Date:
23/02/09

CTM Potters Supplies

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Valentines and Scarva Earthstone Clay Descriptions and Glossary

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Valentines Clay–Terracotta + Stoneware

We usually stock the underlined ones in Exeter but can order any of them and specialise in direct delivery of 1/4 mt, 1/2 mt and 1mt lots by tail lift vehicle.

Terracotta

Standard Red Terracotta – Smooth to Medium – 1080oC-1160oC – Light red, darker as temp. increased. An extremely popular general purpose clay based on a blend of Etruria Marls. Suitable for throwing, handling & casting.

Standard Red Grogged – Medium – 1080oC-1160oC – Light red, darker as temp. increased. Addition of grogg improves throwing strength and increases resistance to cracking and warping on larger pieces. Suitable for throwing and modelling.

Terracotta Fine 120's – Smooth – 1080-1160oC – Light red becoming darker as temp. increased. Blend of Etruria Marls produced finer to make a pleasing smooth finish. Suitable for machining and throwing.

Terracotta V636 – Smooth – 1020oC-1160oC – Smooth – Medium red, darker as temp. increased. Very well behaved clay; blend of Etruria Marls and Shropshire Fire Clays. Good plasticity, suitable for throwing and modelling.

Terracotta RBC 60s – Medium to Smooth – 1040oC-1160oC – Pale red, darker as temp. increased. Contains fine graded China Clay and Etruria Marls. Developed to improve casting. Suitable for all types of production or studio.

Terracotta Sculpture – Medium to Coarse – 1020oC-1220oC – Light red, darker as temp. increased. Contains medium to coarse grogg. Open texture retaining good plasticity and thermal shock resistance. Suitable for large sculptural, garden and slab work.

Terracotta Moulding Clay – Very Coarse – 1020oC-1100oC – Mid red, darker as temp. increased. Traditional coarse, pan milled and pug milled North Yorkshire terracotta clay. Highly plastic, suitable for modelling and sculpture work.

Stoneware

Stoneware V9A – Smooth to Medium – 1180oC-1280oC – Buff to Grey. Excellent general purpose modelling clay, containing Shropshire & South Staffs Fire Clays, fine graded dust free grogg. Suitable for throwing and hand modelling.

Stoneware V9G Grogged – Medium – 1180oC-1280oC – Grey buff to speckled grey. Addition of Grogg giving good resistance to cracking and warping. Behaves well under oxidising and reduction conditions.

Stoneware HT – Smooth to Medium – 1120oC-1280oC – Buff to grey. Recommended for reduction. Contains a fine grogg.
Stoneware HT Grogged – Medium – 1120oC-1280oC – Buff to grey. HT but with addition of mesh graded dust free grogg.
Stoneware HT Special – Smooth to Medium – 1120oC-1280oC – Buff to grey. HT but containing additives to increase resistance to thermal shock. Suitable for oven to tableware.
Stoneware Delta – Smooth to Medium – 1120oC-1280oC – Light Buff to Grey. Pronounced speckle will appear through glaze under oxidising conditions. Suitable for modelling, casting and throwing.
Stoneware Special Fleck – Smooth to Medium – 1150oC-1280oC – Buff to grey. Carefully blended natural stoneware which speckles under normal conditions. Heavier speckling under reduction.
Stoneware White Fleck – Smooth to Medium – 1180oC-1280oC – Off white speckled. Containing high quality China and Ball Clay. Suitable for throwing and modelling with a pronounced speckle.
White Stoneware B17C – Smooth – 1220oC-1280oC – Pale buff. Selected blend of low iron clays providing an ideal background for a decorative approach to stoneware ceramics. Silica sand makes it excellent for throwing.
White Stoneware B17C Grogged – Medium – 1220oC-1280oC – Pale buff. As B17C but addition of fine dust free grogg.
Stoneware White Millennium – Very Smooth – 1160oC-1260oC – Off white. Ultimate white stoneware, firing whiter with high plasticity. Suitable for throwing, modelling and casting and will tolerate e-ware/s-ware conditions.
Stoneware Arctic – Smooth – 1220oC-1260oC – Off White. Even whiter colour, suitable for throwing and modelling.
Stoneware Birch – Smooth to Medium – 1120-1280oC – Buff colour. Good all round clay. Suitable for modelling, throwing and casting.
Crank – Coarse – 1200oC-1280oC – Buff. High plasticity; high thermal shock resistance for large sculpture and slab work.
Stoneware Toasted – Medium to Smooth – 1140oC-1250oC – Warm buff. Carefully blended Stoneware Fire clay and Etruria Clay with a fine grogg. Pleasant reduction under normal oxidising conditions. Suitable as an all purpose body for throwing, hand building and casting.
Raku – Smooth to Medium – 960oC-1060oC & 1220oC-1280oC – Buff to grey. Very fine firebrick grogged clay, suitable for throwing & hand building.
Steve Harrison Body – Medium to Smooth – 1160oC-1280oC – Off White. Similar to the Harry Davis Body, being a white highly versatile fine body containing a fine silica sand with good salt-glazing properties. Suitable for throwing and casting.

Valentines Clay—Porcelain + Additional

Porcelain Clays

Audrey Blackman Porcelain – Very Smooth – 1220oC-1280oC – White and translucent. Developed for modelling and throwing using the finest materials available. Due to high plasticity this body is not suitable for casting and is only available in pugged form.
Royale Porcelain – Very Smooth – 1220oC-1280oC – White and translucent. A blend of Audrey Blackman and Special Porcelain giving high plasticity and ease of handling. Developed by popular demand.
Special Porcelain – Very Smooth – 1220oC-1280oC – White and translucent. High quality porcelain containing fine white clays with an addition of Bentonite. Suitable for modelling, hand building and casting.
P2 Porcelain – Smooth – 1220oC-1250oC – White and translucent. An economy body giving a high degree of translucency at a slightly lower temperature. Suitable for casting and throwing.
Porcelain Grogged – Medium – 1220oC-1300oC – White, translucent. Very plastic, firing extremely white. Fine molochite for drying without cracking or warping. Suitable for throwing, hand building or sculpting. Oxidising or reducing conditions.
Industrial Porcelain – Smooth – 1180oC-1280oC – White. Extremely hard wearing Porcelain when fired upward of 1200oC. Suitable for throwing or modelling, and in grinding applications.
Hard Paste – Very Smooth – 1300oC-1380oC – White. Option A –throwing/pugged & Option B – casting/filtercake. Replicates a Continental type of hard past porcelain – available in two options.

Additional Bodies

Fine Bone China – Very Smooth – 1240oC – White and translucent. Very well know body used extensively by Bone China manufacturers in Stoke on Trent and their overseas subsidiaries. Suitable for casting and machine making.
Parian Body – Smooth – 1200oC-1240oC – White and translucent. A self-glazing body, extremely translucent through a large temperature range. Ideal for cast figurines, dolls, light forms etc.
ETC Semi-Porcelain – Smooth – 1220oC-1250oC – White translucent. Non-bone translucent body to fire along Bone China.
Standard White Earthenware – Smooth – 1120oC-1160oC – White. Suitable for once-firing, giving good green fired strength and produces excellent casting slip.
LF White Earthenware – Smooth – 1060oC-1160oC – Off white. Wide and low fire range. Suitable for throwing, machine making and slab building.

White Earthenware Grogged – Medium – 1080oC-1180oC – Off white. Grogged white earthenware with a wide firing range, suitable for larger work containing white grogg to increase resistance to cracking and warping.

Scarva Clays–Earthstone

Earthstone Clays (Scarva)

E/S 5 Original Body – 1180oC-1280oC – Very white. Highly resistant to warping, cracking and thermal shock. Suited to salt-glazing and reduction firing. Excellent base for colour decoration. Carefully blended with molochite enables it to throw large or wide pieces easily, and is a useful modelling body too. Very popular and versatile clay.

E/S 5 – 20% Original – As E/S 5 with extra molochite.

E/S 10 Extra Smooth – Very smooth – 1160oC-1280oC – Very white. Wide firing range enables use of either low temperature or mid temperature glazes. Excellent base for colour decoration. Throws and casts extremely well; takes sprigged or stamped decoration beautifully. Very reliable quality multiuse clay.

E/S 20 Smooth Textured – 1180oC-1300oC – Very white. Excellent base for decoration; high plasticity and remarkable handling properties make it ideal for throwing, slab building, fine modelling, coiling or sculpture. Low shrinkage due to specially selected molochite means it is highly resistant to warping, thermal shock & cracking and is an excellent hand building body; it is highly recommended for raku, salt-glazes and reduction firings.

E/S 40 Hand Building Material – 1200oC-1300oC – White. This stoneware/ raku body has exceptional handling properties due to the addition of selected and graded molochite creating incredibly strong clay with excellent keying properties, low thermal expansion and high resistance to thermal shock, warping and cracking. Very suitable for large sculptures, large scale slabs and coiling. Its white finish gives excellent results with colour. Its low shrinkage rate means it can be high biscuited and decorated with bright mid temp. colours. It also responds well to stoneware, raku and reduction firing.

E/S 45 Professional Coarse Textured Crank – Very Coarse – 1170oC-1300oC – White. Contains graded chamotte for added building strength and minimizing shrinkage. It is heavily enough grogged to make the most extreme sculptural forms and is highly resistant to warping and cracking. Especially of interest to producers of architectural ceramic handmade tiles, relief panels, murals or restoration work.

E/S 50 Crank – 1160oC-1300oC - Buff – Orange. Produced by the slip house method using lime-free graded grogg providing pure, clean, uniform clay with excellent keying properties, warp resistance, low shrinkage and excellent green and fired strength without the usual disadvantages of lime bearing cranks. Gives toasted buff in oxidation and a rich, warm speckled orange under reduction.

Scarva - Eathstone + Paper Clays + Air Drying

E/S 60 Smooth Textured Crank – 1160oC-1300oC – Similar to E/S 50 but with a finer surface and closer texture – takes surface details well and can be used as a coarse throwing body.
E/S 65 Terracotta Crank – 1080oC-1220oC – Enabling you to create large sculptural pieces without the risk of lime popping, commonly associated with grogged reds. A beautifully textured, richly coloured clay combining the warmth and excellent working properties of red clay with the strength of a crank. Ideal for all types of hand building.
E/S 70 Architectural Body – 1240oC-1300oC – White to off-white – Created with extremely low shrinkage, only 6% from plastic to 1260oC – allowing just sufficient space for grouting. Completely frost proof with excellent thermal resistance.
E/S 75 Smooth Textured Terracotta Crank – Fine grogged alternative to E/S 65 to take surface detail.
E/S 80 Reduction – 1220oC-1300oC – Highly plastic, ideal for reduction firing and for oxidation and salt glazing. Excellent warping and cracking resistance and its high proportion of ball clay make it easy to work. Ideal for producing domestic tableware. Specially developed for the needs of craft and studio potters. Suitable for throwing and jiggering.
E/S 90 Flecked – 1220oC-1300oC – Attractively speckled even in an oxidised electric kiln.
E/S 109 Professional Speckled Stoneware – 1160oC-1290oC – Speckled. Superbly plastic with an attractive speckle; made from ball clays and medium textured silica sands. Gives a reduction effect when fired in an oxidising atmosphere. Designed for the professional potter and is excellent for domestic ware with good thermal shock properties.
E/S 120 Ming Porcelain – 1220oC-1280oC – Extremely white and translucent. One of the best throwing porcelains with excellent standing properties. Fluxed with a slow acting flux to minimise slumping. Intended for cones 7-10.
E/S 130 White Earthenware – 1060oC-1150oC – White. Plastic clay, throws well, excellent colour response and wide firing range. Ideal for school use. Casts well and designed for most commercial low fire glazes. Smooth with no grogg.
E/S 150 Golden Harvest – 1180oC-1280oC – Rich golden harvest yellow. Throws, casts, takes sprigged or stamped decoration beautifully. Highly resistant to warping, cracking and thermal shock. For both S/ware and E/ware firing.
E/S 160 Special – 1200oC-1300oC – White. Excellent base for colour decoration this clay has highly plastic and handling properties making it excellent for large and small pots. Highly resistant to warping, cracking and thermal shock; also suited to salt-glazing and reduction firing. Specially selected and blended

molochite make it incredibly versatile.
E/S 170 Glacier Porcelain – 1250oC-1280oC – White. By using the best and lowest iron bearing china clays, silicas, mineral fluxes & bentonites, Valentines have produced a body that is very white, translucent and plastic - one of the best porcelain bodies available anywhere.

T.S. Flax Paper Clays (Scarva)

E/S 200 Smooth;
E/S 300 Grogged;
E/S 400 White Earthenware;
E/S 600 Porcelain;
E/S 600G Porcelain Grogged
E/S 800 Terracotta
E/S 900 Chunky Crank
Finely chopped fibres of flax and cellulose produce very forgiving clay bodies offering potters the widest possible range of making options. Flax Paper Clay gives strong, flexible lightweight clay with virtually no mould growth. Suitable for raku, oxidation, reduction, salt and soda. The fibres create strong but a flexible internal structure that transfers moisture easily and evenly. Greenware rewets easily and allowing re-work, altering and adding of new clay at any stage of dryness. Possible to build and dry an armature as a support sculpture that need not be removed for firing. Greenware even bone dry is unbelievably strong and easy to handle and transport if necessary. Potters can now concentrate on being artists.

Earthstone Air-Drying (Scarva)

E/S 950 Air-Drying Modelling Clay – Suitable for schools that may not have a kiln, it produces an ideal opportunity for pupils to experiment and create with clay. Manufactured by mixing fibres with the most plastic materials available it has unrivalled strength and plasticity. The super fine particle size allows model makers to produce very detailed forms. Earthstone air-drying clay can be decorated with acrylic paints and clear varnish with excellent results.

Professional Clays

PF560 White Stoneware – 1200oC-1300oC – Off white. Strong grained plastic clay made from the purest white ball clays. A superior body with very smooth throwing characteristics. This body has been designed for the professional production potter. Is excellent for domestic ware with good thermal shock properties. It stands up extremely well and fires to an off white colour. It works well in oxidising and reduction atmospheres.
PF570 White Stoneware Grogged – 1200oC-1300oC – Off white. As PF560 but with 10% Molochite 80’s added for potters who require clay with more

Scarva—Proffessional Clays

tooth to aid in the production of larger work with ease of drying. The molochite allows this body to be used for small hand built and coiled pots.

PF640 GT Material – Sculptural Body – 950oC-1300oC. High performance, extremely workable, durable clay body. Carefully selected grades of molochite have been added to give tooth & strength, minimal shrinkage and excellent thermal shock properties. GT Material can with stand demanding sculptural or tile needs and is ideal for large life-size pieces. It is very useful for mixing with other clays to give them strength and can also be used successfully in raku firings.

PF510 Peter Beard – Heavily Grogged Clay Body – 1140oC-1280oC. Peter Beards own clay body recipe is made from a blend of the most plastic white ball clays available. This white firing, medium textured body is most suitable for hand built pieces to create textural surfaces. A combination of molochite and silica sand gives this body low shrinkage, good warp resistance and green strength.

PF520 Ashraf Hanna – Super White Raku Body – 900oC-1200oC. The very best white smoke fired raku body on the market. With over 55% molochite, this body can withstand the most extreme thermal shock. This is due to its high alumina plastic ball clay, and three different grades of molochite. This body has a very low shrinkage and has a medium texture and is highly resistant to warping and cracking.

PF530 Phil Rodgers – Stoneware Clay Body – 1220oC-1310oC. Phil Rogers own clay body recipe is made from a blend of the most plastic ball clays available today. This fine to medium body allows both small and large items to be thrown effortlessly. It is suitable for oxidising, reduction and salt glazing. Under oxidising conditions it fires to a warm buff. Under reduction it fires to a toasted buff.

PF540 Jim Robinson – Heavily Grogged Crank Body – 1220oC-1310oC. Heavily grogged coarse crank clay. This body has all the elements to allow the maker to produce large textured sculptural pieces. Made from highly plastic iron bearing ball clays. It offers low shrinkage and is ideal for ceramic murals and figurative work. This body is suitable for oxidising or reduction atmospheres.

PF660 Black Chunky Crank – Sculpture Clay – 1180oC-1260oC. Strong body with very low shrinkage, good for building rugged scupltural forms. Its robust nature also makes it ideal for architechural ceramics - from large slabs to sculptural works.

PF670 Smooth Black – Sculpture Clay – 1080oC-1260oC. Good for scupltures, hand building or large thrown pieces. This clay has been specially formulated to fire between 1080oC-1260oC with very low shrinkage. Distinctive, attractive colour and texture.

SCARVA T.S FLAXpaperCLAY – TIPS SHEET

Scarva utilise finely chopped flax fibres and cellulose in a very forgiving clay body, ready to use straight from the bag. Once opened, this bag will need to be placed inside another bag and sealed to maintain moisture content. It has virtually no mould growth and therefore will keep for a long time, until used.

It is extremely versatile and can be rolled into slabs, coiled, sculptured or carved. It has a different slightly stickier feel, due to the combination of fine ball clays, cellulose and fibres for unfired strength.

We recommend that you do preliminary tests, rolling into thin sheets, making coils, pinching, tearing, impressing and carving etc. so that you build up a wide selection of test tiles that can be bisque fired and glazed to earthenware and stoneware temperatures, for future reference.

It can be rolled into either thick or extremely thin slabs. Try allowing these slabs to dry on an un-varnished wooden board or tabletop. They can then be cut with a sharp knife and joined instantly by using a slip. Make the slip from dry off-cuts, which have been dissolved into a slurry by pouring a small amount of warm water on top, then mixed thoroughly.

When rolled into slabs it will not easily tear as it is stretched over hump moulds or other forms made from plaster, wood or cardboard. Once allowed to stiffen, these modules can be joined together using a slurry as described above.

Because it re-wets easily, it is possible to add soft plastic clay over an armature or former made from the same clay, perhaps built from slabs. Spray the dry raw clay under structure with water using a plant sprayer, before scouring the surface a little, using a serrated metal scraper or old fork, paint with a thin slurry, then add the new skin of soft plastic clay.

It can be joined to bisque fired clay. First spray the bisque ware lightly with water, then coat the area to be covered with a thin slurry, before adding the soft new clay. These pieces will need to be re-fired to bisque temperature before glazing. Try with one or two old pots to practice these techniques.

With regard to recycling it or a mix of it and your own clay, it is a good idea to cover your plaster drying batts or plaster moulds with a piece of old cloth sheeting, as it is stickier than ordinary clays and may adhere to plaster alone.

Many makers have looked for a strong, flexible and lightweight clay body for building wall panels or relief. It is now possible to build large, ambitious and complex panels incorporating high temperature wires into the actual structure either to reinforce it or to hang the panels. Please avoid using galvanised wires as they produce dangerous fumes when being fired.

When firing thick or large flat tiles, make sure that it is dried out properly before loading it into your kiln. Fire at no more than 30 degrees per hour up to 400oC, when the fibres and paper will be burned out – this is one way to avoid the edges curling up.

T.S FLAX paperCLAY Pouring Slips

As well supplying plastic FLAXpaperCLAY bodies we can also offer them in ready to use Pouring Slip versions, opening up even more experimental and creative possibilities for Ceramics and Jewellery and saving you considerable time preparing slip.
Sheets of varying thickness can be produced by pouring the slips onto plaster drying batts, giving a smooth surface off the batt and a textured surface on the topside due to the flax fibres.
If you require smooth surfaces on both sides of these sheets, they can of course be rolled lightly on top using a rolling pin freely or using wooden guides of a chosen thickness.
Poured sheets that have been allowed to stiffen a little can be lifted, stretched, twisted and manipulated while still soft, then allowed to stiffen or dry out. They will not tear easily and will stand up well, allowing for further assembly or construction to be carried out, soft onto soft, soft onto dry, dry on dry or joined directly onto bisque sections or sheets, using the Pouring Slip as a joining slurry.
Pouring Slips can also be used to fill hollow, drop-out, cup or dish shaped moulds creating a smooth outside surface against the plaster mould and a textured inside surface due to the flax fibres, which of course burn out in the biscuit firing, resulting in a lighter weight cast.
Casts from open-mould shapes, which have unusual or sharp corners, making them hard to press-mould successfully, can be produced using Pouring Slip.
Extremely thin sheets and thin-walled hollow forms can be poured that have excellent raw dry strength due the reinforcing properties of the flax fibres, making the handling of delicate unfired ware and objects much easier.
The possibilities for making various types of ceramic forms or porcelain jewellery using these techniques are endless.

At Exeter we stock

Valentines + Scarva Clays, Casting Slips, Paper Clays, Raw Materials, Oxides, Rare Earths, Scarva Stoneware, Porcelain, Earthenware Glazes, Contem Underglazes, On Glazes, Raku and Earthenware Crackle, Decorating Slips, Lustres, Underglaze Pencils, Frits, Basic Glazes, Stains, Tile Cranks, Bead Firing Stands, Ceramic Fibre Blanket, Ceramic Fibre Paper, Tools, Needles, Harps, Clay Gun, Sieves, Slip Trailers, Hole Cutters, Throwing Ribs, Press Moulds, Bisque Ware, Bisque Tiles, Strip + Looped Tools, Natches, Clock Parts, Rolling Pins, Stoppers, Magnets, Sponges, Knives, Boxwood Tools, Forged Steel Tools, Orton Cones, Kiln Furniture, Whirlers, Nichrome Wire, Thermocouples, Pyrometers, Wheels, Kilns, Equipment, Books, etc, etc

To Order Call: 01395 233077

Spencroft Clays

We can order any of them for direct delivery of 1/4 mt, 1/2 mt, 1 mt lots including mixed pallets - most are available in 12.5kg and 25kg bags.

Stoneware

SSB/8 Stoneware – Smooth but Firm – 1150oC-1280oC – Extremely well behaved general purpose clay, plastic and resilient. Containing a selected fine grog, excellent for throwing, casting and hand modelling. Suitable for oxidised firing.

SSB/8G Stoneware – 1150oC-1280oC – As SSB/8 but containing 10% 60 mesh grog for strength. Suitable for throwing and all forms of hand building. Excellent resistance to warping and cracking.

SP/1 Stoneware – Medium – maximum 1280oC – Medium shrinkage. A medium textured multi purpose clay giving a typical speckle under oxidation. It is equally useful for throwing large or small ware having a medium grog addition.

Fleck Stoneware – Smooth to Medium – 1150oC-1280oC – An excellent clay for both throwing and casting, gives an attractive dark speckle on a grey buff background. The iron bleeds through at high temperature to give a reduction effect under oxidised conditions.

RS Toasted – Smooth – 1140oC-1250oC – An outstanding body comprising of carefully blended stoneware and red earthenware clays. Contains a selected fine grog, giving a pleasant reduction effect under oxidising conditions. Suitable for throwing, hand building or casting.

Crank Body – 1150oC-1280oC – This body has a high proportion of heavy grog (20/30) making it ideal for large scale work whilst retaining good throwing properties. Fires to a warm tan colour in reduction, cooler in oxidisation. Its low shrinkage and resistance to thermal shock make it ideal for raku.

Stoneware Buff – Smooth – 1140oC-1260oC – A splendidly developed body, based on highly refractory fire clays and grog additives, giving a high resistance to warping and cracking. A very plastic general purpose clay, excellent for throwing and modelling, fires to a light grey.

Buff Grog Stoneware – Smooth – 1140oC-1260oC – As Stoneware Buff but with an addition of 10% 60's sand for extra tooth.

SP4 Stoneware – Medium – 1150oC-1280oC – A highly recommended stoneware, medium texture ideal for throwing large or small ware with medium grog.

AWS/1 White Stoneware – Smooth – 1240oC-1280oC – A body of selected low iron clays giving a light fired colour providing an ideal background for more decorative stoneware pieces. The high content of ball clay with added fine washed sand gives an excellent smooth body ideal for throwing.

Spencroft Clays–cont.

AWS/1G White Stoneware – 1150oC-1280oC – As AWS/1 but containing 10% 40/90 grade sand.v Modelling Clay Stoneware – Medium – A fireclay based sanded body medium coarseness with good hand building properties.
Super White Stoneware – Very Smooth – 1220oC-1280oC – A very smooth stoneware clay, firing to an off white colour, which is highly plastic and suitable for throwing medium pieces as well as fine details for modelling. A small amount of fine molochite makes this clay highly versatile.

Earthenware

SRB/8 Earthenware Red Terracotta – Smooth – 1060oC-1160oC – A highly recommended red terracotta body, based on a blend of Etruria marls. Highly plastic for throwing, handling and casting. Fires to a medium red becoming darker with increased temperature.
SRB/8G Earthenware – Smooth to Coarse – 1060oC-1160oC – As SRB/8 but with a standard 10% of 40/90 sand added. Other percentages and coarser grogs are available to order.
SRB/8S Earthenware – Extra Smooth – 1060oC-1160oC – As SRB/8 but produced to provide a much finer texture. Suitable when an extra smooth finish is required.
Evans Earthenware – Smooth to Coarse – 1060oC-1160oC – Based on Etruria marls, highly plastic with good throwing properties. A heavily sanded red open body, excellent stability to warping.
SWE Earthenware Off White – 1200oC-1269oC – A very plastic white earthenware body which throws quite easily on the wheel. Ball clay based, wide firing range, good green strength.
FEB03 Earthenware White Casting Body – 1100oC-1220oC – Developed specifically with casting in mind. White firing with good crazing resistance.

Porcelain

SP Porcelain – 1220oC-1280oC – A selection of highly refined minerals, highly plastic china clay and the addition of natural plasticisers giving an excellent white translucent body suitable for throwing and fine modelling. Fired colour white.

Raw Materials Glossary

We hope that this information on the characteristics and properties of potters raw materials, frits and oxides is useful to you, especially the way that they interact with each other to create helpful and not so helpful results. This information is provided in good faith, however like all ceramic calculations it needs to be viewed in perspective. Always remember that glazes are made of materials that have chemical, mineralogical and physical properties and you cannot ignore any of these or the way that all materials are affected by others present and many other factors such as age of material, time left standing, contamination from dust, refractories, the weather and of course Murphy's law.

ALUMINA Al_2O_3 Calcined and $Al_2O_3.3H_2O$ or $Al_2(OH)_6$ Hydrated aluminas are fine granular white powders that have good flow properties increasing glaze viscosity, firing range and resistance to crystallisation. This material has a very high melting temperature. It is important that the powder is very fine. The hydrated version of alumina stays in suspension better in glaze slurries and has better adhesive qualities than calcined. Also using hydrated alumina in glazes and glass can promote the fining operation of coalescing and removing finely dispersed gas bubbles. Small additions of fine alumina hydrate added to a glaze can also enhance the colour of Cr-Al pinks. Larger additions (15% of glaze) of fine material can impart matt and opaque effects if the glaze is able to take it into solution (sourcing alumina from kaolin and frits may be more practical). Also used in Batt Wash.

ANTIMONY Sb_2O_3. Antimony oxide is used as an opacifier in porcelain enamel (mainly leadless but it has been replaced to an extent by titania) and ceramic glazes. However it can give a yellowish colour (1-2%) if the glaze contains lead, due to the precipitation of yellow lead antimonate (known as Naples yellow). Antimony is also used as a yellow body stain in combination with rutile or titanium. It is slightly fluxing in higher temperature glazes.

BALL CLAY Fine secondary or tertiary clay mined in Devon and Dorset. Usually grey or blue in colour. It is very plastic and fuses relatively easily with greater density than china clay. Called ball clays because they used to be rolled into balls for loading onto transport. Not normally used on its own due to its high shrinkage - up to 17% so it is usually mixed with china clay

BALL CLAY - Blue - Puraflo AK 32% Al_2O_3, 50% SiO_2, 1.1% Fe_2O_3, 2.1% K/Na_2O. A Devon ball clay, very plastic, clean burning ball clay. recommended for glazes needing ball clay as an ingredient.

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BALL CLAY - Hymod AT 29% Al_2O_3, 55% SiO_2, 2.3% Fe_2O_3, 3.6% K/Na_2O_3. A Dorset ball clay with a high iron content, high strength, useful in the production of warm coloured textured bodies at stoneware temperatures. At earthenware temperatures the colour tends to be deeper.
BALL CLAY - Hyplas 71 20% Al_2O_3, 70% SiO_2, 0.8% Fe_2O_3, 2.3% K/Na_2O_3. A high siliceous Devon ball clay giving good plasticity with medium strength and usefully low iron content.
BARIUM CARBONATE $BaCO_3$. Used in casting slips at low levels to prevent scumming (up to 0.5%). Used in high temperature glazes as a flux and produces matt and semi-matt surfaces at earthenware temperatures. At higher temperatures it can make a distinctive turquoise with copper. In bodies it seems to impart better translucency but can lead to weakness and excessive shrinkage.
BENTONITE Al_2O $2H_2O$ SiO_2. A clay mineral with incredibly small particle sizes. Must be added in the dry state. This, in combination with the active chemistry on the surface of the particles (that makes them hold onto water), makes it the most plastic and impermeable common clay material used in ceramics. Anyone who uses this material should have their eyes open to its advantages and disadvantages. Binder: Bentonite binds particles together in ceramic bodies to make them stronger in the green or dry state (up to 5%). Its minute particles fill voids between others to produce a more dense mass with more points of contact. Adding bentonite to glazes also imparts better dry strength and a harder and more durable surface. 1 part bentonite can plasticize a body as much as 10 parts kaolin. Bentonitic bodies are stronger in the dry form but dry slower, crack more and fire darker with potential iron specks (get a super fine ground grade). 1-2% bentonite can greatly improve glaze suspension by gelling it. In addition it will harden the dry layer. Coarser varieties can impart some glaze speck. If a glaze already contains more than 15% clay (kaolin, ball clay) you should not need more than 1% bentonite. Firing cracks, explosions: Bentonite slows down water penetration. Not only does a bentonite-containing clay body dry slower but it does not dry as completely. Although ware might look dry it is not, several percent water tightly-bound between bentonite particles remains. If ware is not temperature-dried before being fired there is a risk that water will not be able to escape fast enough during firing and ware will crack, fracture under steam pressure. At stoneware temperatures it fuses to produce a typical brown colour.
BISMUTH SUBNITRATE Obtained from metallic bismuth and is soluble in acids but insoluble in water. It gives a pearly luster to glazes and glasses, especially in reduction (and raku) firing. It iSs an ingredient in luster colours. It is a very very strong flux.

BONE ASH CA3(PO4)2. Bone ash has traditionally been added to porcelain to achieve a high degree of translucency (hence the name 'bone china'). The manufacture of bone china is difficult to master because the clays are non-plastic, ware is unstable in the kiln, and it is difficult to burn consistently to the body's narrow firing range. Up to 1-2% bone ash can be used in enamels for opacification or milky character (more will usually cause pinholes). In glazes, as with enamels, too much or too high a temperature will cause blistering. Bone ash or calcium phosphate are used to opacify opal glass (1-3%) because the P2O5 content forms colourless compounds with iron impurities. Not suitable for slip casting.

CALCIUM BORATE FRIT 1030-1180oC. SiO2 17.9%, B2O3 50.3%, MgO 0.1%, Al2O3 4.9%, K2O 0.3%, CaO 26.5%. Insoluble colemanite frit for use where recipes specify greater than 5% colemanite. Can be used as a base in lead free glazes.

CALCIUM CHLORIDE CaCl2 6H2O. Calcium Chloride is used as a suspending agent in glazes 0.05%. It works well with bentonite. Small additions (0.1-0.3%) to glaze slurries also produce gelling qualities that make it easier to apply coatings of even thickness. Vinegar has a similar effect although calcium chloride is said to work better. This material is the key to being able to apply a glaze to non-porous porcelain bisque ware.

CHINA CLAY Al2O3.2SiO2.2H2O. General purpose Kaolin. Because kaolinite mineral has a much larger particle size than ball clay and bentonite materials, blending it with them in bodies can produce a good cross section of ultimate particle sizes imparting enhanced working and drying properties. Kaoilns speed up casting rates in slurry bodies and drying rates in all bodies. Many porcelains contain only kaolin as their clay component but is has a relatively low plasticity and so is usually used (less than 50%) in combination with ball clays, bentonites and other plasticizers. It is also the most common glaze suspender (15-20%). **GROLLEG** is lower in iron and higher in potassium making a whiter stronger material particularly suitable for casting.

CHROMIUM OXIDE A very versatile stain which disperses well through a glaze, normally producing a green colour but giving reds and yellows in lead glazes, and pink in the presence of tin.

Chrome oxide can be used as a body stain in amounts to 5% to give grey-green, up to 3% in glaze recipes. Drab chrome greens can be moved toward peacock green with the addition of cobalt oxide (1% each gives bright color). This works in boron and soda glazes. Chrome in zinc glazes tends to form brown zinc chromate.

Because chrome reacts with normally inert tin to produce chrome-tin pink colors whiting and alumina are usually used instead of tin to lighten and clarify chrome green glazes. Chrome-tin pinks are much more consistent if the combi-

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nation is premelted (i.e. commercial stain) and if the glaze is high in calcium or strontium, and free of zinc. Strontium is most effective if a wide firing range is desired (0.1-0.5% chrome, 4-10% tin).

Chromium oxide is added to enamels for green where borax and zinc are used to increase the brilliance of the colour. However, chrome in ground coat enamels tends to react with the metal to cause blistering.

Zircon opacifier 1-2% is often added to chrome glazes to stabilize them and prevent brown edges.

Chrome – Purple - Chrome-tin pinks move toward purple in glazes with significant boron. One glaze with 3.3 SiO_2, 0.27 Al_2O_3, 0.2 B_2O_3, 0.15 Li_2O, 0.5 CaO, 0.1 MgO, 0.15 Na_2O employed 5% tin oxide, 0.6% cobalt carbonate, 0.17% chrome oxide to produce a good purple at cone 6. Chrome – Green - Chrome is a classic green coluorant for recipes in oxidation and reduction at all temperatures. However, the shades it produces can be opaque, dull, and uninteresting. In the presence of CaO, the color moves toward grass green. Chrome – Green Peacock - Drab chrome greens can be moved toward peacock green with the addition of cobalt oxide (1% each gives bright color, some MgO needed also). This works in zinc free boron and soda glazes. Chrome – Brown - Chrome in zinc glazes tends to form brown zinc chromate. Chrome – Orange - Chrome in high lead glazes forms yellow lead chromate. Zinc and chrome tend to produce orange. Chrome – Black - Chrome is a constituent in almost all black oxidation colours. It is used up to 40% in Cr-Co-Fe blacks and as high as 65% in Cu-Cr blacks. Chrome – Pink / Maroon - Chrome and tin are a widely used combination to produce pinks in zinc free glazes with at least 10% CaO and low MgO (alkaline glazes work well). Many stains are based on this system and typically have around 20-30 times as much tin oxide as chrome oxide. Tin would typically be around 4-5%. Chrome – Chinese Red - Below 950C in high lead, low alumina glazes, chrome will produce reds to ranges, often with a crystalline surface. The addition of soda will move the colour toward yellow. Chrome – Yellow - Chrome in high lead glazes forms yellow lead chromate. Alkalies are recommended in the base glaze. Added zinc can extend the range to orange. In other types of glazes, less than 0.5% chrome oxide will give yellowish or yellow green tints.

COBALT CARBONATE $CoCO_3$. Cobalt Carbonate -A pinkish tan powder. It is a strong colourant and almost always produces blue in glazes. The carbonate form of cobalt is very fine grained and disperses better and gives more evenly distributed colour than cobalt oxide. However, as with any carbonate, it produces gases as it decomposes and these can cause pinholes or blisters in glazes. Also the carbonate form contains less cobalt per gram, therefore colours are less intense than the oxide form.

COBALT OXIDE Co3O4. Cobalt Oxide is a metallic oxide that produces blue in glazes at all temperatures. Black Cobalt Oxide is the principle source of CoO used in glazes, glass, and enamels. Cobalt is the most powerful ceramic colourant and it is stable in most systems. It is also useful as a body and slip stain. Cobalt will often produce glaze specking if it is not thoroughly sieved or ball milled to distribute the particles. Cobalt carbonate tends to disperse better in glazes to give even blue coloration because it is not as powerful and produces some glaze blistering problems. A high cobalt stain is also an alternative.

Cobalt - Violet, Lilac - In magnesia glazes a colour range is from violet to lilac is possible.

Cobalt – Blue - The shade of blue can, however, be affected in many ways by the presence of different oxides. Cobalt is powerful and often less than 1% will give strong colour. If the colour needs to be toned down, additions of iron, titanium, rutile and nickel may work. Brighter blue in alkaline glazes. Cobalt – Soft Blue - Often calcined with alumina and lime for soft underglaze colours. Stains often employ mixes of alumina, cobalt, and zinc for softer blue colours.

Cobalt – Yellow - Used in combination with manganese and selenium to mask excess yellow coloration (yellow plus blue gives green which is masked by the pink of selenium). Cobalt - Blue Slate - Combinations with iron and manganese can give a slate blue.

Cobalt - Blue-green - With barium shades of blue-green are possible.

Cobalt - Blue-black - With chrome and manganese blue-black and black are common.

Cobalt- Blue-green - With chrome and copper, cobalt can yield tints from pure cobalt blue, to greenish-blue, to the green of chromium. These effects work best when silica is not too high and there is adequate alumina.

Cobalt – Purple - With manganese (i.e. 1-3% cobalt carb, 3-5% manganese carb), purples and violets can be made. Less cobalt will lighten the colour. This effect works well in magnesia glazes. In high magnesia glazes, 1-2% cobalt alone will give purple. Add tin to move the colour toward lavender. Cobalt - Lavender, Purple, Violet, Pink - With adequate SiO2 and high MgO (0.4 molar), purple, violet, lavender, and pinks can be made using 1% or more CoO. Mimimizing boron, alumina, and KNaO will help prevent it from turning blue. Note that the high MgO will generally make the glaze matte and it could suffer some ill effects associated with excessive MgO.

Cobalt – Red - With MgO, SiO2, and B2O3, red, violet, lavender, and pinks can be made.

COLEMANITE B2O3 43.9%, CaO 26%, SiO2 4.5%. A popular natural source of insoluble boron for many decades. Gerstley Borate contained significant amounts of colemanite. Pure colemanite, however, is much higher in

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B_2O_3 than Gerstley Borate. Be sure to screen out any materials coarser than 200 mesh, or ball mill the glaze. Gum or other binders also help. Acting as a powerful flux it can intensify the effect of colouring oxides and can increase craze resistance in glazes however

COPPER OXIDE Black Cupric CuO. Red Cuprous Cu_2O. Reduction firing reduces normal CuO copper oxide to Cu_2O to produce bright red coloration in the reaction: $2CuO + CO \rightarrow Cu_2O + CO_2$

Copper is an active flux and may increase melt fluidity and may increase crazing because of its high thermal expansion. Bright red colors are usually achieved with very small amounts of copper (i.e. .5%). If larger amounts of copper are present, the reaction could precipitate very tiny copper metal particles (colloidal copper) in the glaze melt to yield a red colour (i.e. flambâeš or sang-de-boeuf). Copper lustre can be produced by oxidation firing at low temperature glaze (950C) with heavy reduction cooling to leave a metallic layer of copper on the surface. 2-8% copper is required and cooling should be done in 15 minute cycles of reduction, interspersed with intervals where the atmosphere is allowed to clear. This can be carried out in cooling electric kilns by creating reduction through the introduction of flammable materials. Copper - Green - Under normal oxidizing conditions the CuO molecule remains unchanged and produces clear green colours in glazes. The shade of copper greens can vary with firing rate and soaking changes. The best colours are generally obtained with fast firing and little soaking. Copper in calcium/magnesium glazes gives a green very different from that produced with lead.

Copper - Blue-green - Fluoride, when used with copper, can produce blue green colours.

Copper – Red - Copper is well-known for its ability to produce blood-red and fire-red colours in steady reduction atmosphere firings where CuO is altered to Cu_2O. Bright red colours are usually achieved with very small amounts of copper (i.e. 0.2-0.5%) in a low alumina base with at least .4 molar equivalents of CaO and plenty of the alkalis. Tin oxide will enhance colour. Use of silicon carbide in oxidation (2%) can produce red. Copper – Purple - Purple copper reduction glazes are the result of a mixture of copper in its green oxidized and red reduced forms. This effect appears most frequently in high lime glazes or where early stages of firing are oxidizing or latter stages are light or neutral. The use of boron in a copper red reduction glaze will give a purple hue.

The following formula produces good purple at cone 10: BaO 0.1, CaO 0.5, MgO 0.1, KNaO 0.2, ZnO 0.1, B_2O_3 0.15, Al_2O_3 0.2, SiO_2 3.0. Copper – Turquoise - In copper red glazes, barium additions in a high feldspar base will produce turquoise to deep blue depending on how much copper is added. Lithium contributes to the colour also. Combinations of Black CuO with tin or zircon will give turquoise or blue-greens when the glaze is alkaline (KNaO) and low alumina. Look for a frit with this profile for best results. Glazes of this type often craze. Copper - Green Yellowish - K_2O can turn a copper glaze yellowish. If Na_2O or PbO are present, K_2O should not exceed 0.15 equivalent. Copper – Blue - Copper in a barium/zinc/sodium glaze gives a blue. Colour can also be enhanced by lithia. Tin and copper can produce turquoise to robin's egg blue Copper – Metallic - Large amounts of copper (7%) in a glaze give metallic and even graphite effects. COPPER CARBONATE ($CuCO_3$) is bulkier than the oxide form, thus it tends to disperse better to give more even results. It is also more chemically reactive than the oxide form and thus melts better. As such, it is ideal for use in brush work where minimal speck is required. However it produces gases as it decomposes and these can cause pinholes or blisters in glazes. Also the carbonate form contains less copper per gram, therefore colours are less intense than the oxide form. Supplies of green copper carbonate often vary in colour and density. Despite variations in the physical appearance of the material, the amount of contained copper metal remains essentially constant but the ability to stay in suspension can be different from one manufacturer to another and so the ceramic grade must always be used.

Copper normally produces green colours in amounts to 5% whereafter it moves toward black. In reduction firing, it turns to Cu_2O and gives vibrant red hues. Above 1025C copper becomes increasingly volatile and its crystalline structure breaks down. At 1325C CuO melts. This can affect the colour of other glazed pieces in the kiln. Glazes containing copper can change significantly because of loss of copper. Some potters alternate between reduction and oxidation, and even put a dish filled with copper carbonate in the centre of the kiln to minimize this phenomenon. It can act as a strong flux. It is the most stable form of oxidized copper (Black Cuprous oxide oxidizes to Red cupric oxide in normal firings). The oxide form of copper can give a speckled colour in glazes whereas the carbonate form will give a more uniform effect.

Note: When added to low lead solubility glazes copper can cause the solubility of the lead to be greatly increased. Copper also can have similar effects in other types of glazes at other temperatures. If an overnight soak in vinegar or acid changes glaze appearance, be careful.

CORNISH STONE K_2O 3.8%, Na_2O 4%, Al_2O_3 15.3%, SiO_2 69.5%. A secondary flux in earthenware temperature glazes, and an alternative to feldspar at higher temperatures, giving greater fired strength. A decomposed granite however it is not a fusible as feldspar due to its high silica content. Low iron and high silica content promotes whiteness and transparency and so particularly useful in porcelain and similar white bodies.

DOLOMITE CaO_3 31.4%, MgO 20.8%. Dolomite as a ceramic material is a uniform calcium magnesium carbonate. In ceramic glazes it is used as a source of magnesia and calcia to act as a secondary flux. Other than talc, dolomite is the principle source of MgO in high temperature raw glazes but can be used as low as 1060oC. 'Dolomite matte' stoneware glazes, for example, are

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highly prized for their pleasant 'silky' surface texture. Above 5% it begins to opacify eventually making a matt glaze. Dolomite by itself is refractory, but when combined with the typical oxides in a glaze (especially boron) it readily enters the melt. **DOLOMITE WHITE** A purer type of dolomite with fewer trace elements of iron.

ERBIUM OXIDE Er2O3. Erbium oxide is a light baby pink colour. It is an expensive, dense, and weak colourant, but one of the very few ways you will ever get a transparent pink. Erbium oxide's density means it is absolutely essential that you use CMC gum. Erbium oxide gives its best pink colour at concentrations of 8-10%, but it is difficult to get more than 8% to fully dissolve in the melt. It has given a more lavender colour in the presence of iron traces when in reduction.

FERRO FRIT 3110 1000 - 1060oC. Soft low alumina sodium borosilicate frit for glazes. Often used in crystal and crackle glazes. This frit can be very useful to reduce the feldspar content in glazes (since many high feldspar glazes have low clay content and therefore poor slurry suspension properties and dried hardness). The chemistry of this frit is similar to feldspar (but with low alumina and CaO in addition to the alkali fluxes). That means if you substitute this for at least part of the feldspar you can increase the kaolin (to supply the alumina) and thereby improve slurry properties. In addition you will be able to reduce the amount of troublesome calcium carbonate. Helps in the production of copper blues and manganese purples and raku glazes.

FLINT SiO2. A major source of calcined silica for glazes and clay bodies (15%). It increases the fired temperature and craze resistance of glazes and its low expansion and contraction helps to stabilise the glaze. It is added to bodies to reduce shrinkage in drying and firing and to give a certain rigidity and eliminate crazing.

FRITS Glaze materials that have been melted together and then ground to an appropriate particle size - this reduces the handling of toxic materials such as lead by converting them into a silicate. Many materials, particularly carbonates are soluble in water and by fritting them first this prevents this problem. It also removes many volatiles which would have created firing problems. The tend to have a consistent formula and so give predicatbale and relieable results. See Calcium Borate, Standard Borax, Lead Bi-silicate and Sesquisilicate and HAF

HIGH ALKALINE FRIT 860 - 1060oC. Typically SiO2 52.5%, B2O3 3.4%, Al2O3 5.2%, Na2O3 18.6%, K2O 10.3%, CaO 2.9%. A high alkaline (Soda and Potash) version of a borax frit. High expansion rate making them suitable for crackle glazes. Helps create turquoise copper blues and purple/

brown manganese in glazes.

ILMENITE FeO TiO2. Like rutile, ilmenite is quite variable in nature. You can tell the difference between granular rutile and granular ilmenite by doing a smear test against an abrasive surface (i.e. an unglazed white tile). The rutile will be tan or brown, the ilmenite will be black or dark brown. Ilmenite can be used in small amounts (-1%) to produce dark brown specks in bodies and specialized glazes. It is also used in combination with rutile to develop characteristic rutile break glazes; it seeds crystals in titania glazes.

IRON OXIDE Fe2O3. Red iron oxide is the most common colourant in ceramics and has the highest amount of iron. It is available commercially as a soft and very fine powder made by grinding ore material or heat processing ferrous/ ferric sulphate or ferric hydroxide. During firing all irons normally decompose and produce similar colours in glazes and clay bodies (although they have differing amounts of Fe metal per gram of powder).

In oxidation firing iron is an important source for tan, red-brown, and brown colours in glazes and bodies. Iron red colours, for example, are dependent on the crystallization of iron in a fluid glaze matrix and require large amounts of iron being present (eg. 25%). The red colour of terracotta bodies comes from iron, typically around 5% or more, and depends on the body being porous. As these bodies are fired to higher temperatures the colour shifts to a deeper red and finally brown. The story is similar with medium fire bodies.

In reduction firing iron changes its personality to an incredible extent, it changes to a flux, a very active flux. Iron glazes that are stable at cone 6-10 in oxidation will run off the ware in reduction. The iron in reduction fired glazes is known for producing very attractive earthy brown tones. Greens, greys and reds can also be achieved depending on the chemistry of the glaze and the amount of iron. Ancient Chinese celadons, for example, contained around 2-3% iron. Particulate iron impurities in reduction clay bodies 'blossom' during firing, creating large specks that bleed right up through glazes.

The fine nature of red iron is a great asset in spreading it evenly throughout a glaze or body mix. It disperses better in glazes than does black iron. However, it is also a nuisance material for the same reason. In addition, larger amounts of iron oxide tend to gel glaze and body slurries, making them difficult to work with. Some grades of red iron do have coarser specks in them and this can result in unwanted specking in glaze and bodies.

High iron materials with alternate names: burnt sienna, crocus martis, Indian red, red ochre, red oxide, Spanish red.

The black iron oxides (FeO) have a higher iron iron content and gives darker shades usually dark browns and can produce speckles and crystals as an aventurine glaze.

Actual Yellow Ochre iron oxides (Fe2O3) are around 85% Fe2O3 and about

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12% LOI with some impurities (e.g. SiO_2, CaO). In ceramics, yellow irons are used where its raw colour or other raw properties are important to the manufacturing process or colour of the unfired product. It can produce yellowish honey colours (3%) but generally gives shades of brown (up to 8%) especially in lead glazes. It has excellent hiding power, absorbs ultraviolet light, is compatible with a broad range of vehicles, disperses well in aqueous and solvent systems, does not contain heavy metals

LEAD BI-SILICATE FRIT 900 - 1100oC. SiO_2 29%, Al_2O_3 12%, PbO 59%. A good clear, general purpose lead frit for developing rich, bright surfaces and has a good reaction to colours . The safe way to introduce lead. Particularly suitable for red clays.

LEAD SESQUISILICATE FRIT 860 - 1080oC. As above but specially coated to reduce solubility.

LITHIUM CARBONATE Li_2CO_3. Lithium Carbonate is the best source of lithium oxide for glazes. It is slightly soluble. It is unusual to see more than 5% lithium carbonate in glaze because it promotes devitrifaction. Because of the low expansion of Li_2O, high lithium glazes tend to shiver. There are certain basic properties of lithium which are of interest in ceramics. Since lithium has a very small ionic radius in comparison to the other alkali metals, it has a higher field strength. Low expansion coefficients are generally imparted to ceramic compositions containing lithia. Lithium carbonate is a very strong flux (also true of lithium fluoride). It is the lightest, smallest, and most reactive flux. In addition to being soluble, lithium carbonate produces gases as it decomposes and these can cause pinholes or blisters in glazes. In frits and glazes, lithia is used to reduce the viscosity and thereby increase the fluidity of the coatings. This reduces maturing times and lowers firing temperatures. 1% additions can increase glaze gloss to a marked degree and slightly greater amounts (3%) can reduce melting temperature by several cones and affect surface tension of the melt

Lithium – Blue - Lithia can produce blue effects with copper. Lithium – Pink - Lithia can produce pinks and warm blues with cobalt. Lithium – Variegation - Lithia contributes mottled and flow effects when used in small amounts (-1%).

MAGNESIUM CARBONATE $MgCO_3$. In high temperature glazes it acts as a flux (beginning action about 1170C) producing viscous melts of high surface tension and opaque and matte glazes. Like CaO, its melting action drastically accelerates at high temperatures. The surface tension of MgO-containing melts is less of a problem in reduction. Zircon and Magnesia melt at 2800C making them the highest melting oxides. Remarkably, MgO readily forms eutectics with other oxides to melt at surprisingly low temperatures.

It is valuable for its lower expansion and crazing resistance. When introduced into a glaze it should preferentially replace calcia, baria, and zinc before the alkalis to maintain surface character. Adding too much will generally move the surface texture toward matte or dry. MgO is a light oxide and generally is a poor choice for glazes to host bright colours. However, it does work well in earthtone and pastel glazes, especially in high temperature reduction firing. Likewise, it may be harmful to some under-glaze colours. Does not volatilize. Magnesia is well known for the pleasant vellum 'fatty matte' and 'hares fur' tactile and visual effects that it produces around 1200C, especially in reduction firing (dolomite matte). The mechanism is phase separation of the suddenly melting MgO, but MgO can also produce matte effects at lower temperatures as a refractory melt-stiffening additive.

MANGANESE DIOXIDE MnCO3. Above 1080C, half of the oxygen disassociates to produce MnO, a flux that immediately reacts with silica to produce violet colours in the absence of alumina, browns in its presence. Thus if it is being used in glazes fired below 1080C it should be considered as MnO2, if above it should be taken as 81.5 MnO and 18.5 LOI.

Smaller amounts are easily dissolved in most glaze melts, however, around the 5% threshold, the manganese will precipitate and crystallize. In large amounts in a glaze (i.e. 20%), metallic surfaces are likely. In glazes below 1080C, it can give coffee colour browns when used with tin. In glazes it will behave in a refractory manner, stiffening the melt. Because of the expulsion of oxygen at 1080, glazes using manganese should avoid this temperature range to reduce the chance of blistering and ruining of the glaze surface.

Manganese dioxide is the key to Rockingham brown wares which are made by employing about 3% iron oxide and 7% manganese in transparent lead glaze of a recipe such as: Feldspar 28, Kaolin 14, Flint 4, Leadbisilicate 40, Whiting 4. Manganese – Black - Manganese and cobalt mixture produce black. Iron can also be used. For example, a mix of 8 iron, 4 manganese dioxide and 0.5 cobalt make a raw black stain. Manganese - Purple, Violet - Purple colours can be produced in glazes of high alkali (KNaO) and low alumina, especially in combinations with cobalt (look for a frit with this profile for best results).

Manganese – Black - When added to terra cotta bodies in amounts around 5% manganese dioxide will produce dark gray to black firing bodies. Manganese – Metallic - Large amounts of manganese can produce metallic effects in a glaze. However, these glazes must not be used on food surfaces.

MOLOCHITE Al2O3 37%, SiO2 48%. A calcined china clay or aluminium silicate used as a fine powder to increase the firing temperature of glazes as it introduces alumina and silica; it reduces the tendency to crawl in glazes with high clay contents. Large sizes are used as grog for white bodies and to open the texture of bodies; it induces mechanical stability and resistance to thermal shock through the development of mullite crystals.

NEPHALINE SYENITE K2O 9.1%, Na2O 7%, Al2O3 24.9%, SiO2 56%. A beneficiated mineral similar to but more fusible than feldspar, it has lower silica and higher soda and potassium levels and so may be used when a lower

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melting temperature is required. It has a fairly narrow vitrification band typically used in vitreous bodies.

NICKEL OXIDE NiO3. Gives brownish greens through to grey colours (1-3%). In reducing conditions a yellow or blue may be obtained in high zinc stoneware glazes – 0.15 nickel with 0.15 zinc oxide gives a brown, 0.25 zinc a reddish purple, and 0.35 zinc a dark blue. PETALITE K2O 0.2%, Na2O 1.6%, Li2O 4%, Al2O3 15.7%, SiO2 76.1%. A secondary Lithia, alumina, silica bearing flux for use in high temperature bodies such as porcelain and high temperature glazes. It can be used to alter colour response and to reduce thermal expansion lowering maturing temperatures without shortening of firing range, especially when used as a replacement for feldspar.

POTASH FELDSPAR K2O 11.3%, Na2O 3.2%, Al2O3 18.5%, SiO2 65.8%. One of the most important materials for medium and high temperature ceramic glazes. Potash feldspars are not usually as pure and white as soda spars. Glazes high in feldspar (35% or more) are likely to produce crazing problems. 'Flux saturated' glazes with more than 50% feldspar may be unbalanced and lack adequate glass former or alumina. SODA FELDSPAR (K2O 2.8%, Na2O 8.5%, Al2O3 18.5%, SiO2 69.5%) is more suitable at lower temperatures. If recipe only states Feldspar it usually means Potash Feldspar. FFF Finnish Floatation Feldspar (K2O 7.5%, Na2O 3.2%, Al2O3 18.5%, SiO2 67.5%) is a high quality product half way between Soda and Potash Feldspar. (The name Felspar is sometimes used but Feldspar is traditionally the correct name and is used throughout Europe).

PRASEODYMIUM OXIDE Pr6O11. Praseodymium Oxide gives a small range of vibrant lime green colours in oxidation and reduction at concentrations of 5-8%. In small amounts (0.65%) in reduction with a trace of iron, gives a bright spring green colour.

QUARTZ SiO2. Quartz sand is often used in bodies as grog for texture and to increase thermal expansion and craze resistance. Powdered quartz is used in glazes and bodies also. Quartz of very fine particle size (-400 mesh) will typically enter the feldspathic melt or convert to cristobalite during firing if fluxes are lacking, coarse powdered grades help to 'squeeze' glazes into fit. Intermediate sizes (200-300 mesh) seem to be best however, since their greater surface area exerts more compressive squeeze per unit.

RUTILE TiO2 +. Rutile is the mineral name for natural crystals of titanium dioxide. In nature rutile is always contaminated by up to 15% other minerals (especially iron but also things like tantalum, niobium, chromium and tin). The term 'rutile' is thus generally understood to refer to the brown powder into which these minerals are ground and industry accepts up to 15% contaminants and yet still calls it rutile (below 85% titanium is called ilmenite). Rutile is considered an impure form of titanium whereas ilmenite is considered as FeTiO3. In ceramic glazes rutile is more often considered a variegator than a colorant. As little as 2% can impart significant effects in stoneware glazes. It is normally used in combination with a wide range of metal oxide and stain colorants to produce surfaces that are much more visually interesting. In glazes with high melt fluidity (e.g. having high boron), large amounts of rutile (e.g. 8%) can be quite stunning. The rutile encourages the development of micro-crystals and rivulets. Since rutile contains significant iron its use in combination with other colourants will often muddy the colour that they would otherwise have or alter it if they are sensitive to the presense of iron. Even though rutile generally makes up less than 5% of stoneware glazes that employ it, they are often called 'rutile glazes' in recognition of its dramatic contribution.

Excessive rutile in a glaze can produce surface imperfections. In addition, when rutile is employed in higher percentages (e.g. 5%+) a given percentage might work well whereas a slightly higher amount can look drastically different. Such situations are vulnerable to chemistry changes in the supply of rutile. Thus people will often do a line blend trying a range of percentages to determine an optimal amount.

In glazes rutile can be quite sensitive to the presence of opacifiers. While an unopacified glaze glaze might appear quite stunning, the addition of a zircon opacifier will usually drastically alter its appearance and interest because the variegation imparted is dependent on the glaze having depth and transparency or translucency. Strangely rutile and tin, another opacifier, can produce some very interesting reactions and it is quite common to see tin in amounts of up to 4% in rutile glazes. In these cases the tin appears to react in the crystal formation rather than opacify the glaze.

Rutile powder, although its colour makes it appear to be a very crude ground mineral, normally contains 90%+ titanium dioxide. However this does not mean that you can use a 90% titanium:10% iron mix and get the same result in a ceramic glaze (obviously line blending would be needed to match the amount of iron). The mineralogy and significant other impurities in rutile are a major factor in the way it acts in glazes and are not easily duplicated using a blend of other things. Sometimes the special effects that rutile produces in glazes are also partly a product of a coarser grade (larger particle size). These likewise cannot be easily duplicated by more refined materials.

SCMC GLAZE BINDER Glazes being brush applied generally incorporate up to 5% of a glaze binder. Also useful in 0.5 to 2% addition to prevent colour transference.

SILICA SAND A medium silica sand used for either placing or as a grog, helping glaze fit and making the body more refractory.

Raw Materials Glossary—cont.

SILVER CARBONATE & NITRATE Silver nitrate is highly soluble and forms Ag^+ ions when dissolved in water. This ion transfers to ware as adhered material and when fired and reduced the Ag metal gives a gold sheen. It is possible to dry blend the nitrate and carbonate forms and putting these into a glaze to get a better gold sheen. The Nitrate is hazardous the Carbonate is not. 100 grams of Carbonate is equivalent to 123 grams Nitrate. Primarily used in Raku firings to give yellow or gold effects.

SODIUM CARBONATE Na2CO3. In ceramics, a common use of soda ash is as a soluble deflocculant in ceramic slips and glazes. It works well in combination with sodium silicate to produce slips that do not gel too quickly and whose rheology can be adjusted for changes in the hardness of the water. Higher soda ash in proportion to sodium silicate will produce a slip that gives a softer cast (stays wet longer). The total soda ash and sodium silicate amount should be tuned to create a slip that will eventually gel if left to stand. This thixotropic behavior will prevent it from settling.

In low solubility glazes it will weaken their resistance to acidic attacks. Sodium carbonate is the preferred deflocculant for thinning glaze slurries. Its solubility makes it an ideal flux for Egyptian paste glazes.

SODIUM SILICATE Na2 SiO2. The most popular deflocculant used in casting slips for many years. It is nearly always used with soda ash (when employed alone it can make a slip 'stringy' and thixotropic). The material is effective, reliable and inexpensive. However, it attacks the plaster in molds much more than more modern deflocculants and it is easier to over-deflocculate a slip with sodium silicate. The 75TW with Bone China and Terracotta, the 140TW with everything else.

STANDARD BORAX FRIT 900 - 1140oC. Often used in the production of earthenware glazes when a lead-free glaze is required. Slight milkiness, especially at low temperatures, may be evident over red clays, and the colour response with oxides etc is not as vivid as with lead frits.

STRONTIUM CARBONATE SrCO3. A flux typically used in glazes at stoneware temperatures (above 1090oC) with similar effects to whiting and zinc oxide but with less pinholing and as an alternative to lead oxide. It has been used in glazes at low temperatures as low as cone 01 giving a gloss mirror finish with good heat shock resistance. Excessive additions will precipitate a crystalline matt surface.

TALC Typically MgO 32/33%, SiO2 46%. No talcs have the theoretical chemistry, the most common impurities are CaO (up to 8%) and Al2O3 (up to 9%). Along with dolomite, and to a less extent magnesium carbonate, it is an important source of MgO flux for bodies and glazes. Dolomite and magnesium carbonate have high loss on ignitions which can produce glaze bubbles, blisters and pinholes, talc is much less of a problem in this respect. High temperature magnesia matte glazes employ MgO from talc and magnesium carbonate to form magnesium silicate crystals on cooling to give both opacity and a matte silky surface. It reduces plasticity and so is more suitable for castware. Talc is also used to produce thermal shock resistant / flameproof stoneware bodies where it acts as a low expansion flux that reduces body expansion by converting available quartz mineral, mainly in kaolin, to silicates of magnesia. Talc is a curious material in that, by itself it is a refractory powder; yet in amounts of 1-5% in middle temperature stoneware bodies it can drastically improve the maturity and melting. In ceramic slips, where 50% is often used, it produces a body that melts suddenly by cone 4. In glazes at middle temperature talc does not participate much in the melt and its presence tends to create an opaque silky matte surface, at cone 10 it is a powerful flux.

TIN OXIDE SnO_2. Tin oxide has long been used to opacify glazes (make transparents opaque) at all temperatures. Hand decorated tin glazed earthenware of the 1700/1800s is the most famous use of tin in glazes (delftware-England, faience-France, maiolica-Italy). While many potters are keeping this tradition alive today most now use zircon based opacifiers instead.

Thus any discussion about the use of tin oxide as an opacifier ends up comparing it with zircon products: Twice as much zircon is required to produce the same level of opacity. Like zircon, tin melts at very high temperatures and thus does not go into solution in typical glaze melts. Zircon will stiffen the glaze melt more than tin. Zircon is likely produce a harder glaze surface. Zircon will reduce the thermal expansion of the glaze more than tin. The quality of the white colour is different (tin tends to be more of a blue white, zircon a yellowish white). Tin is very expensive, this is likely to be the main reason for its much more limited use as an opacifier today. Zircon tends to have less of an effect on the development of metal oxide colors (e.g. tin reacts with chrome to make pink). Tin can react with titanium and rutile to variegate the glaze.

If gloss is an issue, silica might have to be reduced to compensate for the silica introduced by a zirconium silicate opacifier being substituted for tin. While there are other products that produce varying degrees of opacity, none are as neutral and non-reactive as tin and zircon.

Other opacifiers also tend to variegate the glaze. Copper red glazes require tin, with iron in oxidation tin makes a warmer shade of brown than zirconium does. Tin – Pink - Chrome and tin are the most well known way to produce pink. For example, 7.5% tin and 0.5 chrome oxide will produce pink. Many Cr-Sn stains are available to make many shades of pink. However this mechanism requires that the glaze chemistry be right (e.g. no zinc, boron not excessive). Tin – White - The quality of colour tends to be a 'soft-bluish white'. As little as 4-7% can produce brilliant white, although it is more typical to use 8-10% for full opacity. However, be aware that even tiny amounts of chrome in the kiln will volatilize and combine with the tin to produce pink shades. Tin - Variegation - Tin/Iron Effects - Tin reacts with iron in fluid glazes to produce variegated surfaces. A good example is Albany Slip 85, Tin 4, Lithium 11 glaze for cone 6.

Raw Materials Glossary—cont.

TITANIUM DIOXIDE TiO_2. Although titanium is the strongest white pigment known for many uses, in ceramics the whiteness (and opacity) it imparts to glazes is due to its tendency to crystallize during cooling. Although titanium dioxide is used in glazes as an opacifier, it is not as effective and easy-to-use as tin oxide or zircon. It can be used as an additive to enliven (variegate, crystallize) the colour and texture of glazes (rutile works in a similar manner). Moderate amounts encourages strong melts, durable surfaces and rich visual textures In amounts below 1% titania can dissolve completely in a glaze melt. In slightly greater amounts it can give a bluish-white flush to transparent glazes (depending on their amount of alumina).
Above 2% it begins to significantly alter the glaze surface and light reflectance properties through the creation of minute crystals. This crystal mechanism gives soft colours and pleasant opacity, and breaks up and mottles the surface. In the 2-6% range, it increasingly variegates the glaze surface. Many potters add titania to their glazes or paint on overglaze titania washes for this purpose. Large amounts (10-15%) will tend to produce an opaque and matte surface if the glaze is not overfired. They will also subdue colour and can add sparkle to the surface. As much as 25% can be absorbed by some lead glazes. Up to 0.8 molar can be used to effect crystal melts in glossy glazes. Minute amounts (i.e. 0.1%) can be used to intensify and stabilize colours (i.e. iron can be altered to produce yellow and orange). It can alter and intensify existing colour and opacity in a glaze.
Titania can be reduced to produce colours in keeping with the elements present. If highly reduced it can yield a red, with iron the colour could be yellow, brown or green. Other combinations can yield blues, greens, yellows. Titania is oxygen-hungry and will quickly oxidize from its reduced state if given the chance.
Titanium - Crystal Matte - Titanium can be used in glazes to produce a matte surface with increasing amounts of crystallization in amounts up to 25%. The effect works in most stoneware glazes and is better when the glaze is slow cooled.
Titanium – White - Titanium is a crystalline mineral and encourages crystal development during cooling and freezing of the glaze melt. This generally produces opacity. However, titanium opacified glazes have a much different character than zircon or tin types. The latter produces a much more even and bright white coloration. When used as an opacifier the batch amount can range to 10% or more of the recipe. Lead greatly enhances the yellow at low temperatures.
Titanium – Variegation - Smaller amounts of titanium dioxide (i.e. 5%) added to coloured or opacified recipes can variegate the surface and make it more interesting (e.g. it alters the shape of crystals, shade of colours). The more you use the greater the effect (up to 10%). Titanium – Red - In high fire matte glazes, iron oxide and titanium can produce red colours.

VANADIUM PENTOXIDE V_2O_5 A colouring agent that produces yellows in amounts up to 10%, especially when in combination with tin oxide. Its colour in generally weak, but can be strengthened when fritted with tin and zirconia. Although yellows can be prepared with antimony, vanadium is more stable at higher temperatures. The most vibrant colour is obtained in leaded glazes.
WHITING $CaCO_3$. A fine calcium carbonate (limestone) used as the principle source of lime in glazes and also a flux at high temperatures. Also, contributes hardness and durability. Under reducing conditions it assists in development of the celadon colours; and can enhance salt glazes by enabling a thicker glaze. Too much whiting in recipes will lead to dull and rough surfaces.
WOLLASTONITE CaO47% SiO_2%. The fibrous form of wollastonite can be very beneficial in bodies. In low fired ceramics wollastonite reduces drying and firing shrinkage and drying and firing warpage. It also promotes lower moisture and thermal expansion in the fired product. It fires with no LOI and its fibres help vent out gassing. These factors have made it a valuable component in tile bodies, especially for fast fire. Vitreous and semi vitreous bodies can also show reduced shrinkage with small additions (2-5%), however wollastonite becomes a stronger flux as temperatures go above 1100C.
At higher temperatures the powder form is valuable as a source of CaO flux in glazes (and bodies). The other main raw source of CaO is whiting but it releases a high volume of gases of decomposition which produce suspended micro-bubbles that demand slow firing to clear. Wollastonite is useful in recipes where pinholing is a problem. Also, since wollastonite sources silica as well, glaze recipes employing it do not need as much raw silica powder. Further the SiO_2 and CaO react more readily to form silicates. Thus wollastonite is used as a major flux in high temperature sanitaryware and electrical insulators. Wollastonite is also used in stain and frit formulations to supply CaO in a more easily melted form.
ZINC OXIDE ZnO. Zinc oxide is a fluffy white to yellow/white powder with a very fine particle size coupled with high surface area. It can be an active flux in smaller amounts. It generally promotes crystalline effects and matteness/softness in greater amounts. If too much is used (10%) the glaze surface can become dry and the heavily crystalline surface can present problems with cutlery marking. Also at high levels other surface defects like pitting, pinholing, blistering and crawling can also occur (because its fine particle size contributes to glaze shrinkage during drying and it pulls the glaze together during fusion). The use of zinc in glazes is limited by its price, its hostility to the development of certain colours and its tendency to make glazes more leachable in acids. Zinc oxide will produce opacity or whiteness, especially at low temperatures, if the calcium content is low. It does not opacify as well in boron glazes. It works well in combination with tin.
Zinc has a complicated colour response. It can have harmful and helpful effects on blues, browns, greens, pinks and is not recommended with copper, iron, or

Raw Materials Glossary—cont.

chrome.
Zinc – Enabler - Almost all crystalline glazes are high in ZnO, its presence coupled with low alumina and adequate SiO2 is the secret. The very fluid melt created is perfect for growing a wide range of metallic zinc-silicate crystals.
Zinc - White/Off-White - In larger amounts ZnO can produce opacity or whiteness in glazes. It exhibits refractory properties and can contribute to the development of a crystal mesh surface.
ZIRCONIUM SILICATE ZrSiO4. Zirconium silicate is extremely stable and will survive to very high temperatures in a glaze melt without dissolving (although small amounts do dissolve). 4-7% produces semi opaque, 8-10% usually produces full opacity but some transparent glazes require even higher amounts; amounts beyond 20% reach saturation where crystallization begins to occur. The exact amount needed varies between different glaze types. It is thus most effective at low temperatures. Tin oxide can be a more effective opacifier than zircon (it has various advantages and disadvantages).
High amounts of zircon opacifier can cause cutlery marking (because of abrading angular micro-particles projecting from the glaze surface).
Zircon has a low expansion, so it will tend to reduce crazing. In addition, it will increase melt viscosity, which means that crawling and pinholing can occur in glazes having a lot of zircon. These problems can normally be solved by cooling slower and taking measures to get a better bond between raw glaze and body during application.
Because of its high thermal stability zircon is also employed in making various hi-tech porcelain bodies and materials. It is a major source for the production of zirconium oxide ZrO2.

Converting Farenheit to Centigrade

Tc = (5/9)*(Tf-32); Tc = temperature in degrees Celsius, Tf = temperature in degrees Farenheit

For example, suppose you have a Fahrenheit temperature of 98.6 degrees and you wanted to convert it into degrees on the Celsius scale. Using the above formula, you would first subtract 32 from the Fahrenheit temperature and get 66.6 as a result. Then you multiply 66.6 by five-ninths and get the converted value of 37 degrees Celsius.

Converting Centigrade to Farenheit
Tf = (9/5)*Tc+32; Tc = temperature in degrees Celsius, Tf = temperature in degrees Fahrenheit

Assume that you have a **Celsius** scale temperature of 100 degrees and you wish to convert it into degrees on the **Fahrenheit** scale. Using the stated formula, you first multiply the Celsius scale temperature reading by nine-fifths and get a result of 180. Then add 32 to 180 and get the final converted result of 212 degrees on the Fahrenheit scale.

Orton Cones

Use 3 cones set in plastic clay in the middle of the kiln. Middle cone indicates the ideal temp. the others show under or over-firing.
These tables show the approx. bending temp. deg C at three different heating rates per hour.

Cone	60oC	100oC	150oC
08	942	948	954
07	973	979	985
06	995	1002	1011
05	1030	1038	1046
04	1060	1065	1070
03	1086	1093	1101
02	1101	1110	1120
01	1117	1127	1137

Cone	60oC	100oC	150oC
1	1136	1147	1154
2	1142	1152	1162
3	1152	1160	1168
4	1160	1181	1170
5	1184	1194	1205
6	1220	1230	1241
7	1237	1246	1255
8	1247	1259	1270
9	1260	1270	1280
10	1282	1293	1303
11	1293	1303	1312
12	1304	1314	1324

Metric mass / Imperial / USA weight

Metric, Imperial and USA Systems

The Imperial and USA systems have the same definition of the pound and the same definition of the ounce. However, the Imperial system uses the "stone", which is not used in the USA system. In the Imperial systems a "hundredweight" is not a hundred pounds but is equal to 8 stones, giving a weight of 112 pounds (8 * 14 pounds). Likewise, the Imperial "ton" is defined as 20 "hundredweight", given a weight of 2240 pounds (20 * 112 pounds). Therefore, when speaking of a hundredweight or a ton, one needs to know whether it is the Imperial version of these measures or the USA version.

1000 grams=1 kilogram	16 ounces=1 pound
1000 kilograms=1 ton	14 pounds=1 stone (UK)

8 stones (UK) =1 hundredweight (UK)=112 pounds (UK)
100 pounds=1 hundredweight (USA)
20 hundredweight (UK)=1 ton (UK)=2240 pounds
20 hundredweight (USA)=1 ton (USA)=2000 pounds

The Imperial and USA systems use similar terms for liquid capacity, but the relationships of the units are not the same. The Imperial system has 5 fluid ounces to a gill, while the USA system has 4 fluid ounces to a gill. This means that the gill and all multiples of it (e.g. cup, pint, quart, gallon) are all larger in the Imperial system than in the USA system.
The Imperial fluid ounce (equal to 28.413 milliliters) is slightly smaller than the USA fluid ounce (equal to 29.574 milliliters). Within the UK, the Imperial "tablespoon" is officially defined as 5/8 of a fluid ounce and a teaspoon is 1/24 of a gill. However, in other Imperial countries the tablespoon is often defined as half an ounce and the teaspoon as one third of a tablespoon. For ease of use, we've used these simpler definitions in the following table. For our metric calculators, the official UK definitions are used.

UK liquid capacity

10 mililiters=1 centilitre
2 teaspoons=1 dessertspoon

10 centiliters=1 decilitre
3 teaspoons=1 tablespoon
10 deciliters=1 litre
2 tablespoons=1 fluid ounce
1000 liters=1 cubic meter
5 fluid ounces=1gill
2 gills=1 cup
2 cups=1 pint=20 fluid ounces
2 pints=1 quart
4 quarts=1 gallon

USA liquid capacity

3 teaspoons=1 tablespoon
2 tablespoons=1 fluid ounce
4 fluid ounces=1 gill
2 gills=1 cup
2 cups=1 pint=16 fluid ounces
2 pints=1 quart
4 quarts=1 gallon

Metric	**Imperial**	
1 cubic centimetre	=	0.0610 cubic inches
1 cubic decimetre	=	0.0353 cubic feet
1 cubic metre	=	1.3080 cubic yards
1 litre	=	1.76 pints
1 hectolitre	=	21.997 gallons
1 cubic inch (in3)	=	16.387 cubic centimetres
1 cubic foot (ft3)	=	0.0283 cubic metres
1 fluid ounce (fl oz)	=	28.413 millilitres
1 pint (pt)	=	0.5683 litres
1 gallon (gal)	=	4.5461 litres
US Measures	**to**	**Imperial**
1 fluid ounce (fl oz)	=	1.0408 UK fluid ounce
1 pint (pt)	=	0.8327 UK pints
1 gallon (gal)	=	0.8327 UK gallons
US Measures Metric		
1 fluid ounce (fl oz)	=	29.574 millilitres 1
pint (pt)	=	0.4731 litres
1 gallon (gal)	=	3.7854 litres

CTM Potters Supplies

Contact Information
We are open 9.30 am till 4.30 pm Mon - Fri and from 10.00 am till 3.00 pm on the first Saturday of the month
(ring for which Saturday in January).

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Direction From M5
Take Junction 30 off the M5—we are 4.4 miles from this junction
Take signs to Sidmouth A3052
Straight over at the 1st roundabout (left hand lane) at Clyst St Mary
Take the Sidmouth Road
Pass WestPoint County Show Ground on your left
Pass Random Poultry Farm on your right
As you come down the hill you will see the White Horse Pub on your right - SLOW DOWN
Take the road on the right just before the pub signposted Woodbury Salterton
We are about 1/2 mile down that road - very very narrow
As the road goes over a bridge and bends to the right we are on the Left - Mill Park Industrial Estate
Go up to the top of the estate - we are in the end row of units on the left hand side Unit 10A

We look forward to seeing you !