

NORSTONE[®] Inc.

MIXING & DISPERSING IMPELLERS



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Type 1



Type 1 - Laboratory



Type 2



Type 2 - Laboratory



Type 3



Type 3 - Laboratory



Type 4



Type 5



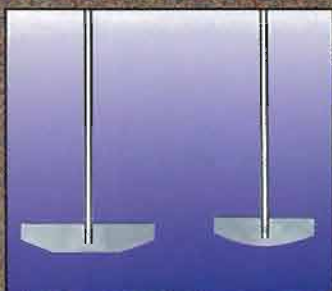
Type 6



Type 5 - Laboratory



Type 6 - Laboratory



Paddle Blades

Norstone Inc. manufactures as well as represents all types of mixing and dispersing blades for a variety of shaft configurations starting at 1" to 2" diameters depending on blade style. Norstone Inc. can also provide shafts, stiffening plates, mixers or dispersers in air, electric, hydraulic and explosion proof electric motors.

Norstone Steel Mixing and Dispersing Impellers

These blades are precision-fabricated on advanced, computer-controlled equipment. Only high-grade, heavy-gauge type 304 stainless steel (316 stainless steel available at higher cost) is used to ensure long life and dependable performance. Most blades are available with a tungsten-carbide hard coating for high-wear applications if polymer blades are not preferred.

Type 1: Standard Blades or F Style

Our most popular blade for paint dispersion work. Also used extensively in clay processing, paper coatings and ink manufacturing. Rugged, efficient design has proven its superiority in thousands of applications. Balances high shear dispersion with pumping action. Stock sizes from 1" up.

Type 2: High Vane Blades or G Style

High pumping action. Mixes an entire batch with minimal shear and heat build-up. Popular in the mixing and letdown of coatings. Available in sizes from 2" up.

Type 3: Combination Blades or E Style

Offers a combination of high shear along with excellent batch movement. Excels in high viscosity and high solids batches. Available in sizes from 2" up.

Type 4: Aggressive Tooth Blades or K Style

Works well on difficult to agglomerate materials. Available in sizes from 2" up.

Type 5: Pick Blades

Perfect for cutting in or shredding rubber, wax and other soft materials that tend to gum up on standard impellers. Unique design features a knife (or pick) extending out from the blade, alternating with vertical teeth. Available in sizes from 2" up.

Type 6: Rectangular Tooth Blades

Another popular all-around blade for high-speed dispersion applications, with a rectangular tooth pattern. Available in sizes from 2" up.



Mixed Flow Impeller



CSI Ring Blade



Norstone Polyurethane Impeller



Norstone Anti Static Polymer Impeller



Norstone Unpigmented Polyurethane Impellers

Fawcett Mixing and Dispersing Impellers

Mixed Flow Impeller

Our most popular impeller for slow speed mixing up to 200 gallons assuring that material is mixed in all directions. Available in regular and high vein with or without collar and set screw. This blade is more effective than a standard 3 bladed prop type blade.

CSI Ring Blade

A patented design using the Venturi principle to produce very fine grinds with laminar flow and less heat build-up. Also excellent for emulsification when operated at low speeds.

The Norstone Polymer Impeller

The Norstone Impeller is the answer to the negative issues which are inherent in metal blades when dispersing certain types of slurries. It is constructed from polyurethane for non-explosion proof applications such as water and oil based products or *anti-static* UHMW (Ultra High Molecular Weight) Polyethylene for explosion proof applications such as alkyd and lacquer products. These blades are USA manufactured and customized to fit any shaft configuration. Sizes start at 1 3/4" diameter.

Abrasion Resistance: This impeller is excellent for abrasive products such as ceramics, TiO₂ and oxide pigments, cement, ferrite, silica and others since it outlasts metal blades due to the wear resistance properties of the polymer. It lasts at least 10 times as long as metal blades and longer than other plastic blades in the market. If you don't believe it we offer you the first blade on a 30 day free trial basis.

Contamination: This impeller will not contaminate your product with metal or the discoloration caused by metal because there is no metal in the blade's construction. Rejected batches are decreased.

Safety: This impeller never gets sharp no matter how worn it becomes unlike metal blades which develop razor sharp edges making them dangerous to change or when they sit above the tank level. They are also reversible or bi-directional and can't be put on backwards. This also means that when the trailing edge wears out, turn it over and the leading edge becomes the trailing edge performing like a new blade.

Improved Production Time: This impeller does more work in less time because its third dimension provides a high torque output producing an aggressive dispersing action; it actually speeds up production for faster batch turnaround. This difference is even more dramatic with higher viscosities as the axial flow is 7 times greater than a steel impeller. These impellers can be sized 1"-2" lower in diameter than metal blades being replaced. You save on labor and downtime because the impeller speeds up production time with far fewer blade changes.

Cost: This impeller initially costs more than a metal blade, however, it has a low cost to wear ratio. In the long run these blades are outright less expensive but added to that is a cost savings due to maintenance needing less time for blade changes.



Type II Conn Blade



Type ITC Conn Blade



Type IIT Conn Blade



Hydrofoil Turbine



Helical Blade



Axial Flow Turbine



Radial Flow Turbine



Squirrel Cage Rotor Stator

The Conn Blade

Excellent for low shear blending or high shear dispersion, these impellers are patented intensive type stirrers with unique design features. The louvers formed in the plain of the blade provide maximum pumping action. Giving positive over all material movement with excellent top to bottom flow, they can decrease the required processing time considerably when compared to other metal blades. They are excellent for lifting quick settling materials off the bottom of a tank.

The structural and balanced design of the Conn blades eliminates the need for stabilizer rings and heavy stiffening plates normally required. The standard heavier gauge construction extends the life of this blade beyond most other metal blades. Type 304 stainless is standard, however, a higher grade stainless, titanium, carbon steel or other materials are available as well as case hardening. Multi-piece construction is available for entry through small manways. Sizes start at 2".

The standard Conn blade is right handed which, when viewing from top or along stirrer shaft, would turn in a clockwise direction thus pumping material down or away from the drive unit. Left handed blades for counter clockwise rotation are also available. For some applications it is desirable to use a right handed and left handed blade on the same shaft thus bringing material up from the bottom and down from the top increasing the blending forces between the blades. This arrangement is also excellent for introducing gas or liquids into the mix.

Type II: Intensive Type

For agitation; positive but gentle material flow; low shear smooth fast mixing without air inclusion.

Type ITC: Intensive Type Cutter

For Shear and agitation; Positive material movement; Good blending and shear for the more fibrous additives and fillers.

Type IIT (Intensive Type with Teeth)

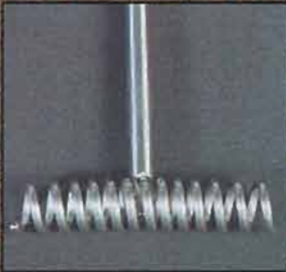
For high shear and agitation; Most positive material movement; Best combination where high shear is required for a rapid and smooth blend or when high shear is not required but is not detrimental.

Slow Speed Mixing Blades

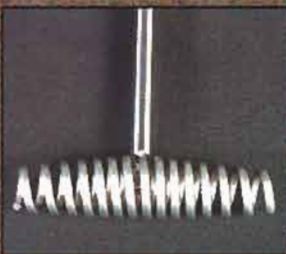
Slow Speed agitator blades are also available such as axial flow turbines, radial flow turbines, hydrofoil turbines, helical blade and special designs like the squirrel cage rotor stator. The blades are made for laboratory applications as well. In addition they can be coated for abrasion resistance or applications requiring metal free mixing.



Type BT Turbomixer



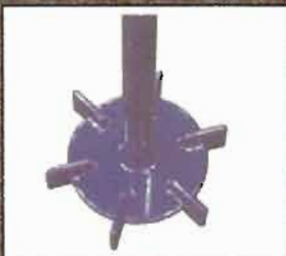
Type ST Turbomixer



Type OV Turbomixer



'U' or Gate Type Blade



Disk Turbine



Bung Hole Blades

The Turbomixer

A unique dispersing coil for solving mixing inefficiency and mixing inability problems. When a coil of specific design and proportion is submerged in a fluid substance and rotationally driven so that its longitudinal axis is perpendicular to the axis of rotation, the coil acts as if it is an unchambered pump. As the coil rotates, material within the coil framework is subjected to centrifugal force, causing it to be ejected from both ends in a nonpulsating flow. The exiting material attains a velocity substantially equal to that of coil tip speed. As material is centrifugally forced from the coil ends, it creates an area of lower pressure within the coil's interior framework. Material adjacent to the coil's exterior is subsequently drawn into the coil's interior through openings in the coil pitch. All material flow within the container is toward the coil, except in a plane adjacent to the coil discharge. Material above, below, in front and behind the coil is sucked into the interior of the coil body.

Material being centrifugally thrown outward, from the rotating coil ends, strikes the container walls, and then flows upward and downward. The material will then circulate toward the lowest pressure zone, which is directly above and below the rotating coil. The material is drawn once again into the coil body and thrown outward to repeat the processed flow pattern. Because the flow through the coil is very rapid the material is subjected to high rates of acceleration and directional change, which causes agglomerates to be broken up and a homogenous mix to be quickly achieved.

Tests have shown that for any given level of required mixing efficiency as well as prevention of settling, mixer shaft speed required for the coil is about 50% of that required by standard metal impellers. It is used for mixing, blending, dispersing, emulsifying, and aerating at shaft speeds from 60-5000 rpm in either rotational direction. Unconditionally guaranteed, starting at 3/8" length up to 40" length. There are many special features available for this. Contact us for more information.

Type BT: Bow Tie Coils

Bow Tie coils are most efficient in materials of relatively low viscosity, up to 12,000 centipoise. It has larger coil loops at its ends than at its center. When resistance to coil rotation is relatively low this shape's large surface area imparts energy into the material quickly, while providing reduced resistance to material passage out of the coil body.

Type ST: Straight Coils

Straight coils are more useful in relatively thick materials, from 12,000 cps to 2 million cps because they provide less resistance to rotation. This shape is particularly useful in situations where semi-solid masses have formed on the container bottom due to settling. This coil may be used to auger agglomerated material prior to high speed dispersion mixing.

Type OV: Oval Coils

Oval coils work best in blending dry, powdered materials or to disperse them into liquids. Its shape, with restricted discharge ends, causes materials to spend fractions of a second longer within the coil body, concentrating the particles into a small stream, having the effect of wetting out high surface tension materials.



Beveled Reinforcing Plates with Roll Pins



Portable Mixing Tank



Permanent Storage Tank



Tote Tanks (square metal)



Tote Tank Round, metal with follower plate (Liqua-Bin)



Plastic Tank (cone bottom with mixer stand)



Pharmaceutical Process Tank



Fiberglass Tank

Beveled Reinforcing Plates

Reinforcing plates are recommended for metal blades since they are thin and will flex leading to bending and/or breaking. The reinforcing or stiffening plate provides structure, holding the blade steady by sandwiching the blade between two plates. This ultimately leads to longer life of the blade and the machine. Once a blade flexes it will pick up a vibration which can cause shaft deformity. plastic blades are thicker and while not subject to flexing, could benefit from the added weight of the plates which is calculated into the critical speed of the machine. All plastic blades which have a keyway mounting must use stiffening plates to avoid having the key torn or stretched. Stiffening plates are made from 304 stainless steel. These plates are permanent and do not need to be changed when the blade is replaced.

Recommended plate sizes:

Blade Diameter	Plate Diameter Metal Blades	Plate Diameter Plastic Blades	For Plastic Drive Pin Bolt Circle
8"	4"	5"	3"
10"	5"	6"	3"
12"-14"	6"	8"	3"
15"-16"	8"	10"	6"
18"-19"	11"	10"	8"
20"-25"	14"	14"	10"
26"-29"	16"	18"	12"
30"-32"	18"	20"	12"
33"-35"	20"	24"	16"
36"-39"	24"	28"	18"

TANKS

Norstone, Inc. represents a variety of tank manufacturers to meet all of your tank requirements. These include:

Indoor
Outdoor
Permanent
Portable
Totes
Stackable

Stainless Steel
Carbon Steel
Fiberglass
Plastic
Aluminum
Exotics

Glass Lined
Polymer Lined
Ceramic Lined
Baffled
Mixer Mounts

Round
Square
Vertical
Horizontal

Dish Bottom
Cone Bottom
Flat Bottom
Slant Bottom

Water Jacketed
Steam Jacketed
Insulated

Open Top
Closed Top
Lidded

Legs
Wheels
Fork Lift Rails

Lab Scale
Storage Scale
ASME

The Norstone Polymer Impellers

The Norstone Polymer Impellers are the answer to the negative issues inherent in metal blades. The benefit derived from these blades are apparent in most applications but especially beneficial in abrasive slurries such as those containing TiO₂, silica, calcium carbonate, iron oxide, limestone and diatomaceous earth.

The two most popular options for these blades are the polyurethane and polyethylene materials. However, this blade is also available in other materials of construction such as nylon and polypropylene.



Variety of blades: UHMW (black), natural urethane (amber) with keyway bore and stainless steel hub, polypropylene (white), dual hard pigmented urethane (yellow) with center bore and urethane hub with set screw.



Urethane Impeller



Anti-Static UHMW Impeller

The polyurethane blade is a thermoset material cast in a special mold to meld two different durometers together giving the center of the blade a rigid construction and the grinding scoops of the blade a softer construction. This material is recommended only for non-solvent products. It is generally cast in bright yellow but can be made unpigmented resulting in natural amber.

The ultra high molecular weight (UHMW) polyethylene blade is a thermoplastic material fabricated in an anti-static grade. This material is recommended for solvent borne products. While it is not as abrasion resistant as the urethane, it is more chemical resistant. The color is always black due to the carbon impregnation for dissipation of static electricity.

Key Advantages:

Safety: Our customers have told us that this is the most important feature of our blade — it never gets sharp like metal blades. Personnel will no longer get cut while changing the blade or backing into the blade.



Overused urethane blade looks mean but can be held without worry even by a child since points are soft and flexible.

Abrasion Resistant: Outlasts metal many times over. It also outlasts other competitive polymer blades. Domestic companies can take advantage of our 30 day free trial. If you don't like the blade just return it.

Reduced Heat: Batches will run cooler using the Norstone impeller which is important with heat sensitive products. It will also reduce the amount of algae formation in water systems.

Reduces Contamination: The polymers are 100% organic. No metal contamination means no discoloration or other imperfections caused by undesirable metal in a product.

Improved Production Time: These impellers do more work in less time because its third dimension provides a high axial flow producing an aggressive dispersing action. Because of this most applications require a smaller diameter blade than is currently being used. It speeds up production for faster batch turnaround.

Cost: These impellers initially cost more than a metal blade, however, it has a low cost to wear ratio. In the long run these blades cost less because there are fewer shutdowns for the operator to change it as often and the batch production quality is maintained.

Double the blade's life with one quick turn. The following edge on the blade will always wear first. Half way through the life of the blade simply turn it over and the untouched leading edge now becomes the new following edge.

Even the most overused abused blade will still have flexible edges that a child could hold without harm. It will be less destructive on items which may fall into the batch preventing it from splintering and flying into the face of the operator.

These blades are also bi-directional. They cannot be put on backwards like other blades which can rip and fly off the shaft or unscrew from the shaft while it is running.



Blade mounted with stiffening plates shown after 15 months in a 40% TiO₂ slurry.

Norstone Inc.
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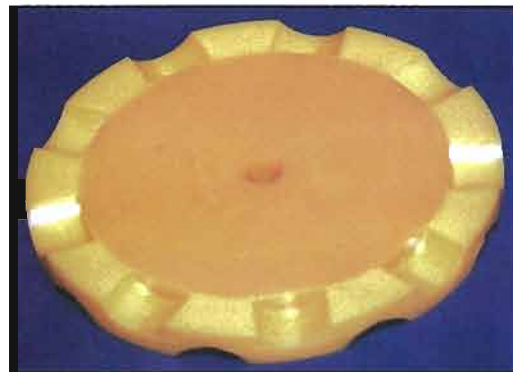
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E: Norstone@NorstoneInc.com
W: www.NorstoneInc.com

Norstone is a female owned and operated business.

Specifications:

Urethane Specifications:

100% organic thermoset
Durometer: 70D-75D core and 65A-95A exterior
Softening temperature: 180 degrees F
Sizes: 1-3/4"-28" diameter
Solvent sensitive: see chart



Urethane Impeller

UHMW Polyethylene Specifications:

100% organic thermoplastic
Durometer: 60D-65D
Softening temperature: 160 degrees F
Carbon impregnated for anti-static
Sizes: 2" - 30" diameter
Chemical resistant: see chart



Anti-Static UHMW Impeller

Mounting Specifications:

These blades can be drilled for any type of shaft mounting. For proper operation we will need to know:

- Center bore measurement
- Pin hole diameter and bolt circle placement
- Hp or Kw of disperser
- Diameter of tank
- Length of shaft portion for mounting blade (distance under shoulder)
- Diameter of current stiffening plates
- Viscosity of product



Blade with counter-sunk center to accommodate stiffening plates where necessary.

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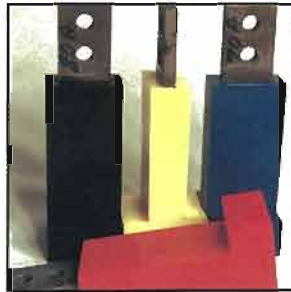
Please let us know your preference for blade type.

SPECIALTY PARTS AND PROJECTS

Norstone manufactures parts for varied end products where abrasion resistance is required. These parts can be made from polymers, ceramics, metals and/or a combination thereof. We can duplicate any part from a drawing or the part itself to give you an abrasive resistant substitute. There is no charge to receive an estimate.



Piping (Rigid and Flexible)



V-Blender Hammers



Pump Impeller Seal



Media Mill Disk



Sand Mill Disk



Hydrofoil Impeller



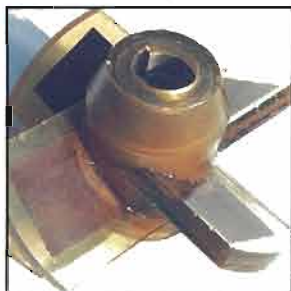
Assorted Blades



Auger Tube



Conveyor Scraper



Axial Flow Blade



Attritor Arm Cap



Pump Liner



Ceramic Victalite Lining



Ceramic Mill Parts



Ceramic Disks



Non-pigmented Jar Liner



Stellite Bushing



Flexible Pipe



Attritor Arms



Homogenizer Assembly



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Impeller Specification Sheet

Disperser Manufacturer: _____ Hp: _____ RPM of Shaft: _____

Variable Speed: _____ Fixed Speed: _____ Two Speed: _____

Current Blade Type: _____ Current Blade Diameter: _____ Customer Machine #: _____

Bolt Pattern: Center Bore: _____ Keyway: _____ Pin Diameter: _____

Pin placement in relation to keyway: _____

of Pins: _____ Bolt Circle: _____ Shaft OD: _____ Hub OD: _____

Max length on shaft where blade sits: _____ (Polymer blades are thicker than steel blades)

Is the shaft fixed? _____ At what height off the bottom of the tank? _____ Diameter of the tank at that height? _____

Stiffening Plate Diameter: _____ Stiffening Plate Thickness: _____

Tank: Diameter: _____ Tank Height: _____ Style of Bottom: _____

Product: Viscosity: _____ Max. Temperature: _____

Solvent: _____ Oil: _____ Water: _____ UV: _____

Application: _____

Product Name: _____ Is product abrasive, corrosive, high ph: _____

Are you interested in: Mixing _____ Dispersing: _____ Metal Blade: _____ Plastic Blade: _____

Customer Information

Name: _____

Title: _____

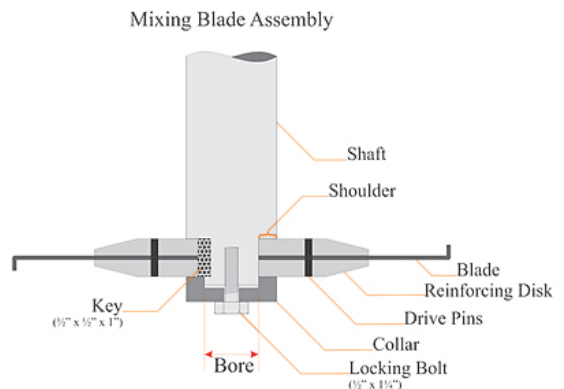
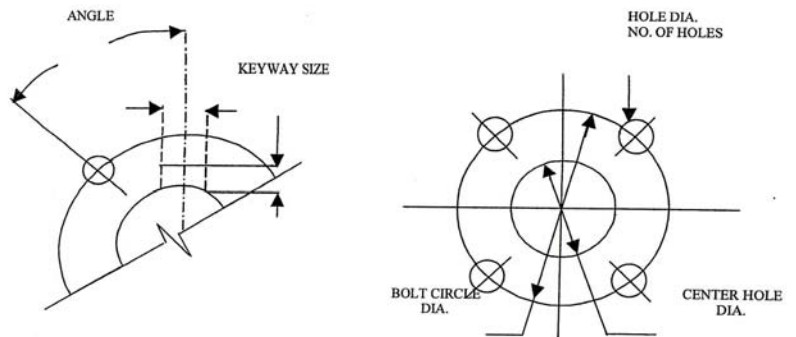
Company: _____

Ship Address: _____

Phone: _____

Fax: _____

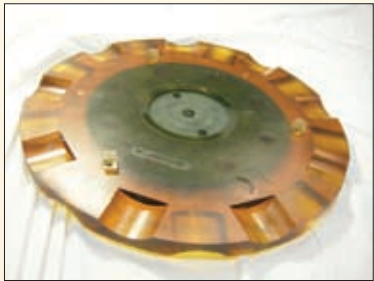
E-Mail: _____



Norstone Inc.

The POLYBLADE

The Norstone's Blade Depot, manufacturer of the POLYBLADE, has announced two new innovations to increase the safety in the workplace, reduce waste, contamination, downtime and energy costs.



Innovation #1: The option for SHEAR PEGS has been added, which increase the shearing ability and reduce the amount of time it takes to process the batch. The TURBO POLYBLADE is powerful and should be used in a tank with a lid. There are three cubed-shape pegs on each side of the blade, set on the diagonal so that the flat adds a new shear zone to the blade. These shear pegs also cut the vortex into two zones, thus creating four high-velocity surfaces rather than two. Our customers have reported that their amp draw is lower than when using a steel blade as well as the standard POLYBLADE.

Innovation #2: The stiffening plate can now be embedded in the urethane POLYBLADE or TURBO POLYBLADE. Unlike stiffening plates, this plate is dynamically balanced. Installation of these blades is a one-piece operation, making it much simpler especially for confined space entry. The sharp edges that form and become a safety hazard on worn plates are eliminated.

The POLYBLADE is still the most preferred polymer blade in the marketplace due to its long life, high pumping power and low heat generation. Elongated scoops are available for processes that need increased heat generation. The blade is also available in a wide range of polymers such as polyurethane, polyethylene, anti-static polyethylene, polyamide, polypropylene and PTFE.

Contact NORSTONE, Inc. for more information on our trial program. Sizes are available starting at 1.25" diameter up to 40"+ diameter.

www.norstoneinc.com

sales@norstoneinc.com

800/726.1366

POLYBLADE[®]

 **BLADE DEPOT[®]**
A Norstone Company

POLYBLADE IMPELLERS

by

Norstone, Inc.

Patent Nos:

5,888,440

8,028,944 B2

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How to Choose the correct GRINDING MEDIA

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Norstone, Inc.

Daniyel Firestone, *President*

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NORSTONE[®] Inc.

GRINDING MEDIA



NORSTONE, INC.

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E-mail: norstone@norstoneinc.com

Website: www.norstoneinc.com

Norstone Inc. is a minority owned and operated business.

PLASTIC

Polystyrene

Non-abrasive, spherical in shape, non-toxic and dust free. A variety of levels of cross linking are available in sizes as small as 50 microns. Also available crosslinked with polymethyl methacrylate. Low in density but tough and wear resistant. (Density 1.05 gm/cc)



Polystyrene

Polyamid/Nylon

Non-abrasive, cubed design, chemical resistant and dust free. Smallest size available is 0.5mm cube x 0.87mm diagonal. Density = 1.13 gm/cc



Polyamid/Nylon

Polycarbonate

High density, non-toxic, cylinder shape. Smallest size available is 0.5mm x 0.5mm x 0.71mm. (Density = 1.20 gm/cc)



Polycarbonate

Polyurethane

Thermoplastic formulation, spherical shape. Size is limited to 0.6-0.7mm. Very abrasion resistant, non-toxic, FDA material available. Not recommended for use with solvents. (Density = 1.20 gm/cc)



Polyurethane

SILICA

Sand

Still used because of its low price but costly in the long run since it is abrasive to the mill and irregular in shape. Since it is more needlelike than spherical, the tips can break off causing contamination. The most popular size is 0.75mm. It doesn't last long thus creating a problem of waste generation. Glass spheres should be considered as an alternative. (Density = 2.5 gm/cc)

Soda Lime Glass

There are several companies making grinding quality glass beads in sizes ranging from 0.4mm to 13mm. Other sizes are available but should be tested for appropriate use as a grinding media. Soda lime unleaded glass is the most popular. Chemical composition is usually 60-70% SiO₂, 12-18% Na₂O, 5-20% CaO, 1-4% MgO and 1-8% Al₂O₃. Available in both virgin and recycled qualities. Color can vary from clear to pink to green. Shape is spherical. Minimum of inclusions is important for strength. Excellent for low viscosity materials. (Density = 2.5 gm/cc)

Borosilicate Glass

This is an alternative glass which is alkali free more expensive than soda lime but has greater crush strength and wear resistance. It can be as much as 2-3 times the price with 2-3 times the life of the bead. Sizes are from 0.6mm - 3.5mm. Chemical composition is SiO₂, CaO, Al₂O₃, B₂O₃ and MgO. (Density = 2.6 gm/cc)

Steatite

This is a fused magnesium silicate composite made up of 62% SiO₂, 27% MgO, 7% Al₂O₃ and BaO, FeO, NaO and CaO. Sizes are from 4.5mm-60mm diameter for use in ball mills and attritors. Product is low in price but must be ordered in metric ton quantities. This is an excellent alternative to pebbles. It is available in satellite type spheres and cylinders. (Density = 2.6 gm/cc)



Sand



Soda Lime Glass



Borosilicate Glass



Steatite



Flint Pebble



Basalt



Alumina Satellites

Alumina Cylinders
or Rods

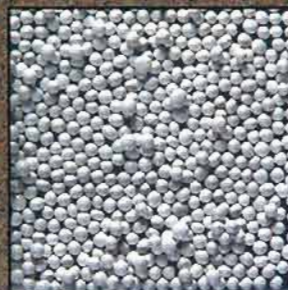
Alumina Naturals



Alumina Beads



Zirconia Toughened Alumina 3



Fused Zirconia Silica



Sintered Zirconia Silicate

SILICA (continued)

Flint Pebble

Pebbles were more widely used in ball mills and attritors 10 or more years ago and are still used in many applications. Steatite sheres and cylinders have been an excellent replacement. These stones usually come from France or Asia. They are basically quartz having similar density to glass but harder with irregular shapes and surfaces. The stones from Asia are lighter in color and smoother. They are not suitable for small media mills. (Density = 2.6 gm/cc)

Basalt

This grinding media has been available since 1998. It is made from volcanic rock chemically composed of SiO₂ 43%, Al₂O₃ 14% and FeO 14%. It is higher in density and hardness than glass. It is very round, has very good wear resistance, low porosity, highly polished finish, spherical in shape and a narrow particle distribution. It is black in color which may restrict its use to certain products. This product was developed for use in small media mills. It is economically priced. (Density = 3.0)

ALUMINA

This grinding media is widely used as it comes in many sizes, shapes and hardnesses, (86-99% alumina content), but can be abrasive in small media mills. A new product, zirconia toughened alumina, is now available in a moderate and high priced variety which has excellent abrasion resistance, size consistency, long wear characteristics and gentle on the mill. Most alumina products are composed of <10% silica. Applications require ceramic lined mills so as to prevent graying of product. (Density = 3.6 gm/cc)

ZIRCONIA SILICATE

This is probably the most popular grinding media today since it has a medium density making it practical for a wide variety of milling products and mill wear. It is more expensive than glass yet still reasonable as it lasts much longer. There are many companies now offering this product but all are not equal. Two basic manufacturing processes are fusing and sintering. The fused zirconia silica is more expensive but lasts longer. It also has a more consistent hardness from the crust to the center of the bead so that the beads can be rescreened and used in mills requiring smaller media. The sintered bead will initially last longer than the fused but deteriorates faster once the initial crust is worn. The fused bead is available in a wider range of sizes, down to 0.05mm. The sintered bead is excellent for the lower energy media mills such as shot mills, sand mills and attritors. The fused bead is a better choice for aggressive small media mills. These two different types should never be mixed together. Zirconia content ranges from 58%-93%, the balance being silica. Maximum size is 4.0 mm. The larger the bead the more likely hollows will be evident and thus conditioning is very important if preconditioned beads are not available. (Density = 3.8 gm/cc)

ZIRCONIA OXIDE

These are higher density grinding medias. Proceed with care if the material is low in viscosity and the mill has softer materials for wetted parts such as an alumina lining or 300 series stainless. These media do very well with hardened steel, harder ceramics and polymer wetted parts such as urethane and ultra high molecular weight polyethylene.

Magnesium Stabilized

This is still the most popular high density bead on the market because of its reasonable pricing although the beads can be very abrasive to the mill. The density almost requires that it be used with viscosities greater than 1000 cps. The small media can be abrasive to the mill. The larger satellites and spheres make a superb grinding media for ball mills and attritors. Wear rates are moderate to low. (Density = 5.4 gm/cc)

Yttria Stabilized

This is top quality high density grinding media and very expensive. However, it is non-porous, very round, every bead is the same size, available as small as 0.1mm, smooth iridescent color, longest wear rates of any media available and excellent for products with serious contamination issues. It cleans up easily, won't wear the mill, can replace all medias. Price is the only downside. (Density = 6.0 gm/cc)

Cerium Stabilized

This media is a tad higher in density than the yttria, reasonably priced, lasts a long time and gaining in popularity replacing steel, zirconia silica, magnesium and yttria stabilized zirconia oxide in many applications. It is available as small as 0.4mm as well as large spheres, satellites and cylinders. This media brings the density of yttria stabilized with the pricing of magnesium stabilized. (Density = 6.1 gm/cc)

EXOTICS

Tungsten Carbide

This is the fastest growing exotic media but still in the experimental and trial stages. The density is extremely high and mills need to be able to handle the weight of the media. This is very popular in attritors for grinding tungsten carbide. New medias are available in <2.0mm. (Density = 15.0 gm/cc)

Titanium Oxide

This is a high priced bead which is an excellent alternative for grinding titanium dioxide. It is not a common choice. Sizes are available down to 0.8mm. It is stabilized with alumina oxide. (Density = 3.9 gm/cc)

Other Exotics

There are other medias which are not as popular but still available in limited sizes such as boron carbide, silicon carbide, silicon nitride, aluminum nitride, sapphire, garnet and agate. Most are expensive. (Densities range from 3.4-6.1 gm/cc)

Norstone, Inc. would like to assist you with your grinding media needs regardless of how ordinary or extraordinary they may be. We can accommodate small orders and sampling for most products.



Magnesium Stabilized Zirconia Oxide - Beads



Magnesium Stabilized Zirconia Oxide - Satellites



Magnesium Stabilized Zirconia Oxide - Cylinders



Yttria Stabilized Zirconia Oxide - Beads



Yttria Stabilized Zirconia Oxide - Cylinders



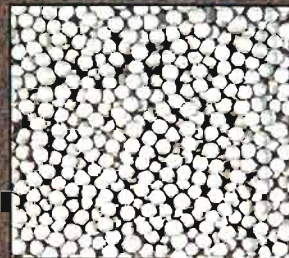
Cerium Stabilized Zirconia Oxide - Beads



Cerium Stabilized Zirconia Oxide - Cylinders 4



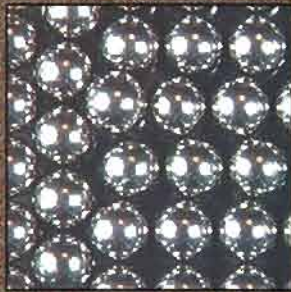
Tungsten Carbide



Titanium Oxide



Carbon Steel Shot



*Chrome Balls
(AISI 52100)*



Stainless Steel Balls



Stainless Steel Shot



*Stainless Steel
Conditioned Cutwire*



Unpolished Steel Balls



Polished Steel Balls



Steel Cylinders

STEEL

This is a popular grinding media since it is inexpensive, very high in density and can be removed from the product with a magnetic separator. The hardness of the bead is determined by a Rockwell scale which measures the hardness from the outside crust through to the center core. It is important to get the correct Rockwell as hardness will affect the performance of the bead and mill. A bead which is too soft will both wear quickly and flatten. A bead which is too hard will wear the mill quickly and crack and break. Some mill manufacturers will recommend a certain Rockwell for use with their mills. If not, Norstone, Inc. can provide guidelines.

Steel Shot

There are many sources for steel shot and all are not equal. Steel shot is the least expensive grinding media to use and is available down to <0.1mm. Sizes greater than 2.5mm will wear quickly. Proper screening, sizing, conditioning and hardening are important. All Norstone shot is through hardened, conditioned and double or triple spiralled. Rockwell hardness is available in 45-50, 50-55, and 55-60. Composition is Carbon 0.85-1.2%, Manganese 0.6-1.2%, Phosphorus <.05%, Sulfur <.05%, Silica >.4% with the balance being Iron. Norstone manufactures several different-grades, all high quality. We recommend our very narrow distribution PLUS steel shot for horizontal media mills. (Density = 7.6 gm/cc)

Steel Balls

This is an excellent media to use in steel ball mills and attritors. There are several grades available such as through hardened, cold headed, and polished. These balls are available from 1/4" up to several inches in diameter. Pricing is very reasonable. (Density = 7.6 gm/cc)

Chrome Balls (AISI 52100)

This is almost ball bearing quality grinding media, very round and very narrow size distribution. Chrome lasts much longer than standard steel, is harder, very slow to rust and slightly more expensive than steel. All Norstone chrome steel is through hardened to a Rockwell C 63-65. Composition is Carbon 0.98-1.1%, Chrome 1.3-1.6%, Manganese 0.25-0.45%, Phosphorous 0.25%, Sulfur .025%, Silica 0.15-0.35% with the balance being Iron. The small beads, <3.0mm can get very expensive but it is available down to 1.0mm. (Density = 7.6 gm/cc)

Stainless Steel

This grinding media is still in the trial stages with only a few customers committed to it. One obvious reason for using it is the high density combined with the elimination of any rusting. However, it is very soft compared to other medias and can become brittle as it work hardens. The stainless steel shot and conditioned cut wire are reasonably priced. The ball bearing quality beads are expensive. It has a relatively high wear rate with the 300 series wearing faster than the 400 series which can be removed with a magnet. (Density = 7.6 gm/cc)

GRINDING MEDIA

Norstone Inc. represents a wide range of manufacturers of grinding media for all applications. We continually look for the best value which means high quality reasonably priced. We conduct wear tests on the media to ensure that the quality meets our requirements for wear resistance.

Grinding media is required for processes using horizontal and vertical media mills, sand mills, attritor mills, vibratory mills, ball mills and shakers. Each type of mill performs best with specific ranges in size, per cent loading, distribution and often times shape. Our expertise in grinding media can help you choose not only the best material for your media but also decisions on other important parameters such as:

- guidance regarding mill type
- chemical compatibility
- production requirements
- temperature limitations
- milling material compatibility
- maintenance
- wear properties
- density/viscosity effect
- budget parameters
- contamination
- particle size

Working with Norstone, Inc. for your media needs ensures that you will be kept abreast of the latest technology available and have opportunities to inspect these products to determine if a change in media will improve your production.

We have included photographs and general information on the 22 most popular grinding medias. Brochures with detailed information such as chemical analysis and size distributions are available. Simply contact us by phone, fax, mail or internet.

There has never been such a large choice of grinding medias as there are today. Norstone, Inc. offers a large selection of these medias which include:

MATERIAL	DENSITY gm/cc	BULK DENSITY				HARDNESS mohs
		kg/l	kg/gal	#/gal	#/l	
PLASTIC						
Polystyrene	1.05	0.63	2.3	5.0	1.4	NA
Polyamid/Nylon	1.13	0.68	2.5	5.5	1.5	NA
Polycarbonate	1.20	0.72	2.6	5.8	1.6	NA
Polyurethane	1.20	0.72	2.6	5.8	1.6	NA
SILICA						
Sand	2.50	1.5	5.5	12	3.3	5.5
Soda Lime Glass	2.50	1.5	5.5	12	3.5	5.5
Borosilicate Glass	2.60	1.6	5.9	13	3.5	6.6
Steatite	2.65	1.6	5.9	13	3.5	7.0
FLINT PEBBLE						
	2.60	1.6	5.9	13	3.5	7.0
BASALT						
	2.90	1.7	6.4	14	3.7	6.0
ALUMINA: larger sizes available in spheres, satellites, cylinders and natural						
90%	3.60	2.2	8.2	18	4.9	8.0
98%	3.80	2.4	8.6	19	5.3	9.0
Zirconia Toughened	4.40	2.6	9.6	21	5.7	9.0
TITANIUM OXIDE						
	3.90	2.4	8.6	19	5.3	6.0
ZIRCONIA OXIDE: larger sizes available in satellites and cylinders						
Silica stabilized - fused	3.80	2.4	8.6	19	5.3	7.0
Silica stabilized - sintered	4.00	2.4	8.6	19	5.3	8.0
Magnesium stabilized	5.40	3.2	11.8	26	7.0	9.0
Ytria stabilized	6.00	3.5	11.8	28	7.7	9+
Cerium stabilized	6.10	3.6	12.7	28	7.9	9+
STEEL						
Steel Shot	7.60	4.5	17.8	38	9.9	6.0
Chrome	7.60	4.5	17.8	38	9.9	7.0
Stainless	7.60	4.5	17.8	38	9.9	4.0
TUNGSTEN CARBIDE						
	15.0	8.2	30.0	66	18.0	9+

Recommended Media Charge for Various Mills	
<i>percent based on void volume</i>	
Pebble Ball Mill	50%
Ceramic Ball Mill	50%
Steel Ball Mill	33-30%
Dry Grind Batch Attritor	45-60%
Wet Grind Batch Attritor	38-45%
Continuous Attritor	78-92%
Circulation Attritor	85-92%
Straight Side Vertical Mill	50-55%
SW Vertical Mill	40-45%
Fryma Vertical Mill	55-70%
Horizontal Disk Mill	70-85%
Recirculation Mill	80-100%
Moh Hardness Scale	
Soft	1 talc, soapstone, waxes
	2 gypsum, salts
	3 calcite, marble, chalk
Intermediate	4 fluorite, limestone, magnetite
	5 chromite, bauxite, apatite
	6 feldspar, ilmenite, orthoclase
Hard	7 quartz, granite
	8 topaz
	9 sapphire, corundum, emery
	10 diamond

Samples are available. We also sell small quantities for a small repack charge.

Call us if you are interested in our blade, tank and/or specialty parts brochures.

Norstone Inc.

Environmentally Friendly Tank Cover



NORSTONE introduces the **TRAPolene**, an environmentally friendly solution to covering open top tanks. The **TRAPolene** is a GREEN solution as well as an ergonomic solution.

Disposable plastic shower caps are not the answer. They are environmentally unfriendly, creating disposable waste that contributes to the serious plastic bag problem seen worldwide. There is no need to spend money on expensive heavy metal tank lids that can cause back, neck and shoulder injuries for the employees that have to put them on and take them off several times each day.

Norstone's **TRAPolene** uses lightweight aluminum tubing and easy-to-clean, chemically resistant coated fabric to create an environmentally friendly tank cover. These covers are custom made to the size(s) needed by your plant. The cover can be made to fold in half for easy storage and comes complete with ports if needed. They can also be made in two half sections for bridge-mounted installations or in a single piece with a shaft slot.

The primary purpose is to contain vapors and prevent debris from entering the tank. A wide variety of colors are available including **anti-static black** and **safety orange** material. The **TRAPolene** is not designed to hold substantial weight. One ruined batch, one VOC fine or one insurance disability claim will more than pay for your **TRAPolene** covers. Call us with your tank ID and OD and we will send you a quote.

www.norstoneinc.com
sales@norstoneinc.com
800/726.1366



315 E. 4th Street Rear, Bridgeport, PA 19444 P: 484-684-6986; F: 610-275-2404

TRAPolene Questionnaire

Outside Diameter of Tank 1: _____ Inside Diameter of Tank 1: _____

Outside Diameter of Tank 2: _____ Inside Diameter of Tank 2: _____

Outside Diameter of Tank 3: _____ Inside Diameter of Tank 3: _____

Outside Diameter of Tank 4: _____ Inside Diameter of Tank 4: _____

Outside Diameter of Tank 5: _____ Inside Diameter of Tank 5: _____

Outside Diameter of Tank 6: _____ Inside Diameter of Tank 6: _____

Outside Diameter of Tank 7: _____ Inside Diameter of Tank 7: _____

Does TRAPolene need to be able to fold in half when not in use: _____

Does mixer need to be running while TRAPolene is on tank _____ If needed, what is the Outside diameter of the shaft: _____ For this option, the TRAPolene will have a slit that leads to a hole in the center.

Does TRAPolene need to have a port so that material may be added into tank: _____

Is solvent being used: _____ If so, what type of solvents: _____

Quantity needed for each tank size: _____

Customer Information

Name: _____

Title: _____

Company: _____

Ship Address: _____

Phone: _____

Fax: _____

E-Mail: _____

