INSTALLATION SPECIFICATION PENNGUARD™ BLOCK ON CONCRETE AND CERAMIC BRICK

1. SCOPE

1.1 This specification covers the recommended installation, quality control, and inspection guidance for the successful installation of the Pennguard Block lining system on concrete and ceramic brick surfaces. For installation on carbon steel substrates, consult Installation Specification CES-355. For installation on other metal substrates, such as titanium, high nickel alloy and stainless steels, contact Armor for guidance.

2. GENERAL

2.1 Pennguard Block is a glass material that requires care during handling, installation, inspection, and maintenance to prevent damage. Protect Block from chips, gouges, cracks, or impalement. Do not poke rods or other hangers into Block to suspend lighting, cords, or other equipment. Use protective boards over Block on floors to support scaffolding.

2.2 If gas stream has high particulate loading or velocity exceeding 100 feet per second (30 m/s), consult Armor. In elbows, on turning vanes, and other changes in the direction of gas flow, the liners performance and longevity may benefit from special treatment for abrasion protection.

2.3 The following sign shall be posted on the exterior of steel sections of the structure during and after lining application. “LINED EQUIPMENT, NO WELDING OR BURNING”.

3. EQUIPMENT AND SUPPLIES

3.1 To mix Pennguard Adhesive/Membrane, use a heavy-duty variable speed drill with a 3/4" (16-18 mm) chuck and sufficient torque to deliver a minimum speed of 230 rpm under load. The drill shall be fitted with a Jiffler mix blade, Model DC312, with 2 x 6.5" (165 mm) propeller blades. Use of any other equipment to mix Pennguard Adhesive/Membrane requires prior written approval from Armor, as incomplete mixing can prevent full cure and severely compromise system performance.

3.2 Insulation saws and rasps, to cut and sculpt the Pennguard Block.

3.3 Flat edged masons’ trowels of a size approximately 8" (200 mm) long x 3" (75 mm) at the heel with

end rounded (preferably not pointed) to approximately 3/4" (20 mm) radius to apply the Adhesive. Do not use a notched trowel.

3.4 Lanolin-based waterless hand cleaner.

3.5 4" (100 mm) wide stiff-bristled paint brushes, paper coveralls, rubber dish-washing gloves, rags, wire brushes.

3.6 Mineral spirits to remove wet Pennguard Adhesive/Membrane from tools, such as trowels and mix blades, and loosen cured Adhesive/Membrane.

3.7 Set of latest installation specifications, drawings, SDS's and product information sheets for all lining materials.

3.8 Dewpoint meter, electronic temperature meter, adequate lighting, especially in a dark chimney where application is taking place, surface thermometers, white (non-wax) marking chalk or white spray paint, a timer. PPE shall be determined by the contractor and comply with local regulations.

4. MATERIAL, ENVIRONMENTAL, AND SUBSTRATE CONDITIONS

4.1 The product and substrate temperatures are important. In cold conditions, the product storage and construction areas shall be heated to achieve and maintain the temperatures outlined below.

4.2 At the time of mixing and application, the temperature of the components should ideally be between 70°F (21°C) and 90°F (32°C).

4.3 Temperature of the prepared surface shall be at least 5°F (3°C) above the moisture dew point and between 50°F (10°C) and 95°F (35°C) at the time the Pennguard Block Lining System is applied.

4.4 The work site must be protected from precipitation. The cartons of Pennguard Block and containers of Pennguard Adhesive/Membrane and primer shall also be protected. Chimneys are typically covered at the top during lining work to prevent ingress of rain.

5. SURFACE PREPARATION

5.1 The surface condition of new and/or existing concrete and brick liners can vary greatly. The surface should be thoroughly inspected to identify the condition and suitability of the surface to accept the Pennguard Block Lining system. An assessment and evaluation of the suitability of the surface should precede quotations, procurement, or mobilization of installation crews. Any buildup, deposits, carry over, or mortar on concrete or brick faces must be removed.

5.2 When forms have been used for placing concrete, they should be designed to yield a smooth continuous concrete surface to which the lining will be applied.

5.3 New concrete shall reach a minimum compressive strength of 3000 psi (20 MPa) and a surface tensile strength of 300 PSI (2.0 MPa) before the lining is applied. Curing compounds must either be removed or tested for compatibility before proceeding.

5.4 Before acceptance for lining, all form marks and protrusions, such as prominent aggregate exposure, tie wires, reinforcing wire, stirrups, etc., must be ground flush with the surface.

5.5 All cavities, stone pockets, honeycombing, and bug holes greater than 1/4" (6 mm) depth shall be filled by repairing with appropriate polymer-modified cementitious materials.

5.6 Damage to the existing structure such as cracks or other structural damage is to be suitably repaired prior to the application of the Pennguard Block Lining System.

5.7 For installations on brick liners, if the offset between adjacent bricks is greater than 1/8" (3 mm), the nature and size of the surface irregularity will dictate the action to properly prepare the surface. For a corbel area where individual brick courses are intentionally offset, consult Armor for specific details.

5.8 Pennguard Adhesive/Membrane can be used to fill mortar joints that are less than 1/4" (6 mm) wide though not completely full provided brickwork is structurally sound. Joints wider than 1/4" (6 mm) shall be filled with appropriate polymer-modified cementitious material before proceeding.

5.9 Attachments to the brick substrate such as liquid condensate collection systems and stop-bars shall be installed without leaving any gaps in between the brick substrate and the attachment to be installed. A cementitious mortar shall be used to level the area behind attachments prior to final installation of such attachments.

6. SUBSTRATE CLEANING

6.1 The brick faces and mortar over which the lining will be applied must be high pressure water or grit blasted to yield a clean, hard, and sound bonding surface. Contaminants must be removed, and the surface shall be pH neutral. The intent is to achieve a sound surface free of contaminants.

6.2 A concrete surface to which the lining is to be applied shall generally be prepared by abrading the concrete and have a resultant surface like a medium grit of sandpaper. The surface shall have a non-glazed appearance. The intent is to remove enough material to achieve a sound concrete surface free of laitance, glaze, efflorescence, and incompatible concrete curing agents or form release agents.

6.3 All prepared surfaces must be dust, dirt, and grease-free. Any foreign material which will interfere with adhesion must be removed. All abrasives and dust must be removed from the substrate.

7. PRIMER

7.1 Penntrowel™ Epoxy Primer is the recommended primer for all concrete and brick liner surfaces. It seals the substrate surface and promotes adhesion of Pennguard Adhesive/Membrane. Consult Product Data Sheet CE-139 and Installation Specification CES-342 for complete details.

8. MIXING ADHESIVE/MEMBRANE

8.1 Remove the lid from the Pennguard Adhesive/Membrane pail. Inspect for damage incurred during transit.

8.2 Ensure that there are no leaks in the Part B Hardener container, there is no water present on or in the Part A Base Resin, and the pail is free of dents in the side wall that Block the mix blade access to the bottom corners of the pail.

8.3 Using drill mixer and mix blade specified above pre-mix Part A by itself for a minimum of one minute.

8.4 A good mixing technique involves movement of the rotating blade within the pail. Move the blade around the base of the pail in a circular motion. Simultaneously lift the blade from the base of the pail without bringing the blade above the surface and continue the circular motion around the side of the pail. During mixing, hold the mix blade occasionally at a 30-degree angle within the mixture, to ensure all contents of the pail are thoroughly mixed. Pay close attention to contact all surfaces of the sides of the pail with the mixing blade. Make sure to mix in the corner of the pail.

8.5 Open Part B Hardener. While mixing Part A Base Resin, take a full 15 to 20 seconds to slowly pour Part B into the vortex created by the mixing blade in Part A.

8.6 When the material temperature is 65°F (18°C) or higher, mix for at least three (3) minutes using a good mixing technique to yield a uniform mix. When the temperature of the components is 50°F (10°C) to 60°F (15°C), mix for at least four (4) minutes using a good mixing technique to yield a uniform mix. Use a timer to prevent under-mixing.

8.7 Pennguard Adhesive/Membrane is ready for use immediately after mixing; however, if left undisturbed after mixing, it will thicken over time.

8.8 Protect unmixed Membrane components and mixed material from any contact with moisture or other contaminants.

9. INSTALLATION

9.1 Before applying Pennguard Block, the contractor shall check the flatness of the prepared substrate in any area which visually may indicate a seating problem. This shall be performed by taking a straight edge of the specified length of the Block to be installed and placing it dry against the prepared surface in the orientation in which it will be installed. If there are any gaps between the substrate and the straight edge greater than 1/8" (3 mm) or if the straight edge rocks on a high point rather than sits firmly on the surface, properly mark the area. Either remove the imperfection in the substrate or cut the standard size Block being used to minimize the effect of the substrate variation and allow a full bond of Block to the substrate using the Pennguard Adhesive/Membrane. A comparable check shall also be applicable to lining curved surfaces.

9.2 Apply by trowel a minimum 1/16" (1.5 mm) thickness of Pennguard Adhesive/Membrane onto the substrate with a suitable trowel as specified in section 3.3. Carry the coverage to approximately 2" (50 mm) beyond the area the Pennguard Block will cover when it is placed in position. The size of

the area to which the Pennguard Adhesive/Membrane is applied at any one time shall be no greater than will allow the area to be lined with the Block before the Adhesive on the substrate loses its tackiness.

9.3 Trowel a minimum of 1/16" (1.5 mm) thickness of the Pennguard Adhesive/Membrane onto the back, one long, and one short side of the PENNGUARD Block piece to be installed, such that the buttered sides will be abutting previously installed Block. Position the Block against the Adhesive applied to the substrate surface; by moving the Block back and forth at least 2" (50 mm) a couple of times as it is slid into place against the adjacent Block to remove voids between the Block and the surface. Be sure to maintain a minimum of 1/8" (3 mm) joint thickness Block to Block, and Block to substrate. Adhesive shall totally fill side joints and shall be seen to 'bead' along edges without exception at the block corners. Listen for the grinding sound of Block scraping against block or the substrate. This is a sure indication of insufficiently filled side joints. Strike the surfaces of joints of Adhesive squeezed out during placement of the Block.

9.4 It is very important the Block coated with Adhesive has full contact with the Adhesive applied to the substrate surface, whether it be flat floors, side walls, overhead areas, curved surfaces, etc. No voids shall be left between the Block and the substrate or between the layers of Adhesive coating them. Cut the Block and create an extra joint when necessary or increase thickness of the Adhesive back joint to exclude voids and gaps. Side and back joints must be full joints and shall not be less than 1/8" (3 mm) thick.

9.5 Side joints shall be struck clean after installation, with attention to removing excess material from the face of the Block. Before moving to a new work area or at appropriate times such as shift changes or scaffold/platform movements, inspectors shall thoroughly inspect the Block surface to detect presence of any excess Adhesive and direct that it is to be removed promptly.

9.6 If the applied Adhesive is still tacky enough to blacken a gloved finger when touched, additional material can be applied over it to continue installing Pennguard Block. If it has cured beyond this stage and transfers no color to a glove when touched, it must be removed. This procedure is critical since wet Adhesive will not bond well to cured Adhesive.

9.7 Cured Adhesive that does not pass the gloved finger wet-tack test must be abraded to roughen the surface and remove surface gloss using wire brushes.

9.8 When a work stoppage is anticipated, remove as much of the wet Adhesive/Membrane as practical from the leading edge of the completed lining. Leave a blackened leading edge of nominal 2-3" (50-75 mm) to marry onto for the next shift's work. Should the time frame between a work stoppage and restart exceed 48 hours, use a wire brush to remove excess Adhesive and de-gloss cured residue.

9.9 Do not install Block that are cracked, gouged, or have other imperfections. Do not install Block with chipped corners.

9.10 Staggered or broken bond construction is recommended to minimize four corners meeting and the possibility of a corner void.

9.11 If partial Block are used, the minimum size shall be a one third (1/3) Block. If the remaining gap is less than one third of a Block, reduce the dimension of the final two Block rows to maintain this minimum Block size. Avoid using small sliver-sized pieces.

10. CURING OF LINING

10.1 In general the lining may be placed into service after curing for 24 hours at 70°F (21°C).

10.2 Contact Armor for special cure schedules if down time does not allow enough curing of the lining as outlined above.

10.3 Consult Armor if initial startup temperatures may rapidly exceed 250°F (120°C).

11. INSPECTION AND QUALITY CONTROL

11.1 The mixing, curing, and adhesion characteristics of Pennguard Adhesive/Membrane shall be evaluated by applying it onto a test area of the same material and surface preparation of the production substrate. Work life and initial set time may be visually observed. Work life is the maximum time the adhesive remains trowelable. Initial set time is defined as the time between mixing adhesive and when the surface of the adhesive is no longer wet to touch.

11.2 The installation procedure of the lining system shall be verified by using Cure Verification Cards (CVC) as supplied for the project. Cards should be retained throughout the duration of the project to ensure cure of all applied batches. The location of specific batches in the chimney shall be noted and checked the next day against the CVC cards. It is good practice to number each sequential row of applied Block with chalk as the work proceeds.

11.3 Inspectors shall determine the frequency of random site checks to determine if back joints have complete contact by pulling random Block while the Adhesive is still wet and visually verifying the back joint and side joints are completely full.

11.4 A photographic history of surface preparation, primer application, Adhesive application, and Block installation is suggested.

12. *REPAIR OF MECHANICALLY DAMAGED AREAS*

12.1 Experience indicates that repairing an area smaller than a standard size Block requires more effort than a larger area.

12.2 Cut out a minimum of a full Block down to Membrane on substrate. Remove remaining Membrane on substrate as best as possible to expose underlying substrate. Clean the Pennguard Adhesive/Membrane using a wire brush to remove excess Adhesive and de-gloss cured Adhesive residue. Reinstall Block as outlined previously.

13. ABRASION RESISTANT SURFACE TREATMENT IN HIGH VELOCITY AREAS

13.1 Consult Armor for details on specifying additional treatments for the Block where abrasive environments are anticipated.

14. STOP BARS AND LINING TERMINATION

14.1 The Pennguard Block Lining System should not be terminated with a free edge. It must be placed against flat stop bars to protect the leading edges. The height of the stop bar should be the full lining thickness. The stop bar shall be of an alloy grade suitable for the anticipated service. Stop bars should be used if the Pennguard Block Lining System abuts manway openings, expansion joints, dampers, pipe stubs, or sample ports and where the lining terminates at the top of the chimney.

15. EXTERNAL INSULATION

15.1 Do not apply external insulation on any structure being lined with Pennguard Block unless specifically authorized in writing by Armor. External insulation retains heat that will overheat the Adhesive and reduce its bond to the Block.

16. FLOOR PROTECTION

16.1 Pennguard Block installed in areas such as horizontal ductwork or chimney floors may be subjected to mechanical damage caused by maintenance procedures such as removal of fly ash carryover. Consult Armor for additional protection options

17. DRAINS

17.1 Horizontal ducting and chimney floors shall incorporate adequately sized and designed drainage to ensure condensate is removed and drains do not plug.

18. SAFETY PRECAUTIONS DISCLAIMER CONTACT INFORMATION

18.1 Consult current Safety Data Sheets (SDS's) before commencement of work.

18.2 While statements, technical information and recommendations contained herein are based on information our company believes to be reliable, nothing contained herein shall constitute any warranty, express or implied, with respect to the products and/or services described herein, and any such warranties are expressly disclaimed. We recommend that the prospective purchaser or user independently determine the suitability of our product(s) for their intended use. No statement, information, or recommendation with respect to our products, whether contained herein or otherwise communicated, shall be legally binding upon us unless expressly set forth in a written agreement between us and the purchaser/user. For all Terms and Conditions of Sale see armor-inc.com.

18.3 Please contact Armor for further information at +1-877-98ARMOR (982-7667) or customerservice@armor-inc.com.