



**Corrosion
Engineering™**

AN ERGONARMOR COMPANY

TECHNICAL INFORMATION

CES-321

04/00 SUPERSEDES 03/99

CORROSION ENGINEERING SPECIFICATION FOR INSTALLATION

GUNITE MIX SDX® 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 SDX gunite-applied lining system shall be as specified by Corrosion Engineering.

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 potable water 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 Gunite Mix SDX shall be installed by specialty contractors employing nozzle men and operators skilled in the art of guniting, and who must have adequate work experience of a similar nature to that required by the contract.
- 1.3 Gunite Mix SDX is to be shot, using specialized equipment such as an Allentown Gun, Reed Gun, or other similar types of so-called "dry guns".
- 1.4 If "pipe and clamp" or "frame and brace" scaffolding is used, it should be kept back from the surface of the lining being installed, at least one (1) foot. It is also recommended that the platforms of these types of scaffolds be positioned so that the nozzle man is able to install the lining by holding the nozzle perpendicular to the surface to be gunited.
- 1.5 In order for Gunite Mix SDX to remain in usable condition the maximum length of time, the same precautions should be taken as for storing 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, Gunitite Mix SDX should stay in good condition for one year from the date of manufacture. If there doubt as to the quality of the SDX, obtain the manufacturing code from the bag and Corrosion Engineering in Philadelphia.

- 1.6 The temperature of the substrate surface, working area, air, and Gunitite Mix SDX dry cement should all be maintained at a minimum of 50°F (10°C) during application and curing period.

2. EQUIPMENT

- 2.1 It is recommended that a water booster pump be incorporated into the equipment set-up. A suitable pump - the Gardener-Denver Air Powered, Twin-Pistoned Pump. It is necessary that the Pump deliver both the volume and the water pressure required for proper hydration of the Gunitite Mix. It is recommended that the water pressure at the nozzle be not less than 100 psi to allow proper hydration and mixing.
- 2.2 The use of a water ring having more, but smaller, holes than typically used in guniting is recommended. Water rings having 16 holes of 1/32" diameter opening, spaced equally around the circumference of the water ring, are preferred. The amount of water 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 water pressure. With any water ring, with a known number of holes, having a known diameter, one can accurately control the amount of water flowing by controlling the water pressure. For proper wetting, the water must be intimately mixed with the material during the brief period in which the material and water move beyond the water ring, through the nozzle, to the surface being lined.

To accomplish this intimate and thorough mixing, the water must discharge from the water ring at a high velocity so that it can penetrate the material stream and uniformly wet down all of the individual particles making up the material. Water velocity is directly related to pressure, and high velocity requires high pressure. Herein lies the problem with conventional water rings - the holes are too large and, consequently, the pressure to deliver the proper amount of water is far too low to provide enough water velocity to penetrate the material stream. The water flows along the periphery of the

material stream, and does not come in contact with most of the material until they both reach the target. This makes for a very dusty, high rebound, type of application.

- 2.3 With respect to the nozzle, Corrosion Engineering recommends that, in shooting SDX, the 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.
- 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 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 gunite machine to prevent any large foreign objects or pieces of paper or hard materials from getting into the chambers of the gunite machine which could possibly result in material plugs.
- 2.7 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.
- 2.8 It is recommended that safety goggles used by the workers have safety glass lenses as opposed to plastic lenses. Plastic lenses scratch too easily.
- 2.9 The wearing of NIOSH Approved dust masks is recommended for all workers involved in the operations.

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 gunite lining.

- 3.2 Surfaces which are not to be gunned must be protected with paper, plastic or other adequate means. The fine particles of gunite 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 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 latence. It is not recommended to gunite 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 gunite 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, whether the V-type metallic anchors or studs and wire mesh, or expanded metal mesh, shall be used to retain SDX 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.

In using mesh-type anchorage systems, it is important that the mesh be installed tightly, and that proper spacing, as specified, be maintained between the mesh layer and surface of the substrate. To ensure this, it may be necessary to locate the retaining pins at closer spacing. The particular anchorage system utilized shall depend upon such parameters as operating temperature, lining thickness, orientation of the substrate, and chemical environment to which the lining is to be exposed. Typically, the anchor system shall be covered with a mini-mum of 3/4" of the SDX lining system.

- 4.2 If anchors utilized are welded by a "stud welding method" (as supplied by either Nelson or KSM), each anchor shall be tested to ensure that it is properly welded. Stud welding is a form of electric arc welding, with the stud serving as the electrode in an electro-mechanical circuit. To test the quality

of anchor installation, when the stud is hit with a light hammer, a good weld produces a ringing sound similar to that obtained when the shell itself is struck. The studs may then be bent with a hammer about 30° from the vertical to further prove the weld quality

5. APPLICATION

- 5.1 Before charging any gunite machine with any SDX, it is advisable to "blow the hoses" with air pressure to ensure the lines are clean and free of any moisture.
- 5.2 Before applying the gunite lining, it is recommended to flash the prepared substrate surface with high pressure air and a little water addition, so as to wet the surface and blow away any dust or dirt from the surface and anchorage system.
- 5.3 The air operating pressure at the gun nozzle shall not be less than 20 psi.
- 5.4 It is recommended that the water pressure at the nozzle be not less than 100 psi to allow proper hydration and mixing.
- 5.5 The water used in the application of gunite linings shall be from a clean potable supply, free of all substances which may be injurious to steel or concrete.
- 5.6 The nozzle body and water ring assembly should be cleaned at least once per shift to ensure that all holes are open.
- 5.7 Due to the very fast setting characteristics of Gunite Mix SDX, we do not recommend the pre-dampening of the material prior to charging of the gunite machine.
- 5.8 It is recommended that good guniting practice be observed during installation which is to include the following:
 - 5.8.1 The nozzle man should direct his nozzle perpendicular to the surface to which he is applying the Lining.
 - 5.8.2 The nozzle should be held two to three feet from the surface being lined.
 - 5.8.3 Care must be exercised to ensure that rebound is not trapped, either

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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.

- 5.8.4 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. This requirement is very important for a material such as SDX Cement which has a very fast setting characteristic to it.
- 5.8.5 The regulation of the water addition at the nozzle should be such as to allow a slight wet "sheen" to the placed material.
- 5.9 To make a repair, the defective area shall be cut out completely. All edges should be square and perpendicular to the surface. Anchors should be welded to the steel shell on specified spacing and orientation. No repair area shall be less than 1 sq. ft. The edges of the patch area shall be blown or brushed clean, and wetted thoroughly immediately before placement. The new material shall then be gunned in place, following standard procedures.
- 5.10 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.
- 5.11 All rebound or aggregate pockets shall be cut out and made good during the course of the work.
- 5.12 No rebound shall be mixed into any batch.
- 5.13 The lining shall be shot to the full thickness in one pass. In flues and chimneys, the gunite is placed in either circumferential bands or shot in panel construction.
- 5.14 The lining should be left as a natural "gunned" finish. Do not trim.
- 5.15 In finishing off a particular area of lining, the gunite shall be shot to a deep 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 latence, rebound, and allowed to set. Before beginning the continuation of the gunite lining, this edge shall be cleaned with an air-water blast and wetted back. This tapered edge shall then be covered with fresh gunite as soon as possible, and the gunned thickness built up accordingly.

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- 5.16 Rebound is a material which ricochets because of the collision with the forms, anchoring steel or other in-place aggregate materials. It is 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.
- 5.17 On in-walls, doorways, off-sets, etc., it is common practice to use a wood strip of 1" x 4", or 1" x 6", either tacked or wedged in place, as an end form and a surface screed guide.
- 5.18 Air pressures which are too high for the quantity of material being delivered to the material hose by the feedwheel, will not only result in high rebound due to the excess of material velocity, but also the material flow will surge, making it impossible to adequately control the water addition at the nozzle.
- 5.19 Air pressures which are too low for the amount of material being delivered to the material hose by the feedwheel will result in a less than desired throughput and, in extreme cases, lead to plugging in the hose.
- 5.20 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.
- 5.21 When available water supplies are below 60°F (15°C), it is recommended that an auxiliary water treater be incorporated as part of the equipment set-up to preheat the water to a temperature of 100°F - 120°F (38°C - 49°C) for gunning. Cold water will retard the setting and curing characteristics of SDX Cement and a slower than normal development of physical properties will result in the gunned in-place lining.
- 5.22 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.
- 5.23 Always leave the nozzle in such a position that if the water nozzle leaks water, that such water will run out the nozzle rather than back down the inside of the material hose.

6. TESTING

- 6.1 The contractor shall provide test panels (where specified) from 3/4" plywood, 2' long x 2' wide, skirted of light expanded metal mesh standing 3" high around the edges of the panel.
- 6.2 The contractor shall produce (where specified) a test panel alongside every stage of the work. At the start of work each day, each nozzle man shall produce a test panel alongside his work for each shooting position to be encountered in the work (horizontal, vertical or overhead). These panels shall be left to cure alongside the work. After curing, the panels shall be removed and cut into 2" x 2" cubes for comparison testing by others.

7. DISCLAIMER

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