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SPECIFICATION FOR INSTALLATION

TUFCHEM[®] SILICATE GUNITE LINING SYSTEM

Engineering design parameters, including lining thicknesses, anchor spacing and layout, curing and heat up schedules, and other considerations to be incorporated as part of the TUFCHEM gunite-applied lining system shall be as specified by the application.

1. GENERAL

- 1.1 Guniting involves the dry powder being metered into the delivery hose or feed wheel within the gun. The material is carried by compressed air through the delivery hose to a special nozzle. The nozzle is fitted inside a perforated manifold through which liquid TUFCHEM Solution is sprayed under pressure and intimately mixed with the dry material jet. The wetted material is jetted from a nozzle at high velocity onto the surface to receive the lining.
- 1.2 TUFCHEM Silicate Gunite is a specialized gunite material and shall be installed only by contractors employing nozzle men and operators skilled in the art of guniting, and who must have adequate work experience of a similar nature.
- 1.3 TUFCHEM Silicate Gunite is shot using specialized equipment such as an Allentown Gun, Reed Gun, or other similar types of so-called “dry guns”.
- 1.4 In order for TUFCHEM Silicate Gunite to remain in usable condition the maximum length of time, the same precautions should be taken as for the storage of Portland cement - it should be kept completely dry. Do not store it where it will rain on the bags or water will drip on them. If the bags are covered with plastic there should be sufficient ventilation to prevent condensation that would wet the bags. Do not set the bags on damp ground or concrete. Avoid storing in areas where the humidity is high, such as in damp basements. Under good storage conditions, TUFCHEM Silicate Gunite should stay in good condition for one year from the date of manufacture. If there is doubt as to the quality of the TUFCHEM Silicate Gunite, obtain the manufacturing code from the bag and contact Corrosion Engineering.
- 1.5 The temperature of the substrate surface, working area, air, and TUFCHEM Silicate Gunite Powder should all be maintained at a minimum of 50°F (10°C)

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during application and curing period. A temperature of 70°F (21°C) is strongly preferred for optimal handling.

- 1.6 Inherent to the formulation of TUFCEM Silicate Gunitite is an acid based catalyst contained in the Powder. This catalyst is a skin irritant and care must be taken that especially the nozzle man and anyone else who may come in contact with the mixed material shall have adequate PPE (Personal Protection Equipment). Pay particular attention to insure the wrists, face, and neck areas are not exposed. If necessary, tape the wrist area to prevent dust from entering around the sleeve.

2. GUNITING EQUIPMENT

- 2.1 It is recommended that a booster pump be incorporated into the equipment set-up. A suitable pump such as the Gardner-Denver Air Powered, Twin-Piston Pump is suggested. It is necessary that the pump deliver both the volume and the pressure required for proper mixing of TUFCEM Silicate Gunitite. It is recommended that the pressure at the nozzle be not less than 80 psi to allow proper mixing.
- 2.2 Water ring size shall be determined by the gunitite contractor. Only experienced nozzle men shall be employed to shoot TUFCEM Silicate Gunitite. The amount of solution that is delivered through the water ring at a given time is determined by the number of holes, the size of the holes, and the pressure. With any water ring, with a known number of holes, having a known diameter, one can accurately control the amount of Tufchem Solution flowing by controlling the pressure. For proper wetting, the Solution must be intimately mixed with the material during the brief period in which the material and Solution move beyond the water ring, through the nozzle, to the surface being lined. If material is too dry there will be excessive rebound and dusting. If the material is too wet, it will slump off vertical and overhead surfaces. Ideally the consistency of the gunitite shall have a very slight sheen when wet.
- 2.3 With respect to the nozzle, Corrosion Engineering recommends that, in shooting TUFCEM Silicate Gunitite, a so-called "black double bubble nozzle" be used. The principal advantage found in using this particular nozzle is that it is very easy to dislodge any buildup in the nozzle should it occur during the guniting operation by the nozzle man hitting it with his fist. The same problem with hard plastic nozzles, or aluminum nozzle bodies, requires hitting it with a hammer frequently in order to dislodge any buildup - not so convenient. This recommended nozzle can be obtained from the Allentown Pneumatic Gun Company. Other flexible rubber nozzles may be considered based on the preferences and choice of the nozzle man.
- 2.4 In order to have ample air capacity for the feed air motor, the material hoses, water pump, blow pipe, etc. it is recommended that either a 600 cfm or 750

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cfm compressor be used in the equipment set-up. It must be ensured that the air is dried to remove moisture. Moisture in the lines can foul equipment, and also lead to material plugs in the conveying hose.

- 2.5 There shall be a good communication set-up between the nozzle man and the machine operator such that instructions can be clearly understood by both parties.
- 2.6 It is also advisable to use a screen on top of the guniting machine to prevent any large foreign objects or pieces of paper or hard materials from getting into the chambers of the guniting machine which could possibly result in hose plugs.
- 2.7 Predampening of the TUFCEM Powder is suggested. Add water or Tufchem Solution to the dry powder at a rate of 1.0-1.5 pints per 50 lb bag of Powder. This can be achieved by mixing the Powder in a rotating blade mixer before dumping into the hopper. Do not over dampen as this will cause premature set of the material.
- 2.8 Pre-wet the Solution supply hoses before beginning the guniting operation. Solution used for this purpose can be recovered and reused.
- 2.9 Always ensure that the immediate work area is well lighted for the lining application. Lights placed at an elevation above the nozzle man are preferred. Poor lighting is a significant hindrance to achieving a quality result.
- 2.10 It is recommended that safety goggles used by the workers have safety glass lenses as opposed to plastic lenses. Plastic lenses scratch too easily.
- 2.11 The wearing of NIOSH Approved dust masks is recommended for all workers involved in the operations. Consult the MSDS for full details.

3. SURFACE PREPARATION

- 3.1 Steel substrate surfaces must be cleaned, and free from paint, rust, scale or any other material that will prevent bond. It is normally recommended that a commercial blast (SSPC #6) be followed in preparing the substrate to receive a guniting lining. If a membrane is to be installed under the guniting consult specifications for the membrane installation.
- 3.2 Surfaces which are not to be gunned must be protected with paper, plastic or other adequate means. The fine particles of guniting adhere to almost any surface. It is always less expensive to properly protect surfaces not to be covered than remove the over-spray.
- 3.3 Any contaminated or deteriorated concrete surface must be removed by

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either sandblasting, high pressure water blasting, or chipping to obtain a clean, structurally sound surface. New concrete should be cured a minimum of 14 days, and must be free of any curing films or laitance. It is not recommended to gunitite directly onto concrete without an anchoring system being utilized.

- 3.4 Certain installations will require the application of a membrane to the substrate before the gunitite lining is placed. The membrane manufacturer shall be contacted for full instructions on the proper application of the membrane of his supply to both the substrate and anchorage system employed.

4. ANCHORAGE

- 4.1 A suitable anchorage system, shall be used to retain TUFCEM Silicate Gunitite linings against the substrate. The quality of metallic utilized, the size of the anchors, spacing orientation, mesh size, stud location, etc, shall be as specified for the respective job. When guniting overhead, or where vibrational considerations are important, special considerations must be given.
- 4.2 Anchors for chemical service shall be SS 304 or any other alloy - made to order and available from Anchors Unlimited, Verona, PA. For a nominal 2" lining, the anchor dimensions shall be 3.25" overall drilled into the concrete to a depth of 2.25" using a hammer drill with SDS drill bit - 1/4" x 6 (drill bit part number 0321, 25 pieces per pack). Upon splitting anchors the total anchor height should not exceed 1.5", ensuring at least 1/2" coverage over the anchor. Anchor spacing is a function of lining thickness and orientation, and shall follow good industry practice. An approximate anchor count per square foot is as follows for the following examples
9" spacing 1.89 anchors - therefore 10SF x 1.89 = 19 anchors per 10 sf.
6" spacing- 4.03
8" spacing - 2.33

Note: Insufficient anchor spacing will result in the gunitite lining cracking and falling away from the substrate. If in doubt err on the side of more anchors rather than fewer.

5. GUNITITE APPLICATION

- 5.1 Before charging any gunitite machine with TUFCEM Silicate Gunitite, it is advisable to "blow the hoses" with air pressure to ensure the lines are clean and free of any moisture.
- 5.2 The air operating pressure at the gun nozzle shall not be less than 20 psi.

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- 5.3 It is recommended that the liquid pressure at the nozzle be not less than 100 psi to allow proper mixing.
- 5.4 The nozzle body and water ring assembly should be cleaned at least once per shift to ensure that all holes are open.
- 5.5 It is recommended that good guniting practice be observed during installation which is to include the following:
 - 5.5.1 The nozzle man should direct his nozzle perpendicular to the surface to which he is applying the Lining.
 - 5.5.2 The nozzle should be held two to three feet from the surface being lined.
 - 5.5.3 Care must be exercised to ensure that rebound is not trapped, either behind or within the thickness of the applied lining. In this regard, it is highly recommended that a blow pipe or air lance be utilized immediate to the installation area.
 - 5.5.4 The nozzle man should shoot "target" areas, measuring approximately 3' x 3', to the full lining thickness as opposed to trying to shoot over a wide area. This procedure minimizes the potential for laminations occurring in the lining thickness.
- 5.6 In guniting application, the work shall begin at the lowest part, i.e., with respect to vertical surface, work shall be from the bottom up.
- 5.7 No rebound shall be mixed into any batch.
- 5.8 The lining shall be shot to the full thickness in one pass. In flues and chimneys, the guniting is placed in either circumferential bands or shot in panel construction.
- 5.9 The lining should be left as a natural "gunned" finish. Do not trim.
- 5.10 In finishing off a particular area of lining, the guniting shall be shot to a tapered edge (approximately 45°) over a width of approximately 2". The finished surface of this edge shall be blown clean, or brushed, to remove any laitance, rebound, and allowed to set. Before beginning the continuation of the guniting lining, this edge shall be cleaned with an air blast. This tapered edge shall then be covered with fresh guniting as soon as possible, and the gunned thickness built up accordingly.
- 5.11 Rebound is a material which ricochets because of the collision with the forms, anchoring steel or other in-place aggregate materials. It is

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mostly composed of the larger particles of aggregate with a very small portion of the cementing material. Rebound shall be removed from the work. This is normally done, using an auxiliary air jet (blow pipe), a trowel, broom and/ or a shovel. The blow pipe operator keeps the material out of the way from the nozzle pattern - without disturbing sound gunite. Surging material leaves dry pockets in place (similar to rebound) which must be cut out and discarded. All loose materials are then swept up and removed by shovel as necessary.

- 5.12 Whenever the gunning operation is shutdown, always blow out the material hoses. If the shutdown is to be greater than one (1) hour, then the machine should be cleaned out. Cold joints should be primed with TUFCEM Silicate Guniting Solution.
- 5.13 Do not use any more hose in the equipment set-up than is necessary to reach the gunning area. Always make large radii in the hoses and avoid sharp bends and kinks in the hoses.

6. TESTING

- 6.1 The contractor shall provide as-gunned test panels where specified.

7. APPLICATION OF CHEMICAL-RESISTANT MEMBRANE

- 7.1 If a chemical resistant membrane is specified under the gunite it is suggested the membrane be applied after the anchors have been installed. Dab wet membrane thoroughly around the base of each anchor to insure the membrane is fully sealed.

8. SAFETY PRECAUTIONS / DISCLAIMER

- 8.1 Read and follow the hazard information, precautions and first aid directions on the individual product labels and material safety data sheets before using. While all 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.

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- 8.2 Please contact Corrosion Engineering for specific recommendations at +1-610-833-4000 or fax +1-610-833-3040.

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