GREENWICH HOUSE POTTERY

HANDBOOK
2019
I'm eternally grateful that I still have the strong desire to work with clay and that Greenwich House Pottery exists where I and so many others have found a precious haven.

Lilli Miller, Student since the early 1950s
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INTRODUCTION

Greenwich House Pottery (GHP) has been introducing New Yorkers to the joy of clay for more than 100 years. Throughout this time we have had thousands of teachers and staff whom have contributed to our institutional knowledge. This is information that cannot be found anywhere else. We have attempted to compile it here, in one convenient volume.

The Greenwich House Pottery Student Handbook is a resource for students of any age or skill level. It contains all of our current clay, glaze, slip and terra sig recipes in addition to the materials we use and the processes in which we use them. However, this is more than a book of recipes or a how-to manual, it also serves as a historical document, a record of our past in addition to a narrative of our present.

The first known version found in our archives was put together sometime in the 1980s. Each subsequent edition is made with the hope of increasing the depth of information, improving upon the format and adding to the ease of use. We purposefully make all of our clay and glaze recipes available, we have no secrets and we want everyone who wants them to have access. We include procedural information so beginners or those starting their own studios can benefit from our century of experience.

This handbook is for educational use only. We make it available for free on our website; however, it can be purchased in printed form in our registration office. We would like to thank the countless people over the decades who have contributed to our success and the development of this information.
“THE STORY OF GREENWICH HOUSE POTTERY IS THE STORY OF AMERICAN CERAMICS. NO OTHER INSTITUTION MATCHES OUR DEPTH OF EXPERIENCE AND HISTORY OR HAS SHAPED THE FIELD OR ART SCENE LIKE GHP.”

Adam Welch, Pottery Director
Greenwich House opened on Thursday, November 27, 1902 (Thanksgiving Day) at 26 Jones Street just 75 feet from where the Pottery now stands. It was founded as the Cooperative Social Settlement Society of the City of New York and incorporated by Felix Adler, Robert Fulton Cutting, Eugene A. Philbin, Henry C. Potter, Jacob Riis, Carl Schurz and Mary Kingsbury Simkhovitch. As a Settlement House (Progressive Era Reform Movement), Greenwich House sought to alleviate poverty and urban congestion, and to help unify immigrants and bring communities together.

Greenwich House Pottery (GHP) traces its humble beginnings back to the manual training programs of Greenwich House. As early as 1904, Greenwich House offered clay modeling classes to children as an activity to keep them off the street and out of trouble. Soon after, amateur clubs geared toward acclimating immigrant adults to America and serving as an alternative source of income were also introduced. In 1905, Gertrude Whitney served as a member of the Greenwich House Board of Directors and donated $5,000 to support clay modeling, facilitating the move to a studio at 28 Jones Street where a comprehensive pottery department was formed by 1908. The Pottery is the only remaining program from that Handicraft School and has the distinction of being the oldest and longest running program at Greenwich House.

The Pottery is located in a beautiful 3-story brick building located at 16 Jones Street. Jones Street is named after Dr. Gardner Jones who married Sarah Herring in 1773, whose father, Elbert Herring, owned a considerable tract of land known as Herring Farm where NYU and much of the West Village now sits. The Pottery’s building was built for Greenwich House by the famous architects Delano & Aldrich in 1928 as the Greenwich House Arts and Crafts Building. It housed Greenwich House’s Handicraft School, but also New York University, the New York Department of Education and even a branch of the New York Public Library system until 1948 when the Pottery officially took up residence.

**AS EARLY AS 1904, GREENWICH HOUSE OFFERED CLAY MODELING CLASSES TO CHILDREN AS AN ACTIVITY TO KEEP THEM OFF THE STREET AND OUT OF TROUBLE.**
Greenwich House has a history of not only being committed to supporting its local community, but of also fostering the growth of statewide and national movements for social reform. Greenwich House and its members and workers were directly and indirectly responsible for the passage of women's suffrage in New York in 1917, tenement housing reform and New York Workers Compensation Law, and for the founding of the ACLU (American Civil Liberties Union, first formed as the National Civil Liberties Bureau), the NAACP (National Association for the Advancement of Colored People) and one of the first black settlement houses. At the first official meeting of the House the board of managers elected Gertrude Whitney to the Board of Directors. She remained committed to Greenwich House until she opened the Whitney Museum of American Art in 1931. Greenwich House had such notable members as: Franz Boas, John Dewey, Amelia Earhart, Crystal Eastman, Learned Hand and Mary White Ovington, to name a few.

Greenwich House currently offers a wide array of programs designed to enrich the lives of New Yorkers in addition to the Pottery, including Barrow Street Nursery School, Greenwich House After-School, Greenwich House Music School, four senior centers and the Children’s Safety Project.

In addition to being an important home for social reform, GHP’s unique history encompasses the evolution of American ceramics. Its earliest iteration was as a craft program geared toward social welfare. For decades the Pottery was also known as a production facility making high quality pots for the garden and table, filling orders for notable New Yorkers such as J.P. Morgan and Edward Harkness. The artists within the Pottery Department called themselves the Greenwich House Potters and later, the Greenwich House Potters and Sculptors. Ceasing production in the 1940s, the Pottery refocused on education. It later became a hub of the post-war studio crafts movement. We have the largest faculty and student body and the widest variety of courses of any ceramics art center in New York City. GHP has something for everyone.

The most respected artists pass through our doors leaving behind a vast array of techniques and inspiration—Ann Agee, Kathy Butterly, Nicole Cherubini, Warren MacKenzie, M.C. Richards, Betty Woodman and Peter Voulkos are just a few. Besides being the preeminent venue for ceramics in the United States, our residency program serves as an incubator for artists such as Ghada Amer, Simone Leigh, Pam Lins and Rirkrit Tiravanija. Our studios also serve artists such as Trisha Baga, Joanne Greenbaum, Alice Mackler, Louise Nevelson, David Salle and thousands of others. Today, with its diverse program of classes, workshops,
lectures and exhibitions serving hundreds of students and thousands of visitors each year, the Pottery is New York City’s center for ceramics. In 2009, New York City Mayor Michael Bloomberg awarded GHP a Mayoral Proclamation and declared September 10th, 2009 “Greenwich House Pottery Day.”

In the spirit of the Greenwich House Potters and Sculptors, the Pottery started a fabrication shop creating custom ceramic production for artists in 2010, the same year that the Ceramics Club found its home here. Ceramics Club was founded in 2007 by artists Pam Lins and Trisha Baga in the basement of Cooper Union as a group interested in using “ceramics as a way to socially interact, make material and collaborate.” The group models itself on “propositions gleaned from amateur ‘clubs’ that in organizing, were interested in dismantling and opposing professionalism—withdrawn distinctions regarding quality, institutions, representations, etc.” The membership of the club is in flux, though its core members include: Ricci Albenda, Trisha Baga, Lucky DeBellevue, Marley Freeman, Kathryn Kerr, Pam Lins, Keegan Monaghan, Lucy Raven, Halsey Rodman, Saki Sato, Shelly Silver and myself. The Ceramics Club meets here regularly creating anonymous works that are sold at “artists’ prices” to raise money for causes that align with their politics. To date we have raised $7000 for Planned Parenthood, $3500 for Critical Resistance, $3500 for White Helmets, $2000 for New Sanctuary Coalition, $2000 for the Sylvia Rivera Law Project, $1800 for GHP, $500 for Make the Road NY, and contributed to a fundraiser that grossed $20,000 for Planned Parenthood.

In 2017, Crafting Resistance was formed from more than 100 of our faculty, staff and students as a group of artists and craftspeople who “support organizations that resist the erosion of freedoms instated by the US constitution.” It was created out of a sense of dread and a need to actively engage in democracy and in supporting organizations that were under attack. Led by Jenni Lukasiewicz and in concert with the GHP community, Crafting Resistance helped to raise money in support of civil liberties ($25,000 for the ACLU), the environment ($10,000 to NRDC and GrowNYC), and LGBTQ rights ($3,000 for Lambda Legal). Our community is dedicated to helping the greater good.

In response to our community's needs, GHP broke ground in 2019 for the first time since the Annex was added to the original Arts and Crafts building in 1929. To keep pace with our current student body and to ensure equal access to the studios for everyone, this building project aims to expand the kiln room into the existing courtyard, add an elevator and a basement with a dedicated clay and glaze mixing lab, and connect the second floor mold-making studio with the main building.

GHP is dedicated to expanding public awareness of the diversity and complexity of ceramics while fostering the development of artists through internships, residencies, exhibitions and classes. Extending our educational mission to make, exhibit and learn from contemporary ceramics, GHP operates Ceramics Now, an exhibition
series committed to supporting emerging, underrepresented and established artists in the Jane Hartsook Gallery.

Greenwich House's first exhibition was held at 26 Jones Street in 1905, and showcased pottery and modeling made by students. The exhibition was organized to acquaint the community with the activities the neighborhood youngsters had been engaged in. Prior to the development of a dedicated space, exhibitions took place at multiple locations: 27 Barrow Street, 16 Jones Street (where the Pottery has been since 1948), off-site storefronts, Gertrude Whitney's studio on 8th Street, a New York City Public Library and patrons' garden estates. In 1970, Jane Hartsook (Director, 1945-1982) created an exhibition space on the second floor. Upon her retirement in 1982, the second floor gallery was renamed the Jane Hartsook Gallery in her honor. In 2013, the Gallery was relocated to street level and inaugurated with Linda Lopez's New York City solo-exhibition debut. The gallery continues Jane Hartsook's legacy in its new location, leading the field in the presentation of the most important ceramics exhibitions in New York City.

The Residency and Fellowship Program is designed to support artists' projects and increase awareness around the importance of creative engagement with ceramics. Operating since the early 1960s when Jane Hartsook invited Peter Voulkos to teach and work at the Pottery, and reinvented in 2013, when Ghada Amer was invited to be a long-term resident. In its current form, the program is an opportunity for experienced ceramic artists to have the time and resources to experiment and create a new body of work, and for artists adept in other media to have the space and support to learn how to work creatively with clay.

GHP is an art center supporting artists and their projects, and teaching and promoting ceramics to the world. Through war, depression, recession and a century of growth and change, GHP perseveres and remains a stalwart of innovation and art. It offers a diverse program of classes for adults and children; solo, group and juried exhibitions; residency and fellowship programs; a lecture series; Masters Series Workshops; and community outreach, all of which serve newcomers, amateurs and professional artists alike. GHP plays a vital role in community building and providing access to the arts. We offer a chance to learn from clay in a direct way and to foster connections between artist, material and community.

Adam Welch, Director 2019
“WHEN I FIRST STEPPED INTO THE DOORS OF GREENWICH HOUSE POTTERY, I FELT A SENSE OF WELLNESS, A FEELING OF PLACE AND ATMOSPHERE, WHICH BROUGHT TO ME A SENSATION OF JOY AND COMFORT.”

Rirkrit Tiravanija, Resident Artist 2017
1902
* Greenwich House opens Thanksgiving, at 26 Jones St.
* Gertrude Whitney joins Board

1904-1905
A * Starts offering clay modeling classes in 26 Jones
B * First kiln is installed in the basement of 26 Jones
B * Holds exhibition including clay modeling
* Gertrude Whitney donates $5000 for clay modeling
* Pottery moves to 28 Jones

1908
* Starts a separate department within the Pottery School; here pottery is made and sold outside of regular classes

1909
* Pottery School officially begins under director Leon Volkmar (Director, 1909-1911) at 28 Jones

1910
C * Greenwich House purchases 16, 18, 20 Jones for $40,000 (1910)

1925
D * Partners with the Metropolitan Museum of Art and Elizabeth “Libbie” Custer (widow of George Custer) to film “The Pottery Maker” starring our own Victor Raffo

1926
* Installs new kiln in the basement of 27 Barrow St. published in encyclopedia as “largest of its kind”

1928
* Delano & Aldrich design Greenwich House Arts & Crafts building at 16 Jones Street

1930-1935
* A. Sterling Calder, father of Alexander Calder fires his sculpture at the Pottery

1933
* Jackson Pollack takes class; to pay tuition he becomes our janitor
* Lee Krasner takes a class

1939
E * Pottery exhibits work at the World’s Fair

1942
* Maude Robinson retires (Director, 1911-1942)

1948
* Moves to 16 Jones St., formerly the Arts and Crafts building also known as the Workshops

1950s
* Lilli Miller begins taking classes
* Anna Siok begins teaching

1952
* Bernard Leach and Shoji Hamada visit

1954
* Kitaoji Rosanjin lectures and demonstrates
1960
* 1960-1964, 1978 Peter Voulkos teaches in the summer

1970
* Dedicates Gallery on the second floor

1973
* The Potluck Cook Book is published

1978
* Names the Jane Hartsook Gallery in honor of Jane Hartsook (Director, 1946-1982) upon her retirement

1982
* Names the Jane Hartsook Gallery in honor of Jane Hartsook (Director, 1946-1982) upon her retirement

1983
* Ann Agee Artist in Residence

1984
* Kathy Butterly and Ann Agee on faculty

1999
* Alice Mackler begins taking classes

2005
* Joanne Greenbaum Artist in Residence
* Nicole Cherubini on faculty

2010
* Started GHP Fabrications to produce art for Rirkrit Tiravanija at Gavin Brown Enterprise.
* Ceramics Club begins meeting at the Pottery

2013
* Hires Ogawa | Depardon Architects to relocate the Gallery

2016
* Ghada Amer Artist in Residence
* David Salle takes private lessons

2017
* Ghada Amer has solo exhibition, Déesse Terre
* Rirkrit Tiravanija Artist in Residence
* Crafting Resistance forms by faculty, staff and students to raise $25,000 for the ACLU, $10,000 for NRDC & GrowNYC and $3,000 to Lambda Legal

2018
* Ghada Amer has solo exhibition, Chawan
* Pam Lins Artist in Residence
* Hires Ogawa | Depardon to expand the studio
* The Potluck Cook Book 2 is published

2019
* Breaking ground on first new construction at the Pottery since 1929
* Rirkrit Tiravanija has solo exhibition, Untitled (Billy Wilder doesn’t drink green tea)
STUDENT INFORMATION & GUIDELINES
This information is provided to remind returning students and to acquaint new students with Greenwich House Pottery’s (GHP) guidelines. We encourage each student to become familiar with this information to ensure that things run safely and smoothly in the studios and we can provide you with the best experience possible.

OUR STUDIOS
• Information about the studio and its activities will be listed in Pottery Notes, posted on the Message Center, Social Media, and on the website.
• Follow us on Facebook, Instagram and Twitter to stay current on our activities.
• In case of emergency, exit out the front of the building, if not possible then the garden or the roof.
• First Aid kits are located in the 1st floor bathroom, 1st floor glaze room, 2nd floor bathroom, and each of the 3rd floor studios.
• Cell phones are not permitted in the building or garden except for emergencies.
• GHP and its garden are SMOKE FREE.
• No smoking in front of the building.
• Bathrooms are on the 1st floor in the kiln room and both studios on the 2nd floor.
• You may only attend the class for which you are registered. Under no circumstance may you attend another class.
• Do not handle or touch the work of others.
• If you damage another’s work, leave a note.
• No storing personal possessions on class shelves, under or on top of lockers.
• GHP is not responsible for the loss or damage of work or personal property.
• Locker rentals are $5 per term for currently enrolled students. Limit one per student.
• If a locker is not renewed at the end of the term it will be emptied and reassigned.
• Lock personal items in your locker.
• No student is permitted to remain in the building after closing.

STUDIO STAFF & LIAISONS
• All administrative questions or concerns should be directed to a Liaison.
• Report studio issues to a Studio Technician.
• With questions regarding firings, clay or general studio concerns speak with the Studio Manager or a Studio Technician.
• Firing issues should be directed to the Studio Manager.
• We encourage you to register online; however, Liaisons can register you in the Registration office.

CLAY & GLAZE
• Clay in the barrels is free to use; however, it is not to be removed from GHP.
• Porcelain can be purchased from the Liaison office in 25 lbs bags.
• Recycling buckets are provided for each clay body. Be careful not to mix clays or add foreign materials to the clay or to the bucket.
• Break up clay to reclaim before it dries out.
• When putting clay back into the bucket mash it down to keep it from drying out.
Always leave lids on clay and glaze buckets to avoid drying out and contamination.
No outside clay or glaze is allowed. Any exceptions must have prior approval from Studio Manager.
Glazes are food-safe unless otherwise noted.
Unglazed washes & slips are not food safe.
Do not thin glazes. Ask a Studio Technician for assistance if you have questions about glaze consistency.

FIRINGS & PROCEDURES
- GHP is not a production studio and cannot accommodate large volumes of work due to limited materials, shelf space, and kiln space.
- Always BISQUE work before you glaze fire.
- Place all work on appropriate shelves.
- Low fire clay should NEVER be high fired.
- Do not glaze or apply wash to the bottom of work.
- Do not use stilts in Cone 10 firings.
- Missing work? Check the “Hospital Shelf.”
- Do not let work pile up on greenware or bisque shelves, keep it moving: bisque dry work; glaze bisque work; take home glazed work.
- Work must be measured by the Student Liaisons and paid for prior to firing.
- Work will be measured during measuring times, only.
- All work must be accompanied by a firing slip. For greenware use a class chip.
- GHP is not responsible for lost firing slips.
- Pieces placed on the kiln room shelves without an accurate firing slip will be put on the “Hospital Shelf.”
- Requests for firing credit should be placed on the shelf behind the spray booth with a completed firing credit request form.
- GHP does not issue firing credit for undesired or inconsistent firing results, kiln accidents, or work that is lost or damaged. Firing credit is given at the discretion of the Studio Manager for work that is damaged as the result of mishandling by staff.
- Unclaimed work on the finished glaze shelves, the unclaimed bisque shelves, or hospital shelves are subject to discard after 4 weeks.

CLEAN-UP
- Leave the studio cleaner than you found it.
- Faculty members and studio staff may delegate cleanup responsibilities to ensure complete clean up of the studios.
- Classes and open studio participants are responsible for leaving studios clean.
- Minimize dust: cleanup with a wet sponge.
- Rinse out sponges when done using them.
- Wipe down sink when finished cleaning.
- Tables, bats, ware boards, and banding wheels should be cleaned and put away.
- Potter’s wheels should be cleaned, shut off and splash pans washed and returned.
- Do not store work on bats. Use ware boards.
- Clean up spills as they happen.
- Clean up and leave the building by the end of open studio or closing time.
• Work left on the tables or counters will be discarded.
• All personal items, clothing and shoes, must be taken home during inter-term breaks unless they are stored in a paid locker.

OPEN STUDIO
• Open Studio is only available to currently enrolled students, on a first-come basis.
• Observe studio hours. Clean up before leaving.
• Do not show up early or leave late.
• Open Studio hours are posted on the website and in all the studios.
• No tables or wheels can be saved or placed on hold.
• No children, friends, or pets allowed.
• Keep conversations quiet.
• During Open Studio hours students may use wheel or handbuilding studios, though priority goes to students in the studio that corresponds to their class registration.
• Open Studio time may be canceled for GHP functions or events.
• Glaze room may be used during Open Studio but not during an open studio that runs concurrent with classes.
• When the studio is busy please keep yourself to a 3-hour limit.

STUDIO SAFETY
• Do not touch kilns, opens kilns or attempt to unload kilns.
• Never place anything on kiln lids.
• No sanding or scraping dry clay or glaze in the studio. Always use the spray booth.
• Do not use the spray booth, slab roller, or extruder without an orientation from a teacher or staff member.
• Students should not use the clay hoist, clay mixers, grinders, or dremels.
• No sharp objects, X-ACTOs, razor blades, homemade pin tools, thumbtacks, needles, glass shards.
• We require faculty, staff and students to wear appropriate footwear while in the studio at all times.

MAKE-UPS & CLOSINGS
• During weather emergencies, GHP closes in accordance with the NYC public school system, as broadcast on the radio and local TV news.
• Emergency closures are announced via email and can be retrieved on the phone system at 212-242-4106 ext. 5.
• GHP is not responsible for providing makeup classes or issuing refunds for programs or classes changed or missed due to illness, emergency, weather closings, substitute teachers, or other events beyond our control.
• There are no prorates given for late registration or missed classes.

DISMISSAL
Students are expected to abide by studio rules and to comport themselves in a courteous and polite manner at all times. Greenwich House Pottery reserves the right to exclude from its programs and activities anyone who fails to do so.
CLAY BODIES
CLAY BODIES

GHP clay bodies have, in some cases, been in use for decades. The recipes were introduced through contact with those whom invented them; therefore, we do not take credit for them or claim fidelity to the original recipes as things change over time. In some cases when we have record of the change it will be noted in the recipe.

At GHP we mix and use about 100,000 pounds of clay annually. Our clays are shipped premixed dry (except our porcelain) from Standard Ceramic Supply in Pittsburgh, PA through Ceramic Supply of New Jersey. Previously our clay was shipped from Amherst Pottery in Massachusetts. In 2011, GHP switched its clay distributor which affected our clay composition. Over time, the former manufacturer had adjusted the recipe as needed based on material availability. Therefore some changes had to be made when the switch occurred, which explains why so many took place at that time. Our clay bodies are suitable for handbuilding and throwing. Because we go through so much clay it does not have proper time to age therefore we use a de-airing pugmill for our T1, Throwing, and White Stoneware. Val Cushing wrote, “Four to six weeks of aging will greatly improve the plasticity of all clay bodies—six months to a year is ideal. One run through a de-airing pug mill is the equivalent of three months of aging.”

These clay bodies can be used for high-fire or low-fire and in reduction or oxidation atmospheres, although results vary according to atmospheric conditions and the temperature reached within the kiln. High-fire indicates the clay bodies are formulated to vitrify at or around \( \Delta_{10} \). Typically, though not always, high temperature firings occur within a reduction atmosphere. Low-fire indicates the clay bodies are formulated to mature at or around \( \Delta_{04} \). Low temperature clay and firings are likely fired in an oxidation or neutral atmosphere. The red earthenware is low-fire clay and is not formulated for temperatures above \( \Delta_{04} \) firings though we use it to good effect in our \( \Delta_{2} \) firings.

In 2013 we added slip casting to our curriculum and hired Hiroe Hanazono to develop and start the program. At that time we introduced a \( \Delta_{10} \) porcelain casting slip using a recipe we received from Beth Katleman via Brad Parsons. Though slip casting had been attempted at other times in our history, it did not take off. Now we operate 4 classes in a separate studio above the kiln room.

In 2015 we added a paperclay class to the curriculum and with it modified two clay bodies, \( \Delta_{10} \) porcelain paper clay slip and a \( \Delta_{10} \) T1 paper clay, with claybody research and development done by Lisa Chicoyne who began the paper clay craze at GHP. We use regular coreless toilet paper in our paperclay. If you can afford it, Lisa recommends pre-shredded cotton linters for additional strength and reduced molding. Paper clay has proven to be more versatile to handle than a regular clay body. The paper fibers create a capillary effect and help the clay rehydrate more evenly so that it can be rewetted and added to without cracking as regular clay would do.
CLAY BODY RECIPES
Ingredients: Measurements are in pounds unless otherwise noted.

SLIP CASTING PORCELAIN (2011, credited to Beth Katleman)
Firing Range: Δ06-10, Oxidation or Reduction
Shrinkage: Green=2%, Δ06=3%, Δ04=3%, Δ2=6%, Δ6=11%, Δ10=13%
Porosity: Δ06=14%, Δ04=13%, Δ2=10%, Δ6=2%, Δ10=1%
Color/texture: White, smooth
Ingredients: Mixed in this order
Water 78
Darvan #7 170ml
Grolleg 81
Custer Feldspar 37
Silica 31

STANDARD S257 ENGLISH PORCELAIN (Formerly Amherst 2011)
Firing Range: Δ06-10, Oxidation or Reduction
Shrinkage: Green=4%, Δ06=5%, Δ04=5%, Δ2=8%, Δ10=14%
Porosity: Δ06=15.1%, Δ04=15%, Δ2=10.2%, Δ10=0.4%
Color/texture: White, smooth

STANDARD S417 RED EARTHENWARE (Formerly Dicarlo 2011)
Firing Range: Δ06-02, Oxidation or Neutral
Shrinkage: Green=6%, Δ06 =6%, Δ04=9%, Δ2=14%, Δ10=10%
Porosity: Δ06 =9.6%, Δ04=6.9%, Δ2=0.3%, Δ10=0.3%
Color/texture: Red, smooth, some grog

T-1 SCULPTURE CLAY BODY (Takako Saito student 1970)
Firing Range: Δ06-12, Oxidation or Reduction
Shrinkage: Green = 7%, Δ06 = 8%, Δ04=8%, Δ2=11%, Δ10=13%
Porosity: Δ06 =10.9%, Δ04=10.3%, Δ2=4.9%, Δ10=1.3%
Color/texture: Orange-tan with iron specks with good green strength
Hawthorne Bond Fire clay 200
Thomas Ball clay 28
Custer Feldspar 25 (added for shivering issues, 2013)
Lizella 20 (replaced Ocmulgee in 2009)
Bentonite 11
Fine grog 70
Medium grog 30

T-1 SCULPTURE PAPER CLAY (Takako Saito 1970/Lisa Chicoyne 2015)
Firing Range: Δ06-12, Oxidation or Reduction
Shrinkage: Green = 7%, Δ06 = 8%, Δ04=8%, Δ2=11%, Δ10=13%
Porosity: Δ06 =10.9%, Δ04=10.3%, Δ2=4.9%, Δ10=1.3%
Color/texture: Orange-tan with iron specks with excellent green strength
Water 9.3 liters
Strained Paper Pulp 14 liters
T-1 clay (See above) 200
THROWING CLAY BODY (Credited to Jeff Oestreich)
Firing Range: Δ06-12, Oxidation or Reduction
Shrinkage: Green=6%, Δ06=7%, Δ04=8%, Δ2=12%, Δ10=15%
Porosity: Δ06=13.5%, Δ04=12.7%, Δ2=4.3%, Δ10=4%
Color/texture: Tan-Brown, speckled in reduction smooth clay
  - Hawthorne Bond Fire clay  350 (increased from 200 in 2016)
  - OM-4 Ball Clay  165 (increased from 50 in 2016)
  - Custer Feldspar  150 (increased from 30 and replaced G200)
  - Fine grog  100 (increased from 30 in 2016)
  - Red Art  100 (replaced Red Iron Oxide 2016)
  - Salt Lick Clay  300 (added in 2016)

WHITE STONEWARE (Credited to Greg Pitts)
Firing Range: Δ06-12, Oxidation or Reduction
Shrinkage: Green= 6%, Δ06=6%, Δ04=6%, Δ2=10%, Δ10=13%
Porosity: Δ06=14.2%, Δ04=13.1%, Δ2=6.7%, Δ10=.1%
Color/texture: White to gray in reduction smooth and plastic
  - Foundry Hill Cream  200
  - Custer Feldspar  206 (changed from G200 in 2016)
  - Flint 200  200 (changed from Flint 325 in 2016)
  - Tile #6  200
  - XX Saggar  150
  - Pyropholite  50
  - Bentonite  20
MIXING CLAY
MIXING CLAY

Equipment:
1. Pound scale
2. Clay mixer
3. Dust mask

Procedure:
1. Calculate the quantity of clay.
2. Measure the materials using scale.
3. If mixing from scratch add water first according to total desired quantity.
4. Add clay ingredients slowly before adding fillers and allow to mix.
5. If using bentonite, mix with water up to 24 hours before to allow water to percolate between clay particles.
6. If using nylon fibers mix with hot water so that they can disperse.
7. If using barium carbonate, mix with water prior to adding it to the clay.
8. If adding macaloid, mix with water prior to adding to the clay.
9. Check consistency. If it is getting too dry stop adding dry clay.
10. Mix entire batch for 10 minutes. Over mixing heats the clay up, drying it out and wears down the equipment.

MIXING PAPER CLAY

Equipment:
1. Metal mesh strainer
2. 5-gallon bucket
3. Clay mixer
4. Electric drill and blunger
5. Dust mask

Procedure:
1. Put 9.3 liters of water in clay mixer.
2. Add 1 bag dry clay or 50 pounds of premixed clay recipe.
3. Mix to slip consistency.
4. Prepare pulp by breaking down 1 roll of coreless toilet paper in hot water and mix with blunger until paper becomes slurry.
5. Strain excess water from the pulp and measure out necessary amount.
6. Add strained paper pulp to slip.
7. Using your hand, make sure the pulp is completely mixed into slip. Scoop slip from the bottom of the clay mixer so that it is mixed in thoroughly.
8. Add 1.5 cups of bleach and mix, which helps with mold growth and smell.
9. Add dry clay mixture slowly and allow to mix before additions.
10. Check consistency. If it is getting too dry stop adding dry clay.
11. Scrape the sides of mixer and continue to mix.
12. Mix entire batch for 10 minutes. Over mixing heats the clay up, drying it out and wears down the equipment.
MIXING PAPER CLAY SLIP

Equipment:
1. Metal mesh strainer
2. 2 5-gallon buckets
3. Drill and blunger attachment
4. Dust mask

Procedure:
1. Decide on your paper to clay ratio by volume of slip to toilet paper pulp. We use 1 part strained pulp to 4 parts slip.
2. Measure out necessary slip and mix to a smooth consistency.
3. Prepare paper pulp by breaking down toilet paper in hot water and mix with blunger until paper becomes slurry.
4. Strain excess water from the pulp and measure out necessary amount.
5. Add pulp to slip and mix well, making sure to check bottom of bucket.

MIXING PAPER CLAY SLIP for the 3D Printer

Equipment:
1. Plastic or metal taping knife
2. Clean printing tube
3. Same procedure as above, yet half the paper pulp.
4. Add water to the clay to soften, consistency should be unwedgeable but not yet liquid, like a Brie.
5. Scrape out air bubbles with a paint scraper until a decent amount accumulates.
6. Wedge into the clay canister and repeat until full.
7. Air bubbles in the clay will cause the print to sputter. (Eun-Ha Paek)
TESTING YOUR CLAY BODY
**ABSORPTION TEST**

Absorption is an indication of the pore space within fired ware. Stoneware and earthenware never actually reach zero pore space, while porcelains come quite close. For unglazed ware to be functional in the modern sense of sanitary ware it can tolerate about 1% porosity without leaking. Industry has differing tests to determine the absorption rate of ceramics. Using the fired clay bars from the shrinkage test, weigh each fired bar dry. Boil the bars in water for an hour, remove each separately, blot and re-weigh: This gives you your clay body’s porosity at each firing temperature. We sampled 5 bars for each temperature. The test herein is standard within the field, though one industrial example recommends 5 hours boiling and 19 hours soaking.

\[
\text{fired weight wet} - \text{fired weight dry} \times 100 = \% \text{ of absorption}
\]

\[
\text{fired weight dry}
\]

**SHRINKAGE TEST**

Conducting shrinkage tests on your clay will give you a better understanding of what your clay body goes through during its different stages from wet to fired. Make test bars of each clay body you use in your studio, two or more bars for each temperature for greater accuracy, we sampled 5 bars for each temperature. Make the bars 5” L x 2” W x ½” thick and mark a 10 cm line with short perpendicular lines across the ends of the line. Use centimeters for greater accuracy. To calculate the shrinkage, measure each clay bar from wet to dry and from dry to fired by: \( \Delta 06, \Delta 04, \Delta 2, \Delta 6, \Delta 10 \), or whatever your preferred firing range(s).

\[
\text{wet to dry: line wet} - \text{line dry} \times 100 = \% \text{ shrinkage}
\]

\[
\text{line wet}
\]

\[
\text{dry to fired: line dry} - \text{line fired} \times 100 = \% \text{ shrinkage}
\]

\[
\text{line dry}
\]

\[
\text{wet to dry} \% + \text{dry to fired} \% = \% \text{ total shrinkage}
\]

Average Shrinkage: Earthenware 10%, Stoneware 12–15%, Porcelain 15–17%

**WATER WEIGHT TEST**

To calculate the % of water in clay, first it is necessary to discover the water content of a piece of plastic clay.

Plastic weight – Dry weight = Weight of water

Dry Clay: \( \frac{\text{weight of water}}{\text{weight of dry clay sample}} \times 100 = \% \text{ moisture content} \)

Plastic Clay: \( \frac{\text{weight of water}}{\text{weight of plastic clay}} \times 100 = \% \text{ moisture content} \)
GLAZES
GLAZES
Our glaze recipes come from many sources. The $\Delta_{10}$, $\Delta_{6}$ and $\Delta_{04}$ glazes at GHP are regarded as food safe unless otherwise noted. (*To be certain of the safety of a glaze have your pottery tested by the Brandywine Science Center. Phone: 610-444-9850 web: www.bsclab.com/Pottery_Testing.html.) This means our glazes are, in theory, chemically stable and contain no lead, barium or other materials currently deemed toxic when fired properly. Whether or not a glaze is “food safe” is determined by a number of factors: glaze and clay body maturity and solubility or stability of fired glaze materials. For a glaze to be food safe it must be properly sealed (i.e. clay and glaze have bonded properly and fired to maturity).

Our “not-food-safe” glazes are so designated because they are unstable in the fired state and may leach. High-fire clays that have not been fired to maturity (i.e. $\Delta_{6-10}$) have not had sufficient temperature to vitrify the clay and bond glaze to ceramic. Low-fire glazes on high-fire bodies might craze and peel off because the thermal expansion is not suited to the high-fire clay and food or liquid can penetrate the glaze surface. For this reason we consider our low-fire glaze food-safe ONLY when applied to our low-fire Red Earthenware.

The finished results of a glaze has many variables: kiln temperature, length of firing, where it is in the kiln, density of the kiln stack, volatile oxides, kiln atmosphere, barometric pressure, length of firing, timing of reduction, rate of cooling, glaze application, and even the length of the time the work sits on the shelf waiting to be fired. With this many variables it can be difficult to achieve consistent results, which is why we are cautious of test tiles.

NOTES ABOUT GLAZE APPLICATION
All glazes are affected by application including but not limited to, thickness, thoroughness of mix, specific gravity (relative density), thickness of the bisqueware, peak temperature achieved, the surrounding ware and firing atmosphere.

1. Bisque the object. We only fire glaze work that has been bisqued first.
2. Clean off bisqueware by either quickly rinsing under running water, let dry completely (30 minutes), brush off, or spray with air to clean off dust.
3. Stir the glaze thoroughly, be sure to scrape & stir the bottom and sides of bucket.
4. If using wax or latex resist allow to dry completely before glazing.
5. Use dipping tongs, dip into glaze, pour over your piece, or use your hands then shake piece and wipe the foot and the lid/gallery.
6. You can also spray glaze on the ware using a spray gun.
7. If using multiple glazes allow glaze to dry between coats or risk contamination.
8. Know the glaze and your desired application (this takes experimentation).
9. Glaze that is too thick can run or crawl.
10. If the glaze begins to crack and peel when drying, rub cracks.
11. If the glaze flakes off or has been applied too thickly, wash off the glaze entirely and allow drying for 24 hours before re-glazing.
MIXING GLAZES

Equipment:
1. Triple beam gram scale for measuring
2. Two 5-gallon buckets - A 10,000-gram batch of glaze will fit in a 5-gallon bucket, one to mix one to pour into while sieving
3. Jiffy mixer and drill
4. Sieve - A 60-mesh or an 80-mesh sieve
5. Dust mask

Procedure:
1. Calculate the quantity of glaze.
2. Measure the materials using scale; add to an appropriately sized container.
3. Dry mix the measured materials in the container; avoid raising dust.
4. Wet mix by adding about 2/3 water by volume and stir.
5. Sieve the glaze through a 60-mesh or 80-mesh sieve at least 2 times to remove lumps and evenly distribute materials pouring from one bucket through the sieve into the other bucket.
6. When adding bentonite mix with water up to 24 hours in advance.
7. Consistency of glaze should be a heavy cream. Do not mix in more water than needed to reach this consistency. It is easier to thin out a glaze then it is to make it thicker.
Δ10 GLAZE RECIPES
Ingredients are in grams

ADAM WELCH AVERAGE SHINO (Replaced spotted shino in 2010)
Color: Rust to white carbon-trapping
Nepheline Syenite 3800
Spodumene 1700
OM 4 Ball Clay 1100
EPK (or Georgia) 1000
Minspar 200 1000
Custer Feldspar 400
Redart 200
Soda Ash (dissolve) 800

BYRD MATTE
Color: Matte brown to tan, glossy & blue gray on whiteware
Nepheline Syenite 6500
Dolomite 2100
Zircopax 900
OM 4 Ball Clay 500
Bentonite 300
Manganese Dioxide 200
Cobalt Carbonate 50

CHARLIE D BLACK
Color: Opaque semi-gloss black, breaks bluish black over whiteware
Nepheline Syenite 2000
Minspar 200 2000
Silica 2000
Dolomite 1500
Talc 1300
OM 4 Ball Clay 1000
Whiting 200
Cobalt Oxide 500
Mason Stain 6600 300
Manganese Dioxide 300
Bentonite 175
Epson Salts (dissolve) 200

CHINESE WHITE (Added in 2016)
Color: Opaque gloss white.
Glaze settles fast and hard. Stir regularly.
Custer Feldspar 8300
Zircopax 1000
Whiting 900
Silica 800
Bentonite 330
CHUN BLUE
Color: Opaque gloss orange rust to mottled baby-blue with some violet
Minspar 200 4556
Silica 2944
Gerstley Borate 952
Dolomite 952
Whiting 281
Zinc Oxide 184
EPK 130
Bentonite 100
Copper Carbonate 82
Rutile 433
Tin Oxide 281

CHUN RED
Color: Opaque glossy mottled red to pink-grey when thin
Custer Feldspar 4230
Silica 2680
Gerstley Borate 880
Dolomite 880
Strontium Carbonate 400
Tin Oxide 260
Whiting 260
EPK 230
Zinc Oxide 180
Copper Carbonate 50

DARK CELADON
Color: Transparent glossy olive green, darker green
Minspar 200 4400
Silica 2800
Whiting 1800
EPK 1800
Red Iron Oxide 240
Manganese Dioxide 120

DON REITZ GREEN
Color: Matte green to black
Nepheline Syenite 7007
EPK 707
Petalite 1519
Whiting 507
Gerstley Borate 202
Cobalt Carbonate 101
Rutile 101

HIGH ALUMINA MATTE
Color: Matte speckled tan, off-white and lavender on whiteware
Custer Feldspar 4890
EPK 2510
Dolomite 2240
Whiting 350
Epsom Salts (dissolve) 200
NELSON’S CELADON
Color: Glossy green to icy-green
Minspar 200 4400
Silica 2800
Whiting 1800
EPK 1000
Red Iron Oxide 100
Bentonite 100

OESTREICH TENMOKU
Color: Glossy black breaks brown
Custer Feldspar 4838
Whiting 1164
EPK 537
Silica 2014
Zinc Oxide 224
Barium Carbonate 224
Bentonite 300
Red Iron Oxide 805

OHATA KAKI (Added in 2016)
Color: Glossy persimmon rust
Custer Feldspar 3000
Silica 2000
EPK 2000
Dolomite 1500
Bone Ash 1500
Red Iron Oxide 1000

OLD YELLOW
Color: Satin yellow to ochre
Nepheline Syenite 6390
Dolomite 2110
Zircopax 1600
OM 4 Ball Clay 430
Red Iron Oxide 100
Bentonite 300
Epson Salt (dissolve) 200

ORIBE (Not Food Safe)
Color: Gloss iridescent dark green
Custer Feldspar 3090
Silica 2530
Whiting 2240
EPK 1250
Talc 780
Bone Ash 110
Black Copper Oxide 550

RUTILE GOLD MATTE
Color: Satin yellow gold - blue, runny if thick
Custer Feldspar 4900
OM 4 Ball Clay 2500
Dolomite 2250
Whiting 350
Rutile 800
### SCHERZER RED
Color: Opaque satin matte brick red to golden ochre metallic black

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### (GHP) SUE’S CLEAR
Color: Transparent gloss icy green

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### TEMPLE WHITE
Color: Opaque satin cream white

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<td>Dolomite</td>
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<tr>
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### VAL’S (CUSHING) BLUE (aa cobalt blue)
Color: Matte blue to black

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<tr>
<td>Cobalt Carbonate</td>
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</table>

### VAL’S (CUSHING) GREEN (aa copper blue-green)
Color: Matte blue-green to black

<table>
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<tr>
<th>Ingredient</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Cornwall Stone</td>
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<tr>
<td>Whiting</td>
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<tr>
<td>EPK</td>
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<tr>
<td>Tin Oxide</td>
<td>400</td>
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<tr>
<td>Copper Carbonate</td>
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### WHITE SHINO
Color: Opaque glossy orange salmon to white. Crawls when thick

<table>
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<tr>
<td>Nepheline Syenite</td>
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<tr>
<td>Spodumene</td>
<td>1520</td>
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<tr>
<td>OM 4 Ball Clay</td>
<td>1500</td>
</tr>
<tr>
<td>Minspar 200</td>
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<tr>
<td>EPK</td>
<td>1000</td>
</tr>
<tr>
<td>Soda Ash (dissolve)</td>
<td>400</td>
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</table>
YING CHING BLUE
Color: Transparent glossy light blue
- Custer Feldspar 4000
- Silica 3000
- EPK 1000
- Dolomite 700
- Strontium Carbonate 600
- Whiting 310
- Red Iron Oxide 150
- Cobalt Carbonate 50 (up from 25g in 2014)

Δ6 GLAZE RECIPE
Ingredients are in Grams

HIROE HANAZONO CLEAR (Added in 2011)
Color: Clear with slight green hue
- Minspar 200 3500
- Silica 2100
- EPK 1000
- Whiting 800
- Gerstley Borate 1800

Δ04 GLAZE RECIPES
Ingredients are in Grams

ANDREA GILL’S MAJOLICA
Color: Opaque semi-gloss white
- Frit 3124 6600
- Minspar 200 1800
- EPK 1000
- Nepheline Syenite 600
- Zircopax 1500
- Bentonite 300

BERMUDA BRUCE (added in 2015)
Color: Green glossy
- Gerstley Borate 4365
- Nepheline Syenite 1575
- EPK Kaolin 1485
- Silica 1395
- Bermuda Green Stain 900

BLUE BRUCE (added in 2015)
Color: Sky glossy blue
- Gerstley Borate 4365
- Nepheline Syenite 1575
- EPK Kaolin 1485
- Silica 1395
- Robin's Egg Blue Stain 900
DEB’S BLUE
Color: Deep sea blue
Frit 3195 3600
Frit 3134 2400
EPK 2000
Copper Carbonate 200
Cobalt Carbonate 40

DEB’S MOSS GREEN
Color: Translucent light green
Frit 3195 3600
Frit 3134 2400
EPK 2000
Copper Carbonate 200
Burnt umber 320

DEB’S ORANGE-RED
Color: Orange-red
Frit 3195 3600
Frit 3134 2400
EPK 2000
Mason stain 6026 400

DEB’S PURPLE
Color: Light to medium lavender
Frit 3195 3600
Frit 3134 2400
EPK 2000
Mason Stain 6385 240
Cobalt Carbonate 24

EXPERT BROWN (added in 2015)
Color: Light glossy brown
Frit 3195 7920
EPK Kaolin 900
Bentonite 180
Golden Ambrosia Stain 630

EXPERT GREY (added in 2015)
Color: Glossy gray
Frit 3195 7920
EPK Kaolin 900
Bentonite 180
Cobalt-free Black Stain 45
Tin Oxide 270

FAT YELLOW
Color: Translucent bright yellow
Frit 3124 8500
EPK 1000
Flint 500
Mason Stain 6450 800
Bentonite 300
JACKIE’S GREEN
Color: Satin grass green
Gerstley Borate 3420
Lithium Carbonate 900
Nepheline Syenite 450
EPK 450
Silica 3870
Victoria Green Stain 900

JACKIE’S IVORY
Color: Matte pearlescent ivory
Gerstley Borate 3040
Lithium Carbonate 800
Nepheline Syenite 400
EPK 400
Silica 3360
Bentonite 80
Light Rutile 320
Zircopax 480

JACKIE’S PEACOCK BLUE
Color: Matte mottled peacock blue
Gerstley Borate 3040
Lithium Carbonate 800
Nepheline Syenite 400
EPK 400
Silica 3360
Bentonite 80
Copper Carbonate 240

KATHY’S AMBER
Color: Transparent glossy amber
Frit 3124 3000
Gerstley Borate 3000
Nepheline Syenite 2000
EPK 1000
Silica 1000
Red Iron Oxide 400

KATHY’S TURQUOISE
Color: Glossy turquoise
Frit 3195 3000
Gerstley Borate 3000
Nepheline Syenite 2000
EPK 1000
Flint 1000
Copper Carbonate 200

KD CLEAR
Color: Transparent gloss clear
Frit 5301 1430
Gerstley Borate 535
Silica 1430
EPK 2860
**PAD DUSK**  
Color: Light turquoise  
- Lithium Carbonate: 2090  
- Nepheline Syenite: 5600  
- EPK: 875  
- Magnesium Carbonate: 40  
- Rutile: 240  
- Mason Stain 6319: 3000

**ROB’S SATIN MATTE BLACK**  
Color: Opaque satin black  
- Minspar 200: 2400  
- Whiting: 880  
- Zinc Oxide: 400  
- Gerstley Borate: 900  
- Frit 3124: 1920  
- EPK: 800  
- Manganese Dioxide: 640  
- Copper Carbonate: 400  
- Red Iron Oxide: 160  
- Chrome Oxide: 80

**WEIRD BASE**  
Color: Semi-transparent satin clear  
- Gerstley Borate: 5000  
- Wollastonite: 5000

**YELLOW BEAD** (Not Food Safe) (added in 2015)  
Color: Opaque yellow beading  
- Frit 3195: 3850  
- EPK: 1400  
- Magnesium Carbonate: 1750  
- Praseodymium Stain: 700
SLIPS / WASHES / TERRA SIGILLATA
/ REPAIRS / KILN WASH / RESISTS
SLIPS
Slip is typically considered an underglaze, that is, it is applied under the glaze. Industry makes underglaze which is slip that is formulated to be applied on greenware, bisqueware or even over a glaze. Industry has added gum or sodium silicate to help with application and settling. Slips are a mixture of clay, possibly a colorant, and water used for coating a clay body, generally applied to the surface of greenware to change its color, texture and/or to add decoration. Because slip is made of clay it shrinks as the clay body shrinks which allows it to be applied to wet and/or leather-hard clay. If applied to bisque do not apply too thickly as it will likely crack and/or flake off. Alternatively, use a deflocculated slip or one with calcined clay for bisqueware. Slip is not to be confused with an engobe, though often these terms are used interchangeably. An engobe is cross between slip and glaze, firing to a more vitreous state than slip though not as dense as glaze. Engobe is made with a flux and a colorant in addition to clay.

Slip is also a term for a process: To slip and score. This slip (slurry) is used as a construction adhesive to ensure greater joint strength between clays, i.e., handles, slabs, coils, etc. Slip is like glue for clay. This slip is generally the same clay formula as the clay body—only wetter. There is no reason you could not use colored slip to join clay together, other than the bond might be weaker with the addition of colorant.

Δ04-Δ10 SLIP RECIPES
Ingredients are in grams

**BARRY’S FISH SAUCE** (BASE)
Color: Matte white
- Grolleg 4370
- Minspar 200 2350
- Silica 1560
- Bentonite 940
- Pyrophyllite 780

**BLACK SLIP**
Color: Matte black to brown
- Grolleg 2190
- Redart 2190
- Minspar 200 2350
- Silica 1560
- Bentonite 940
- Pyrophyllite 780
- Red Iron Oxide 500
- Black Iron Oxide 300
- Manganese Dioxide 300
- Cobalt Oxide 100
COBALT SLIP
Color: Matte blue
Grolleg 4370
Minspar 200 2350
Silica 1560
Bentonite 940
Pyrophyllite 780
Cobalt Oxide 150

GREEN SLIP
Color: Green
Grolleg 4370
Minspar 200 2350
Silica 1560
Bentonite 1560
Pyrophyllite 780
Chrome Oxide 400 *replaced Green Chrome Stain, 2017

RED SLIP
Color: Matte red
Grolleg 2190
Redart 2190
Minspar 200 2350
Silica 1560
Bentonite 940
Pyrophyllite 780
Red Iron Oxide 500

RUTILE SLIP
Color: Matte tan
Grolleg 4370
Minspar 200 2350
Silica 1560
Bentonite 940
Pyrophyllite 780
Rutile 80
WASHES
Washes, also called majolica stains, sink-in decoration and inglaze, are similar to watercolors and can be applied to bisque, over or under glaze. If a wash is applied to the foot of a pot it may pick up kiln wash when fired. A typical application is to apply wash over majolica glaze, but they could work over all glazes, though it is advisable to test first. Wash can be applied to the surface of bisqueware and then wiped clean leaving residue behind in the recesses. Washes are extremely concentrated colorants and will act as a flux in combination with glaze or if applied too thickly, often causing the glaze or wash to run. This can damage kiln shelves, other people’s works and your own piece. Be careful!

Using Ceramic Stains* or Oxides to Create a Wash
At GHP we mix ceramic stain or oxides with gerstley borate (hydrated calcium borate, which means it contains calcium and boron) to create a soft glaze. A soft glaze is a low temperature glaze that melts between 1112°F–1922°F. It is designed this way so that it can be applied on top of an unfired glaze so that when fired it “sinks-in” (i.e. fluxed in) and stains the glaze. These “washes” traditionally were used as an inglaze decoration painted on top of majolica, but have been adopted for many other purposes. Compare with enamel or lustering, which are onglaze techniques that do not flux into the glaze below.

Stains are purchased in powder form and are used in clay bodies, glazes, slips and enamels. The strength of color depends on the amount of stain used in the mixture. Typical applications of stains are: up to 5% in transparent glaze, up to 10% in opaque glaze and up to 15% in clay bodies. Experiment and test. Stains are expensive so use only as much as needed to get your desired effect.

CERAMIC STAINS VERSUS OXIDES
Stains mostly maintain their color through environmental change whereas oxides will be dramatically affected by the firing atmosphere and the glaze formula. Oxides are the chemical combination of oxygen with a metal. Unlike stains the colors they produce in the firing is dependent on the oxides “around” them. Therefore to achieve certain colors it is necessary to create a bond in isolation and protect the colorant from combining with the “wrong” molecules. These stains are made by mixing together the oxides or materials and calcining them so that they combine on a chemical level. Compared to oxides, stains are formulated to give the same color without interference with the environment. Further still there are stains that are encapsulated by zircon through sintering (a mutual attraction and bonding without a liquid melt that happens just before the liquid phase, an electrical friction). Zirconium silicate (a compound of zircon and silica) is the basis for many high-temperature stains and is mostly unaffected by temperature up to 2372°F.

We have long termed these as “washes”, ceramic stains mixed with a flux and water, though that moniker is actually a verb not a noun. The idea is that the “wash” is used similarly to watercolor painting, applied to greenware, bisque, as inglaze, over or underglaze.

*Mason Stains, Cerdec-Degussa, Spectrum, Blue Heron are proprietary
MIXING WASHES AND STAINS

Equipment:
1. Triple beam gram scale for measuring
2. Clean sealable container for storing
3. Dust mask

Procedure:
1. Calculate the quantity of wash needed
2. Measure the materials using scale; add to an appropriately sized container
3. Mix into 1 pint of water to make a thin watercolor-like consistency
4. To make your own washes, start with a 50:50 mix of stain and Gerstley Borate and test
5. Add more Gerstley Borate if test is dry after it is fired

Δ04-Δ10 WASHES RECIPES
Ingredients are in grams

BLACK COPPER WASH
Color: Matte black
Gerstley Borate 100
Black Copper Oxide 150

BLUE WASH
Color: Matte bright blue
Gerstley Borate 441
EPK 8775
Mason Stain 6339 220.5 (Royal Turquoise Blue Stain)

GERSTLEY BORATE WASH
Color: Matte milk white/brownish
Gerstley Borate to taste

GREEN WASH
Color: Matte green-brown
Gerstley Borate 441
EPK 8775
Chrome Oxide 220.5 *replaced Mason Stain 6209, 2017

RED IRON WASH
Color: Matte red to black
Gerstley Borate 100
Red Iron Oxide 167

RUTILE WASH
Color: Matte yellow to tan
Gerstley Borate 100
Rutile 167
TERRA SIGILLATA

NOTES ABOUT TERRA SIGILLATA APPLICATION:
Terra sigillata, also called “Terra Sig” is applied to greenware with a soft brush. If you desire a burnished finish, apply sigillata to a bone-dry pot, a few square inches at a time. When the area has lost its surface moisture but is still dark, rub with a soft cotton cloth, plastic bag over your finger, the back of a spoon, or a stone. You may apply several coats, but more than two can cause the sigillata to flake. Terra sigillata does not work well under glazes because its dense burnished surface is less porous and therefore is less easy for glaze to adhere. The ideal firing temperature range is $\Delta 04-\Delta 02$ to maintain burnishing but it can be fired up to $\Delta 10$.

Equipment:
1. Measuring cup
2. One-gallon container with lid
3. Length of clear rubber or plastic flexible hose
4. Ball Mill

Procedure:
1. Dissolve the soda ash in 1 cup of hot tap water then pour into the other 13 cups of cold water.
2. Blend clays into this water and mix well. Break up lumps. Use a mixer if available.
3. Ball-milled for 6 to 10 hours.
4. Let stand, undisturbed, for 24 hours.
5. Do not move the container; carefully siphon off the uppermost, thinnest liquid. This thin liquid is the Terra Sigillata.
6. Adjust through the addition or evaporation of water to measure 1.2, or less, on a hydrometer, the consistency of skim milk.

$\Delta 04-\Delta 10$ TERRA SIGILLATA RECIPES

Ingredients are in Grams

**BLACK TERRA SIGILLATA**

Color: Opaque matte black
- Fire Clay 500
- OM4 Ball Clay 500
- EPK 500
- Black Iron Oxide 105
- Manganese Dioxide 105
- Black Stain (6600) 210
- Soda Ash 10
- Water 14 cups

**WHITE TERRA SIGILLATA**

Color: Opaque matte white
- OM 4 Ball Clay 500
- EPK 1000
- Soda ash 15
- Water 14 cups

**RED TERRA SIGILLATA**

Color: Opaque matte brick red
- Newman Red 300
- Redart 1200
- Soda Ash 15
- Water 14 cups
KILN WASH
A mixture of refractory materials, kiln wash is used to protect the kiln shelves from glaze, washes, and melting ware. It is made to the consistency of heavy cream so that it can be painted on the shelf between firings. It is formulated so that it adheres to the shelf but is able to be scrapped off after firing and reapplied. In a private studio some might decide not to use kiln wash. Kiln wash can cause issues, as it can fly around in the kiln, drop into work during the firing and prevents alternating the kiln shelves from firing to firing - something done to keep them from warping.

TRADITIONAL KILN WASH
Alumina Hydrate 5000
Silica 5000

GHP CURRENT KILN WASH (2017)
Alumina Hydrate 500
Silica 250
EPK 250
Gerstley Borate 40

RESISTS
Wax resist is melted wax or wax emulsion traditionally been used to coat the bottom of a pot or gallery of a lid to resist glaze during application. Before industry began producing water-based wax products paraffin wax was used. Paraffin is a petroleum based wax that would need to be heated prior to application. It was smelly and toxic and required a heating source. Shellac and latex are also popular materials in the decoration process. Anything that creates a barrier between the surface and the liquid/substance being applied is a resist; paper, tape, crayon, etc.

New wax products are much easier to use and nontoxic. Wax resist can be applied to greenware, bisqueware or fired ceramic surfaces to assist in the decoration process. It has also been used to help slow the drying of handles to help reduce cracking. It can also be used over top of shino glaze to encourage varying glaze effects. There are several brands that one can buy that vary in quality and cost. We add black food dye to our resist so that it is easier to see in the application process. Be careful when applying wax, once it is on the piece there is no taking it off unless it is fired. We add alumina to our wax to create “lid wax” or wax that helps to create a barrier between the lid and gallery.

Latex resist is excellent for use where you require multiple layers or need to be able to remove the resist prior to adding additional layers.

COLORING WAX RESIST
Food dye Add to taste
Wax Pint

LID WAX
Alumina Hydrate 1/2 cup
Wax Pint

REPAIRS
Repairing greenware, bisqueware and glazed ware is extremely difficult with varying degrees of success. Though commercial products have been invented to aid in repairing, such as Aztec Mender, Magic Mender and Patch-A-Tatch, we have discovered that paper clay is the most consistently reliable material for repairs of both greenware and
bisqueware. Other homemade remedies are below.

PAPER CLAY REPAIR (Researched and compiled by Lisa Chicoyne 2018)

Uses: Repairs bisque and greenware (Make repairs with same base clay as original.)
1. Mix clay into slip the consistency of yogurt. Sieve out grog.
2. In a separate container make paper pulp with a handful of TP in warm water.
3. Strain water from pulp using a wire mesh strainer.
4. Measure out three parts slip and one part paper pulp (25% paper clay.)
5. Mix well. It should have an oatmeal-like consistency.

REPAIRING YOUR BISQUE PIECE (Traditional clay + paperclay)
1. If you are joining parts, thoroughly wet both parts. If repairing a crack saturate it.
2. Generously apply paper clay slip and put the two parts together.
3. For crack repairs push as much slip into the crack as possible.
4. Allow piece to dry, if seam or crack present using a paint brush wet the area and add more slip. Use a soft rubber rib to compress slip into cracks. Dry and repeat as necessary. Clay shrinks when it dries so you may need repeat a couple of times.
5. Clean unwanted slip using a damp sponge.

For large and/or structural repairs you should bisque fire again before glazing. For small repairs (non-structural) you do not need to bisque again before glazing.

BASIC REPAIR STEPS
Clear your workspace. Always work in an uncluttered area and give yourself plenty of time to do your repair.
6. Evaluate the break or crack. What material are you going to use? Do you have all the pieces? What kind of supports will you need?
7. Gather and prepare all necessary materials: all the pieces, tools, soft padding and supports, repair material, ware board or firing tray.
8. Inspect the repair. Plan your strategy. How do the pieces fit together? Do you need to score or prepare parts. Set up your repair pieces so you know ahead of time how you are going to approach your repair. Carefully note how the pieces fit together.
9. Follow procedure for the material you chose to use for your repair. For most materials you will have to work swiftly while the material is wet.
10. Allow plenty of time for your mended parts to dry before handling your piece. Once you've set the parts do not disturb until it's dry, and even then treat the broken piece carefully.
11. For major repairs (to bisque) always bisque again. Minor bisque repairs may not need to be

TIPS FOR SUCCESSFUL REPAIRS:
• Repairs take time and attention. Don't rush and don't try to take short cuts.
• If using a coarse or grogged clay, sieve slip before making repair mixture. Smoother clay does a better job.
• Always check the fit and plan your repair before applying repair material to your pieces.
• Rough surfaces hold repairs better than smooth surfaces. When possible roughen
or score surfaces to be repaired.
• Complex repairs or multiple breaks may require drying and setting one part before repairing subsequent parts.
• Hairline cracks: It's almost impossible to get repair material into the crack. You can try to widen the crack by carving away some clay.
• The larger the surface area for the repair, the better chance you have of success.
• Use foam, newspaper, etc. to help support piece while you work. You want to limit the stress on the break as much as possible.
• When possible reinforce breaks with extra repair material around the break. The challenge is to make repaired area look blended and intentional.
• After making the repair do not move the piece until it is completely dry. Most failed repairs are due to disturbing the repair.
• Always inspect repair before firing and add more repair material if traces of the crack are visible. Remember, clay shrinks as it dries.
• Always wait for the repair material to dry before lightly sanding or painting with underglaze and/or glaze.
• Always let the repair dry completely before firing.
• Take great care when loading the repaired piece into the kiln. Use a firing tray to avoid mishandling. Protect the repaired area.

REPAIRING GREENWARE
Uses: Repairs greenware
1. For breaks and large cracks generously apply paperclay slip and put parts together. DO NOT WET CLAY.
2. For small cracks open up crack a bit by carving away clay. Fill with paperclay slip.
3. Allow piece to dry. Add more slip if crack reappears.
4. Repeat as needed.
5. Sand lightly to clean up.

BISQUE REPAIR
Uses: to repair cracks in bisqueware
White Glue 50%
Sodium Silicate 50%
Add: EPK
Water until mixture is the consistency of mayonnaise

GREENWARE PATCH
Uses: Repairs leatherhard clay cracks and breaks
Vinegar 1 teaspoon
Karo Syrup ¼ cup
Soda Ash pinch
Nylon Fibers pinch
Powder Clay till pasty consistency

MAGIC WATER
Uses: Aids to prevent cracking and supports joints
Sodium Silicate 3 tablespoons
Soda Ash 5 grams
Water 1 gallon
<table>
<thead>
<tr>
<th><strong>GHP CLAYBODY</strong></th>
<th><strong>Method</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apt II Enhancer (High Fire)</strong></td>
<td>Use same slip as piece you are repairing, add Apt II until slip thickens, apply Apt II to dry areas to be fixed; while wet, apply slip mixture and press parts together. Cleanup excess. Tip: Use Apt II to thicken glaze when glazing a piece.</td>
</tr>
<tr>
<td><strong>Apt II Enhancer (Low Fire)</strong></td>
<td>Use same slip as piece you are repairing, add Apt II until slip thickens, apply Apt II to dry areas to be fixed; while wet, apply slip mixture and press parts together. Cleanup excess with a tool. Tip: Use Apt II to thicken glaze when glazing a piece.</td>
</tr>
<tr>
<td><strong>Aztec Hi-Fire Mender</strong></td>
<td>Fill container to ridge above label with matching slip, mix well. With a brush, apply to edges to be repaired (bisque or dry greenware). (Do not apply water). While mender is still wet press parts together and hold until they stick together.</td>
</tr>
<tr>
<td><strong>Magic Mender (Aztec)</strong></td>
<td>Do not wet clay. Use like glue. Fire to 04.</td>
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<tr>
<td><strong>Magic Water</strong></td>
<td>Not recommended for dry repairs. Use for wet attachments only.</td>
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<tr>
<td><strong>Paperclay</strong></td>
<td>Use same slip as piece you are repairing. If clay has grog, sieve. Slip should be thick like yogurt. Dissolve toilet tissue in hot water until it's pulp, strain excess water but do not squeeze. Use 3 parts slip to one part pulp. (Looks like oatmeal.) Wet clay before patching.</td>
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<tr>
<td><strong>Patch-A-Tatch (Duncan)</strong></td>
<td>Greenware: roughen up surface with needle tool, moisten surface to be fixed with water, apply one layer of Patch-A-Tatch then put broken edges together while still wet. For bisque: wet edges, apply one layer of Patch-A-Tatch. Let dry and fire. Cleanup with water if needed. Lowfire use only.</td>
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<tr>
<td><strong>Thermeez 7020 Putty</strong></td>
<td>Apply to bisque, use like glue to join parts. Use soft rib to smooth. Fires to cone 10. After firing has black specs so if leaving unglazed or using a transparent glaze cover with underglaze before glazing. Can be used to fill cracks after glaze firing. Refire. Let dry before glazing.</td>
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<tr>
<td><strong>Vinegar</strong></td>
<td>Wet broken surfaces to mend with vinegar, make light slurry on surface of break. Put parts together hold until bonded. Not a reliable method.</td>
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<tr>
<td><strong>Vinegar, clay &amp; syrup</strong></td>
<td>Mix dry clay with vinegar to thick consistency. Add a little syrup (1-2 tsp to ¼ cup slip), mix well. Use like glue. Not tremendously reliable but with some care it can work. There are many other better choices. Will not repair bisque.</td>
</tr>
</tbody>
</table>
### Dry Greenware Repairs

- **Earthenware**
- **Porcelain**
- **T1**
- **Throwing Clay**
- **White Stoneware**

<table>
<thead>
<tr>
<th>Earthenware</th>
<th>Porcelain</th>
<th>T1</th>
<th>Throwing Clay</th>
<th>White Stoneware</th>
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○ Dry Greenware Repairs  ● Bisque Repairs  ◊ Glaze Fired Repair

Research conducted by Lisa Chicoyne 2018
“GREENWICH HOUSE POTTERY IS A NEW YORK TREASURE: ALIVE; ESSENTIAL; AWAITING YOUR DISCOVERY. GREENWICH HOUSE POTTERY IS ONE OF THE GREAT GIFTS OF NEW YORK.”

Jerry Saltz, Senior Art Critic for New York Magazine, Pulitzer Prize for Criticism
GLOSSARY: TERMS & MATERIALS
GLOSSARY: TERMS & MATERIALS

MATERIAL: alias, see OTHER SOURCE. F,A,G,O,C*, (Formula). Definition.

These are definitions of terms, processes, and techniques useful to the field, that are now or have been used at the Pottery over the century, or they can be found in this handbook. This is by no means an exhaustive list and has been culled from many other books that contain much more detailed information. The authority on definitions is The Potter’s Dictionary, if you want more information we recommend you go there first. With each definition we have included other information such as other names that the material is called as well as the scientific formula. We have coded them with one or more letters–F,A,G,O,C–which corresponds to their function within a glaze. This information comes from Robin Hopper’s, The Ceramic Spectrum, which is a superb book about glazes. There are times when materials fulfill multiple functions within a glaze. If the material is listed F,A,G (For Any Glaze) it has everything it needs to be a glaze. The key is as follows:

*Flux, Alumina, Glass-Former, Opacifier, Colorant:
These terms represent how the material acts in a glaze or clay body. To be a glaze the formula needs to have Flux, Alumina and a Glass-former and the Opacifier and Colorant to alter the color and texture of the finished surface. It is often the case that one material can fulfill multiple functions in a particular mix.

ACTIVE FLUX: Fluxes do not all act the same. Some are active at low temperatures and others at higher temperatures. Active flux means that it has a strong fluxing action.

AGING: There is no definitive answer for the optimum time for aging clay – associated with the percolation of water between clay particles. Some say it is a matter of days while others believe it takes years. Aged clay is more plastic and workable than un-aged clay. Val Cushing said that “Four to six weeks of aging will greatly improve the plasticity of all clay bodies - six months to a year is ideal.”

ALBANY CLAY: see ALBANY SLIP. C
ALBANY SLIP: New York slip, Albany clay. C. A plastic alluvial clay from

Albany, New York used extensively in clay and glaze until 1986 when the mine closed. It turns into glaze between Δ8-10 without any additional material.

ALKALINE EARTHS: see OXIDE. Oxides of calcium, barium, magnesium, and strontium.

ALKALINE METALS: see OXIDE. Oxides of sodium, potassium and lithium.

ALLUVIAL: Material deposited by a river.

ALUMINA: see ALUMINUM OXIDE. A.

ALUMINA HYDRATE: hydrated alumina. A. (Al₂O₃ • 3H₂O) or (Al₂ • (OH)₃). A refractory material and a source of alumina used primarily for kiln wash and wadding.

ALUMINUM OXIDE: alumina corundum, dialuminium trioxide, aluminium sesquioxide. A. (Al₂O₃).
Refractory, used in glazes to promote viscosity, stability, gives hardness and durability. In a glaze it promotes matte surface and helps adhere glaze to the ceramic surface, with too little the glaze will run with too much it pinholes. In clay bodies aluminum oxide is a refractory material and cuts down drying shrinkage.

**ALUMINUM SESQUIOXIDE:** see **Aluminum Oxide.**

**ANTIMONATE OF LEAD:** [naples yellow](https://www.ghp.org). \((\text{Pb}_3\text{(SbO}_4\text{)}_2)\) This is a poisonous creamish yellow pigment once used to introduce antimony oxide into lead glazes.

**ANTIMONY OXIDE:** diantimony trioxide, stibium sesquioxide. \(\text{G}_2\text{O}_3\text{C}.\) An oxide whose properties are determined by its combination with other oxides. A glass-former but also a opacifier and used to produce yellow.

**AP GREEN:** see **Fire Clay.** Mined in Missouri, has medium plasticity and low shrinkage.

**ASH GLAZE:** Made with wood or vegetative-derived ash characteristically runny.

**AUXILIARY FLUX:** see **Secondary Flux.**

**BAKING SODA:** see **Sodium Bicarbonate.**

**BALL CLAY:** blue clay. \(\text{A.}\) A highly plastic fine particle refractory clay that adds plasticity to clay bodies and alumina to glaze in addition to acting as a suspender. It has a higher shrinkage rate than stoneware and fire clay.

**BALL MILL:** jar mill, pot mill, pebble mill. A machine that uses ceramic balls within a rotating cylinder to more finely crush material within a liquid.

**BARITUM CARBONATE:** \(\text{F.}\) \((\text{BaCO}_3).\) A secondary flux in high temperature glaze producing satin matte. Not food safe in low-fire glaze. (.02-.08%) added to clay stops scumming or efflorescence, mix with water before adding to the clay body.

**BARIUM OXIDE:** \(\text{F. O.}\) \((\text{BaO}).\) An auxiliary flux in frits and high-temperature glaze. It can have a crystallizing effect and gives satin mattes.

**BARNARD CLAY:** see **Earthenware Clay.** An iron-bearing earthenware clay and is often used as a substitute for Albany slip.

**BENTONITE:** \((\text{Al}_2\text{O}_3 \cdot 5\text{SiO}_2 \cdot 7\text{H}_2\text{O}).\) An extremely fine particle colloidal volcanic clay consisting mainly of montmorillonite used in clay for plasticity and dry strength - up to 3%, though it has a high shrinkage rate. In glaze it keeps the mix in suspension. Mix with water up to 24 hours before to allow water to percolate between the clay particles.

**BICHROMATE OF POTASH:** potassium dichromate. \((\text{K}_2\text{Cr}_2\text{O}_7).\) A soluble crystalline material with a bright red-orange color. It is used to introduce chromium oxide into low-temperature glazes.

**BISQUE:** The first firing of greenware (GHP fires bisque to \(\Delta 06\) or \(1828°F\)) making the ceramic sufficiently hard to accept glaze and durable enough to handle. It is also chemically different from clay and therefore cannot return back to a state of workability. \(1112°F\) is generally accepted as the point of ceramic change - the temperature where the clay turns to ceramic.
BLACK COBALT OXIDE: see Cobalt Oxide. C.
BLACK COPPER OXIDE: cupric oxide. see Copper Oxide. C. (CuO). Coarser grain size and yields more copper than copper carbonate.
BLACK CORE: carbon core. The dark gray/black center seen in sherds – the result of heavy or over reducing, where carbon built up in the body cannot burn out. Normally, oxygen enters the pores of the clay and combines with the carbon and escapes as a gas. In reduction the carbon cannot escape. To remedy, go slowly from 1382°F - 1652°F in oxidation. During this time carbon will take the oxygen from red iron oxide, resulting in the production of black iron oxide and at 1652°F the newly produced black iron oxide becomes a flux and cannot be reoxidized. It is believed that the greatest cause of black coring in bodies is insufficient burn out in bisquing. The effect weakens the clay body and leads to dunting and bloating.
BLACK IRON OXIDE: ferrous oxide. synthetic magnetite. C. (Fe₃O₄). A source of iron for clay and glaze and it disperses better than Red Iron Oxide.
BLISTERING: Unwanted gassing that results in bubbles and craters in the glaze that occurs when the glaze has not had time to smooth out, or is applied too thickly, or incompatible glaze combination.
BLOATING: Blistering or swelling of the clay body caused by trapped gases resulting in bumps on the surface.
BLUE CLAY: see Ball Clay.
BLUE JOHN: see Fluorite.

BLUNGER: A machine commonly used in the pottery industry for mixing clay and water.
BONE ASH: calcium phosphate. F.O. (Ca₃(PO₄)₂) or (4Ca₃(PO₄)₂CaCO₃). Ground calcined bones, usually of a cow, it is produced by calcining and crushing bone. It is a high-temperature secondary flux and an opacifier in low-temperature glaze. It gives the translucency to bone china.
BONE CHINA: A translucent English porcelain made with a minimum of 30% bone ash. One recipe to try is 25% Kaolin, 25% Cornwall Stone, 50% bone ash.
BORATE: A chemical compound which includes the element boron.
BORAX: tincal. F,G. (Na₃O • 2B₂O₃ • 10H₂O) or Na₂B₄O₄ • 10H₂O). A powerful flux in glaze.
BORIC ACID: (H₃BO₃) or (B₂O₃ • 3H₂O). Crystalline water soluble boron mineral.
BORIC OXIDE: boron oxide. F. (B₂O₃). An active flux with a low coefficient of expansion.
BOROCALCITE: see Colemanite.
BORON: (B). Chemically uncombined boron is not found on earth.
BORON OXIDE: see Boric Oxide. F.
BUCK SPAR: see Potash Feldspar. F,A,G. Possibly short for Buckingham Feldspar a potassium feldspar.
BUCKINGHAM FELDSPAR: see Buck Spar.
BURNISHING: Polishing leatherhard clay by rubbing with a smooth pebble or the back of a spoon and works best if fired under Δ03. Typically a technique used with Terra Sigillata.
BURNT UMBER: C. (Fe₂O₃ • H₂O • MnO₂ • SiO₂). Hydrated calcined iron oxide, a form of ochre with a significant amount of manganese.
CALCINE: Heating a material to red heat or a minimum of 1112°F, removing the chemically bonded water and thus giving it the same chemical content without the additional shrinkage. Calcined materials are useful to reduce shrinkage in clay bodies or glaze.

CALCINED KAOLIN: \( \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \). Kaolin that has been fired to at least to 1112°F to remove the chemically bonded water and eliminating the shrinkage. Used in clay and glaze to reduce shrinkage and crazing.

CALCIUM BORATE: see GERSTLEY BORATE. F,G.

CALCIUM CARBONATE: carbonate of lime, whiting, limestone, lime. F,O. (CaCO\(_3\)). Carbonate of lime used to introduce calcium oxide into glaze. It is the most frequently used flux in high temperature glazes and helps reduce fired shrinkage in low temperature bodies.

CALCIUM FLUORIDE: see FLUORITE.

CALCIUM MAGNESIUM CARBONATE: see DOLOMITE. F,O.

CALCIUM METASILICATE: see WOLLASTONITE. F,G.

CALCIUM OXIDE: F, (CaO). A flux used in nearly all glazes giving whiteness, hardness, and durability while lowering the coefficient of expansion.

CAMPBELL RED CLAY: Clay mined in New Jersey. Most likely an earthenware clay.

CAN SPAR: Unidentified feldspar used in the Mottled Blue \( \Delta o6 \) glaze from the archive.

CARBON: Is present in most clays which gives clay its grayish color, though this is removed during the bisque oxidation firing. Carbon builds up on pots during atmospheric firings, what is often termed sooting. Though later the carbon burns off helping produce heat within the kiln. This carbon will not burn off unless proper oxidation occurs above 1292°F will discolor glaze and cause black core.

CARBON CORE: see BLACK CORE.

CARBON TRAP: Glazes with patterns of gray and black below the surface caused in an atmospheric firing without adequate oxygen. Carbon is refractory and stays in the glaze as long as the kiln is in a reduction atmosphere. Typical of high sodium glazes with considerable solubility. Early reduction before glassification of fluxes enables the porous clay to trap carbon which later appears as spots within the glaze.

CARBONATE: To combine or infuse with carbon.

CARBONATE OF LIME: see Calcium Carbonate, F,O.

CARBOXYMETHYLCELLULOSE: see CMC GUM.

CAROLINA STONE: see CORNWALL Stone. F,A,G.

CASTING SLIP: A clay and water solution with deflocculant used in slip-casting.

CERAMIC: Keramic. Clay that has been made permanent through heat. Originating with the Greek, keramos.

CERAMIC CHANGE: The change from workable plastic clay into hardened ceramic. After this point the clay can no longer be rehydrated and worked. Once it is subjected to heat of about 1112°F, it is no longer plastic clay. This is done through higher temperature heating that removes the two molecules of water that are molecularly bound.
CMC GUM: carboxymethylcellulose. A glaze suspender used to harden unfired ceramic glazes.

COBALT CARBONATE: F,C. (CoCO₃). A strong blue colorant and flux used in glaze and slip. More finely ground than the oxide which gives more even color.


COEFFICIENT OF EXPANSION: expansion, thermal expansion. The physical change of an oxide when heating and cooling affecting the way glaze and clay bodies react to one another. Too much of a difference creates glaze flaws (see blistering, crawling, crazing, dunting, shivering). Here is a list of the oxides listed in order of highest expansion to least.

<table>
<thead>
<tr>
<th>Oxide</th>
<th>Coefficient of Expansion</th>
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</thead>
<tbody>
<tr>
<td>Na₂O (Sodium Oxide)</td>
<td>4.32</td>
</tr>
<tr>
<td>K₂O (Potassium Oxide)</td>
<td>3.90</td>
</tr>
<tr>
<td>BaO (Barium Oxide)</td>
<td>1.73</td>
</tr>
<tr>
<td>CaO (Calcium Oxide)</td>
<td>1.63</td>
</tr>
<tr>
<td>PbO (Lead Oxide)</td>
<td>1.06</td>
</tr>
<tr>
<td>B₂O₃ (Boric Oxide)</td>
<td>0.66</td>
</tr>
<tr>
<td>MgO (Magnesium Oxide)</td>
<td>0.45</td>
</tr>
<tr>
<td>Al₂O₃ (Alumina)</td>
<td>0.17</td>
</tr>
<tr>
<td>ZnO (Zinc Oxide)</td>
<td>0.07</td>
</tr>
<tr>
<td>SiO₂ (Silica)</td>
<td>0.05</td>
</tr>
</tbody>
</table>

COLEMANITE: borocalcite, hydrated calcium borate, pandermite, priceite, (2CAO • 3B₂O₃ • 5H₂O). A powerful flux, source of insoluble boron, and adds brilliance in color and gloss for glazes.

COLLOIDAL: A substance that consists of particles dispersed throughout another substance.

CONES: (Δ) see Pyrometric Cones. Cone chart on page 67.

producing a wide range of colors and very responsive to atmospheric change inside the kiln. It is volatile so will affect pieces near it in the kiln.

**COPPER CARBONATE ORE**: see **Malachite**.

**COPPER MONOXIDE**: see **Copper Oxide**.

**COPPER OXIDE**: F, C. (CuO). A flux that is responsive to atmosphere in firing.

**COPPER STANNATE**: (CuO₃Sn). Used in the Δ₁₀ glaze Copper Red Kring #2 from the archive.

**CORDIERITE**: (2MgO • 2Al₂O₃ • 5SiO₂). A magnesium aluminum silicate with low thermal expansion used for kiln furniture.

**CORNISH STONE**: see **Cornwall Stone**. F, A, G.

**CORNWALL STONE**: carolina stone, china stone, cornish stone, df stone, growan. F, A, G. A feldspathoid material more complex than potash or soda feldspar and contains numerous trace elements, is low in iron and used as a flux in clay and glaze.

**CORUNDITE**: see **Aluminum Oxide**.

**COTTLE**: cockle, cockling. Expendable wall of wood, metal or plastic to contain poured plaster in the mold making process.

**CRACK**: A break in greenware, bisqueware or glazeware. There are several varieties of cracks; each has a uniqueness that aids in discovering the reason for it.

**CRAWLING**: A glaze effect or defect, depending on intention, characterized by glaze separating from the clay body and forming beading or bunching on the surface. It can be caused by dirt, dust or oil on the bisque before glaze is applied or from the glaze being applied to thickly.

**CRAZING**: Is a common glaze effect (crackle) or defect characterized by fine cracks in the glaze surface. It is caused by the glaze contracting more than the ceramic body, glaze thickness or rapid cooling. To remedy, try increasing the silica, boric oxide or alumina or you can decrease the feldspar; alternatively, you can alter the clay body by adding silica.

**CROCUS MARTIS**: (FeSO₄). Is an anhydrous iron sulfate calcined copper used in glazes as a substitute for red iron oxide.

**CRYOLITE**: cryolite, kryolith. sodium hexafluoroaluminate. (Na₃AlF₆). A fluoride of aluminum and sodium and a source of insoluble sodium used in enameling, frits and glaze used in crater glazes.

**CUPRIC OXIDE**: see **Black Copper Oxide**.

**CUPRIC STANNATE**: (CuO₃Sn). Used in the Δ₁₀ glaze Copper Red Kring #2 from the archive.

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giving greater workability. Val Cushing wrote: “Four to six weeks aging will greatly improve the plasticity of all clay bodies—six months to a year is ideal. One run through a de-airing pug mill is the equivalent of three months aging.”

**SEE AGING.**

**DEFLOCCULANT**: A material that disperses clay particles.

**DEFLOCCULATION**: The action of dispersing clay particles and making slip, clay and glaze more fluid and requiring less water.

**DF STONE**: see Cornwall Stone. F.A.G.

**DIALUMINIUM TRIOXIDE**: see Aluminum Oxide. A.

**DIANTIMONY TRIOXIDE**: see Antimony Oxide.

**DOLOMITE**: calcium magnesium carbonate, F.O. (CaMg(CO₃)₂ or CaCO₃)

- MgCO₃). A high temperature flux with calcium and magnesium producing matte durable surfaces.

**DUNTING**: Cracking of ceramic caused by stress during cooling, primarily from the contraction of body and glaze, if cooled too fast and/or from stress from the glaze and body. Some types:
- A thick layer of glaze on the inside of a pot and a thin or no glaze on the outside resulting in a spiral dunt
- If the glaze stops short of the foot producing a ring crack.
- If the glaze pools inside the pot creating a split that carries up the rim.
- Unequal thickness of the body.
- A thin brittle body.
- A thin, open or weak body that is underfired.

**DEARTHENWARE**: A porous clay ware made from low firing secondary clay.

**EARTHENWARE CLAY**: Common, usually red, ground clay that contains impurities, and has a low maturing temperature. Used to make earthenware.

**EFFLORESCENCE**: In French means “to flower out” is when salt leaches through to the surface within a porous material. It happens through the dissolving of an internally held salt. The salted water migrates to the surface, then evaporates and leaves a coat of salt on the surface.

**EGYPTIAN PASTE**: A low-temperature self-glazing clay body.

**ENGobe**: A term used interchangeably with “slip”, though it includes materials in addition to clay. An engobe is halfway between slip and glaze, firing to a more vitreous state than slip though not as dense as glaze.

**EPK**: see Kaolin. Stands for Edward Plastic Kaolin, mined in Florida.

**EPSON SALT**: magnesium sulfate, F. (Mg₄SO₄ • 7H₂O). A deflocculant used in glaze usually with gerstley borate. Improves plasticity in clay bodies.

**EUTECTIC**: The lowest melting point of two or more substances when combined which is always a lower melting point than either of their individual melting points.

**EXPANSION**: see Coefficient of Expansion.
FELDSPAR: F,A,G. (K$_2$O • Al$_2$O$_3$ • 6SiO$_2$). An alumino-silicate mineral similar to clay with a proportionally higher flux. The single most important material in high temperature glaze as it contains all three necessary constituents.

FERRIC OXIDE: see Red Iron Oxide. F,O,C.

FERROUS OXIDE: see Black Iron Oxide. C.

FERROUS TITANATE: see Ilmenite. C.

FILLER: Material added to clay bodies to control plasticity, increase working strength and reduce shrinkage.

FIRECLAY: A relatively pure coarse particle clay that is highly refractory though the varieties vary widely in properties.


FLASHING: A visual effect on bare clay surfaces in fuel burning kilns particularly wood kilns. This flashed area has been subjected to a thermal variation due to contact with flame, ash or kiln atmosphere and vapors.

FLINT: G. (SiO$_2$). A black variety of quartz and a source of silica.

FLAMEPROOF CLAY BODY: A clay body that can withstand direct flame for use in cooking.

FLOCCULATION: Altering the physical properties of particles in a suspension so that they aggregate and settle.

FLUORIDE: (F-). An inorganic anion of fluorine and the main component of fluorite.

FLUORINE: (F). Is an extremely reactive and poisonous chemical element and the primary source of fluorine is fluorite.

FLUORITE: blue john, calcium fluoride, fluorspar, (CaF$_2$). Is composed of calcium fluoride. It is used in frit preparation and as a low temperature opacifier. It is an active flux at the same time that it opacifies. At higher temperatures fluorine becomes volatile and is released as a poisonous gas.

FLUORSPAR: see Fluorite.

FLUX: Any oxide that lowers the melting point of a clay body or glaze.

FOUNDRY HILL CREAM: see Stoneware. A clay blend similar to a ball clay.

FRENCH CHALK: see Talc. F,G.

FRET: Materials that have been combined and heated into glass and reground removing the toxicity hazard. In clay bodies frit strengthen, improve glaze fit, limit glaze defects and lower the vitrification point.

G


GALL CLAY: see Ochre. C.

GERSTLEY BORATE: calcium borate. F,G. (CaO • B$_2$O$_3$ • 5H$_2$O). The preferred flux used in glaze as a replacement for colemanite.
GLASS-FORMER: The oxides used to form glass in glazes.

GLAZE: Any substance that melts and fuses into place at a given temperature rendering the ceramic ware food safe and/or giving color to form. For a glass surface there are three necessary constituents, 1) Flux 2) Alumina 3) glass-former and for effect you can add 4) opacifier 5) colorant.

GODFREY SPAR: see Sodium Feldspar. F.A.G.

GOLDART: see Stoneware Clay. A plastic variety of stoneware clay.

GOLD LUSTRE: see Lustres.

GREENWARE: Clay that is not yet fired.

GROG: chamotte. see Molochite. Fired clay which has been ground and used in clay bodies as a filler to reduce shrinking, warping and cracking. Grog comes in a variety of mesh sizes usually considered Coarse, Medium, or Fine. Mesh size corresponds to how many holes per inch in the screen. 20-mesh is more coarse then 40-mesh which is more coarse then 60-mesh. For maximum shrinkage reduction and workability it is suggested to use a variety of mesh sizes in combination so the total is made up of 50% coarse, 10% medium and 40% fine grog. Can be used to add dry strength and decrease shrinkage. Other materials can be substituted such as coffee grounds, rice, cheerios, etc.

GROLLEG KAOLIN: see Kaolin. An extremely pure English kaolin.

GROWAN: see Cornwall Stone. F.A.G.

GUM: see CMC Gum.

HAKAME: Slip applied with a wide often straw-like brush causing deep grooved brush strokes.

HARD PASTE PORCELAIN: A porcelain clay composed of feldspathic rock, cornwall stone, and kaolin and fired to a high temperature. Has the advantage over soft paste porcelain because it is less likely to crack when exposed to hot liquids.

HAWTHORNE BOND FIRE CLAY: see Fire Clay. Mined in Missouri

HELMAR KAOLIN: see Kaolin. Mined near Helmar, Idaho with great flashing if woodfired.

HYDRATED ALUMINA: see Alumina Hydrate. A.

HYDRATED CALCIUM BORATE: see Colemanite.

HYDROMETER: see Relative Density. see Specific Gravity. An instrument used to measure the relative density of liquids—the ratio of density of the liquid to the density of water used to create consistency in glaze results.
ILMENITE: ferrous titanate. C. (FeO • TiO₂ or FeTiO₃). The ore of iron and titanium that is used as a colorant in clay and glaze similar to rutile but darker.

IMPURE TITANIUM OXIDE: see Rutile. O,C.

INGLAZE: sink-in decoration. Inglaze is decoration which sinks in to the glaze beneath it. Typically applied on top of an unfired glazed piece which will sink into the glaze below during the firing. Typically used in majolica painting. (See section on Washes)

INLAY: A technique where lines are scratched in clay and filled with colored clay, slip or glaze.

INSOLUBLE: Incapable of being dissolved in water.

JIGGERING: Forming a pot by using a spinning mold which shapes the inside while cutting and forming the other side with a shaper.

JOLLEYING: Forming a pot using a spinning mold which shapes the outside while a profile shapes the inside.

JORDAN CLAY: Jordan Fire Clay, Maryland Ball Clay/Stoneware. A low iron fire clay.

JORDAN FIRE CLAY: see JORDAN CLAY.

KALIUM OXIDE: see Potassium Oxide. F.

KAOLIN: china clay. (Al₂O₃ • 2SiO₂ • 2H₂O). The purest, least plastic and most refractory natural clay, essential for making porcelain.

KARO SYRUP: Corn syrup used for the greenware patch (see Section on Repairs) that when mixed with the other ingredients dries very hard, encouraging bonding.

KEYSTONE SPAR: see Potash Feldspar. F,A,G.

KONA A-3: see Potash Feldspar. F,A,G.

KONA F-4: see Sodium Feldspar. F,A,G.

No longer mined.

KILN: A structure built to contain heat in order to turn clay into ceramic.

CROSS-DRAUGHT KILN: cross-draft kiln. natural-draft kiln. A horizontal kiln where flame and gases travel across the chamber and through the ware, typical of wood fired kilns.

DOWN-DRAUGHT KILN: down-draft kiln, where flames are deflected downward through the chamber, dispersing heat more evenly, before exiting out the chimney in the back or bottom of the kiln.

ELECTRIC KILN: uses electricity to heat the chamber in a neutral/oxidizing atmosphere.

GAS KILN: are usual up or down-draft kilns that use natural gas for combustion to heat clay into ceramic.

NATURAL-DRAUGHT KILN: natural-draft kiln. cross-draft kiln.

UP-DRAUGHT KILN: up-draft kiln. A kiln in which the hot gases and flame pass upwards through the ware to the chimney.

KILN WASH: Is a layer of material between the ceramic ware and the kiln shelf. It is designed to prevent glaze, wash or other fluxing materials from sticking to the kiln shelf. The ingredients that are used are highly refractory. (See Section on Kiln Wash)

KINGMAN SPAR: see Potash Feldspar. F,A,G. No longer mined.

KRYOLITH: see Cryolite.
LANDTHANIDE: Comprises the fifteen metallic chemical elements with atomic numbers 57 through 71 on the periodic table. They are collectively known as the rare earth elements.

LEAD CARBONATE: see WHITE LEAD.

LEATHERHARD: cheesehard. The stage that clay reaches when it can be picked up without being distorted yet soft enough to work, smooth or apply slip and engobe to.

LEPIDOLITE: lithium feldspathoid, lithium-potassium mica. Lithium-potassium mica. (LiF • KF • Al₂O₃ • 3SiO₂). A natural material used to introduce lithium oxide into glaze. It has a lower fusion point than other feldspars and contains fluorine which causes an increase in glaze bubbles and pitting.

LEVIGATION: see TERRA SIGILLATA. Refining clay by floating in water so heavier particles settle out and the smaller particles can be removed.

LIGHT RUTILE: see RUTILE, Q.C.

LIME: calcium oxide. Lime calcium. (CaO). This encompasses several different minerals and manufactured products which are used to introduce CaO into mixtures. CaO is not found in nature. It is used as a flux in glaze and it becomes active above 2012°F.

LIMESTONE: see Calcium CARBONATE. (CaCO₃).

LITHIUM CARBONATE: F. (Li₂CO₃). An active flux with color responses similar to sodium and potassium. Reduces glaze expansion and promotes crystallization.

LITHIUM FELSPATHOID: see LEPIDOLITE.

LITHIUM OXIDE: F. (Li₂O). A powerful flux that can be used in place of potassium and sodium oxides and helps reduce crazing.

LITHIUM-POTASSIUM MICA: see LEPIDOLITE.

LITHIUM MICA: see LEPIDOLITE.

LIZELLA: see EARTHENWARE. A light red earthenware clay similar to Redart though with higher shrinkage and more iron.

LUSTRES: onglaze, metallic compounds suspended in an oil-based resin which when fired in an oxidized firing creates a pure metal. These are typically applied on top of gloss glaze and re-fired at Δ014-019. We began firing on the hotter side for better adhesion.

MACALOID: A magnesium alumino-silicate and refined white variety of bentonite, though not quite as plastic, used to keep glaze in suspension. Mix with warm water before adding to the mixture (less than 3%). Also used as a plasticizer in porcelain.

MAGNESIUM CARBONATE: F. (MgCO₃). A high temperature flux which produces a smooth, buttery, matte surface similar to Dolomite.

MAGNESIUM OXIDE: F. (MgO). A refractory at lower temperature but a flux at high temperature. It lowers the
coefficient of expansion in glazes to reduce crazing.

**MAGNESIUM SILICATE:** see *Talc, F,G.*

**MAGNESIUM SULFATE:** see *Epsom Salt, F.*

**MALACHITE:** *copper carbonate ore,* 
(CuCO₃ • Cu(OH)₂). A weathered ore of copper used as a colorant in glazing.

**MANGANESE CARBONATE:** *C.* 
(MnCO₃). Colorant for glazes. In alkaline glaze it can produce blue-purple and plum.

**MANGANESE DIOXIDE:** *F,C.* (MnO₂). A colorant used to develop purple in low temperature and beige in high temperature glaze.

**MARYLAND BALL/STONEWARE:** see *Jordan Clay.*

**MASON STAINS:** a U.S. supplier of stains used as colorants in glazes, clay bodies, slips and washes.

**MIN-PRO SPAR:** minipro feldspar. see *Sodium Feldspar, F,A,C.* A soda feldspar similar to Kona F-4.

**MINIMUM:** see *Red Lead.*

**MINSPAR 200:** minspar feldspar. see *Sodium Feldspar, F,A,C.* A soda feldspar used to replace Kona F-4 and G-200.

**MISHIMA:** see *Inlay.*

**MOLOCHITE:** *chamotte, grog,* (Al₂O₃ • 2SiO₂). The trade name for calcined china clay with a low-iron content used as a filler in porcelain or white clay to reduce shrinkage and increase green and fired strength. Available in a wide range of mesh sizes.

**MONTMORILLONITE:** the main constituent of the volcanically produced bentonite.

**MOTHER OF PEARL:** An overglaze that produces an opalescent color and is iridescent over white but the overall look depends on the glaze it is applied on. It is typically applied over a glazed surface and then fired again at Δ020.

**NAPLES YELLOW:** see *Antimonate of Lead.*

**N.A. FIRE CLAY:** unidentified fireclay used in one of our sculpture clay bodies from the archives.

**NATRIUM OXIDE:** see *Sodium Oxide, F.*

**NEPHELINE SYENITE:** *neph sye, F.A.G.* (K₂O • 3Na₂O • 4Al₂O₃ • 8SiO₂). Alternative to feldspar, active fluxing powers, high in sodium, which may cause crazing.

**NEUTRAL ATMOSPHERE:**
the atmosphere inside a kiln that is neither oxidizing nor reducing. Typically, an electric kiln fires in a neutral atmosphere going through bouts of reduction and oxidation, though predominantly the latter.

**NEW YORK SLIP:** see *Albany Slip, C*

**NEWMAN RED:** see *Fireclay.* A red burning low plastic fire clay.

**NICKEl CARBONATE:** a mixture of inorganic compounds that contain nickel and carbonate.

**NICKEl OXIDe:** see *Black NiCkEl Oxide.*

**NICKeLIC OXIDe:** see *Black NiCkEl Oxide.*

**NiCkEL SESQUIOXIDe:** see *Black NiCkEl Oxide.*

**NYLON FIBERS:** Short cut fibers used in clay bodies from .1-.5% to increase green and dry strength. Disperse in hot water before adding to the clay mixture. T-153 Available through Hercules Inc. 404-447-9120.
OCHRE: gall clay. C. Colorant used to produce tan, brown and brick red hues. A ferric oxide earth with manganese and other metals.

OCMULGEE: A sandy, coarse, iron bearing sedimentary clay. No longer mined.

OM-4 BALL Clay: see BALL CLAY. Old Mine #4 references the clay mine this clay is harvested in Kentucky.

ONGLAZE: overglaze. Color applied on top of the fired glaze surface and subsequently re-fired. The firing is at a lower temperature than the first glaze firing in order that the first fired glaze is undisturbed while the onglaze color fuses.

OPACIFIER: Minerals used in glaze recipes to make glazes opaque.

OVERGLAZE: see ONGLAZE.

OXIDATION ATMOSPHERE: An atmosphere in a kiln where there is a plentiful amount of oxygen enabling metals in clays and glazes to develop their oxide colors. Typical of electric kilns and the cooling phase in gas kilns.

OXIDE: A binary compound of oxygen with another element.

PANDERMITE: see COLEMANITE.

PAPER CLAY: A clay body that uses paper pulp as a filler to increase green strength. Usually the recipe contains between 5 – 49%. The paper must be mixed with water into a pulp before adding to the clay mixture. (See Section on Clay)

PEARL ASH: potassium carbonate, \( \text{K}_2\text{CO}_3 \). A highly soluble form of potassium, usually used in a fritted form.

PERRINE: Unidentified clay possibly mined in New Jersey that was used in archived sculpture clay body.

PETALITE: \( \text{F}_2\text{A}_2\text{G}_3 \). (\( \text{Li}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 8\text{SiO}_2 \)). Feldspar-like material containing lithium and behaving like Nepheline Syenite, but less likely to craze. It is thermal shock resistant therefore commonly used in flameproof clays (60-70%). Used as a substitute for flint to eliminate expansion caused during quartz inversion which occurs at 439°F and causes cracking in the claybody.

PIN-HOLE: A smooth-edged hole in a glaze surface, usually occurring when a bubble of gas bursts during firing.

PIT FIRING: A way of firing ceramic where the work is placed in a pit and combustibles place all around.

PLASTICITY: Capacity of wet clay to hold its shape. It is associated with the fineness of grain within the clay body. Clay improves with age. Plasticity is difficult to measure. One reason for the development of plasticity over a period of time is the thorough wetting of the clay particles. Over time the water percolates through the clay and permeates each individual particle of clay. One way to speed up the effects of this is to first mix the clay as a fluid slip. After a couple of weeks drying the clay will begin to change and it becomes denser.

PORCELAIN: A vitrified high temperature white ceramic clay body whose main ingredient is kaolin.

POROSITY: The capacity of a fired body to absorb water.

POTASH FELDSPAR: potassium feldspar, potash spar. \( \text{F}_2\text{A}_2\text{G}_3 \). (\( \text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2 \)). The most common form of feldspar and the type generally used in glaze.
**POTASSIUM CARBONATE**: see *Pearl Ash*.

**POTASSIUM DICHROMATE**: see *Bichromate of Potash*.

**POTASSIUM FELDSPAR**: see *Potash Feldspar*.

**POTASSIUM OXIDE**: *kalium oxide*, F. (K₂O). A powerful flux similar to sodium.

**PRASEODYMIUM STAIN**: C. (PR). A chemical element is the third member of the lanthanide series considered a rare-earth.

**PRICEITE**: see *Colemanite*.

**PUGMILL**: A machine used to make and mix clay.

**PYROMETER**: An electronic device indicating the temperature inside the kiln.

**PYROMETRIC CONES**: cones, (Δ). Developed in 1896 by Edward Orton Jr. used to measure the effects of time and temperature inside a kiln. They are made of ceramic material and experience heat the same way as the ware making them a more accurate temperature gauge. In a traditional kiln pack there will be three cones placed in successive order from left to right, lower temperature to higher temperature. The first cone will be the lower of the temperatures and called the “Guide Cone” (one cone cooler). The second cone will be the “Firing Cone” or the temperature the firing should be. The third cone is called the “Guard Cone” (one cone hotter) to make sure you do not over fire. See Cone Chart on Back Cover.

**PYROPHYLLITE**: (Al₂O₃ • 4SiO₂ • H₂O). A hydrous alumino-silicate material used to replace some or all of the flint and feldspar in industrial tile clays. It brings about a decrease in thermal expansion.

**QUARTZ**: see *Silica*, G. (SiO₂). A source of silica in glaze and clay, it increases the expansion rate so is not usually added to sculpture clay.

**QUARTZ INVERSION**: cristobalite inversion, quartz phase, silica inversion. The change in silica (alpha quartz and beta quartz) which occurs every time the crystalline quartz passes through 1063°F and cristobalite inversion at 439°F. There is a change in size which may cause cracks in the ceramic body if it goes through this stage too quickly. There is a 2% increase in volume which is reversible upon cooling.

**RAKU**: American raku is very different from the original Japanese raku, which originated in the 16th century. The American version comes to us from Robert Pipenberg and Paul Soldner. This version is a form of firing in which ceramic objects are pulled out of the kiln at red heat and placed into a container of combustibles.

**RED COPPER OXIDE**: *copper monoxide*, (Cu₂O). See *Copper Oxide*.

**RED IRON OXIDE**: *synthetic hematite*, ferric oxide, F.O.C. (Fe₂O₃). The most common and useful coloring oxides, though very refractory.

**RED LEAD**: minium, red lead oxide, (Pb₃O₄). A powerful low-fire flux creating vibrant color responses from oxides and carbonates.

**RED LEAD OXIDE**: see *Red Lead*.

**REDART**: see *Earthenware Clay*. An earthenware clay with a high iron content.
REDUCTION ATMOSPHERE: An atmosphere where there is little oxygen due to the excess of carbon— an incomplete combustion process. The effect turns the oxides back into their metal state. If not enough oxygen is present during combustion the free carbon will seize oxygen from any source including the oxides in the ceramic materials.

REDUCTION COOLING: When maintaining a slight reduction atmosphere in the kiln during the cooling cycle in order to minimize the reoxidation of clay and glaze.

REFRACTORY: Capable of withstanding high-temperatures.

RELATIVE DENSITY: specific gravity.
Expressed as a number for each material representing the weight of a specific volume of the material. Since 1ml (cc) of water weighs 1 gram the relative density is the same as the weight in grams of 1 cc of the material.

RUTILE: light rutile, impure titanium oxide, O, C. (TiO₂). A natural source of titanium, usually containing iron and occasionally chromium and vanadium. It has a strong effect on other colors and is refractory.

SALT FIRING: A firing process that heats ceramic through gas or wood combustion and at peak temperatures introduces salt into the kiln. The salt volatilizes and the sodium is attracted to the ware creating an orange-peal texture and clear glazed surface.

SALT LICK CLAY: Is a stoneware clay similar to GOLDART but slightly more sandy.

SAGGAR: A container used to protect ware from direct contact with flames and gases. An alternative use is to produce an artificial atmosphere creating localized reduction.

SAGGAR CLAYS: Similar to fireclay and as smooth as ball clay used as an addition to stoneware, terra cotta, and earthenware bodies.

SAWDUST FIRING: A way to fire ceramics using sawdust that creates intensive surface effects. The temperature does not get hot enough to vitrify the clay rendering the ware porous and not functional.

SCUM: Scumming. Light-colored marks that appear along the edges of ware on unglazed surfaces. This is caused by soluble salts in the clay that crystallize at the surface as the water evaporates. Can be corrected with an addition of 1-2% barium carbonate in the clay.

SECONDARY FLUX: A flux that is not active on its own but becomes active when used in conjunction with other fluxes.

SGRAFFITO: A decorative technique where one scratches through slip to the clay body beneath.

SHELLING: A glaze defect in which glaze, or glaze and slip falls from the body in flakes. It is caused because there is an insufficient bond between the glaze and the body. This happens when the slip is applied to the ware when it is too dry or greasy and therefore never properly adheres to the clay. The glaze pulls at the slip which is not properly bonded to the clay.

SHIVERING: A glaze defect in which slivers of glaze shear away from the pot, as the glaze shrinks less than the...
clay body. To remedy try increasing the high expansion oxides, feldspar or decrease the silica. Or you can adjust the clay body by decreasing silica or adding feldspar.

**SILICA:** flint, quartz, silicon dioxide. G. (SiO₂). The main glass-former and source of silica in both glaze and clay.

**SILICON CARBIDE 600:** (SiC). Non-oxide ceramic and is used in products that must perform in situations of high thermal shock. Can be used to make crater or foam glazes.

**SILICON DIOXIDE:** see Silica. G.

**SLIP:** A mixture of clay and water used for coating clays, generally applied to the surface of greenware to change its color, texture and/or to add decoration. Because slip is made of clay it shrinks as the clay shrinks which allows it to be applied to wet and/or leather-hard clay. If applied to bisque do not apply too thickly as it will likely crack and/or flake off. Alternatively use a deflocculated slip or one with calcined clay for bisque ware.

**SLURRY:** slip. A semi-liquid mixture of clay and water, generally used in slipping to attach or the condition in order to recycle clay.

**SOAPSTONE:** see Talc, F,G.

**SODA ASH:** sodium carbonate. (Na₂CO₃). The common source of sodium for glazes, used as a deflocculant in slip.

**SODA FELDSPAR:** see Sodium Feldspar.

**SODA FIRING:** A firing process that heats ceramic through gas or wood combustion and at peak temperatures introduces Sodium Bicarbonate: baking soda. (NaHCO₃).

**SODIUM BICARBONATE:** baking soda. (NaHCO₃). Used in Soda Firing and in Egyptian paste.

**SODIUM CARBONATE:** see Soda Ash.

**SODIUM FELDSPAR:** soda feldspar, soda spar. F,A,G. (Na₂O • Al₂O₃ • 6SiO₂). Less common than potash feldspar and containing more sodium than potassium, though it has a similar performance. A form of feldspar used as a body flux and in glazes as a silicate provider.

**SODIUM HEXAFLUOROALUMINATE:** see Cryolite.

**SODIUM METASILICATE:** see Sodium Silicate. F.

**SODIUM OXIDE:** natrium oxide. F. (Na₂O). An active flux having strong influence on color. It has the highest coefficient of expansion therefore it decreases the tensile strength and causes crazing.

**SODIUM SILICATE:** sodium metasilicate, water-glass. F. (Na₂ • SiO₃ or Na₂SiO₄ or Na₂O • SiO₂). Sodium oxide and silica combined in equal proportions used as a deflocculant, nearly always in conjunction with soda ash. Don Bendel says it “makes water wetter!”

**SOFT PASTE PORCELAIN:** soft paste. see Bone China. A porcelain clay used in manufacturing and is termed “soft” because of its lower firing temperature. It is an early attempt to replicate Chinese Porcelain.

**SOLUBLE:** Susceptible to being dissolved in water.

**SPECIFIC GRAVITY:** see Relative Density.

**SPODUMENE:** F,A,G. (Li₂O • Al₂O₃ • 3SiO₂). A lithium alumino-silicate similar in behavior to petalite. Used in glazes and in flameproof bodies. Substitute for feldspar helps correct crazing.

**STAINS:** Inorganic coloring agent for adding to clay bodies, slips, washes, and glazes.

**STANNIC OXIDE:** see Tin Oxide. O.
STEATIDE: see TALC. F,G.
STIBIUM SESQUIOXIDE: see ANTIMONY OXIDE.
STONEWARE: A hard and vitrified ware fired to a high temperature so named for its resemblance to stone. 2266°F - 2491°F (Δ6 – 14).
STONEWARE CLAY: Clays that mature between Δ5 – 11, and vary in plasticity.
STRONTIUM CARBONATE: F. (SrCO₃). A rare alkaline earth used as a flux in clay and glaze and is a source of strontium oxide.
STRONTIUM OXIDE: F. (SrO). An active flux increasing the fluidity and thermal expansion in glaze.
SYNTHETIC HEMATITE: see RED IRON OXIDE. F,O,C.
SYNTHETIC MAGNETITE: see BLACK IRON OXIDE. C.
SYNTHETIC MALACHITE: see COPPER CARBONATE. F,C.

| TERRACOTTA: see EARTHENWARE. Italian meaning “fired earth.”
| TERRA SIGILLATA: Latin for “sealed earth.” A slip that has been refined by levigation. It has an extremely fine particulate structure and is usually burnished to a high polish. Best if fired between Δ08-02.
| THERMAL EXPANSION: see COEFFICIENT OF EXPANSION.
| THERMAL SHOCK: The stress created in a ceramic object by temperature change resulting from the expansion and contraction of the clay body causing the ware to crack.
| THIXOTROPY: Tendency of a mixture in suspension to gel after setting for a time and to re-liquefy after agitation.
| THOMAS BALL CLAY: see BALL CLAY.
| TILE #6: see KAOLIN. A type of kaolin mined in Georgia.
| TIN DIOXIDE: see TIN OXIDE.
| TIN OXIDE: white tin oxide, tin dioxide, stannic oxide. O. (SnO₂). The most widely used opacifier, whitener and very refractory.
| TINCAL: see BORAX. F,G.
| UNDERGLAZE: Slip or wash that is usually applied to bisqueware underneath the glaze.
| URANIUM OXIDE: yellow uranium oxide. (U₃O₈). A coloring oxide giving yellow, orange and red it has very low radioactivity; however, the final glaze too will be slightly radioactive.
| VANADIUM OXIDE: vanadium pentoxide. F,O,C. (V₂O₅). Is used to produce yellow colors in clay }
and glaze. A rare metal oxide giving weak colors.

**VEEGUM**: VeeGum T, VGT, VeeGum Pro, VeeGum Cer. Is not a “gum” but a material much like bentonite. It is a complex colloidal extremely plastic magnesium aluminum silicate. You must mix with water before adding into glazes or clay. It is used as a suspension agent and hardener in glaze and adds plasticity (up to 5%) in clay bodies.

**VINEGAR**: (CH₃COOH) Is a liquid consisting of between 5-20% acetic acid and water. The acid is produced by the fermentation of ethanol by acetic acid bacteria.

**VITRIFY**: The hardening, tightening, and partial glassification of clay, giving fired clay its hard, durable, dense and rock-like properties.

**VOLATILIZE**: To change from a liquid or solid into a vapor.

**WASH**: A wash is more of an action than a product. We refer to our inglaze or overglaze stains as our washes. (See Section On Washes)

**WATER**: (H₂O). A necessary ingredient in clay and glaze. It passes through several stages in the clay process. Clay is made of up to 40% water.

**SHRINKAGE**: Water that evaporates during drying.

**PORE**: Water the remains when greenware has reached stasis with the atmosphere.

**HYGROSCOPIC**: Water removed when heated above room temperature.

**CHEMICALLY BONDED**: Water driven off at temperatures up to 900°F.

**WATER GLASS**:see Sodium Silicate, F.

**WEDGING**: The preparation of clay involving thorough mixing to expel air and make homogeneous.

**WHITE GLUE**: polyethenyl ethanoate, (C₄H₆O₂). An aliphatic rubbery synthetic polymer. Also known as white glue, school glue, Elmer’s glue.

**WHITE LEAD**: lead carbonate, (2PbCO₃ • Pb(OH)₆). A source of lead for glaze though not in use as it is highly toxic.

**WHITE TIN OXIDE**: see Tin Oxide. O.

**WHITING**: see calcium carbonate. Added to earthenware to counteract crazing.

**WOLLASTONITE**: calcium metasilicate, F.G. (CaO • SiO₂). A natural calcium silicate used to replace whiting and flint. It reduces firing shrinkage and adds thermal shock resistance in clay and glaze. Makes a satin type glaze and added to earthenware to counteract crazing.

**WOOD FIRING**: Firing clay using wood as a source of fuel.

**XX SAGGAR**: see ball clay. Finely grained secondary clay which flashes in the wood kiln.

**YELLOW URANIUM OXIDE**: C. formerly used for clay and glaze coloring but because of toxicity it is no longer used.

**ZINC OXIDE**: F.O. (ZnO). A useful mid-to-high-temperature flux which produces brilliant, glossy, trouble-free glazes. It has a low coefficient of expansion which reduces crazing. High amounts gives a crystalline texture.

**ZIRCOPAX**: zirconium silicate, F.G.O. (ZrO₂ • SiO₂). A flux and opacifier more stable than tin oxide and used to produce white glazes.

**ZIRCONIUM OXIDE**: O. (ZrO₂). An opacifier three times the strength of tin oxide.

**ZIRCONIUM SILICATE**: see Zirconopax.
“GREENWICH HOUSE POTTERY HAS A UNIQUE PLACE IN THE ARTWORLD AS WELL AS THE HISTORY OF ART IN NEW YORK. THE POTTERY HAS A RARE VISION FOR THE IMPORTANCE OF CERAMICS AND CONSISTENTLY EXPRESSES DIVERSE POINTS OF VIEW.”

Ghada Amer, Resident 2013, 2017
REFERENCES AND BIBLIOGRAPHY

POTTERY DIRECTORS
2010 – Present Adam Welch
2007 – 2010 Sarah Archer
1994 – 2007 Elizabeth Zawada
1987 – 1990 Shoshanah Goldberg
1982 – 1987 Susan B. Wood
1945 – 1982 Jane Hartsook (deceased)
1942 – 1945 Patricia Clark Stetson (deceased)
1941 – 1942 William Soini (deceased)
1911 – 1941 Maude Robinson (deceased)
1909 – 1910 Leon Volkmar (deceased)
### ORTON CONE CHART

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JANE HARTSOOK, Director
“THERE IS NO OTHER PLACE LIKE GHP IN NYC. GHP WELCOMES ALL PARTICIPANTS TO EXPERIENCE WORKING TOGETHER AS AN OPTIMISTIC SOCIAL GATHERING. I SEE GHP AS AN AMAZING SOCIAL SPACE.”

Pam Lins, Resident 2013, 2018