



# Study Guide for the AGMT Certification Knowledge-based Test (KBT)



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**Before reading this Study Guide, please review and familiarize yourself with the AGMT Candidate Handbook, found on [agmtprogram.com](http://agmtprogram.com).**

**The AGMT Certified Glazier:**

Congratulations on your decision to take the Architectural Glass and Metal Technician (AGMT) Certification Program Test. Those who pass the knowledge and physical based tests and become certified set themselves apart as individuals whose fundamental knowledge, skills, and abilities have been proven through an independent, 3<sup>rd</sup> party means of evaluation. Those glazing technicians who possess this certification confidently demonstrate to employers that they have a core competency and are ready to contribute safely and meaningfully to the glazing industry. Those who have this certification bring value to any project and organization and have the skills verification necessary to succeed in this industry.



**Purpose of the Study Guide:**

This study guide is intended to help focus the study efforts of the test taker. It covers all of the major glazier knowledge categories that will be on the knowledge-based portion of the test. Sample questions are provided at the end of this document to allow for practice and evaluation of the candidate's level of understanding.

**Resources:**

Included in the study guide are links to websites and documents that the candidate may find useful. Applicable links are found within each sub-category of the study guide. Material found at these links may only partially cover test materials or may provide additional information not covered by the test. Many of the links direct candidates to on-line courses that are available for purchase from an unaffiliated, 3<sup>rd</sup> party organization. It is up to the individual candidate to decide if such courses would be of value. (Note: Links provided within a particular sub-category may also apply to other sub-categories within the study guide.)

**The Knowledge-based Test:**

The Knowledge Based Test (KBT) is administered on a computer in a test center. The test consists of 125 multiple choice questions. Each question has 4 possible answers from which the candidate must select the correct response. Candidates will be given a 2-hour time limit to complete the test.

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## Section 1: Testing Skills

### A. Test Preparation:

1. **Don't Procrastinate/Cram**
2. **Make a study plan**
  - a. Weekly
  - b. Monthly
3. **Review with a group**
4. **Organize reference materials**
5. **Use visual aids**
  - a. Charts
  - b. Outlines
  - c. Diagrams
  - d. Tables
6. **Get plenty of sleep**
7. **Stay healthy and hydrated**
8. **Arrive early to testing site**



### B. Test-taking Skills:

#### 1. General test taking strategies:

- Be prepared.
- Listen attentively to last-minute instructions given by the instructor.
- Read the test directions very carefully and watch for details.
- Make certain your answer has been accurately registered on the computer screen.
- Plan how you will use the allotted time.
- Answer all the questions.

#### 2. Specific Strategies for computer-based tests

- **Use scratch paper:** Having and using scratch paper will allow you to jot down details, formulas, etc. while you look at other areas of the screen. This will save scrolling time. Scratch paper and pencil will be provided to each candidate.
- **Practice with a Timer:** Practice with the sample questions at the end of this document. To match the pace required for the actual test you should be able to complete the 20 questions in 19 minutes.

## Section 2: Test Content

### 1. Testing Categories:

- The Knowledge-based test is divided into 7 major Categories:



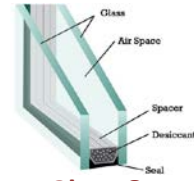
**Glazing Theory**



**Tools & Equipment**



**Documents & Layout**



**Glass & Panels**



**Systems**



**Sealants & Gaskets, etc.**



**QC & Failure Prevention**

### 2. Sub-categories:

- Each test Category is further divided into between 3 and 6 sub-categories, for a total of 28. On the following pages the sub-categories are identified.
- To assist the candidate in preparing for the Knowledge-based Test, the general knowledge and skills requirements of an experienced glazier are provided for each sub-category, along with additional requirement descriptions, where applicable. The test questions have been drawn from these general requirements.

## Section 3: Test Categories

### A. Glazing Theory

#### 1. *Applied Glazing Related Math*

**General requirements:**

**Possess basic mathematical skills required to effectively perform day-to-day fundamental glazing measurements, layouts, and calculations.**

- Ability to work with both metric and imperial measurements
- Use basic glazing related geometry
- Add, subtract, multiply, and divide whole numbers and fractions, and convert fractions to decimal equivalents, feet to inches, and metric conversions.

**Links to resources:**

- ☐ **Math Conversion Chart**

<https://www.mathsisfun.com/metric-imperial-conversion-charts.html>

#### 2. *Terminology/Communication Skills*

**General Requirements:**

**Understand and communicate effectively using appropriate glazing terminology.**

- General Construction, and glazing specific terminology
- Listening and reading comprehension

**Links to resources:**

- ☐ **NGA: Glossary of Terms:**

<https://www.glass.org/industry-resources-glossary.html>

- ☐ **NGA MyGlassClass.com Online Courses: *Introduction to Glass Handling***

<https://glass-nle.myabsorb.com/#/online-courses/5686b0e4-8aa3-4c7e-a8d7-c52561fd580c>

- ☐ **NGA MyGlassClass.com Online Courses: *Glass & Metals 101***

<https://glass-nle.myabsorb.com/#/online-courses/2338f7be-8d59-4af4-9d3d-0f45f8199451>

- ☐ **The LTI Group: *Glossary of Terms for the Glazing Industry***

<http://www.ltisg.com/3.0/glossary.php>

### 3. Glazing Specific Safety

#### General Requirements:

**Have a general working knowledge of glazing-specific safety precautions required when working around and with glazing materials (glass, aluminum extrusions, unitized walls, chemicals, etc.).**

- Safely handle, move, lift, and maneuver glazing materials (glass, aluminum extrusions, panels, sheet metal and cladding, etc.)
- Inspect glass/panels and frames for potential hazards
- Bracing and securing glazing materials while stored, being maneuvered, or in transit

#### A Few Common Safety Precautions:

1. Always wear safety glasses with side shields and gloves when moving or handling glass.
2. Inspect the glass before moving it to assure there isn't any damage that may cause spontaneous glass breakage.
3. Use proper lifting and moving techniques. Hold the glass firmly in your hands. Do NOT carry it over your head or under your arms.
4. Do not let any surface bump or hit the glass' edges or corners.
5. When setting glass on the floor, or other any other surface, gently place it down on the long edge.
6. Do not place glass directly on hard surfaces. Instead, use padding, or another type of cushioning agent.
7. Wrap or cover glass in blankets, or other cushioning agents, to protect it against incidental bumps that could cause chips or scratches.
8. Carry only one piece of glass at a time.

#### Links to resources:

- ❑ **State Compensation Insurance Fund: *A Window to Glazier Safety***  
<https://content.statefundca.com/pdf/e22104.pdf>
- ❑ **International Hazard Datasheets on Occupation: *Glazier***  
[http://www.ilo.org/wcmsp5/groups/public/@ed\\_protect/@protrav/@safework/documents/publication/wcms\\_193164.pdf](http://www.ilo.org/wcmsp5/groups/public/@ed_protect/@protrav/@safework/documents/publication/wcms_193164.pdf)
- ❑ **Canadian Centre for Occupational Health and Safety: *Glazier***  
[https://www.ccohs.ca/oshanswers/occup\\_workplace/glaziers.html](https://www.ccohs.ca/oshanswers/occup_workplace/glaziers.html)
- ❑ **NGA MyGlassClass.com Online Courses: *Safe Glass Handling 101***  
<https://glass-nle.myabsorb.com/#/online-courses/01838cd6-2d7d-47c5-88a2-50ad0bb319fd>
- ❑ **NGA MyGlassClass.com Online Courses: *Personal Protective Equipment for Working with Flat Glass***  
<https://glass-nle.myabsorb.com/#/online-courses/f0694920-933f-4c69-8df7-2d1d6caa204e>



- ❑ NGA MyGlassClass.com Online Courses: *Best Practices for Removing Broken Glass*  
<https://glass-nle.myabsorb.com/#/online-courses/9b79f8b6-cf0d-4b6d-8edd-ab1bc79d3d98>

## B. Tools and Equipment of the Trade

### 1. Hand Tools

#### General Requirements:

Identify commonly used glaziers' tools and their uses, and select the appropriate hand tools for specific tasks, and use safely and effectively.

- Selecting the right tool for the job
- Care, maintenance, storage, and inspection of hand tools
- How to store and secure tools at height

#### Common hand tools for the glazier include but are not limited to:

1. **Measuring Tools:** Rules, Straight Edges, Squares
2. **Glass Cutting Tools:** Strip cutter, dry glass cutter
3. **Glass Breaking Tools:** plate pliers, breaking pliers
4. **Sealant Applicators:** Caulk guns, Putty knife
5. **Utility Knives**

#### Links to resources:

- ❑ Canadian Centre for Occupational Health and Safety: *Hand Tools*  
[https://www.ccohs.ca/oshanswers/safety\\_haz/hand\\_tools/](https://www.ccohs.ca/oshanswers/safety_haz/hand_tools/)
- ❑ Mano Mano Products: *List of Glazier tools*  
<https://advice.manomano.co.uk/glazing-tools-buying-guide-995>
- ❑ NGA MyGlassClass.com Online Courses: *Hand and Power Tool Safety for Construction*  
<https://glass-nle.myabsorb.com/#/online-courses/95cf304c-c0d0-412e-88c8-7e94b2f05337>
- ❑ NGA MyGlassClass.com Online Courses: *How to Cut Glass, Part I*  
<https://glass-nle.myabsorb.com/#/online-courses/5451a53b-fe0f-4293-9fc9-5a476cf75477>
- ❑ NGA MyGlassClass.com Online Courses: *How to Cut Glass, Part II*  
<https://glass-nle.myabsorb.com/#/online-courses/16f4c968-b573-4091-b283-5dab20dbc823>

## 2. Glass Handling Equipment

### General Requirements:

Selection of appropriate glass handling equipment (i.e. vacuum glass hoists, suction cups, A-frame carts, spider-lifts, etc.) and their effective and safe use.

- Glass prep, positioning and securing
- Protecting glass edges and surfaces
- Understanding capacity and limitations

### Links to resources:

- ❑ **Vitro Flat Glass Products: *Handling Do's and Don'ts to Reduce Glass Breakage***  
[http://www.vitroglazings.com/VitroGlazings/media/sitedocuments/TDs/24\\_TD1\\_12F.pdf](http://www.vitroglazings.com/VitroGlazings/media/sitedocuments/TDs/24_TD1_12F.pdf)
- ❑ **ASE Systems: *General Safety Rules When Using Powered Vacuum Lifters***  
<http://www.asesystems.com/vacuum-lifters/general-vacuum-lifter-safety/>
- ❑ **Bystronic: *Handling Systems for flat glass and plates***  
<https://www.bystronic-glass.com/wp-content/uploads/2016/08/Bystronic-glass-Handling-EN.pdf>

## 3. Portable Power Tools

### General Requirements:

Identify commonly used glaziers' power tools and be familiar with their uses and selection of appropriate power tools for specific tasks; and use the tools safely and effectively.

- Selecting the right tool for the job
- Inspection of the cord, grounding, housing
- How to use, store, and secure at height

Some examples of Power Tools:

- Jig Saws
- Belt Sanders
- Dust Extractor
- E-cut Blade
- Mushroom Blade
- Drills and drivers
- Powder actuated fasteners



### Links to resources:

- ❑ **Power Tool Institute**  
<https://www.powertoolinstitute.com/>
- ❑ **OSHA: *Hand and Power Tools***  
<https://www.osha.gov/Publications/osha3080.pdf>

- ❑ **NGA MyGlassClass.com Online Courses: *Metal Tools of the Trade***  
<https://glass-nle.myabsorb.com/#/online-courses/9d6c5fd6-01af-4195-ab2c-a89ca930ade1>
- ❑ **NGA MyGlassClass.com Online Courses: *Metal Fabrication Tools & Techniques***  
<https://glass-nle.myabsorb.com/#/online-courses/694b7abd-0e09-4a27-afcc-fe59ab19d645>
- ❑ **NGA MyGlassClass.com Online Courses: *Glass Fabrication Tools & Techniques***  
<https://glass-nle.myabsorb.com/#/online-courses/8b0e8321-cfb2-48fc-ad8a-f4bc5b3efc51>
- ❑ **NGA MyGlassClass.com Online Courses: *Electrical Safety for Construction: Cords and Plug Connected Equipment***  
<https://glass-nle.myabsorb.com/#/online-courses/968390f4-5f98-4d2c-a350-1ee681060203>

#### 4. *Scaffolding and Personal Lifts*

##### **General Requirements:**

**Appropriate selection of, and knowledge/ability to work from elevated work platforms (i.e. scaffolding, personal lifts); and correct placement and assembly (where applicable) of equipment and components.**

- Load limitations and correct applications
- Consideration for terrain and base surfaces, plus barriers
- Inspect for damage and unsafe conditions

##### **Links to resources:**

- ❑ **Spider/Brand Safeway: Information about Staging**  
<http://spiderstaging.com/index.aspx>
- ❑ **ManLift Study Guide**  
<http://www.pati.org/Journey%20Test%20Study%20Guide/ManliftStudyGuide.pdf>
- ❑ **NGA MyGlassClass.com Online Courses: *Aerial Lifts and Scissor Lifts***  
<https://glass-nle.myabsorb.com/#/online-courses/7a11def2-5d28-4e85-b75c-6e4a936019f8>
- ❑ **NGA MyGlassClass.com Online Courses: *Fall Protection***  
<https://glass-nle.myabsorb.com/#/online-courses/b1f70d6a-4e03-48c0-ace7-6c491e7b45ea>
- ❑ **NGA MyGlassClass.com Online Courses: *Scaffold Safety Awareness***  
<https://glass-nle.myabsorb.com/#/online-courses/90eeaeb9-d1e5-4082-a822-1878dd125394>

## 5. *Bits, Tips, Taps*

### **General Requirements:**

**Proper selection and uses of bits, tips, and taps, and their effective and safe use.**

- Identification of types and sizes
- Select right one for the job
- Proper inspection practices and processes

### **Link to resources:**

- ❑ **Mano Mano Products: *Drill bits buying guide***  
<https://advice.manomano.co.uk/drill-bits-buying-guide-897>

## 6. *Rigging and Hoisting*

### **General Requirements:**

**Use of appropriate rigging, hoisting, tag lines and signaling to manipulate (or facilitate movement of) materials on the job site in a safe and effective manner.**

- Identify components of rigging that encounter glazing materials
- Selection of proper rigging based upon size and capacity of materials being lifted
- Securing perimeter and pre-task path planning

### **Links to resources:**

- ❑ **Environmental Health Safety-Princeton University: *Hoisting and Rigging*** <https://ehs.princeton.edu/workplace-construction/construction-safety/hoisting-rigging>
- ❑ **U.S. Department of Energy: *Hoisting and Rigging Fundamentals***  
[https://www.energy.gov/sites/prod/files/2014/01/f6/HoistingRigging\\_Fundamentals.pdf](https://www.energy.gov/sites/prod/files/2014/01/f6/HoistingRigging_Fundamentals.pdf)
- ❑ **NGA MyGlassClass.com Online Courses: *Basic Rigging Awareness***  
<https://glass-nle.myabsorb.com/#/online-courses/31436e70-0459-4c4e-8b67-0b1c47384265>

## C. Construction Documents and Layout

### 1. *Project Drawings and Document Review*

#### **General Requirements:**

**Utilize construction documents to determine correct materials, components, systems, quantity, size, fit, opening conditions, and locations of glazing systems.**

- Understand different views of drawings (i.e. plans, sections, elevations, details, symbols gridlines); and how to maneuver from one view to another within the same opening

- Determine appropriate materials, quantities, lengths, sizes from construction and shop documents, and locate accurately
- Identify glazing related materials from those of other trades

**Links to resources:**

- ❑ **Vitro Architectural Glass: *What's in Your Spec? A Checklist for Glazing Contractors.***  
<http://inspirescapes.vitroglazings.com/whats-in-your-spec>
- ❑ **Glass Magazine: *Glass and Metals 201: A Guide to Glazing Specifications***  
<https://glassmagazine.com/article/commercial/glass-and-metals-201-guide-glazing-specifications-1716336?page=0%2C1>
- ❑ **NGA MyGlassClass.com Online Courses: *Introduction to Estimating***  
<https://glass-nle.myabsorb.com/#/online-courses/29764225-196e-45a1-8cb0-c4ae18157537>
- ❑ **NGA MyGlassClass.com Online Courses: *Reading Plans and Blueprints***  
<https://glass-nle.myabsorb.com/#/online-courses/10a0a3a9-5f21-4050-a118-dd06719d88d5>

## 2. Basics of Layout

**General requirements:**

**Ability to use math, appropriate contract documents, tools and layout principles to accurately locate framing members (plumb, level, and square). Determine from blueprints and contract documents location of control lines and reference points as they relate to scope of glazier's work.**

- Ability to evaluate site conditions as compared to contract documents
- Determine plumb, level, and square, and apply to benchmark/reference points; and understanding tolerances
- Proper selection and use of layout tools (i.e. tape measure, level, laser, etc.).

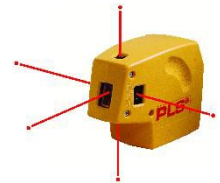
**Plumb:** Plumb is defined as true to a vertical plane. A correctly plumbed object such as a support column takes maximum advantage of gravity, transferring loads directly to the ground.

**Level:** Level is defined as true to a horizontal plane.

**Square:** Square is when a plumbed object intersects with a level object, they create a 90-degree angle.

**Link to resources:**

- ❑ **Renovation-Headquarters.com: *Plumb, level, and square***  
<http://www.renovation-headquarters.com/plumb-level-square.html#.XDVbQ1VKh0w>



### 3. *Measurement and Layout Equipment*

#### General requirements:

Proper use of measurement and layout equipment, including care, maintenance, calibration, storage, and handling. Must be able to verify accuracy and demonstrate proper setup, conversion and location of control points.

#### Common Measurement and Layout Equipment:

- Tape Measure
- Carpenter Pencil
- Protractor
- Speed Square
- Laser Measure
- Scriber

#### Links to resources:

- ❑ Quizlet Inc.: *Measuring and Layout Tools*  
<https://quizlet.com/241958081/chapter-3-measuring-and-layout-tools-flash-cards/>
- ❑ Westport Corporation: *How to Properly Care for and Handle your Precision Measuring Instruments*  
<https://westportcorp.com/blogs/calibration-repair-services/how-to-properly-care-for-and-handle-precision-measuring-instruments>
- ❑ Delmar Learning: *Layout Equipment and Tools*  
[http://www.delmarlearning.com/companions/content/143549718X/student/text\\_figures/ch08\[1\].pdf](http://www.delmarlearning.com/companions/content/143549718X/student/text_figures/ch08[1].pdf)

## D. Glass and Panels

### 1. *Proper Installation*

#### General requirements:

Select and use necessary tools and equipment, handling and installation procedures for proper placement of system's components to receive glass, in proper sequence. Install glass in proper sequence with attention to edges and surface to prevent damage and maintain glass integrity as relates to strength and aesthetics; maintaining prescribed edge coverage and sightlines. Install glass retaining devices (i.e. pressure plates, snap-in channels, gaskets, etc.) as per manufacturer's installation instructions avoiding too little or too much edge pressure on glass.

- Install glass properly oriented (e.g. outboard/inboard lite, left-hand/right-hand, up/down, logo location)
- Proper selection and placement of setting/edge blocks
- Properly prepare channels to receive glass or panels, and keep weep holes and water paths unobstructed

**Links to sources:**

- ❑ **Stiles Custom Metals, Inc.: *Glass Installation Guidelines***  
<https://stilesdoors.com/techdata/pdf/Glass%20Installation%20Guide%200710.pdf>
- ❑ **Viracon: *Glazing Guidelines***  
<http://www.viracon.com/page/glazing-guidelines>
- ❑ **NSG: *General Glazing Guidelines***  
<https://www.pilkington.com/resources/ats192generalglazingguidelines2013102.pdf>

## **2. Storage and Handling**

**General requirements:**

**Properly protect materials (and personnel) throughout all aspects of warehousing, staging, storage, and movement of materials, taking into consideration surroundings and environment.**

- Proper tool and equipment selection and procedures for transporting, handling, and moving
- Inspection practices and processes
- Selection of storage location and protection from elements

**Links to sources:**

- ❑ **NSG: *Protecting Flat Glass Surfaces***  
<https://www.pilkington.com/resources/ats104protectingflatglasssurfaces20130114.pdf>
- ❑ **NSG: *Preventing Moisture Stains on Stored Glass***  
<https://www.pilkington.com/resources/ats112preventingmoisturestainsonstoredglass20130114.pdf>
- ❑ **Glasshape, LTD: *Handling, Storage, & Protection***  
<https://glasshape.com/wp-content/uploads/2015/08/Handling-Storage-Protection-For-IGU.pdf>
- ❑ **Glass & Glazing Assoc. of Australia: *Storage of Glass-On Site***  
<https://www.agga.org.au/docs/d2aa110d-7021-4f98-9d22-3a2fc549a7ba/SFS-SOGOS-Dec2015v01.pdf>
- ❑ **NGA MyGlassClass.com Online Courses: *Safe Glass Handling 101***  
<https://glass-nle.myabsorb.com/#/online-courses/01838cd6-2d7d-47c5-88a2-50ad0bb319fd>

## **3. Insulating Glass Units (IGU) ( A.K.A. Double-glazed units)**

**General requirements:**

**Properly handle IGU to protect from potential shearing effect, or surface, edge or seal damage; understand the potential for detrimental effects from the use of incompatible glazing sealants, gaskets, and setting/centering blocks, always using specified materials.**

- Understand causes and how to prevent shear stress, always providing equal support of both lites of an IGU
- IG Compatibility with glazing sealant, setting/centering blocks, gaskets
- Determine proper surface orientation (1,2,3,4)

**Links to sources:**

- ❑ **Glass.com: *Understanding Insulating Glass Windows***  
<https://info.glass.com/understanding-insulating-glass-windows/>
- ❑ **Guardian Industries: *Insulating Glass***  
<https://www.guardianglass.com/commercial/ToolsandResources/Resources/GlossaryandTerms/InsulatingGlass/index.htm>
- ❑ **Cardinal IG Co.: *Compatibility with Insulating Glass Sealants***  
[https://www.cardinalcorp.com/source/pdf/tsb/ig/IG15\\_1-2016.pdf](https://www.cardinalcorp.com/source/pdf/tsb/ig/IG15_1-2016.pdf)
- ❑ **NGA MyGlassClass.com Online Courses: *Basics of Insulating Glass Units***  
<https://glass-nle.myabsorb.com/#/online-courses/5bfcbbdee-22ae-42bb-b747-03fa902aa304>

## E. Systems

### 1. Framing Basics

**General Requirements:**

**Utilize shop drawings and construction documents to select, fabricate, assemble, and install components of fenestration framing as per manufacturer’s fabrication/assembly/installation instructions.**

- Proper location and application of sealants at substrate interfaces
- Select appropriate anchors and fasteners, properly locating frame to benchmarks, installing plumb, level, and square.
- Properly sequence material and component installation



**Links to sources:**

- ❑ **Glass Magazine: *The Art of Measuring, Fabrication and Installing Storefront***  
<https://glassmagazine.com/article/retail/art-measuring-fabricating-and-installing-storefront-1412354>
- ❑ **Efco Corporation: *Storefront Installation Instructions***  
<http://www.efcocorp.com/images/products/remote/instructions/Y001%20-%20Storefront.pdf>
- ❑ **NGA MyGlassClass.com Online Courses: *Storefront Metal Fabrication Techniques***  
<https://glass-nle.myabsorb.com/#/online-courses/25bef62e-e7c8-403e-9c96-cb2324af3fb0>



- ❑ **NGA MyGlassClass.com Online Courses: *Curtainwall Fabrication Techniques (Stick System)***  
<https://glass-nle.myabsorb.com/#/online-courses/cab44b95-2ce3-49fa-8d52-2eaa24f18b49>
- ❑ **NGA MyGlassClass.com Online Courses: *Storefront Installation***  
<https://glass-nle.myabsorb.com/#/online-courses/95bd154b-ed21-4db8-9bc4-bb52937f08d0>
- ❑ **NGA MyGlassClass.com Online Courses: *Curtain Wall Installation (Stick System)***  
<https://glass-nle.myabsorb.com/#/online-courses/804e13b3-0869-4136-b5d0-1b914226db91>

## 2. *Fasteners and Anchors*

### **General Requirements:**

**Properly select and install fasteners, anchors, shims and spacers in the correct location with proper frequency, with consideration for the opening substrate; using correct hole sizes for both anchors and fasteners.**

- Identify types and correct uses of fasteners, anchors, shims and spacers understanding their compatibility with substrates and materials
- Use of correct hole sizes for anchors (in substrate) and fasteners (in frames), and use of shims where applicable

### **Links to sources:**

- ❑ **Albany County Fasteners.com: *Fasteners 101; Types of Fasteners***  
<https://www.albanycountyfasteners.com/Fastener-Varieties-s/1130.htm>
- ❑ **Grainger: *Anchor Selection Guide***  
<https://www.grainger.com/content/supplylink-anchor-selection-guide>

## 3. *Storefront / Window Wall General Knowledge*

### **General Requirements:**

**Possess an understanding of the types and typical uses and applications and limitations of storefront and window wall systems; their similarities and differences; and how they differ from curtainwalls. Familiarity with their components and assembly sequence and methods, and a working knowledge of their water management elements.**

- Types of storefronts/Window walls and typical applications, including limitations
- Sequence of installation and glazing methods
- System makeup; and interchangeability of components

**Window wall** systems are commonly used in ribbon **window** configurations or punched openings. The framing system spans from slab-to-slab and can be installed from the building's interior to improve logistics and reduce installation costs.

A **storefront** is the facade or entryway of a retail store located on the ground floor or street level of a commercial building, typically including one or more display windows.

**Links to sources:**

- ❑ **Wausau Window and Wall Systems: *Product Selection Storefront, Curtainwall, or Window Wall?***  
<http://archive.constantcontact.com/fs015/1102578453004/archive/1109810435802.html>
- ❑ **Building Enclosure: *Curtainwall vs. Storefront: Selecting Architectural Aluminum***  
<https://www.buildingenclosureonline.com/articles/85428-curtainwalls-vs-storefronts-selecting-architectural-aluminum>
- ❑ **Alufab: *Installation Manual - Storefront Door***  
[https://sweets.construction.com/swts\\_content\\_files/100336/508293.pdf](https://sweets.construction.com/swts_content_files/100336/508293.pdf)
- ❑ **NGA MyGlassClass.com Online Courses: *Basics of Storefront and Entrances***  
<https://glass-nle.myabsorb.com/#/online-courses/9a8df0a9-8645-4202-996b-0d1362e8c2d3>
- ❑ **NGA MyGlassClass.com Online Courses: *Basics of Architectural Aluminum***  
<https://glass-nle.myabsorb.com/#/online-courses/fb5c1cbe-24ac-40b7-8a70-bcd2d3154100>

#### 4. *Curtainwall General Knowledge*

**General Requirements:**

**Possess an understanding of curtainwall materials, their uses, general features and benefits; their differences from storefront and window wall systems; and assembly methods, as well as their water management elements; understand the different types of curtainwalls (stick, unitized), and their sequence of installation and glazing methods.**

- Principles of the different types of curtainwalls (stick, unitized), and their sequence of installation and glazing methods
- Transition and expansion joints; deadload/windload anchors
- Recognition of torque specifications and the effects of not adhering to them (over/under)

A "curtainwall" is any non-load-bearing exterior wall that hangs (like a curtain) from the face of floor slabs, regardless of construction or cladding material. However, in common usage, the term **curtainwall** usually refers to aluminum-framed systems carrying glass, panels, louvers, or occasionally, granite or marble.

**Links to sources:**

- ❑ **Glass Magazine: *Curtain Wall Fundamentals***  
<https://glassmagazine.com/article/commercial/curtain-wall-fundamentals-1413202>

- ❑ **Building Enclosure Council: *Glass Curtainwalls: Design, Engineering, and Performance***  
[http://www.bec-baltimore.org/wp-content/uploads/2015/11/2016-06-14-Glass-Curtain-Walls\\_BEC-Baltimore.pdf](http://www.bec-baltimore.org/wp-content/uploads/2015/11/2016-06-14-Glass-Curtain-Walls_BEC-Baltimore.pdf)
- ❑ **Building Enclosure: Curtainwall vs. Storefronts: Selecting Architectural Aluminum**  
<https://www.buildingenclosureonline.com/articles/85428-curtainwalls-vs-storefronts-selecting-architectural-aluminum>
- ❑ **NGA MyGlassClass.com Online Courses: *Basics of Curtainwall***  
<https://glass-nle.myabsorb.com/#/online-courses/59e9a509-f42e-4f12-b13b-3ea7f641eee2>

## 5. Aluminum Entrances General Knowledge

### General Requirements:

Possess an understanding of the various types of aluminum entrance doors, their components and assembly, door frame materials, and various door hardware including pivots, hinges, pulls and locking devices. Have ability to fabricate, assemble and install framing and hang door in opening and perform typical adjustments. Understand general ADA and safety glazing requirements.

- ADA knowledge and safety glazing requirements
- Sequence of installation (relative to itself and to surrounding glazing materials) and coordination and interface w/ adjacent glazing systems
- Tolerances/clearances

### Links to resources:

- ❑ **Tubelite Inc.: *Entrances***  
<https://www.tubeliteinc.com/aluminum-doors-entrances-framing/>
- ❑ **Trustile: *ADA Compliance***  
<https://www.trustile.com/technical-information/ada-compliance>
- ❑ **NGA MyGlassClass.com Online Courses: *Commercial Entrance Installation***  
<https://glass-nle.myabsorb.com/#/online-courses/3385a5c2-b239-488b-9917-ce7e29b4c00c>

## F. Sealants and Gaskets / Ancillary Materials

### 1. Joint Prep, Weather Seal, and Internal Sealing

#### General Requirements:

A detailed understanding of the need for, and uses of wet sealants to control and prevent water and air infiltration. A clear understanding of where wet sealants are needed, how to verify proper locations using manufacturer's instructions, proper

**cleaning and preparation, application and tooling of sealants; with consideration for potential material compatibility issues.**

- Cleaning methods and primer selection and application
- Knowledge, selection, and insertion of backer rods and sealant application and tooling
- Principles of material compatibility and importance of only using specified materials

There are **five basic steps** for proper joint preparation and sealant application:

1. **Clean** – Joint surfaces must be clean, dry, dust free, and frost free.
2. **Prime** – If required, primer is applied to the clean surface(s)
3. **Pack** – Backer rod or bond breaker as required.
4. **Shoot** – Sealant is applied by “pushing the bead” into the joint cavity.
5. **Tool** - Dry tooling techniques are used to strike a flush joint and make certain the sealant has the proper configuration and fully contacts the joint walls.

**Links to resources:**

- ❑ **UNIPRO: *Joint Surface Preparation and Sealant Application***  
<http://www.masonryinstitute.com/wp-content/uploads/Surface-Preparation-and-Sealant-Application.pdf>
- ❑ **Sika Corporation: *Construction Sealant Training***  
<https://usa.sika.com/dms/getdocument.get/225956c9-ec92-31a2-a5a1-444823adbc31/pres-cpd-SealantTrainingFundamentals-us.pdf>
- ❑ **Metal Construction News: *Caulk and Sealant Guide***  
<https://www.metalconstructionnews.com/articles/caulk-and-sealant-guide>
- ❑ **DOW: *Contractor’s Handbook***  
<https://consumer.dow.com/en-us/document-viewer.html?ramdomVar=6775586470832822747&docPath=/documents/en-us/app-tech-guide/62/62-06/62-621-01-dow-contractor-handbook.pdf>
- ❑ **NGA MyGlassClass.com Online Courses: *Basics of Sealant***  
<https://glass-nle.myabsorb.com/#/online-courses/52375885-214f-4e23-9e2d-fb9bd0e2c359>

## **2. *Setting/Edge Blocks***

**General Requirements:**

**Proper selection and placement of setting and edge blocks in relation to glass and framing components, and consideration for water management functionality of the system. Understanding material compatibility concerns and the importance of only using specified material, or selecting proper material (in the absence of a specification).**

- Compatibility issues and cautions
- Selecting proper size and determining location of setting and edge blocks

Setting blocks are typically used as cushions between glass and aluminum in architectural systems. Blocks come in many thicknesses, widths and lengths as well as many different polymers. They can be extruded or fabricated to any length required. A pressure sensitive adhesive (PSA-1) can also be added to these materials.

Each lite of glass should be set on two setting blocks centered approximately at the bottom edge quarter points. When this is impractical, the end of the setting block can be moved within either 6" (152mm) or 1/8 the width of the glass from the vertical edge, whichever distance is greater. Blocks should always be an equal distance from the center of the glass and should be of a material with a Shore A durometer hardness of  $85 \pm 5$  e.g. neoprene, EPDM or silicone. In a metal glazing system, the length of each setting block should be 0.1" for each square foot (27 mm per square meter) of glass area, but not less than 4" (100 mm). All setting blocks should be of sufficient height to provide the minimum edge clearance for the type of glass being glazed and for the nominal bite recommended. Setting blocks should be 1/16" (2 mm) less than full channel width or positively located in the channel so they cannot be misaligned during glazing. If setting block shims are required, they must be located under the setting blocks and have a durometer rating equal to or greater than that of the setting blocks.

**Links to resources:**

- ❑ **Central Rubber Extrusions: *Setting Blocks***  
<https://www.centralrubberextrusions.com/setting-blocks/>
- ❑ **NSG: *General Glazing Guidelines***  
<https://www.pilkington.com/resources/ats192generalglazingguidelines2013102.pdf>

### 3. *Dry Glazing (Gaskets)*

**General Requirements:**

**Proper selection, sizing, and installation and sealing of gaskets in glazing systems, both interior and exterior; proper sizing, cutting, and sequence of installation; types, uses and purposes of gaskets.**

- Using sealants with gaskets

**Dry Glazing** is the installation of glass using extruded gaskets in PVC, EPDM or Santoprene to one or both sides of the glass to provide a compressed weather seal. No sealants or putties are present in this system and the windows are designed to be self-draining.

Installation of gaskets commences from the corner of a frame and they are inserted under pressure to form a tight compressed weather seal. Gaskets should be cut over-size to allow for shrinkage and to assist with installation they can be lubricated and softened by immersion in hot soapy water.

**Advantages:**

- Allows interior glazing
- Less dependent on workmanship and weather
- Less costly than wet glazing

**Disadvantages:**

- Not as water resistant
- Gaskets can shrink which can create openings for water penetration
- Gaskets can roll into pocket and place uneven stress on glass.
- Gaskets can allow glass to move

**Links to resources:**

- ❑ **Fadelfacadedesign: *Wet vs. Dry Glazing***  
<http://fadelfacadedesign.blogspot.com/2013/04/wet-vs-dry-glazing.html>
- ❑ **Link to Glazing Gaskets:**  
[http://www.conservationtechnology.com/building\\_glazing.html](http://www.conservationtechnology.com/building_glazing.html)

#### **4. Wet Glazing (Structural Glazing)**

**General Requirements:**

**Possess knowledge and ability to apply gunable “wet” sealant for structural purposes, in shop and field environments, using appropriate means and as per silicone and system’s installation instructions, using proper application and tooling of sealant.**

- Follow sealant manufacturer installation instructions
- Proper application and tooling of structural sealants
- Read and interpret specifications, drawings and systems’ installation instructions

**Structural Glazing** is a method of bonding glass to a building’s structural framing members utilizing high strength silicone.

**Advantages:**

- Increases the thermal efficiency of buildings, because the exterior exposure of metal framing is either reduced or eliminated
- Reduces or eliminates water and air infiltration
- Reduces the potential for thermal breakage of glass
- Help to reduce glass movements

**Disadvantages (in curtainwall fabrication and installation):**

- Requires exterior access for installation, maintenance and glass removal
- High workmanship
- Costs more than dry glazing

**Link to resources:**

- ❑ **Adshead Ratcliffe & Co: *Structural Glazing Information***  
<http://www.arbo.co.uk/wp-content/uploads/2011/11/Structural-Glazing-Information.pdf>

## G. Quality Controls / Failure Prevention

### 1. *Water Management/Drainage Systems*

**General Requirements:**

**Possess a fundamental working knowledge of the principles of water infiltration, accumulation, and drainage for various types of glazing systems, and how attention and inattention to proper routine glazing processes may affect them.**

**Understand how various systems manage water infiltration.**

- Correctly install water management components (e.g. deflector, end dams, joint plugs, setting blocks)
- Proper application and tooling of internal sealants at designated locations per instructions
- Proper location, placement, size, and shape of weep holes

Glazing sealants cannot exclude all water, so providing internal drainage is critical. The water resistance/weatherproofing performance of a glazing system depends on the following:

- Details of the framing system that promote drainage
- internal framing seals
- external (i.e. glass-to-frame) seals

**Links to resources:**

- ❑ **Tubelite Inc.: *Controlling Storefront and Curtainwall Water Infiltration:***  
<https://www.tubeliteinc.com/shared-learnings-controlling-storefront-and-curtainwall-water-infiltration/>
- ❑ **Link to Door and Window Maker Magazine- Drainage:**  
[https://industry.glass.com/Door\\_and\\_Window\\_Maker/Backissues/2003/MayJune03/drainage.htm](https://industry.glass.com/Door_and_Window_Maker/Backissues/2003/MayJune03/drainage.htm)
- ❑ **Link to Whole Building Design- *Glazing:***  
<https://www.wbdg.org/guides-specifications/building-envelope-design-guide/fenestration-systems/glazing>

## 2. Material Compatibility

### General Requirements:

Possess a working knowledge of issues that might arise from the use of glazing materials that are incompatible with other glazing components, and the importance of using only specified or tested materials; no field substitutions. Have knowledge of all materials that might pose an incompatibility threat to a system, including the potential for issues arising from dissimilar materials in contact with each other, as well as the potential for deleterious effects on glass and metal coatings, and structural adhesives.

- Know the detrimental effects of using incompatible glazing materials, cleaners, primers, sealants, blocks, and gaskets; and their potential effect on IGU's, glass coatings, and metal coatings.
- Know which materials have the potential for incompatibility issues
- Select and use only specified glazing materials

### Links to resources:

- ❑ **ArnoldGlas: Material Compatibility around insulating glass**  
[http://www.ornilux.com/assets/unpacking\\_material\\_compatibility\\_cleaning\\_care\\_installation\\_sticker\\_visible\\_quality\\_083017.pdf](http://www.ornilux.com/assets/unpacking_material_compatibility_cleaning_care_installation_sticker_visible_quality_083017.pdf)
- ❑ **Cardinal IG: Compatibility with Insulating Glass Sealants**  
[https://www.cardinalcorp.com/source/pdf/tsb/ig/IG15\\_1-2016.pdf](https://www.cardinalcorp.com/source/pdf/tsb/ig/IG15_1-2016.pdf)
- ❑ **NGA Glass Information Bulletins: Assessing the Compatibility of Glazing Materials Components**  
[https://www.techstreet.com/gana/standards/assessing-the-compatibility-of-glazing-materials-and-components-glass-information-bulletin-dd-02-0317?product\\_id=1947911#jumps](https://www.techstreet.com/gana/standards/assessing-the-compatibility-of-glazing-materials-and-components-glass-information-bulletin-dd-02-0317?product_id=1947911#jumps)

## 3. Interfaces

### General Requirements:

Identify interfaces and the potential for leaks, expansion/contraction, aesthetic issues, as well as chemical reaction between dissimilar materials – utilizing a basic working knowledge of the principles of water infiltration, accumulation, and drainage.

- Proper installation of glazing products in relation to material from other trades
- Ability to select and install correct sealing materials for interface joints
- Understanding the importance of tolerances

### Links to resources:

- ❑ **RCI, Inc.: Lessons Learned from Curtain Wall Failure Investigations**  
<http://rci-online.org/wp-content/uploads/2011-03-mccowan-kivela.pdf>



#### 4. Inspections

##### **General Requirements:**

**Visually review and/or mechanically test completed steps to ensure proper conformance to installation instructions, construction documents, and/or other benchmarks; including opening substrates (as completed by other trades).**

- Properly identify/document inspected areas
- identify / Isolate non-conforming work when there are problems (i.e. tagging/markings)
- Verify proper function of operable components (i.e. doors, windows, vents)
- Verification of materials proper use within manufacturers guidelines (e.g. proper torquing, temperature range, expiration dates, surface protection, etc.)

##### **Inspections of Glazing System**

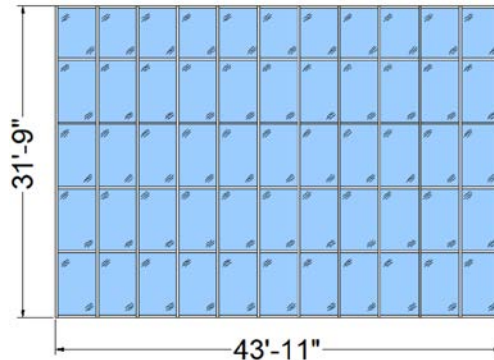
- Window and door installation quality
- Conservatory installation quality
- Material Quality
- Visual quality of glazing
- Insulating Glass Units with Seal Failure
- Spontaneous and other breakage types
- Inclusion Analysis
- Condensation and ventilation issues
- Sealant incompatibility
- Design calculations
- Water ingress and Drainage investigations
- Safety, security and thermal (Glass type and function analysis)



## Section 4: Practice Questions for AGMT Knowledge-based Test

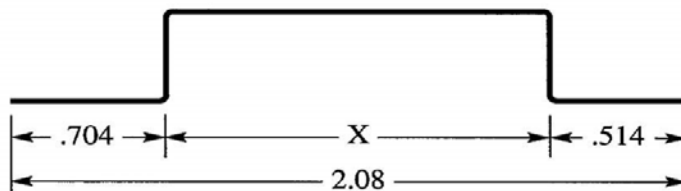
Following are examples of the type of questions that might be found on the AGMT Knowledge-based test. The Answers can be found in Section 5, below.

1. A curtainwall opening measures 43' -11" along its width and 31' -9" in height. What is the perimeter of its opening?



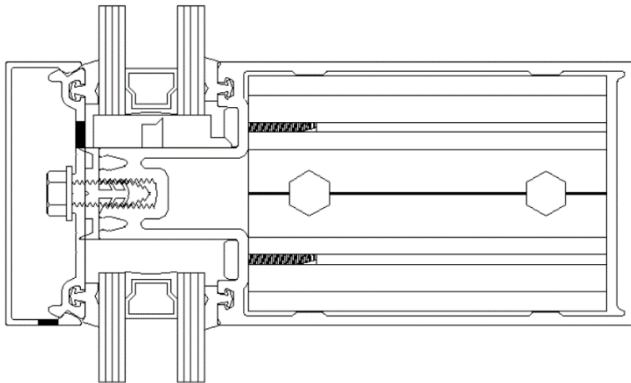
- a. 149'-8"
  - b. 75'-8"
  - c. 151'-4"
  - d. 150'-8"
2. What is meant by "deflection"?
    - a. The angle at which light is reflected by a glass surface
    - b. The amount of bending movement of a structural member
    - c. The specified pressure a product is designed to withstand
    - d. The tendency to scatter or disperse a direct beam of light
  3. The ability of a sealant to stick to a surface is the definition of:
    - a. Adhesion
    - b. Shear Strength
    - c. Elasticity
    - d. Cohesion
  4. Which of the following is MOST important when considering using a heavy, all-glass door in a storefront system?
    - a. Locking device
    - b. Size of door pulls
    - c. Pivot and closer
    - d. Door stops
  5. Where should slings be placed when lifting glass overhead?
    - a. On the side of cases
    - b. On the sides under cleats
    - c. Underneath at 1/3 points
    - d. Underneath at ¼ points

6. What is the first step before changing a unit in a pressure bar curtainwall?
  - a. Remove cover caps
  - b. Cut away the caulking
  - c. Remove the vinyl gasket
  - d. Remove the fastening screws
  
7. Which one of the following documents has the final say concerning the performance characteristics of glass required for a particular opening?
  - a. Specifications
  - b. Architectural drawings
  - c. Building code
  - d. Shop drawings
  
8. Which type of glass is best suited for use in a balcony?
  - a. Annealed
  - b. Laminated
  - c. Tempered
  - d. Wire
  
9. When glazing a lite of  $\frac{3}{4}$ " glass measuring 168" wide, where should the setting blocks be placed?
  - a. Closer to the corner than typical
  - b. Closer to the center than typical
  - c. At typical  $\frac{1}{4}$  points
  - d.  $\frac{1}{4}$  points plus an additional block in the center
  
10. Which of the following is not an advantage of dry glazing?
  - a. Can be done from the interior
  - b. Less costly than wet glazing
  - c. Is less dependent on workmanship and weather
  - d. Is more watertight
  
11. Find dimension "x":



- a. .862
- b. .19
- c. 1.89
- d. 3.29

12. In describing the makeup of an IG unit, which glass surfaces is the spacer adhered to?
  - a. #1 and #3
  - b. # 1 and # 4
  - c. # 2 and # 4
  - d. # 2 and # 3
  
13. Which of the following types of systems are installed between floor slabs on upper floors?
  - a. Unitized curtainwall
  - b. Window wall
  - c. Stick-built curtainwall
  - d. Storefront
  
14. Weep holes are designed for what primary reason?
  - a. Equalize air pressure between the exterior and interior of a building
  - b. Allow interior air pressure to escape a building while preventing water from entering
  - c. Allow water that has infiltrated a curtainwall system a place to escape
  - d. Equalize curtainwall temperature to minimize condensation
  
15. What type of curtainwall system is depicted in the detail below?



- a. Structurally glazed
  - b. Pressure bar
  - c. Point support
  - d. Interior glazed
  
16. What is the mechanism called that is attached to the end of a lock cylinder plug and is used to actuate the bolt as the key is turned?
  - a. Cylinder stop
  - b. Compression ring
  - c. Cam
  - d. Strike

17. What are vertical door members called?
  - a. Rails
  - b. Stiles
  - c. Flush panels
  - d. Pivot receptors
  
18. Which of the following has removable stops to allow for glass installation?
  - a. Intermediate horizontals
  - b. Vertical mullions
  - c. Corner member
  - d. Door jamb
  
19. Which type of architectural drawing shows the exterior of a building as typically viewed by a person?
  - a. Elevation
  - b. Plan
  - c. Section
  - d. Detail
  
20. When determining if a bubble level is accurate, first take a reading, and then perform which of the following?
  - a. Turn the level 45 degrees and compare the two readings
  - b. Turn the level 90 degrees and compare the two readings
  - c. Turn the level 180 degrees and compare the two readings
  - d. Flip the level over and compare the two readings

## Section 5: Answer Key

1. C
2. B
3. A
4. C
5. D
6. A
7. C
8. B
9. A
10. D
11. A
12. D
13. B
14. C
15. B
16. C
17. B
18. A
19. A
20. C

## Section 6: Resources

### General Glazing Resources:

**NGA/Glass Association of North America: *Association Website***

[www.glasswebsite.com](http://www.glasswebsite.com)

**National Glass Association: *Association Website***

<https://www.glass.org/>

**NGA/GANA: *Glass Information Bulletins***

<http://www.glassdocs.com/>

**NGA: *MyGlassClass.com Online Courses***

<https://www.myglassclass.com>

**Video Links:**

**A Unitized Curtainwall Installation Demonstration:**

<https://www.youtube.com/watch?v=KLAXo43k8ik>

**Caulking Seamed Glass Medium:**

<https://www.youtube.com/watch?v=jxGWSM88hOI>

**Safety Glass Handling:**

[https://www.youtube.com/watch?v=HIPzAAIaE\\_8](https://www.youtube.com/watch?v=HIPzAAIaE_8)

-END-