds, minutes, or longer) where the pressure loading decay is removed from the door over a long duration.

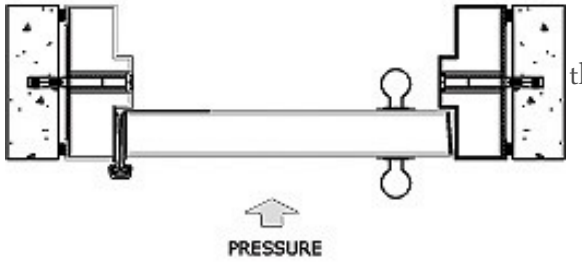
  - Blast Resistance
    - Refers to a high pressure shock of very short duration (i.e. milliseconds) with pressures decaying with distance and time.

Blast and Pressure Doors and Windows

- Seated Pressure vs. Unseated Pressure

  - Seated Pressure
    - Seated pressure loading acts against the stops.

  - Unseated Pressure
    - Unseated pressure acts to unseat where hardware is an integral



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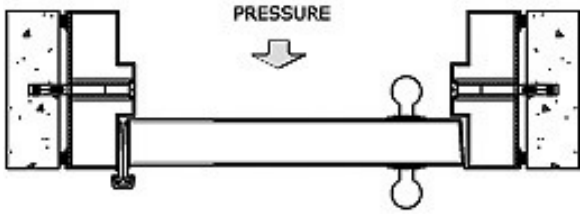


Blast and Pressure Doors and Windows

- Fragmentation
  - Fragmentation refers to the scattering of heavy fragments as the result of an explosion.
  - These heavy fragments travel at a high velocity and may penetrate a door or window, depending on its thickness and other characteristics.
  - Fragmentation resistance is an important consideration when specifying a blast resistant door or window product.

Blast and Pressure Doors and Windows

- Protection Categories
  - Class A
    - provides life safety, protects from fragments, falling portions of a structure or equipment, attenuates blast pressures and structural motion.
  - Class B
    - protects from fragment impact , blast pressures, structural motions, and against uncontrolled releases of hazardous materials.
  - Class C
    - protects against communication of detonation by fragments and high blast pressures.
  - Class D
    - protects against mass detonations of explosives as a result of sympathetic detonations produced by communication between two adjoining areas.

Blast and Pressure Doors and Windows

- What is available on the market today?
  - Blast Resistance
    - Low Range: 1.0 PSI or less (50-144 PSF)
    - Mid Range: 3.0 PSI or less (145-432 PSF)
    - High Range: 12 PSI and higher
    - Blast yields for military applications would be supplied by engineering firms.
    - Most standard hollow metal doors cannot be supplied with blast and pressure certification.

Blast and Pressure Doors and Windows

- What is available on the market today?
  - Combination Performance
    - You can specify acoustical ratings up to STC 53 (for low and mid range doors).
    - Products are also available with bullet ratings for UL level 1-8, or NIJ standards.
  - Fire Ratings
    - Products are available with fire ratings ranging from 20 minutes up to 3 hours.
  - Vision Lights
    - It is possible, using calculated, certified glass or glass polycarbonate glazing.
  - Finishes
    - Products are available in a wide variety of finishes, including wood veneer, stainless steel, bronze, brass, copper, and plastic laminate.

Specifying Blast and Pressure Doors and Windows

- Hardware Implications
  - Make the desired hardware applications known (i.e. function, egress requirements, etc.).
  - Incorporate access control to be part of the blast resistant design.
  - Hinging, latching and other hardware components need to meet loading criteria.
  - Be aware of limitations of using electronic or pneumatic operations.
  - Solicit hardware advice from a competent manufacturer.

Specifying Blast and Pressure Doors and Windows

- Questions to Consider
  - What is the overpressure? (PSI or PSF)
  - Is the overpressure dynamic? If so, what is the duration?
  - Is the overpressure static equivalent?
  - What is the maximum allowable deflection? (L/60, L/120)
  - What is the rebound requirement? (33, 50 or 100%)
  - Do doors need to be functional after a single incident or after multiple incidents?
  - Do doors need to resist penetration of explosion borne fragments?
  - Are there acoustical considerations?

Specifying Blast and Pressure Doors and Windows

- Common Mistakes
  - Failing to define the specific PSI or PSF blast rating that is required.
  - Specifying inadequate wall conditions.
  - Not identifying the correct lock device (i.e. exit device, lockset, etc.).
  - Specifying a UL fire rating where it is not required.
  - Requesting too large a vision light for the specified blast rating.
  - Mixing up technologies (i.e. blast doors vs. bullet doors).
  - Incorrectly specifying a dynamic load.
  - Glazing requirements that fail to identify who will furnish the glass (i.e. manufacturer or third party supplier).

Understanding Bullet-Resistant

Doors and Windows

Bullet-Resistant Doors and Windows

- Introduction
  - Bullet-resistant doors and windows are designed to protect personnel and property from direct fire from small firearms.
  - Doors are typically constructed using formed, heavy gauge, steel face sheets around a custom engineered, steel rib core with interior armor plating as required to protect against specified threat.
  - Doors are available in flush designs or with vision lights, as singles or pairs of hinged doors, including single or bi-parting horizontal sliding doors, and as manual or power operated assemblies.

Bullet-Resistant Doors and Windows

- Typical Uses and Applications
  - Banking Facilities
  - Courtrooms
  - Government Offices
  - Corporations
  - Border Patrol Stations
  - Drive-Thru Applications
  - Post Offices
  - Military
  - Retail Operations
  - Aerospace
  - Defense
  - Test Cells
  - Laboratories
  - Police Stations
  - Transportation Centers
  - Federal Agencies

Bullet-Resistant Doors and Windows

- Bullet Resistance Standards
  - UL 752 "Standard for Safety for Bullet-Resisting Equipment" outlines standard code requirements for materials, devices, and fixtures used to form bullet-resisting barriers which protect against robbery or holdup.
  - This standard covers protection against complete penetration, passage of fragments of projectiles, and spalling or fragmentation of the protective material.
  - This standard applies to doors, windows, and teller fixtures, such as driven deal trays, package passers, intercommunication (voice ports), and other integral parts of a bullet-resistant assembly.

Bullet-Resistant Doors and Windows

- UL 752 Bullet Resistance Levels

UL Level	Weapon	Grain	Velocity	Shots
Level 1	9 mm FMJ Lead Core	124 (8.0)	1175 (358)	3
Level 2	.357 Magnum Lead JSP	158 (10.2)	1250 (381)	3
Level 3	.44 Magnum Lead SWC/GC	240 (15.6)	1350 (411)	3
Level 4	.30 Caliber Rifle Lead Core SP	180 (11.7)	2540 (774)	1
Level 5	7.62 mm Rifle Lead Core FMJ Military Ball	150 (9.7)	2750 (838)	1

FMJ = Full Metal (Copper) Jacket SWC/GC = Semi-Wadcutter/Gas Checked

JSP = Jacketed (Copper) Soft Point SP = Soft Point (with Copper Jacket)

Bullet-Resistant Doors and Windows

- UL 752 Bullet Resistance Levels Cont'd...

UL Level	Weapon	Grain	Velocity	Shots
Level 6	9 mm FMJ Lead Core	124 (8.0)	1400 (427)	5
Level 7	5.56 mm Rifle Lead Core FMJ	55 (3.56)	3080 (939)	5
Level 8	7.62 mm Rifle Lead Core FMJ Military Ball	150 (9.7)	2750 (838)	5
Supplementary	12 Gauge Rifle	437 (28.3)	1585 (483)	3
Shotgun	Lead Slug, 12 Gauge 00 Lead Buck Shot,12 Pellets	650 (42)	1200 (366)	3

FMJ = Full Metal (Copper) Jacket SWC/GC = Semi-Wadcutter/Gas Checked

JSP = Jacketed (Copper) Soft Point SP = Soft Point (with Copper Jacket)

Bullet-Resistant Doors and Windows

- NIJ 0801.01 Bullet Resistance Levels

Armor Type	Test Ammunition	Req. Hits/Specimen
I	.22 LRHV Lead	5
	.38 Special RN Lead	5
II-A	.357 Magnum JSP	5
	9 mm FMJ	5
II	.357 Magnun JSP (higher velocity round)	5
	9 mm FMJ (higher velocity round)	5
III-A	.44 Magnum, Lead SWC, Gas Checked	5
	9 mm FMJ	5
III	7.62 mm, 308 Winchester FMJ	5
IV	30-06 AP	1

SWC = Semi-Wadcutter
FMJ = Full Metal Jacket
AP = Armor Piercing
LRHV = Long Rifle High Velocity
JSP = Jacket Soft Point
RN = Round Nose

Specifying Bullet-Resistant Doors and Windows

- What is available on the market today?
  - Bullet Resistance
    - Current bullet-resistant doors and windows are tested to the latest UL 752 standards (Levels 1-8, 8th Edition) and NIJ standards.
    - Products are available to withstand 10, 15, 20 and 30 minute "forced entry" in accordance with Department of State standards.
  - Components & Hardware
    - In addition to doors and windows, other bullet-resistant components are available, including frames, voice ports, gun ports, pass through trays and transfer boxes.
    - In order to provide a complete bullet-resistant assembly, fiberglass wall panels are also available.
    - Custom or standard hardware can also be specified, including mortise and cylindrical lock sets, exit devices and electric access controls.

Specifying Bullet-Resistant Doors and Windows

- What is available on the market today?
  - Combination Performance
    - You can specify bullet-resistant doors with acoustical ratings up to STC 53.
    - You can also specify bullet-resistant doors with pressure resistant capabilities.
  - Fire Ratings
    - You can specify fire rated doors with ratings up to and including 3 hours.
  - Vision Glass
    - Bullet-resistant doors can have vision glass using calculated and certified glass or glass/polycarbonate glazing materials.
  - Finishes
    - Products are available in a wide variety of finishes, including wood veneer, stainless steel, bronze, brass, copper, and plastic laminate.

Specifying Bullet-Resistant Doors and Windows

- Common Mistakes
  - Failing to apply bullet resistant materials to the wall assembly.
  - Failing to ensure that all components of the assembly, including glass, glazing and hardware, are also bullet resistant.
  - Specifying inaccurate wall types by failing to consider the weight of bullet resistant products.
  - Mismatching components from different manufactures when designing a bullet resistant envelope.
  - Failing to specify all components from compatible manufacturers.

Understanding Radio Frequency

Doors and Windows

Radio Frequency Doors and Windows

- Introduction
  - Radio frequency doors and windows are designed to contain radio frequencies generated from electronic equipment, and/or shield susceptible equipment from outside electromagnetic interference.
  - Radio frequency doors are an integral component of a room that is designed to contain radio frequencies: conductive surfaces on the ceiling, floors, walls, door and frame, all interface together to form an impermeable radio frequency enclosure.
  - Doors are available in singles or pairs, as hinged doors, in standard or custom sizes, and as manual or power operated assemblies.

Radio Frequency Doors and Windows

- Typical Uses and Applications
  - Offices
  - Laboratories
  - Research Facilities
  - Industrial Sites
  - Radio Stations
  - Computer Rooms
  - Transient Electromagnetic Pulse Emanation Surveillance Technology (TEMPEST) Sites
  - Embassy
  - X-Ray Facilities
  - Medical Facilities
  - Military Installations
  - Government Offices
  - Communication Centers
  - Sensitive Compartmented Information Facilities (SCIF)

Radio Frequency Doors and Windows

- Sources of Radio Frequency
  - Radio frequencies can come from high power broadcast systems, such as AM/FM radio, television transmitters, and other communications systems.
  - Radio frequencies can also originate from power lines, transformers, and electromechanical switches, along with natural sources like lightning.
  - Devices such as computers, cellular phones, and medical equipment can also emit potentially hazardous radio frequencies.

- Potential Hazards of Radio Frequency
  - Interference from radio frequencies can cause disruption of radio and TV signal quality, and poor connectivity between communication points.
  - Radio frequencies can also be used for electronic eavesdropping, disruption of communication systems, and in some cases, detonation of explosives .

Radio Frequency Doors and Windows

- How is radio frequency (RF) shielding achieved?
  - In order to achieve proper RF shielding, it is important to think of the facility as a six-sided enclosure: four walls, plus a ceiling and a floor.
  - Each of these components, along with all interfacing connections (joints, seams, thresholds, frames, etc.) must be 100% electrically conductive in order to ensure that RF energy cannot enter or exit the enclosure.

Radio Frequency Doors and Windows

- Components and Construction
  - Walls
    - Shielding material in walls might consist of welded steel of various gauges, metal panels consisting of 24 gauge sheet steel laminated to particle board, foil faced drywall, or metallized non-woven fabric (Saf-N-60) applied like wallpaper.
  - Floors
    - Floors are typically constructed using light gauge galvanized steel, which completes the contact with the walls and bottom of the door frame.
  - Doors
    - Doors are similar to standard 1 ¾" thick hollow metal doors, with a contact surface of polished stainless steel on the "push" side of door and an RF gasket on the frame in order to make contact with the door and complete the circle of contact.

Radio Frequency Doors and Windows

- Components and Construction
  - Frame
    - All joints must be welded or otherwise constructed to achieve an RF tight electrical bond, with continuous contact flange frame completing contact with the walls.
    - The frame bottom or threshold can be a stainless steel plate or threshold with RF Monel mesh gasket assembly, which completes the contact with the floor.
  - RF Gasket
    - Adjustable RF gaskets mounted on the door frame makes contact with the door and also completes the circle of contact with the frame.
  - Hardware
    - Doors are typically latched with a cylindrical or mortise lockset, and exit devices, or dial combination deadlocks.

Specifying Radio Frequency Doors and Windows

- What is available on the market today?
  - Radio Frequency Shielding
    - Metal RF doors that are able to shield at least 60 dB of electric field and plane wave energy from 1 kHz through 10 GHz, in accordance with laboratory tests and field certification as per NSA 65-5, NSA 73-2A, and MIL STD-285.
  - Hardware and Components
    - Products are available with custom or standard hardware, including mortise and cylindrical lock sets, exit devices and electric access controls.
  - Accessibility
    - Products are available with low profile sill conditions to meet ADA requirements.

Specifying Radio Frequency Doors and Windows

- What is available on the market today?
  - Combination Performance
    - You can specify RF doors with acoustical ratings up to STC 53.
    - You can also specify RF doors with bullet and blast resistant capabilities.
  - Fire Ratings
    - You can specify RF doors with ratings up to and including 3 hours.
  - Finishes
    - Products are available in a wide variety of finishes, including wood veneer, stainless steel, bronze, brass, copper, and plastic laminate.

Specifying Radio Frequency Doors and Windows

- Common Mistakes
  - Walls are not designed high enough acoustically for specified RF/Acoustical door.
  - There is no provision to isolate electrical systems within the shielded room.
  - Carpeting in shielded room installed higher than the RF door threshold.
  - There is no provision in wall shielding system for RF interface with the door frame.
  - There is no provision in floor shielding system for RF interface with the threshold.
  - Failing to consider special hardware requirements for RF shielded doors.
  - Not addressing special installation requirements of RF doors and RF system.

Understanding Stainless Steel

Doors and Windows

Stainless Steel Doors and Windows

- Introduction

  – Stainless steel doors and windows are used in situations where exposure to severe weather, salt and/or corrosive compounds is of concern, or in situations requiring constant washing and sterilization efforts.

  – Doors are available in flush designs or with vision lights, as singles or pairs of hinged doors, including single or bi-parting horizontal sliding doors, and as manual or power operated assemblies.

  – Stainless steel is defined as a series of steel alloys which include at least 10% chromium, and is available in a variety of grades.

Stainless Steel Doors and Windows

- Typical Uses and Applications
  - Hospitals
  - Food Processing Plants
  - Chemical Plants
  - Swimming Pool Areas
  - Marine Environments
  - Clean Rooms
  - Public Restrooms
  - Beach Facilities

Stainless Steel Doors and Windows

- Common Stainless Steel Grades
  - Grade #340
    - Typically the most common grade of stainless steel, it is non-magnetic and corrosion resistant (18% chromium and 8% nickel) and is found in hospitals, food processing plants, chemical plants and swimming pools.
  - Grade #316
    - Also known as "Marine Stainless", it is non-magnetic and corrosion, salt, chlorine, heat and humidity resistant (16% chromium, 10% nickel, 3% molybdenum) and is used with success in highly corrosive and humid environments.
  - Grade #430
    - Another commonly used grade, #430 is magnetic and is typically used for fire rated doors, doors over 8' tall, and applications where appearance is of primary concern.

Stainless Steel Doors and Windows

- Common Stainless Steel Finishes
  - Finish #2B
    - A dull, unpolished and less expensive finish, which is available prime-painted or ready to accept a prime finish, and suitable for use in corrosive industrial environments where appearance is of low priority.
  - Finish #4
    - Also known as 32D, this is a general purpose bright finish with a visible grain that prevents reflection.
  - Finish #6
    - A dull, satin finish that is less reflective than #4 and is used in applications where a higher luster is undesirable.
  - Finish #8
    - Also known as 32, this is a highly reflective, mirror finish, which is most suitable for decorative environments.

Stainless Steel Doors and Windows

- Additional Stainless Steel Treatments
  - Bead Blast Finish
    - Achieved by bead blasting a #2B finish to a mat with a dull to glossy sheen depending on the size of bead used.
  - Non-Directional Finish
    - Achieved by sanding a #2B finish to a fine grit swirl (non-directional) finish.
  - Acid Etched Finish
    - Can be achieved by exposing a #2B, #4 or #8 finish to a patterned acid etching.

Stainless Steel Doors and Windows

- Preventing Corrosion
  - Stainless steel should not be allowed to come into contact with any other metal components, such as zinc-plated fasteners, iron or copper, which can create rust and cause staining of the surface.
  - To avoid galvanic corrosion, use only stainless steel components (screws and bolts) or consider the option to receive pre-installed hardware from the manufacturer.
- Maintenance & Cleaning
  - Clean stainless steel a few times per year, using a cotton cloth with soap and water, or a non-abrasive detergent and wipe in the same direction as the surface grain using a light and steady pressure.
  - Do not use cleaning solutions that contain hydrochloric acid, or rags with zinc (or other metal products) that may rust and stain the surface, or paper towels and abrasive materials (such as Scotch Brite or steel wool) that may scratch the finish.

Specifying Stainless Steel Doors and Windows

- What is available on the market today?
  - Fire Ratings
    - Stainless steel doors are available with fire ratings up to 1.5 hours.
  - Grades
    - Products are available in dozens of grades, including the popular #304, #316 and #430.
  - Finishes
    - You can specify a variety of finishes, including #2B, #4 (satin), #6 & #8 (mirror).
    - Stainless steel can be colored by chemically bonding the color to the stainless steel, to achieve colors such as deep blue, dark bronze, bright brass, copper, rose, black and others.
    - Products can also be treated to created patterned, embossed and etched finishes.

Specifying Stainless Steel Doors and Windows

- Common Mistakes
  - Specifying carbon steel reinforcement as opposed to stainless steel for the entire assembly.
  - Specifying steel stiffened cores, which results in an excessive number of welds to face sheets of doors.
  - Mistakenly burying a stainless steel specification in the hollow metal section where it is likely to be missed.
  - Cladding stainless steel over a standard hollow metal door.
  - Failing to specify the desired stainless steel grade and finish.
  - Failing to specify whether seamless edges are required.
  - Failing to specify whether frames should be butt or mitered.

Understanding Thermal

Doors and Windows

Thermal Doors and Windows

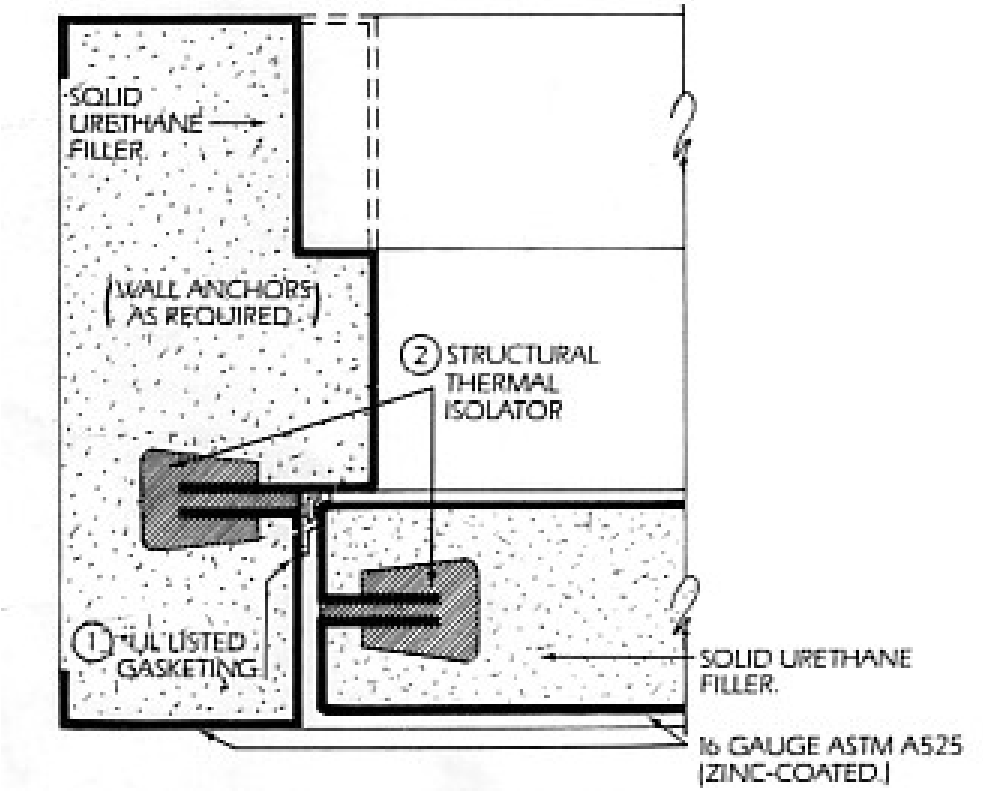
- Introduction
  - Thermal doors and windows are used for protection against the extremes of cold and heat.
  - Doors are typically constructed with 16 gauge galvanized skins, which are reinforced with internal steel stiffeners and separated by structural isolators.
  - Doors are available in flush designs or with vision lights, as singles or pairs of hinged doors, including single or bi-parting horizontal sliding doors, and as manual or power operated assemblies.

Thermal Doors and Windows

- Typical Uses and Applications
  - Food Processing Plants
  - Chemical Plants
  - Research Facilities
  - Arctic Environments
  - Desert Environments
  - High-Humidity Applications
  - Other locations requiring thermal insulation

Thermal Doors and Windows

- Thermal Breaks
  - In order to achieve a "true" thermal break, there must be absolutely no metal-to-metal contact from the exterior to the interior of the assembly.
  - In order to eliminate the transfer of temperature, the exterior facing surface of the door and/or window assembly must be prevented from coming into contact with the interior facing surface.



Thermal Doors and Windows

- Thermal Breaks Cont'd...
  - To achieve the required separation, refrigeration foam is installed in the door frame and the door is typically utilized to separate exterior surfaces from interior surfaces.
  - Non-conductive structural thermal isolators are typically utilized to separate door and window surfaces.
  - Non-conductive anchors must be utilized (no metal bolts or screws) and standard builder's hardware weatherstripping is typically used to provide a seal between door and frame.

Thermal Doors and Windows

- U-Values & R-Values
  - U-values are a measure of conducted heat gain or heat loss through doors and are given in BTU's (British Thermal Units) per hour per square foot per degree Fahrenheit (BTU's/hour/sq. ft./°F).
  - The lower the U-value, the better the insulating performance of the door (e.g. a door with a U-value of 0.35 will outperform a door with a U-value of 1.1 in terms of conducted heat gain or loss).
  - U-values are the reciprocal of R-values (U = 1/R or R = 1/U), such that a U-value of 0.25 corresponds to an R-value of 1/0.25 or 4.

Thermal Doors and Windows

- U-Values & R-Values: A Practical Example

  - Consider a 21 sq.ft. door in Alaska on a winter night,with an outdoor temperature of 5° F and an indoor temperature of 70°F.

  - The door system has an overall U-value of 0.50, which refers to the total door system U-value including the frame, door perimeter, and door center.

  - Since the indoor temperature is higher than outdoor temperature, conducted heat flow (in this case, heat loss) will occur from the interior to the exterior.

  - The amount of heat loss can be calculated by multiplying the U-value with the temperature difference between the exterior and interior environments, using the formula (U-value) x (T_i - T_o).

  - In this example, we have (0.50) x (70°F - 5°F) = 32.5 BTU's/hour/sq. ft., and given a 21 sq. ft. door, the total heat loss will be 21 x 32.5 or 680 BTU's/hour.

Thermal Doors and Windows

- Thermal Testing
  - Specimens are placed in a “guarded hot box” which simulates the extreme heat and/or freezing conditions that are expected in the actual installation.
  - Each face is exposed to the appropriate temperature (i.e. exterior side may be exposed to frost, while interior is exposed to regular room temperatures).
  - Data is then collected from temperature sensors placed on each face in order to determine the U-value.
- Thermal Testing Methods
  - One testing method involves placing a thermal coupling in a specific location in the center of the door to be tested.
  - Another testing method, which yields more accurate results, involves testing an operable door and window assembly by measuring temperature differences from the source side to the receiving side.
  - It is important that thermal assemblies be tested for U-values and R-values in conjunction with the air infiltration tests.

Specifying Thermal Doors and Windows

- What is available on the market today?
  - Thermal Protection
    - Complete thermal assemblies are available in U-values up to 0.504 and R-values up to 2.0 in accordance with ASTM procedure C236-80.
    - Although some manufacturers claim U-values up to 0.9, it is unlikely that. these assemblies are “true” thermal break doors.
    - In many cases these high U-values reflect the U-values of the individual materials used, rather than the fully functional, operable door.
    - It is important to thoroughly investigate all manufacturer claims.
  - Combination Performance
    - Multiple performance requirements can be specified, including acoustical, bullet resistance, blast resistance, and RF shielding.
  - Finishes
    - Products are available in a variety of wood veneer, metal and plastic laminate finishes.

Specifying Thermal Doors and Windows

- **Common mistakes**

  - Specifying products and manufacturers that do not provide “true” thermal break doors.
  - Failing to specify that test results should be based on an operable assembly.
  - Specifying thermal break doors on projects that do not need them - “true” thermal break doors are expensive and should only be specified on projects where the cost is warranted.
  - Failing to allow for proper lead times – you should typically factor at least 10 weeks for the manufacture of thermal assemblies.
  - Specifying hardware that conflicts with the thermal break.
  - Specifying incorrect gauges of steel.
  - Assuming that all thermal break doors are available with fire ratings.

Specifying Thermal Doors and Windows

- **How to Evaluate Manufacturers of Special Purpose Doors and Windows**

1. Will installation be simple enough so as not to compromise performance?
2. Is it easy to specify the product? Are CAD's, technical specifications and other aids readily available from the manufacturer?
3. How accessible are the manufacturer's technical people when I have questions?
4. How accessible are the representatives who will visit jobsites to inspect installations?
5. What is my/others prior experience with this manufacturer? Are references available and willingly offered?

Specifying Thermal Doors and Windows

- **How to Evaluate Manufacturers of Special Purpose Doors and Windows**

6. What is their experience as demonstrated by other projects?
7. What is the nature of this manufacturer? Are they trustworthy?
8. How long has this manufacturer been researching and developing special purpose products?
9. Are product performance and test reports available from independent laboratories?
10. Are installation and other field services available?
11. Is the price competitive? What are the others charging?
12. Will my client be happy with the performance of this product?

Summary of Special Purpose

Doors and Windows

Summary of Special Purpose Doors and Windows

- Special purpose doors and windows are used in everyday applications
  - Performance Venues
  - Recording Studios
  - Drive-Through Applications
  - Banking Facilities
  - Retail Establishments
  - Movie Theaters
  - Museums
  - Schools
  - Laboratories
  - Courtrooms
  - Post Offices
  - Government Offices
  - Factories
  - Police Stations
  - Hospitals
  - Airports

Summary of Special Purpose Doors and Windows

- **Current Capabilities of Manufacturers**
  - Fire Rated Doors
    - Fire rated doors are available with ratings up to and including 3 hours.
  - Acoustical Doors
    - Acoustical doors are available with ratings up to STC 62 and windows up to STC 58.
  - Blast & Pressure Doors
    - Blast doors can withstand pressures up to 12 PSI and assaults of up to 10 minutes.
  - Radio Frequency Doors
    - Doors can shield up to 60 db and block frequencies from 1kHZ up to 10GHz.
  - Stainless Steel Doors
    - Doors can be fire rated up to 1.5 hours and are available in various grades and finishes.
  - Thermal Doors
    - "True" thermal break doors with U-values up to .504 and R-values up to 2.0.

Summary of Special Purpose Doors and Windows

- **Common Specifying Mistakes**
  - Acoustical Doors
    - Under-specifying the wall system and over-specifying the door assembly.
  - Blast & Pressure Doors
    - Failing to specify the required PSI or PSF rating in a blast door assembly.
  - Radio Frequency Doors
    - No provision for wall shielding system for RF interface with RF door frame.
  - Stainless Steel Doors
    - Specifying carbon steel reinforcement or dissimilar metal components.
  - Thermal Doors
    - Specifying components that conflict with ability to achieve a “true” thermal break.

Quick Code and Testing Reference

Purpose	Testing Standard	Testing Facility
Fire Resistance	UBC 7-2, UL10C, ANSI/NFPA 252 (doors) UBC 7-4, UL9, ANSI/NFPA 257 (windows)	Underwriters Laboratories Intertek Testing Services Warnock Hersey Factory Mutual
Air Infiltration	UBC 7-2, Part II (smoke and draft control) UL 1784	Underwriters Laboratories Intertek Testing Services
Sound Resistance	ASTM E90 (the test) ASTM E413 (measurement of test) ASTM E 336 (field test)	Riverbank Acoustical Laboratories, Western Electro-Acoustic Laboratory and other NVLAP accredited labs
Bullet Resistance	UL 752 NIJ (National Institute of Justice)	Underwriters Laboratories H.P. White Laboratories Intertek Testing Services
Blast & Pressure Resistance	ASTM standard currently in development Lab must utilize "shock tube" test equipment	Wilfred Baker (utilize shock tube)
Thermal Performance	ASTM C236	Northwest Laboratories
Radio Frequency	MIL - STD 285 NSA 73-2 and NSA 65-6	TRW