APPLICATION MANUAL AND GUIDELINES FOR
Pyrocrete® 241

DOCUMENT No.: 111320-SFRM-PC241-A
DATE: June 2024

DOCUMENT CONTENTS

SECTION -. REVISION SUMMARY

Revision	Date	Amendments
A	11.13.20	First Edition
B	11.16.21	Amendments to: - Appendix Reference Headers - Appendix F, Approved Primers
C	02.16.23	Update Section 8: Repair Procedure to include Pyrocrete 341 as a suitable material
D	04.27.23	Formatting Updates and Caulking Requirements
E	06.03.24	Minor Typos Fixed

SECTION -. PREFACE

Audience

We assume that applicators of Carboline products understand the terminology associated with our products and the various pieces of spray equipment and application techniques.

The installation of the Pyrocrete® 241 spray fire resistive material shall be performed only by contractor personnel trained and/or qualified by Carboline in the installation of the materials.

Locating Information

This guide incorporates a number of aids to help you locate information easily.

- Document Contents
- Figure and Table Listings
- Page Headers and Footers
- Frequent Section, Subsection, and Topic Headings

Numbering System

To avoid a cumbersome numbering system, only chapters, sections, and subsections have a numerical designation. For example, “2.3.1” represents Chapter 2, Section 3, Subsection 1.

Illustrations, drawings and design details generally appear at the end of this document in the appendix section.

Breakdown of Information

Frequent section and subject headings highlight other significant information within a chapter. Heading type style and indentations indicate the level of importance for the topics.

Related Publications and Documents

This document occasionally refers to other Guides, data sheets, or specifications that may be helpful. Copies are available from Carboline.

Other documents that may be helpful, include:

- OSHA - Occupational Safety and Health Administration Safety Rules
- Pyrocrete® 241 Material Safety Data Sheet
- Power tools, hand tools or other mechanical equipment operating procedures.

Safety Precautions

Pyrocrete® 241 materials weigh approximately 50 pounds (22.9 kg) per bag. Caution should be taken when lifting and moving the material to prevent injury.

Installation Notes

The installation steps and procedures in this application guide were prepared with the best available data. All of the steps and procedures presented in this application guide are based upon tests. As additional test and installation data becomes available, including revised installation procedures, Carboline may update and modify this guide.

Note: This is a general Application Manual and cannot cover all possible situations which may arise in the field. For technical assistance, contact Carboline's Fireproofing Technical Service Group at: 1-800-848-4645.

SECTION 1. INTRODUCTION

1.1 INTRODUCTION

This Application Manual describes the requirements for the installation of Pyrocrete® 241 sprayed fire resistive materials to steel surfaces for the petrochemical and commercial cellulosic markets, based on the requirements of UL 1709, BS 476-20 Appendix D, OTI 95 634, ASTM E119, UL 263 and CAN/ULC S-101.

For the application to any other substrates, markets or specifications, contact Carboline Technical Service or your local Carboline Sales Representative.

1.2 CERTIFIED INSTALLERS

Due to the environments in which Pyrocrete® 241 is most commonly installed, the need to ensure that systems are installed correctly and in accordance with our listed details is of paramount importance. As such, all Pyrocrete® 241 installations shall be completed by certified and trained installers only, approved by Carboline Company.

SECTION 2. PRODUCT DESCRIPTION

Pyrocrete® 241 is a high-density cementitious fireproofing designed for the fire protection of exterior and interior structural steel.

Pyrocrete® 241 is A 55 lb./ft³ (881 kg/m³) density, Portland cement based, cementitious fireproofing. It provides both hydrocarbon and cellulosic fire protection for structural steel and can also be used to upgrade the fire resistance of existing concrete. Recommended areas of application include refineries, petrochemical, pharmaceutical facilities, pulp and paper mills, nuclear and conventional power plants, factories, warehouses, institutional and biomedical facilities.

SECTION 3. ENVIRONMENTAL & MATERIAL STORAGE CONDITIONS

3.1 MATERIAL STORAGE

Pyrocrete® 241 should be stored indoors, in a dry environment between -20°F - 150°F (-29°C - 66°C). Pyrocrete® 241 must be kept dry or clumping may occur.

3.2 SHELF LIFE

Pyrocrete® 241 has a minimum shelf life of 24 months when kept at recommended storage conditions.

SECTION 4. APPLICATION EQUIPMENT

4.1 PUMP

Pyrocrete® 241 can be pumped with a wide range of piston, rotor stator and squeeze pumps designed to pump cement and plaster materials including:

- Essick
  - Model FM9/FM5E (Rotor/Stator - 2L4)
- Putzmeister
  - Model S5-EV (Rotor/Stator – 2L6)
- Hy-Flex
  - Model HZ-30E (Rotor/Stator – 2L6)
- Strong Mfg.
  - Model Spraymate 60 (Rotor/Stator – 2L6)

4.2 MIXER

Use a heavy-duty mortar mixer capable of rotating at 40 rpm with rubber tipped blades, that has a minimum volume of 8 ft^3 (227 L).

4.3 TROWEL

Standard plasterers hawk and trowel may be used for the application of Pyrocrete® 241. A rubber float may also be used to aid finishing.

4.4 MATERIAL HOSE

- Minimum 1” (25.4 mm) I.D. hose with 300 psi minimum bursting pressure.
- For lengths over 50’ (15 m) use 1-1/2” (38 mm) I.D. hose.
- Do not reduce hose diameter by more than ¼” (6.4 mm) per 25’ (7.6 m) unless a tapered conical reduced equipped with swivel fitting is used.
- A 10’ (3 m) length of 1” (25.4 mm) I.D. hose may be added at the gun for use as a whip.

4.5 NOZZLE/GUN

- Binks
  - Part 7E2 (47-49 fluid tip, 3/8” – ½” air cap)
- Graco
  - Part 204000 (3/8” – ½” fluid tip and air cap)
- Speeflo
  - Part 701 (3/8” – ½” fluid tip and air cap)
- Airtech
  - Internal mix with 3/8” – ½” fluid tip.
- Standard plasterers’ gun with 3/8” – ½” fluid tip

4.6 COMPRESSOR

Ensure that the air supply is a minimum 22 cfm at 100 psi (689 kPa) and higher when distances longer than 75’ (22 m) are required.

4.7 AIR LINE

Use ½” (12.7 mm) I.D. line, with a minimum bursting pressure of 100 psi (689 kPa)

SECTION 5. SURFACE PREPARATION & REINFORCING MESH/METAL LATH

5.1 SURFACE PREPARATION

Prior to the installation of Pyrocrete® 241, the substrate shall be free of all oil, grease, condensation, or other contaminants.

5.1.2 STEEL

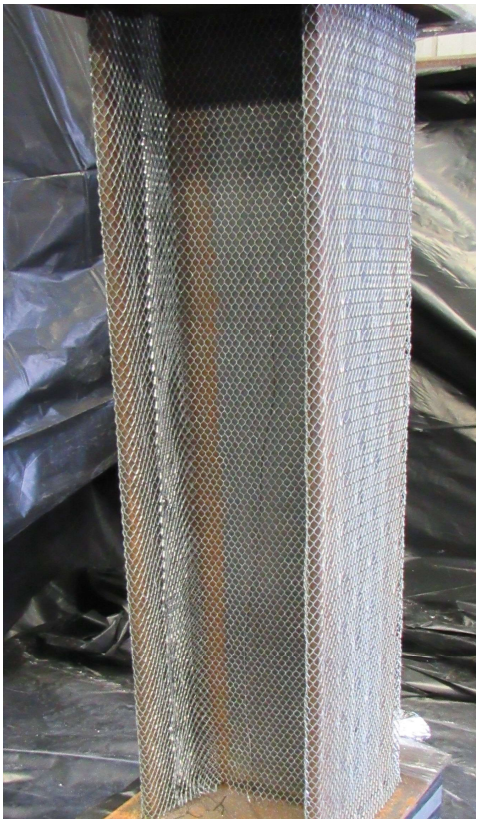
If a protective coating system is required, steel preparation should be done in accordance with the recommended primers product datasheet. Please contact Carboline Fireproofing Technical Service for a list of approved primer systems.

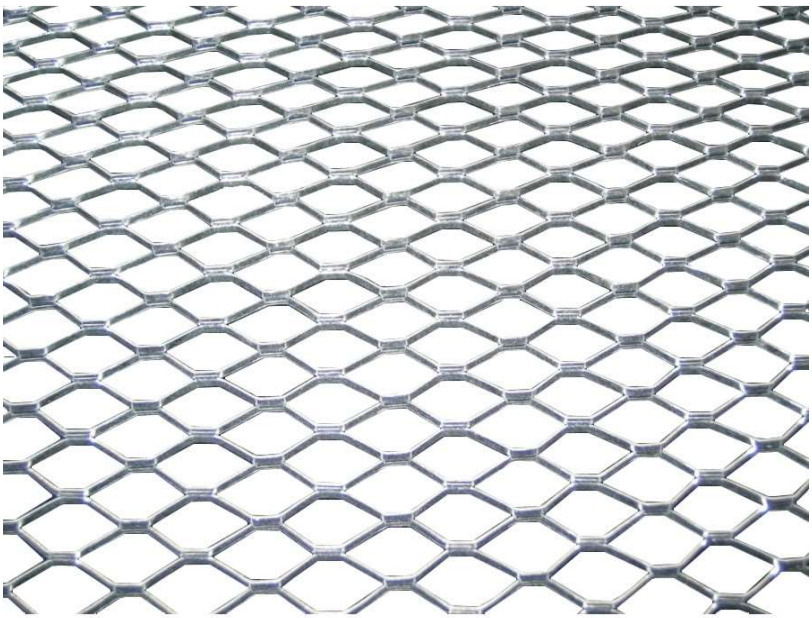
5.1.3 GALVANIZED STEEL

Pyrocrete® 241 is usually applied directly over galvanized surfaces. If a tie-coat primer is required, please contact Carboline Fireproofing Technical Service for recommendations.

5.2 REINFORCING MESH/METAL LATH

In accordance with the tested design details for Pyrocrete® 241, a minimum 3.4 lb/yd2 (1.85 kg/m2) galvanized metal lath shall be pre-bent and tie wired into place in accordance the tested design. Optionally, beam furring clips or electrically welded, pneumatic, self-tapping screws, studs or mechanical fasteners may be used as a fixing aid to secure the lath in place to the steel substrate, prior to the application of Pyrocrete® 241.





SECTION 6. MIXING & DENSITY PROCEDURES

6.1 MIXING

Pyrocrete® 241 shall be mixed to a consistent and uniform texture in accordance with the following procedure:

Note: A water metering device is a mandatory requirement with all Pyrocrete® applications. Please use a calibrated 5-gallon pail to verify water meter accuracy.

a. Ensure that the equipment is clean, and free from any debris or other material that would affect the mix process.
b. Set mixer speed at 35-40 RPM.
c. With the blades rotating, add fresh, clean potable water. Target water level is 4.5 gallons (17.03 liters), +/- 0.5 gallons (1.89 liters). Total water not to exceed 5.0 gallons (18.92 liters) per 50 lb. (22.7 kg) bag of material.
d. With mixer running slowly, add Pyrocrete® 241 powder.
e. Mix for 5 minutes (10 minutes maximum) until a homogenous mortar-like consistency is achieved.
f. The mix may appear dry, do not add additional water and allow time for the material to “wet-out”
g. Stop the mixer and verify the wet density. Reference 6.2, and/or Appendix A for target wet density. If target has not been achieved:
    a. To increase the density, add additional clean, potable water.
    b. To decrease the density, increase the mix time and/or vary the speed of the blades. Please be cautious not to over mix the material beyond the maximum time, as noted.
h. Once the target wet density has been achieved, determine the amount of water and mix time, and use for subsequent mixes.
i. Restart the mixer to re-blend the material prior to releasing it into the hopper.
j. Always ensure the entire mix has been dumped and the mixer is empty prior to mixing subsequent batches.
k. Mixed Pyrocrete® 241 can be used for up to 2 hours at 70°F (21°C). The pot life of the material ends when the material thickens and becomes unusable. Do not re-temper the material.

6.2 DENSITY

Wet density measurements are critical to obtaining correct dry densities. When verifying wet densities of Pyrocrete® 241 please use the following procedures:

TARGET WET DENSITY

PRODUCT	WATER/55 lb. BAG (Gallons)	MIXER DENSITY	UNIT
Pyrocrete® 241	4.5	76 – 82 (1217 – 1313 kg/m3)	PCF (KG/M3)

EQUIPMENT

a. 1-liter (1000 cc) polyethylene cup
b. Small metal spatula
c. Scale accurate to 1 gram

PROCEDURE

a. Weigh the empty polyethylene cup to the nearest gram, then tare the scale.
b. Use the spatula to completely fill the cup with mixer material (do not tamp)

c. Remove the excess material on top by placing the vertical edge of the spatula on the top edge of the cup. Use a sawing motion to level the mixed Pyrocrete® 241 flush with the top of the cup.
d. Weigh the filled cup to the nearest gram.
e. Record the weight of the material in grams. This value equals the wet density in grams/liter and kg/m^3.
f. To calculate the weight of the material in lf.ft^3, multiply the value in grams/liter by 0.0624.

SECTION 7. APPLICATION PROCEDURES

7.1 GENERAL

Pyrocrete® 241 may be applied by spray and/or trowel.

Material build will depend on application method, weather conditions and equipment used. For all applications, a scratch coat is recommended to key into the 3.4 lb. lath, a full coat can then be applied up to ¾" (15.9 mm).

7.2 APPLICATION

ENVIRONMENTAL CONDITIONS

The application of Pyrocrete® 241 should be in accordance with the environmental conditions as described below and as shown on the PDS.

Condition	Material	Surface	Ambient	Humidity
Minimum	40°F (4°C)	40°F (4°C)	40°F (4°C)	0%
Maximum	100°F (38°C)	125°F (52°C)	110°F (43°C)	95%

SURFACE PREPARATION

a. Prior to the installation of Pyrocrete® 241, the substrate shall be free of all oil, grease, condensation, or other contaminants.

PRIMER/PROTECTIVE COATING SYSTEM

b. If a protective coating system is required, steel preparation should be done in accordance with the recommended primer product datasheet. Please contact Carboline Fireproofing Technical Service for a list of approved primer systems.

MESH REINFORCEMENT

c. In accordance with the tested design details for Pyrocrete® 241, a minimum 3.4 lb./yd2 galvanized metal lath shall be pre-bent and tie wired into place. As a fixing aid, lath may also be secured using powder actuated fasteners, welded studs, high temperature adhesive stick pins, self-tapping screws or beam furring clips.

MIXING

d. Mix Pyrocrete® 241 with 4.5 gallons (17.03 liters) (+/- 0.5 (1.89 liters) gallons) of clean, potable water per 50 lb. (22.7 kg) bag of material
e. Mix for 5 minutes (10 minutes maximum) until a homogenous mortar-like consistency is achieved.
f. Verify wet density.
g. For detail mixing instructions, please refer to section 6.1 of this application guide.

PUMP

h. Wash equipment/pump hopper down with water and fill the hopper with a minimum of 2 gallons of clean potable water.
i. Ensure the orifice and cap have been removed from the spray nozzle.
j. Ensure the air stem is pulled back to minimize any restrictions.
k. Once Pyrocrete® 241 has been mixed, start the equipment/pump and discharge the water from the hopper into the material lines.

l. When the hopper is almost empty, rotate and dump the mixed Pyrocrete® 241 into the hopper.
m. Continuing pumping until the Pyrocrete® 241 at the nozzle is of normal consistency.
n. Shut off the pump and install nozzle orifice.
o. Restart the pump and adjust air accordingly to obtain desired surface texture.

APPLICATION

p. For all applications, a scratch coat is recommended to key into the lath, a full coat can then be applied up to ¾" (15.9 mm).
q. Allow the applied Pyrocrete® 241 to set for 2 hours at 70°F (21°C) before applying additional lifts to the required thickness.
r. Carboline recommends that the total required thickness be applied within a 24-hour period. If this is not possible, the preceding coats should be left as sprayed or scored after application. Pyrocrete® 241 must be dampened with clean potable water before the application of additional lifts.
s. Fresh Pyrocrete® 241 must be protected from rain or running water for 24 hours at 70°F (21°C).
t. All lifts should be applied monolithically to the entire perimeter of the steel section.
u. At no time shall Pyrocrete® 241 be applied at a thickness less than ¼" (6.4 mm) or "skim" coated.
v. The maximum time to achieve the full thickness is 3 days at 70°F (21°C) and 50% R.H.

Note: Do not start work if ambient temperatures are expected to drop below 35°F (2°C) for 24 hours after application.

FINISHING

Pyrocrete® 241 can be left as sprayed or finished with a trowel to improve the surface appearance and general aesthetics of the applied product.

SEALERS / TOPCOATS

Topcoats are generally not required, and do not form part of the fire resistive tested system(s). In severely corrosive environments, topcoats may be used for added durability and chemical resistance. Please contact Carboline Fireproofing Technical Service for a selection of topcoats most suited to the end use environment.

w. If a topcoat is required, apply Carboguard 1340 to the Pyrocrete® 241 as a surface seal coat. Carboguard 1340 shall be thinned 25% with Carboline Thinner # 76. The application of Carboguard 1340 may be applied 24 hours after the final application of Pyrocrete® 241. Please review the Carboguard 1340 PDS for minimum and maximum cure times.
x. Prior to the application of a topcoat system, the surface hardness of Pyrocrete® 241 should be a minimum Shore DO 64 as measured with a durometer.

TERMINATION POINTS/CAULKING

For exterior use, all exposed top and/or side termination points of Pyrocrete® 241 should be caulked with Acrilast Caulk II. Alternative caulking materials may be approved by Carboline on a project-specific basis.

CLEANUP

Pump, mixer, and hose should be cleaned with clean, potable water at least once every 2 hours at 70°F (21°C), and more often at higher temperatures. Sponges should be run through the hoses to remove residual material. Wet Pyrocrete 241 overspray must be cleaned up with soapy or clean potable water. Cured overspray may require chipping and/or scraping to remove.

SAFETY

Follow all safety precautions on the product Safety Data Sheets. It is recommended that personal protective equipment be worn, including spray suits, gloves, eye protection and respirators. Mixer personnel should wear respirators with replaceable disposable filter masks, protective goggles, gloves and eye shields protection. All fireproofing products can be slippery when wet and therefore proper precautions must be taken. It is suggested that caution signs be posted to alert other trades.

SECTION 8. COLD WEATHER APPLICATION PROCEDURES

The minimum application temperature for Pyrocrete 241 is 40°F and rising.

- For cold weather application a Visqueen enclosure is recommended around the unit or individual members.
- Inside the enclosure, indirect-fired heaters and air movement are recommended to maintain temperature.
- Enclosure should be left in place for a minimum 5 days to allow the Pyrocrete to cure.
- If no enclosure is used, DO NOT begin application if the temperature is expected to drop below 32°F and remain below that temp for 24 hours or more.
- The use of warm water, up to 110°F can be used for mixing the Pyrocrete to improve the cold weather application.
- Do not apply Pyrocrete until the surface temperature is at least 5° above the dew point.

SECTION 9. REPAIR PROCEDURES

The following repair procedures have been provided as general information. If you are in doubt or unsure on how to approach any repairs to damaged Pyrocrete® 241, please contact Carboline Fireproofing Technical Service.

9.1 MAINTENANCE REPAIR PROCEDURES

a. To remove damaged Pyrocrete® 241 use a cold chisel, air chisel, or circular saw with a masonry blade.
b. To patch the repair or damaged area:
    a. Remove the Pyrocrete to expose the lath for a 2” border around the patch area. The undamaged Pyrocrete® 241 should be cut to the lath leaving a 90° face or butt edge.
    b. Ensure that all loose material and dust residue has been removed.
    c. Touch up primer if applicable.
    d. If the lath was damaged in removal, cut new 3.4 lb. galvanized lath to cover the exposed area, including the 2” border of the existing lath. Attach the new lath to the existing lath using galvanized tie-wire or mechanical fasteners.
    e. Wet the existing Pyrocrete®241 butt edges with clean, potable water.
    f. Apply the Pyrocrete® 241 or 341 to the thickness required for the desired hourly rating.
    g. Do not featheredge Pyrocrete® 241 or 341.
    h. Do not apply Pyrocrete® 241 or 341 less than 1/4” thickness at any time.
    i. In exterior applications, Pyrocrete® 241 or 341 require a minimum of 72 hours of cure and must meet minimum Shore DO requirements before applying caulk and topcoats.

9.2 CRACK REPAIR PROCEDURES

Observed hairline cracks that may appear, of which are less than 1/8” (3.18 mm) will not impair the fire resistive rating of Pyrocrete® 241.

For all cracks that are greater than 1/8” (3.18 mm), please route and repair in accordance with the following procedure:

a. To cosmetically cover the crack, it is suggested to either caulk using Acrilast Caulk II or sacking the surface.
b. Remove the fireproofing along the crack to the existing lath. The width of the repair should be a minimum of 1” with a butt joint finish.
c. Clean away any loose debris and all dust residue.
d. Wet the edges of the existing Pyrocrete® 241 using clean potable water.
e. Apply freshly mixed Pyrocrete® 241 or 341 to the thickness required for the design hourly rating.
f. Do not featheredge Pyrocrete® 241 or 341.
g. Do not apply Pyrocrete® 241 or 341 at less than 1/4” (6.4 mm) thickness at any time.
h. In exterior applications, Pyrocrete® 241 or 341 require a minimum of 72 hours of cure and must meet minimum Shore DO requirements before applying caulk and topcoats.

SECTION 10. INSPECTION & QUALITY CONTROL GUIDANCE

10.1 GENERAL

The importance of quality control should not be overlooked. Carboline recommends that, as a minimum, Pyrocrete® 241 shall be inspected and tested daily to record the following:

- Environmental Conditions
  - Ambient/Substrate Temperature
  - Relative Humidity
  - Dew Point
- Material Storage Conditions
- Surface Preparation
- Lathing & Mixing
  - Batch # (s) of Pyrocrete® 241 used
  - Water Consumption/Bag
  - Wet Density (minimum 2 x daily)
- Equipment
- Application Procedures
- Thickness
  - Record Thickness measurements in accordance with specification requirements on testing. If no section exists, for guidance only, follow Technical Manual 12-A or SSPC-PA2.
  - Carboline recommends that thickness measurements be taken using a 6” ruler, or instrument with a rounded edge, so the lath is not penetrated.
  - The thickness is measured from the face of the lath, not the steel.
- Additional Comments
- Non-conformance Reporting

Quality Assurance/Quality Control Templates have been provided for reference only, attached to Appendix C of this manual.

APPENDIX A. UL DESIGN DETAILS & ASSEMBLY ILLUSTRATIONS

Please visit https://iq.ulprospector.com/en/profile?e=18111 for the most up to date, Pyrocrete 241 Series third party UL XR certifications.

APPENDIX B. SHOP APPLICATION & FORMING DETAILS

PYROCRETE® 241 SHOP APPLICATION INTRODUCTION

The following guidelines detail the correct techniques for Pyrocrete® 241 shop application, including:

- Project Set-Up
- Substrate Preparation
- Lath Requirements
- Application Procedures
- Finishing & Terminations
- Curing & Handling
- Field Connections

1.0 PROJECT SET-UP

- Stage steel to have access to all sides being protected.
- Determine swing radius of the members needed to erect completed steel. Typically, a minimum of a 12” block-out on each side of the holes of primary member.
- Prior to application, define and cover block-outs. Dimensions to be determined by the project team.
- Ensure application conditions in shop facility are within Carboline’s prescribed tolerances.

2.0 SUBSTRATE PREPARATION

- Substrates shall be free of dirt, oil, grease, release agent, and loose mill scale.
- Pyrocrete can be applied directly to galvanized steel.
- For carbon steel application requiring a primer, follow surface preparation requirements for approved primer system and/or project specification.

STEEL STAGED FOR APPLICATION

CLEAN GALVANIZED STEEL WITH LATH AND CORNER BEAD

3.0 PRIMERS

- Any Corrosion protection or alkaline resistant primers must be approved by Carboline prior to application.
- Use Carboguard surface tolerant epoxies, Carbozinc zinc-rich epoxies or Carbozinc 11.
- Galvanized metal is an acceptable primer for corrosion protection.

STEEL READY FOR PRIMER APPLICATION

4.0 LATHING [MESH REINFORCEMENT]

- Use minimum 3.4 lbs./yd² galvanized metal lath.
- Anchoring fasteners can be used as a secondary fixing aid, but do not form part of the fire resistive design.
- Pins for attachment of lath shall be minimum 14-gauge copper coated stud welded pins or powder actuated pneumatic pins secured 12” O.C.
- Typical application utilizes 100% lath contour for Pyrocrete shop and field applications.
- Pyrocrete shall be terminated 6”-12” from the end of the member, or 6”-12” from bolt holes to allow for field erection without damage.
- Lath is overlapped 1” and tie wired 12” O.C.
- Lath shall extend a minimum of 1” beyond the block-out termination to allow for lath overlap when installing field block-outs.

PRE-CUT LATH PRIOR TO APPLICATION

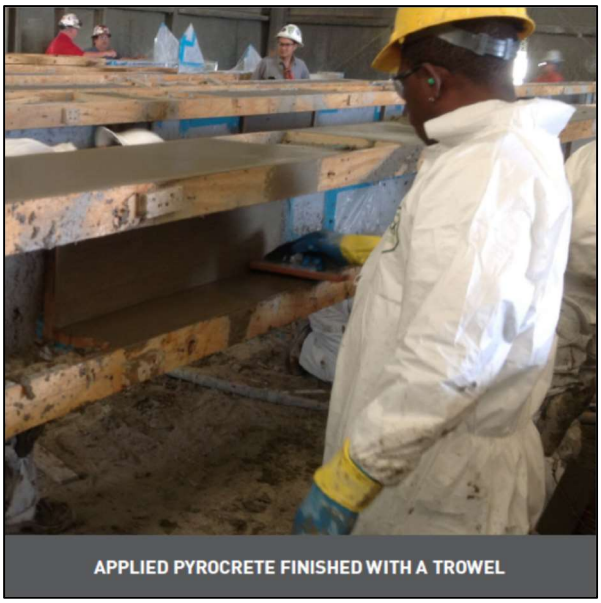
CORNER BEAD INSTALLED FOR THICKNESS CONTROL

5.0 APPLICATION

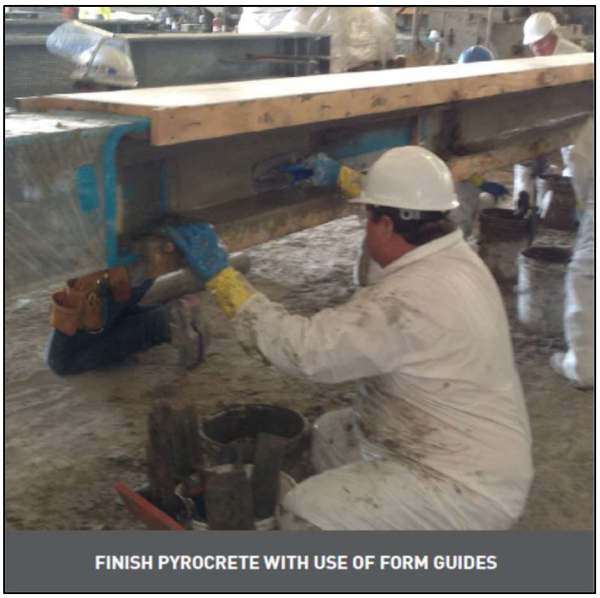
- Pyrocrete shall be mixed and applied in full compliance with the product data sheet and Carboline's written application procedures, outlined in this manual.
- Pyrocrete thickness can be determined by the use of temporary forms or corner bead, set to the required depth prior to application.
- Pyrocrete is installed in one or more lifts to achieve the required thickness.
- Pyrocrete thickness shall be measured from the lath.
- Pyrocrete shall be applied within stated recoat times.
- Minimum thickness per coat of 1/4".
- All terminations left as 90° butt joints.

FORMS SET TO REQUIRED THICKNESS

PYROCRETE SPRAY APPLIED TO REQUIRED THICKNESS



APPLIED PYROCRETE FINISHED WITH A TROWEL



FINISH PYROCRETE WITH USE OF FORM GUIDES

6.0 FINISHING

- Pyrocrete may be installed by spray or trowel.
- Finish using a hand trowel technique for smooth and even texture.
- Finish to match mock-up sample for project.

PYROCRETE INSTALLED TO THICKNESS AND FINISHED WITH TROWEL

REMOVAL OF FORMS AND EDGES FINISHED WITH TROWEL

7.0 SEALER/TOPCOATING

- Pyrocrete sealer and topcoat are optional.
- When sealing Pyrocrete, use Carboguard 1340 in compliance with product data sheet instructions. Carboguard 1340 shall be thinned 25% with Thinner # 76.
- Seal coat can be applied 24 hours after the final application of Pyrocrete.
- Additional chemical or moisture resistance topcoats can then be utilized to meet project requirements.

- Additional topcoats can be applied once material reaches sufficient Shore DO hardness.
- Contact Carboline Fireproofing Technical Service for specific product recommendations.

8.0 TERMINATIONS/CAULKING

- Terminations of Pyrocrete to non-fireproofed steel or dissimilar materials shall be caulked with Acrilast Silicone Caulk II or a project-specific approved alternate.
- Block-out terminations are left as 90° butt joints and left uncaulked.
- Areas where water may enter, such as the top flanges of pipe racks and the upper level of vertical column terminations, shall be caulked.
- Terminations to non-fireproofed steel or dissimilar materials shall have the Pyrocrete sloped or chamfered downward to create a positive watershed and facilitate drainage.

9.0 CURING & HANDLING

- Pyrocrete is ready to ship when material has sufficient hardness to withstand handling, transportation and off-loading.
- An average Shore DO surface hardness of 64 is required using a Type DO Durometer hardness gauge.
- Steel should be rigged at a block-out or non-fireproofed area.
- Shackles at end holes are safest method for unloading members.
- Stage members on proper dunnage with webs vertical to avoid exposure to ground moisture, ponding water or snow.
- If stacking, use dunnage at non-fireproofed areas to prevent damage.
- Lift from block-outs or shackle to erection tabs or bolt holes. Avoid using chokers against fireproofed surfaces.
- We do not recommend the use of chokers for lifting, transporting or erecting steel areas protected with Pyrocrete, however, if used, preformed wooden sections must be placed against the Pyrocrete to distribute the load.

10.0 FIELD CONNECTIONS

- Field applied Pyrocrete shall be mixed and applied in full compliance with the product data sheet and Carboline's written application procedures as detailed herein this application manual.
- Substrate shall be free of all contaminants prior to installing lath 3.4 lbs./yd² galvanized metal lath shall be mechanically affixed to entire surface of the blockout and overlapped with shop applied lath - 1".
- A 90° butt joint termination to the shop applied fireproofing.
- Mechanically attach lath over bolted connections with lath firmly against the bolts and bolt heads.
- Prior to the application of Pyrocrete to block-outs, the butt surfaces surrounding block-outs shall be thoroughly wetted to prevent dehydration of the fresh material applied in the field.
- The completed thickness of the fireproofing at blockouts shall match the thickness and finish of the shop applied section.
- When sealing Pyrocrete, apply Carboguard 1340 in compliance with product application instructions and
- Section 7.0 of this appendix. Sealer can be applied 24 hours after the final application of Pyrocrete.

- All terminations onto non-fireproofed steel or dissimilar materials shall be caulked with Acrilast Caulk II or a project-specific approved alternate.

SHOP APPLIED BLOCK-OUT WITH 1" LATH EXTENDED

LATH INSTALLED TO BLOCK-OUT IN THE FIELD

PYROCRETE INSTALLED TO BLOCK-OUT AREA

APPENDIX C. HANDLING, SHIPPING & ERECTION GUIDE

HANDLING

Pyrocrete 241 is ready to ship when material has sufficient hardness to withstand handling, transportation and off-loading.

An average Shore DO surface hardness of 64 is required using a Type DO Durometer hardness gauge.

LOADING AND UNLOADING

Fireproofed steel is generally loaded and unloaded with a crane to permit maximum loading of each truck. Do not unload fireproofed steel with forklifts, as the steel is nested in ways that forklifts will damage the fireproofing.

RIGGING

Chokers and chains should not be utilized on the fireproofed portion of the steel members. Shackles at end holes are a generally acceptable practice and provide the best method for unloading steel members.

Follow all site-specific safety standards for handling structural steel.

DUNNAGE

Steel members should be stored on proper dunnage (on the block out areas) to avoid crushing the Installed Pyrocrete 241. Avoid storing fireproofed steel on the ground (exposure to ponding water, snow, etc.).

ORIENTATION OF MEMBERS

Steel members should always be stacked with the webs in a vertical position to avoid ponding of water and snow.

Always elevate one end of the steel member to provide positive water drainage.

STACKING

Where steel members must be double stacked, avoid placing dunnage on the fireproofed surfaces.

ERECTION

Wherever possible, use erection tabs. Where chokers must be used, use wooden softeners to avoid crushing the fireproofing. *Never use chokers to erect columns.* This will damage the fireproofing and when the fireproofing is crushed, chokers can slide, creating a very unsafe condition.

SWING RADIUS

When utilizing infill beams, use framing angles. The erector must be aware of the swing radius of the steel member that impacts the fireproofing. Typically, this type of connection has a 12-inch blockout on each side of the holes on the primary member. When the block out dimension is insufficient, the erector is advised to chip out a minimal amount of fireproofing on *one side only*. It is better to chip a minimal amount of fireproofing than to make all the connections unnecessarily large. Safety precautions such as respirators, eye and other protection should be in accordance with OSHA and

site safety requirements. Reference Pyrocrete 241 SDS for additional information.

CONSIDER GROUND ASSEMBLY

Pre-assembling the bents on structures that are repetitive in nature will often minimize damage to the fireproofing.

APPENDIX D. SINGLE & DOUBLE LEG CORNERBEAD DETAIL

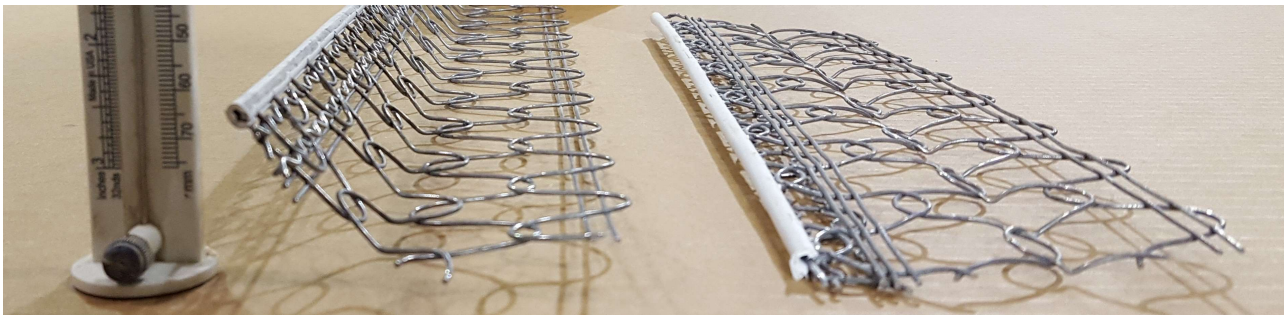
PYROCRETE® 241 SINGLE CORNERBEAD CONTOUR APPLICATION

1. Prepare the column for application.
2. Attach lath where required.
3. Calculate the bend point needed to achieve the correct thickness using the Carboline-approved single leg corner bead (SLCB). The bend point is measured from the plastic nose and can be calculated using the equation below. The SLCB can be used to achieve a maximum coating thickness of 1-3/4”.

$$D\ x\ 1.414 = B$$

B = Bend Point
D = Desired Coating Thickness

4. Bend the SLCB from a 180-degree angle (pictured below on the right) to a 135-degree angle (pictured below on the left) at the bend point found in Step 3.

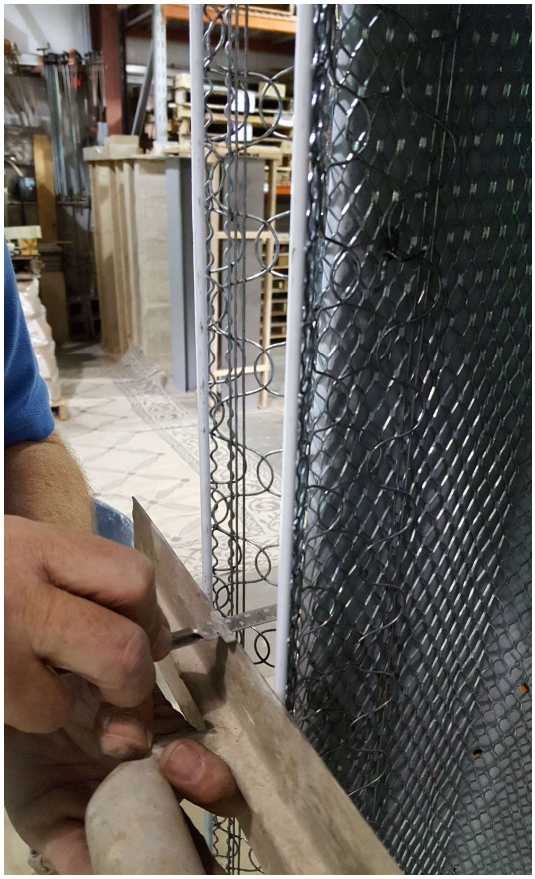


Bent SLCB Flat SLCB

5. Place the SLCB on the flange face and align the bend with the lath on the flange tip.
6. Attach the SLCB using tire wire or Hilti stud at 12” O.C.
7. Attach the SLCB to the inner flange edge following steps 5 and 6.
8. When more than one section of SLCB is used, join the ends together by a needle or Braid inserted in the plastic nose end of both sections. This will bridge the sections and make a smooth joint.

9. When positioned correctly, a trowel riding the plastic noses will give the required fireproofing thickness on the flange face and flange edge. The Inner flanges are trimmed to the required thickness by riding the plastic nose while keeping the trowel perpendicular to the web.

Checking flange face thickness



Checking flange tip thickness

PYROCRETE® 241 DOUBLE CORNERBEAD CONTOUR APPLICATION

1. Prepare the column for application.
2. Attach lath for a contour application.
3. Measure the width of the lathed flange edge to calculate the required width of the Carboline-approved double corner bead piece. The width will be twice the thickness of fireproofing plus the width of the lathed flange edge. Total thickness will be measured from plastic nosed edge to plastic nosed edge.
4. Tie wire the two corner bead pieces together in a U shape to set the required width of the edge face. Use tie wire in 12” O.C. A wood form at the required width will make the attachment easier to tie at the required width. As an alternate to tying together, the two corner pieces could be welded at the required width.
5. Position the centerline of the doubled corner bead over the centerline of the steel edge. Position the face of the doubled corner bead out from the lathed edge to give the required thickness of fireproofing on the column edge. This thickness is measured using a trowel riding on the plastic noses down to the face of the lath.
6. While maintaining the position of the face of the doubled corner bead, flex the two sides down to the lath and tie wire in position. Tie at 12” O.C.
7. Bend or flex the attached corner beads to get the required thicknesses of fireproofing on the flange face and inner flange. Check that the center face of the doubled corner beads is still perpendicular to the steel edge and set at the correct thickness of fireproofing. Flex the tie wired center face down so that the so that no wires stick out when the trowel rides across the plastic noses.
8. If positioned correctly, a trowel riding the plastic noses will give the required fireproofing thickness on the flange face and flange edge. The inner flanges are trimmed to the required thickness by riding the plastic nosed corner bead while keeping the trowel perpendicular to the web.
9. During application of fireproofing, the doubled corner bead must be completely filled with material.

APPENDIX E. QUALITY CONTROL TEMPLATES

TEMPLATES

PYROCRETE 241 QUALITY CONTROL FLOW CHART

ITEM	PROCEDURE / OPERATION	HOLD POINT	INSPECTION	ACCEPTANCE
	Surface Preparation (Where required)			
1	**Profile (if primer required)**	Yes	Yes	Yes
	Preparation Standard	Yes	Yes	Yes
	Galvanized Steel	Yes	Yes	Yes
	Profile (if primed): *Min 40 microns according to ISO 8503 or ASTM D 4417*			
	Preparation Standard: *Minimum of Sa 2 according to ISO 8501-1 or SSPC-SP6 or Din 55928*			
			Acceptable?	
			Yes / No	Remedial Procedures
	Primer Coat	**Go to 2**		**Back to Step 1**
2	**Type(s)**	No	No	Yes
	Thickness	Yes	Yes	Yes
	Cure	Yes	Yes	Yes
	Adhesion	Yes	Yes	Yes
	Type*: Document compliance with Carboline & Project requirements.*			
	Thickness: *Apply primer according to manufacturer's required d.f.t., measurements according to ISO 2808.*			
	Cure: *A min 70% of full cure according to manufacturer's data. Adhesion tests to ISO 4624 to confirm. Min acceptable value = project specifications*		Acceptable	
	Adhesion: *As above, tested to ISO 4624 (ASTM D4541).*		Yes / No	Remedial Procedures
	Site Organization/Personnel	**Go to 3**		**Back to Step 2**
3	**Up to date/latest Revision of Pyrocrete manual available?**	No	No	Yes
	Up to date project specification available?	No	No	Yes
	Supervisor in possession of appropriate qualification?	No	No	Yes
	QC personnel in possession of appropriate qualification?	No	No	Yes
	Key operatives trained?	No	No	Yes
	Visual Inspection: *Contractor to document personnel qualifications and have necessary data available.*		Acceptable	
			Yes / No	Remedial Procedures
	Equipment	**Go to 4**		**Back to Step 3**
4	**Compliance with Carboline manual and project specifications.**	No	No	Yes
	Maintenance log/records for pumps and mixing equipment	No	No	Yes
	Calibration records for inspection equipment	No	No	Yes
			Acceptable	

Yes | No | Remedial Procedures

Application Conditions — **Go to 5** — **Back to Step 4**

5

Temperature (air)	Yes	Yes	Yes
Humidity	Yes	Yes	Yes
Temperature (substrate)	Yes	Yes	Yes
Adequate weather protection	Yes	Yes	Yes
Adequate environment control	Yes	Yes	Yes
Air Temp and Humidity: *To be recorded prior to the start of production and periodically during application (minimum 3 times per 8-hour shift) and according the Pyrocrete product datasheet requirements*			
Substrate Temp: *To be recorded at start of shift*			

Acceptable?

Yes | No | Remedial Procedures

Material storage — **Go to 6** — **Back to Step 5**

6

Temperature Control	No	Yes	Yes
Cleanliness	No	No	No
Protection from Environment	No	No	Yes
Visual checks only			

Acceptable?

Yes | No | Remedial Procedures

Raw Material — **Go to 7** — **Back to Step 6**

7

Record Batch Numbers	No	No	Yes
Certificates	No	No	Yes
Certificates of conformity to be provided where required by project			
Visual checks only			

Acceptable?

Yes | No | Update records

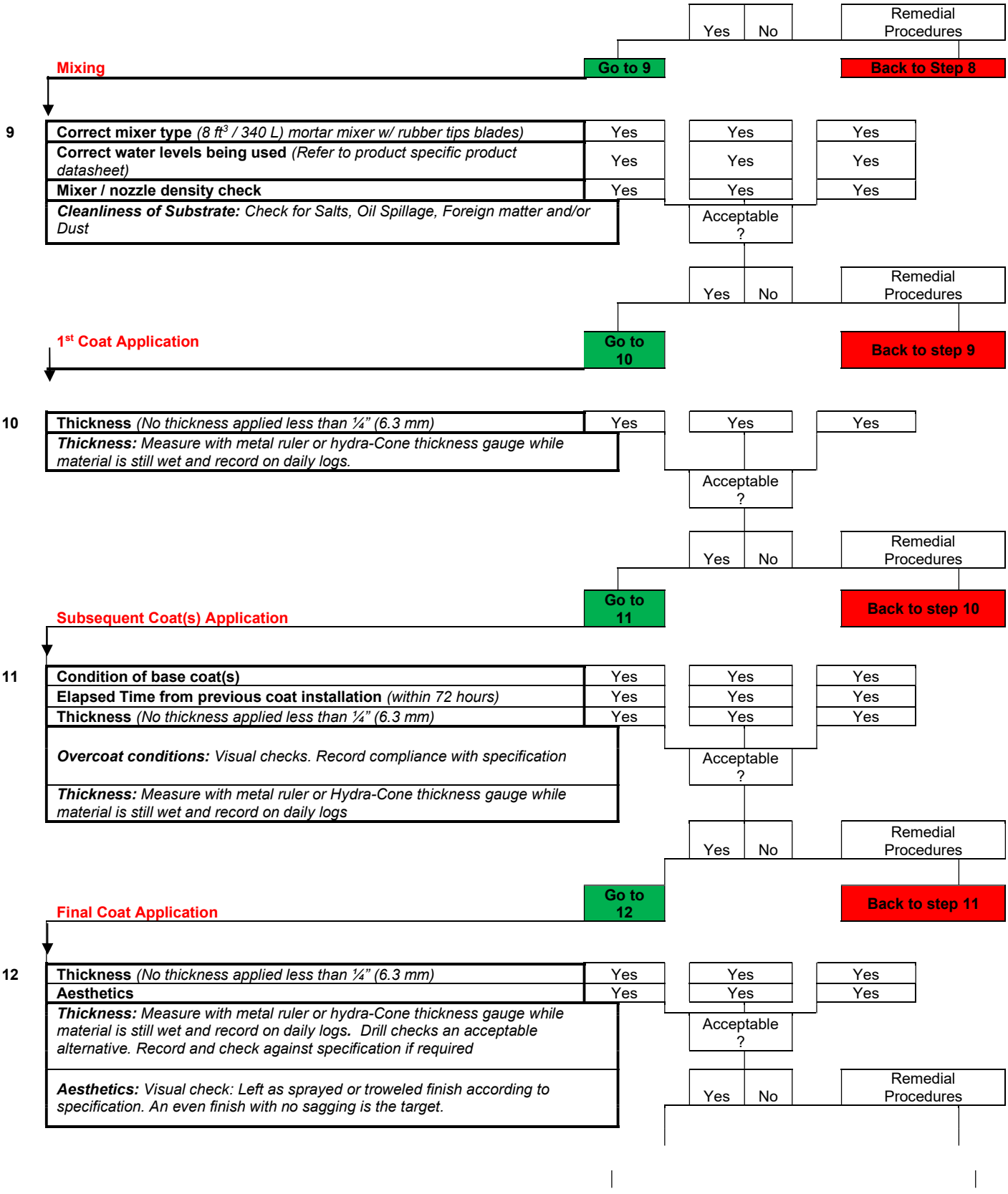
Go to 8 — **Back to Step 7**

Installation of Mesh Reinforcement

8

Material type, diameter and length of pin or fastener.	No	Yes	Yes
Lath type: (3.4 lb/yd² / 1.85 kg/m² galvanized)	Yes	Yes	Yes
Pattern and distance between fasteners (12" / 304 mm on center) – if used as a fixing aid, not required by design	Yes	Yes	Yes
Pin / fastener test conducted? *First 50 pins, bend to 45° and return to vertical*	Yes	Yes	Yes
Cornerbead used (depth set)?	Yes	Yes	Yes
Tie-wire used (gauge)?	Yes	Yes	Yes
Lath type & overlaps complies with specification?	Yes	Yes	Yes
Visual checks only			

Acceptable?


Yes
No
Remedial Procedures
Mixing
Go to 9
Back to Step 8
9
Correct mixer type (8 ft³ / 340 L) mortar mixer w/ rubber tips blades)
Correct water levels being used (Refer to product specific product datasheet)
Mixer / nozzle density check
Cleanliness of Substrate: Check for Salts, Oil Spillage, Foreign matter and/or Dust
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Acceptable ?
Yes
No
Remedial Procedures
1st Coat Application
Go to 10
Back to step 9
10
Thickness (No thickness applied less than ¼" (6.3 mm)
Thickness: Measure with metal ruler or hydra-Cone thickness gauge while material is still wet and record on daily logs.
Yes
Yes
Yes
Acceptable ?
Yes
No
Remedial Procedures
Subsequent Coat(s) Application
Go to 11
Back to step 10
11
Condition of base coat(s)
Elapsed Time from previous coat installation (within 72 hours)
Thickness (No thickness applied less than ¼" (6.3 mm)
Overcoat conditions: Visual checks. Record compliance with specification
Thickness: Measure with metal ruler or Hydra-Cone thickness gauge while material is still wet and record on daily logs
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Acceptable ?
Yes
No
Remedial Procedures
Final Coat Application
Go to 12
Back to step 11
12
Thickness (No thickness applied less than ¼" (6.3 mm)
Aesthetics
Thickness: Measure with metal ruler or hydra-Cone thickness gauge while material is still wet and record on daily logs. Drill checks an acceptable alternative. Record and check against specification if required
Aesthetics: Visual check: Left as sprayed or troweled finish according to specification. An even finish with no sagging is the target.
Yes
Yes
Yes
Yes
Yes
Yes
Acceptable ?
Yes
No
Remedial Procedures

Topcoat & Caulking Application — **Go to 13** — **Back to step 12**

13

Elapsed time from final coat installation prior to applying topcoat	No	No	Yes
Condition of Pyrocrete	Yes	Yes	Yes
Seal with Carboguard 1340 *(24-hour minimum cure prior to installing sealer coat if required in specification)*	Yes	Yes	Yes
Terminations sealed with Acrilast Caulk II *Pyrocrete requires 72 hours minimum and must meet minimum Shore DO requirements prior to applying Acrilast caulk)*	Yes	Yes	Yes
Topcoat Type? / Thickness? *(if required in specification) Pyrocrete must meet minimum Shore DO requirements prior to installing topcoat over Carboguard 1340 sealer coat* ***Thickness measurements****: according to ISO 2808*	Yes	Yes	Yes

Elapsed time: *Check with manufacturer's data sheets and document compliance with Carboline requirements*
Condition of Pyrocrete: *Record compliance with Carboline/ maunufacturer's requirements*
Seal with Carboguard 1340: *Check with manufacturer's data sheets and document compliance with Carboline requirements*
Topcoat Type: *Check with manufacturer's data sheets and document compliance with Carboline requirements*

Acceptable?

Yes | No — Remedial Procedures

Back to step 13

PYROCRETE 241 INSPECTION DETAILS

No.	Procedure/Operation	Details
1	Surface Preparation	All aspect of preparation of the substrate to be verified as in accordance with specifications and Carboline requirements. This includes methods of preparation and the standards achieved + confirmation that the necessary standards of cleanliness and environmental control were achieved.
2	Primer Coat / Galvanized Substrate	The specific type of primer coat(s) used must be approved by Carboline. The applied d.f.t. cure of primer and or adhesion characteristics are to be verified as acceptable. Galvanized substrate to be clean and free of all oil, grease, dust, dirt and contamination
3	Site Organization / Personnel	Contractor must verify that key site personnel are qualified to apply Pyrocrete. Different projects require a higher % of trained operatives but as a minimum the Site Supervisor, Lead Applicator and QC representative should be able to confirm and document their application qualifications.
4	Equipment	The accepted equipment is listed in the Pyrocrete application manual(s). The contractor shall demonstrate and document that the equipment is in the proper order. This applies to both production and the calibration/operation of measuring / inspection equipment.
5	Application Conditions	The ambient, substrate and general conditions for the working environment are listed in the Pyrocrete Application Manual. It is the responsibility of the application contractor to adequately show that these have been followed during the application periods for Pyrocrete products
6	Material storage	The storage condition for Pyrocrete are listed in the Pyrocrete Application Manual The application contractor must be able to show that these conditions have been achieved.
7	Raw Material	Contractor must record batch numbers and document those used in production, showing that the material is correct and within the specified shelf life. Confirming also that any ancillary materials used are of the correct type
8	Installation of Pins / Fasteners / Lath	Contractor must document type, diameter and length of pin or fastener, lath type: (3.4 lb/yd^2 galvanized) Lath must be installed per the ANSI/UL1709 certification. Fasteners can be used as a fixing aid in diamond pattern. Pattern and distance between fasteners shall be 12" / 304 mm on center. The first 50 welded pins, bend to 45° and return to vertical and mechanical fasteners must be verified prior to production. The cornerbead, tie-wire gauge and lath type used must be approved by Carboline in writing prior to project start. All lath overlaps, terminations and orientation must comply with Carboline's Pyrocrete Application Manual and design details
9	Mixing	Contractor must verify that the correct mixer type is used and that the correct water levels and mixer density is being achieved prior to commencing application
10	Pre-Application (1st Coat)	Contractor must document that the surface is acceptable for over coating with Pyrocrete and that the mixing and spray machinery is functioning correctly
11	Application (1st Coat)	Wet film thickness checks taken during application and recorded.

PYROCRETE 241 TYPICAL INSPECTION EQUIPMENT LIST

Equipment	Type	Comments
WFT Gauge / Ruler	Metallic	Do not use plastic types. Do not clean gauge with grinding paper or similar mechanical action. Always clean immediately after each measurement. Measurements should be made immediately (within minutes) after application.
Temp/humidity/dewpoint meter	Electronic	Calibrated regularly.
Sling Psychrometer	With two fixed thermometers	Make sure that the wet thermometer is moist with preferably distilled water. Sling for two (2) minutes, read, sling for another ½ minute, read, continue until two consecutive readings give the same results.
Dew Point Calculator	The disc-type is recommended	Consists of two overlapping discs with the same rotation center.
Surface Thermometer	Mechanical or Electronic	Calibrated regularly, able to read substrate and liquid surface temperatures
Ruler/tape measure	Steel	Measuring size of steel for calculation purposes.
Vernier Caliper	Steel	Precise measurements.
Knife	Folding or safety fitted.	High quality steel, sharp. Preferable with attachment to conduct cross hatch adhesion test where necessary.
Marking Chalk		Yellow or white, non-grease.
Filling Knife (Spatula)		Keep clean and sharp.
Camera, Flash and Film	Digital pocket size with built-in electronic flash and video enabled.	Minimum 5 megapixels.
Note Book and Ball Pen	Carboline Note Book	Use water-proof pens for writing.
Marking Pens	Permanent Ink Types	Thick felt types, black, red and green.
Sealable plastic bags		Isolation of material samples if required.

APPENDIX F. APPROVED PRIMERS & SEALERS

The following Carboline products have been tested per ASTM E736 and determined acceptable as primers for Pyrocrete 241. Carboline Company does not claim repeatability of these tests as may be influenced by cure time, primer recoat characteristics, site conditions, or other factors beyond our control. Consult the individual Product Data Sheets for application and recoat instructions. Use of primers other than those listed below is not recommended without prior consultation and approval by the Carboline Fireproofing Technical Service Group.

Primer	Generic Type	VOC Content (g/l)
Galvanizing	-	-
Carbozinc 11	Solvent Based Inorganic Zinc	As supplied: EPA Method 24: 4.0 lbs./gal (479 g/l)
Carbozinc 11 VOC	Solvent Based Inorganic Zinc	As supplied: EPA Method 24: 3.20 lbs./gal (389 g/l)
Carbozinc 858 (3K)	Solvent Based Organic Zinc-Rich Epoxy	As supplied: 2.65 lbs./gal (318 g/l)
Carbozinc 859	Organic Zinc-Rich Epoxy	As supplied: 2.72 lbs./gal (326 g/l)
Carboguard 635	Epoxy Phenalkamine	As supplied: 2.47 lbs./gal (296 g/l mixed)
Carboguard 880	*Epoxy Polyamide*	*As supplied: 1.98 lbs./gal (238 g/l)*
Carboguard 890	Cycloaliphatic Amine Epoxy	As supplied: 1.81 lbs./gal (217 g/l)
Carboguard 893	Cycloaliphatic Amine Epoxy	As supplied: 1.6 lbs./gal (195 g/l)
Carboguard 893 SG	Epoxy polyamide with corrosion inhibitor (zinc phosphate)	As supplied: 2.70 lbs./gal (324 g/l)
Carbomastic 94	Polyamide Epoxy with corrosion inhibitor, (zinc phosphate)	As supplied: 1.0 lbs./gal (120 g/l)
Carbomastic 615	Phenalkamine epoxy	As supplied: 1.44 lbs./gal (172 g/l)
Carboline 801	*Two component, cross-linked epoxy*	*As supplied: 1.74 lbs./gal (208 g/l)*
Carbocoat 150 UP	Single Component Phenolic Modified Alkyd	As supplied: 3.4 lbs./gal (407 g/l)
Rustbond	Polymeric epoxy amine	As supplied: EPA Method 24 0.7 lbs./gal (85 g/l)

Topcoats are generally not required, and do not form part of the fire resistive tested system(s). In severely corrosive environments, topcoats may be used for added durability and chemical resistance. Please contact Carboline Fireproofing Technical Service for a selection of topcoats most suited to the end use environment.

- If a topcoat is required, apply Carboguard 1340 to the Pyrocrete® 241 as a surface seal coat. Carboguard 1340 shall be thinned 25% with Carboline Thinner # 76. The application of Carboguard 1340 may be applied 24 hours after the final application of Pyrocrete® 241. Please review the Carboguard 1340 PDS for minimum and maximum cure times.
- Prior to the application of a topcoat system, the surface hardness of Pyrocrete® 241 should be a minimum Shore DO 64 as measured with a durometer.