

SECTION 03 35 43 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes refined (polished) concrete finishing (PC-1):
 - 1. Includes multi-step grinding, chemical treatment for hardening, multi-step refinement, and finishing treatment for protection for exposed concrete slabs.
 - 2. Includes repair of exposed concrete slab repair as required for refined concrete finishing.
 - 3. Installer is responsible for reviewing reference projects and coordinating finishing procedures and any other concrete related items impacting finishing for concrete floors to receive refined concrete finishing with Section 03 30 00 "Cast-in-Place Concrete" including trowel finishing and curing.
 - 4. Extents of PC-1 extends to areas concealed by carpet finishes CPT-# in public areas and excludes offices.
 - 5. Sequence refining operations as follows:
 - a. No sooner than 7 days after placement and when concrete strength f'c is no less than either 90 percent of f'c or a minimum 3,100 f'c.
 - b. No later than 35 days after placement.
 - c. To maintain appearance consistency by minimizing and obviating need for hand tooling at edges due to wall and partition framing and other obstructions.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete materials, placements procedures, curing requirements, and edge protection for concrete slabs indicated for refined concrete finish.

1.2 DEFINITIONS AND REFERENCES

- A. ACI 310: 310.1-20 "Specification for Polished Concrete Slab Finishes."
- B. CSDA: CSDA ST 115 "Measuring Concrete Micro-Surface Texture", 2014.
- C. Design Reference Project/ Sample: Project or Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of refined concrete finishing.
- D. High Traction Coefficient of Friction (COF):
 - 1. ANSI B101.3 Measuring Wet DCOF of Common Hard-Surface Floor Materials.
- E. Mohs Hardness Scratch Test: MNL46 Special Methods for Hardness Testing.
- F. Reflectivity (DOI): Image clarity value, according to ASTM D5767.
- G. Relative Humidity: ASTM Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

- H. Surface Texture Grade (STG): Micro surface profile measurement of concrete surface roughness for establishing aesthetic and aid in quantifying performance according to
 - 1. Measured and noted as Ra, in microinch (μin).
 - 2. ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay).
- I. Vapor Transmission, Permeability: ASTM E96.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with refined concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Refined concrete finishing Subcontractor.
 - 2. Review curing procedures, concrete repair procedures, finishing, and protection of slab edges and refined concrete.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Refinement Schedule: Submit plan showing refined concrete surfaces and schedule of refinement operations for each area of refined concrete finishes before start of operations.
 - 1. Show extents of repair where required due to construction damage as applicable. Include method statement and remediation procedures for review.
 - 2. Architect-Owner will submit change extents according to Section 01 20 00 "Price and Payment Procedures" after approval of refinement schedule plan.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Installer.
 - 2. For individual responsible for field-quality control.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Repair materials.
 - 2. Liquid floor treatments.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For refined concrete finishes. Include the following:
1. Methods for cleaning and stain-removal products and procedures and recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to refined concrete surfaces.

1.7 QUALITY ASSURANCE

- A. Special Finish Concrete Work: Performed by expert entity having in-depth knowledge of a wide variety of finish methods and equipment suitable for the type of finish in the locations required for the Work. Applicator shall be approved by the manufacturer of the required finishing system and have a successful record of experience with this finish process and the equipment proposed for the Work. Submit documentation for five previous projects including equipment and methods used and the name of the equipment operator(s), complete information on the finishing process and photographic documentation of finishing from original surface to completion.
1. Individual in Responsible Control: For work of this Section have ACI Craftsman Certification as Commercial/Industrial Flatwork Specialist - High Tolerance; individual shall be on site at all times work is actively in progress.
- B. Field Quality Control - Surface Measurement and Evaluation:
1. Surface finish quality shall be evaluated in accordance with ACI 310 for overall finish classification, visual appearance including DOI, and general surface characteristics.
 2. Micro-surface texture measurements shall be performed using procedures outlined in CSDA to provide supplementary quantitative data for surface profile evaluation.
 3. Field technicians shall demonstrate proficiency in the use of specified measuring instruments and competency in interpreting measured values according to both referenced standards.
 4. All surface measurements shall be documented with notation of the applicable standard used for each test method, and results shall be reported using the terminology and units specified in the respective standard.
 5. CSDA methods shall be used for comparative analysis and numerical surface texture values where discrepancies exist between the two standards and as determined by Architect.
- C. Mockup, Repair Areas: Prior to mockup and final finishing, mockup area requiring repair for review of repairs as specified in Section 03 30 00 "Cast-in-Place Concrete."
1. Proceed with remaining repairs after approval of repair areas mockup.
- D. Mockups: Build mockups to verify selections and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Locate mockup(s) in area acceptable to Architect:
 - a. Offices 110 and 111.
 - b. Storage 112.
 - c. Exterior Storage 150.
 - d. Standalone mockup slab on grade where required by sequencing.
 2. Provide initial mockup with three varying finish textures in one mockup, equally sized and divided for comparison, with minimum overall size of 300 square feet for initial review and no less than size required to evaluate differences. Each finish to represent successive refinement procedures.

- a. Mockup each of the three with different DOI within the range specified, 10-plus, plus-minus 23, minus-35.
 - b. Provide final mockup for review, with selected DOI and finish approved by Architect, of not less than 100 square feet.
3. Review and adjust depth of cut and STG and other visual criteria as required to achieve finish specified and approved by Architect.
 4. Demonstrate curing, finishing, and protecting of refined concrete.
 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace materials and installations that fail to maintain performance and appearance as specified in "Performance Requirements" Article, including stain resistance within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Refined concrete surfaces shall match Architect's control reference sample. Installer is responsible for coordinating concrete mix designs, placement, finishing procedures and any other concrete related items impacting finishing for concrete floors to receive refined concrete finishing.
 1. Grit-based evaluations are not permitted for comparative purposes.
 2. Distinctness of image and specular gloss have been provided to establish valuation criteria, and final appearance shall be confirmed by Architect in mockup with adjustments made to finishes as required.
 3. Appearance shall match Architect's Design Reference Project and mockup.
 - a. Appearance shall be confirmed acceptable by Owner.
 4. Design Reference Projects: Provided by Architect. References are provided for appearance only, not tolerances of installation.
 - a. Owner's Reference Projects: Owner to confirm projects where polished floors are not acceptable.
- B. System Description: The various steps, processes, means methods and equipment necessary to achieve the required finish are not limited by this Section; final determination of these shall be the responsibility of the Special Finish applicator as necessary to achieve the finish appearance specified herein and represented by approved submittals at no additional cost to the Owner.

1. Chemical Treatment: Clear, waterborne solution of inorganic mixture of lithium silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for refined architectural concrete surfaces, compatible joint cleaning and filling system and equipment for wet installation.
 2. Appearance of Finished Work: Provide uniform characteristics including but not limited to depth of removal of cement paste, degree of concrete matrix and aggregate exposure, texture, gloss, slip resistance and all other aspects of appearance in the finished work.
 - a. Provide corrective and remedial measures for cracks, voids and similar characteristics.
 - b. Provide detail treatment and finish control joints and all other joint types present in the work.
 - c. Provide remedial measures necessary to correct surfaces that exceeds FF or FL required for the Work
 3. Do not apply or provide additional coatings or sealers to achieve specified performance. Added products are acceptable for warranty requirements where products do not change floor performance or appearance and require reapplication within specified warranty duration.
- C. Refinement Level: Provide refined concrete surfaces meeting the following criteria:
1. STG: 32µin, and not less than 16µin.
 2. DOI, Reflectivity: 10 to 35 percent; matte, and as selected by Architect in mockup. DOI values shall be measured only after STG measurements are achieved and are included for reference.
 3. Maintain High Traction COF as defined by ANSI B101.3 WDCOF.
 4. Finished Surface Coefficient of Friction: 0.60 Dynamic Coefficient of Friction (DCOF) on non-sloped surfaces as tested per ANSI B101.3.
 5. Hardness: Meet or exceed densifier manufacturer's published values.
 6. Aggregate Level: Provide cream aggregate exposure; reveals only fines and sands were approved in mockup.
 - a. Fine Aggregate Allowable Limit 5-10 percent of exposed field.
 - b. Aggregate Appearance: Fine aggregate exposure with little or no medium aggregate exposure at random locations; "Salt and Pepper" appearance as approved by Architect.
- D. Refinement Process:
1. Dry refinement is not permitted for surface repair requirements during refinement operations and for compliance with OSHA silica regulations.
 2. System shall be wet refinement process including wet cutting compound.
 3. Abrasive and grinding pads shall not be epoxy, resin or plastic-based.
 4. Added guards and sealers to achieve specified performance are not permitted.
- E. Regulatory Requirements: Silica Dust Regulation OSHA 29 CFR 1926.1153.
- F. Vapor Transmission and Stain Resistance: Final concrete floor finishing to meet the following:
1. ASTM E96 Water Vapor Transmission of Materials.
 2. ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete.
 3. Stain-Resistant: Provide stain resistance as defined in ASTM D1308.

2.2 MATERIALS

- A. Penetrating Liquid Floor Treatments for Refined Concrete Finishing: Water-borne, zero VOC, chemically reactive colloidal silica liquid hardener that both penetrates concrete and forms its own surface; that penetrates, hardens, and is suitable for refined concrete surfaces with wet refining application, with cutting compound and densifier.
1. Prohibited Systems: Sodium- and potassium- based formulas are not permitted.
 2. Subject to compliance with requirements, provide refinement densifier product or from one of the manufacturers:
 - a. Adhesives Technology Convergent, Pentra-Sil (HD).
 - b. ArmorPoxy, Ghostshield lithi-tek 4500.
 - c. Global Polishing.
 - d. Smartkrete Densifier XL.
 - e. Sikafloor, Sikafloor-956 LD.
 - f. Specification Products.
- B. Cementitious Repair Materials: Other than surface crack filling during refining activities, provide cementitious repair materials as required and recommended by refinement installer and refinement manufacturer for use, and with materials and execution acceptable to Architect. Comply with Section 03 30 00 "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with roofing system Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify and identify FF values of slab in each area where refined finish is scheduled and verify compliance with requirements of Section 03 30 00 "Cast-in-Place Concrete".
 - a. Flatness: Evaluated specified minimum per ACI 117 and ASTM E1155.
 2. Verify surface imperfections requiring repair. Force cementitious repair materials into the pore structure of the concrete substrate to fill cracks and surface imperfections not filled otherwise during refined finishing operations.
 3. Verify that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 4. Verify sealants and repair materials are cured to sufficient levels for refining activities.
 5. Verify moisture content of concrete:
 - a. Moisture Testing, Prior to Refining: Perform tests after 14 hours of placement so that each test area does not exceed 500 sq. ft, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - 1) Relative Humidity Testing: Using in situ probes, ASTM F2170, to establish relative humidity level measurement.
 - a) Test in areas to be covered by other construction, where repair is inconspicuous or in mockup areas.
 - b) Install probes at 40-percent of slab depth and maintained for 72 hours before initial readings.

- 2) Anhydrous Calcium Chloride Test: ASTM F1869. Evaluate moisture-vapor-emission rate in lb of water/1000 sq. ft. in 24 hours.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPERATIONPREPARATION

- A. Protect adjacent areas not scheduled for refining finishes and protect slab edges from moisture intrusion beyond edge of slab.
- B. Repairs: Repair cracks, surface imperfections and damage that will not be corrected ~~during~~ and repaired during refinement operations.
 1. Prepare and repair damage to exposed surfaces according to Section 03 30 00 "Cast-in-Place Concrete."
- C. Clean floor of debris. Take and record initial Ra and Mohs measurements to determine appropriate abrasive tool for initial cut.

3.3 REFINEMENT

- A. General: Prepare and refine with appropriate Ra tooling and cutting compound required to achieve approved finish.
- B. Wet floor thoroughly.
- C. Apply cutting compound to cured and prepared slabs to make initial mechanical grinding pass.
- D. Machine grind floor surfaces to receive refined concrete finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 1. Perform finishing operations in as continuous an operation as possible. Provide uniform STG and DOI readings throughout the finished Work
- E. Apply penetrating liquid floor treatment for refined concrete finish and refine according to manufacturer's written instructions, allowing recommended drying time between successive steps.
- F. Continue refining to achieve specified STG range and DOI level, to match approved mockup.
 1. Provide edge refinement extending to all visible edges of floor and other surfaces indicated for finish type.
 2. Control and dispose of wet and dry waste products produced by grinding and refinement operations.
 3. Neutralize and clean refined floor surfaces.

3.4 FIELD QUALITY CONTROL

- A. Moisture Testing, After Refining: Test areas that have been protected from surface moisture after refining.

1. Perform tests after 45 days after placement and after refining so that each test area does not exceed 500 sq. ft, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas and adjacent to initial test areas except as otherwise indicated.
 - a. Relative Humidity (RH) Hood Test: ASTM F2659. Evaluate relative humidity levels at locations of corresponding in-situ probes.
 - 1) Maximum RH shall not exceed in-situ probe levels.
 - b. Anhydrous Calcium Chloride Test: ASTM F1869. Evaluate moisture-vapor-emission rate in lb of water/1000 sq. ft. in 24 hours.
 2. Compare values against moisture tests.
 3. In-situ RH per ASTM F2170 shall not exceed 80 percent. Post-densification surface RH per ASTM F2659 shall not exceed 75 percent. The differential between in-situ and surface readings shall be between 3 percent and 10 percent. Differentials less than 3 percent may indicate insufficient densification or excessive slab moisture. Differentials greater than 10 percent indicate unacceptable moisture gradients requiring remediation.
- B. Review recommendation of the manufacturer of the specified Finish System materials for the finish floors including products, procedures and frequency.
1. Provide a minimum of three tests for each ~~pass and~~ machine-grinding pass.
- C. Refined Concrete Surface Testing: Installer to measure and evaluate concrete:
1. Measure DOI.
 2. Provide measurement and evaluation of texture of concrete micro surface texture.
 3. Slip Resistance Traffic Surface: Evaluate finished flatwork per ANSI B101.1 Static Coefficient of Friction and B101.3 Dynamic Coefficient of Friction for compliance with requirements.
- D. Independent Testing: Owner may engage the services or a qualified testing and inspecting agency or consultant to inspect and test refined concrete in addition to installer's testing.
- 3.5 CLEANING AND PROTECTION
- A. Clean and protect floor finishes from damage during remaining construction period.
 - B. Coordinate subsequent work to ensure finished concrete is free from damage and deterioration at Substantial Completion.

END OF SECTION