

# Lightnin Mixers

GENERAL OVERVIEW



Based in Charlotte, North Carolina, SPX Corporation (NYSE: SPW) is a global Fortune 500 multi-industry manufacturing leader. The company's highly-specialized, engineered products and technologies serve customers in three primary strategic growth markets: infrastructure, process solutions, and diagnostic systems. Many of SPX's innovative solutions are playing a role in helping to meet rising global demand, particularly in emerging markets, for electricity, processed foods and beverages, and vehicle services. The company's products include thermal heat transfer equipment for power plants; power transformers for utility companies; process equipment for the food & beverage industry; and diagnostic tools and equipment for the vehicle service industry. For more information, please visit <http://www.spx.com/>.

For more than 85 years SPX's Lightnin brand has been recognized as the leader in Mixing Technology. Our extensive knowledge base and dedication to continuous product development ensure efficient and reliable plant operations around the world. With our unsurpassed process application expertise, and state of the art analytical design tools we can solve virtually any mixing challenge no matter how complex.

## Lightnin Mixers

### ADVANCED SOLUTIONS FOR OPTIMIZED PROCESS PERFORMANCE

At the heart of SPX's continuous development program is its dedicated, industry leading research center. Used on a daily basis to support its customer base, the extensively equipped facility is manned by highly talented researchers and engineers, producing innovative solutions for difficult mixing applications, ensuring that the Lightnin brand remains at the forefront of Mixing Technology.



#### LDV – Laser Doppler Velocimeter

Efficient mixing is at the heart of most successful process operations. Our Laser Doppler Velocimeter (LDV) allows us to accurately establish a given impeller's performance. Power, speed and shaft loading measurements are taken simultaneously with the fluid flow data, allowing a full understanding of each impeller's unique operating characteristics to be established.



#### Scale Testing – laboratory, through pilot scale to full scale production

We can test your process from laboratory, through pilot scale to full scale production. SPX's Lightnin laboratory is fully equipped to model test any mixing application whether it be liquid-liquid, liquid-solid, gas-liquid, or gas-liquid-solid. Whenever possible we prefer to test your actual material, or to use a suitable simulant which mimics the rheological properties of your process. Our dedicated Explosion-Proof laboratory area can be used for hazardous materials testing. Our testing capability ranges from 200 ml to 2000 m<sup>3</sup> (8 fl.oz. to over 500,000 USgal.). Using SPX's proven scale up / scale down techniques and experience, we can confidently predict full scale equipment design requirements.



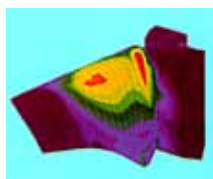
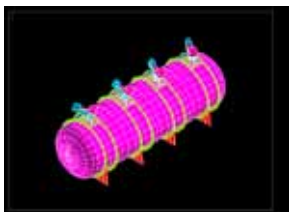
#### CFD – Computational Fluid Dynamics software

LDV data and scale model testing is augmented by state of the art Computational Fluid Dynamics (CFD) software. CFD models the combined dynamic effects of impeller design, vessel geometry and fluid properties. This powerful capability allows quick evaluation of existing process mixing problems, and significantly reduces the cost of pilot scale experiments and full scale trials.

## ENGINEERED PRODUCTS – ASSURED OPERATION

The depth of technical knowledge gained from more than 85 years of operating experience and an installed base exceeding 1 million units is supported by state of the art analytical design tools.

Finite Element Analysis (FEA) is often employed to carry out mechanical, thermal and vibration analysis. We can look at stress levels, structural deflections, vibration modes and harmonics. We have the know-how and ability to analyze the mixer, its mounting structure and the vessel to ensure total system integrity.



## PROCESS CONSULTING

You can leverage the resources and knowledge base of Lightnin by optimizing your mixing processes and solving any mixing problems. Lightnin's Process Technology Lab enables this support to be efficiently executed to minimize your costs. Lightnin will evaluate your existing mixer design and process goals to determine opportunities for improvement. Lightnin will team with your technical group to reduce the time and expense for developing new mixer applications. Lightnin can assist in the specification of mixer design, tank internals, feed stream locations and product draw-off position to optimize your operation. Lightnin has extensive experience in scaling up lab designs and achieving guaranteed full-scale performance.

Lightnin's consulting work starts with a discussion of your needs and process information. Then a proposal is created to define the project scope, responsibilities, deliverables, cost and schedule. A path forward is then concisely and clearly written and agreed to by both parties. Bidirectional confidentiality agreements are frequently a necessary and common course for doing business.

## Application Knowledge

SPX has a process solution for a wide variety of mixing applications. Mixing applications can be broken down into the following mixing duties: liquid-liquid, liquid-solid, gas-liquid, gas-liquid-solid and fluid motion. Many applications are often a combination of these duties and thus having a full understanding of each of these areas is crucial to recommending an optimized design that is also economical.

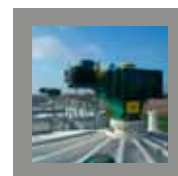
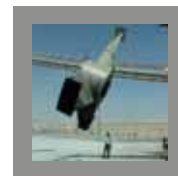
### LIQUID-LIQUID

- Solvent Extraction of Copper and other Metals
- Continuous pH control in potable water or effluent treatment
- Blending of additives and ingredients in food and beverages



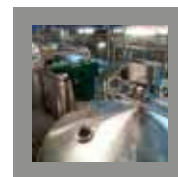
### LIQUID-SOLID

- Petroleum blending and drilling mud suspension
- Blending of additives and ingredients in food and beverages
- Draft Tube Crystallisers, used in the production of Alumina
- Suspension of Slurries in Large Tanks at Slurry Pipeline facilities



### GAS-LIQUID

- Flue-Gas Desuplurization for municipal and industrial power plants
- Hydrogenation for chemical and pharmaceutical Industries



### GAS-LIQUID-SOLID

- Pressure Oxidation and High Pressure Acid Leach Autoclave Mixers
- Fermentation, a key process step in many Biopharma and Biofuel plants
- Surface Aeration and Anoxic Mixing Basins at Industrial and Municipal Water/Waste Water Treatment Plants



### FLUID MOTION

- Milk storage and Cream Aging for dairies
- Homogenization of storage tanks

## Reliability By Design

SPX understands that when it comes to efficient process plant operations, equipment reliability is of paramount importance. As a long-standing member of AGMA (American Gear Manufacturers Association) SPX's Lightning brand recognizes that multi-purpose commercial gearboxes are poorly suited to Agitator service. For more than 50 years the Lightning products have utilized proprietary, purpose designed agitator gear drives to ensure dependability and lowest cost of ownership. With more than 1 million units in the field our operating experience is unsurpassed.

SPX's agitator drive designs which are continually evolving to take advantage of latest materials technologies and manufacturing techniques, range from 125 W (0.17 HP) to units greater than 2500 kW (3350 HP).



### PORTABLE AND FIXED MOUNT

The Enhanced Classic Line (ECL) are fixed mount and portable mixers that offer the highest performance and quality, giving our customers an even stronger and more versatile product.

#### SERIES 10

Durable, versatile, cost-effective, the field proven series 10 unit was designed with minimal maintenance in mind. The largest taper roller bearings in a mixer of this class help produce an B10 life of 100,000 hrs or greater, the integrated "drywell" and casing design eliminate the risk of oil leakage over the tank or into the product.

#### SERIES 70/80

The workhorse of the Lightning mixer drive range with over 40,000 placed in service since its introduction in 1970, the 70 series mechanical design technology is the industries most proven agitator drive technology.

#### SERIES 98

A parallel shaft all helical gear design provides enhanced installation flexibility where there are space limitations on top of the vessel

#### SERIES 780/880

From 15 kW (20 HP) to 1000 kW (1350 HP) the 780/880 series drive range is designed specifically for the most arduous large scale mixing applications. With thousands of drives operating globally on some of the most demanding duties, reliability is assured.

#### SERIES 7000

Series 7000 custom designed agitator gear drives can be found on some of the world's largest and most complex mixing applications with power requirements in excess of 1000 kW (1350 HP).

#### VSF

Purpose-built agitators for harsh FGD environments. The rugged gearbox is designed with a high service factor for long life, while removable couplings make maintenance easier. An FGD Slurry seal is designed to further lengthen the availability of the unit in operation.

## Core Technology Impellers

### A310/A510

**Low blade solidity hydrofoil, recommended for low viscosity blending and solid suspension applications:**

- Varying tip chord angle allows for further optimization of mixer selection
- Maximizes flow generation while minimizing fluid shear and minimizing loads on the agitator drive
- The A310 is standard for all Lightnin gear drive portable mixers
- Generates the same flow as a pitched bladed turbine (A200) for 60% of the power and 50% of the torque

### A320

**High solidity hydrofoil design recommended for high viscosity blending applications:**

- High efficiency wide bladed impeller design with high flow/power ratio
- Improved axial flow at low Reynolds numbers ( $N_{re} < 500$ ) reduces power requirements up to 50% over a pitch bladed turbine (A200) for equal blending performance
- Can be successfully used for gas handling applications

### A315

**High solidity hydrofoil design recommended for gas-liquid dispersion and mass transfer applications:**

- High blade solidity improves gas handling by up to 3 times that of a conventional hydrofoil impeller such as the A510
- Generates strong axial flow which reduces staging that occurs with radial flow impellers in tall reactors
- Can improve mass transfer by 30% compared with a Rushton impeller (R100)
- Operates at lower torque than a conventional radial flow impeller, thus reducing capital costs

### R130

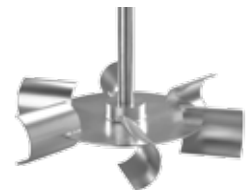
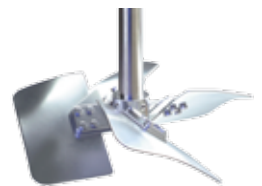
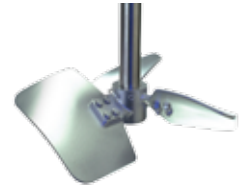
**Recommended for high shear mixing and gas dispersion applications:**

- Half pipe shaped blades improves gas handling over R100 impeller while reducing torque requirements by up to 40%
- Radial design provides shear to achieve good contacting for liquid-liquid and gas-liquid dispersions and emulsions

### R135

**Parabolic radial flow impeller recommended for high shear mixing and gas dispersion applications:**

- Optimized parabolic blade shape improves gas handling ability by 20% and reduces torque requirements by 40% over an R130
- Radial design provides shear to achieve good contacting for liquid-liquid and gas-liquid dispersions and emulsions



## New & Specialty Impellers

### A333 CLEAN EDGE

**Specifically designed as a non-stringing axial flow impeller:**

- Unique blade design resists ragging, making it suitable for low viscosity applications where ragging material is present such as in Waste Water Treatment
- Produces strong axial flow in low viscosity fluids with similar flow/power performance as an A510 hydrofoil

### A620

**Recommended for non-Newtonian transitional flow blending, where Reynolds numbers are between 50 and 500:**

- Optimal two bladed design creates down flow in the center and up flow at the wall, creating a complete turnover of tank's contents
- Provides similar blend time for less power than traditional open impellers (A320, A200) and less torque (lower cost) than traditional close clearance impellers (A400, R400)
- Operates at high impeller diameter/tank diameter ratios, which improves heat transfer at the wall
- Bolted construction available for tanks with small diameter manways

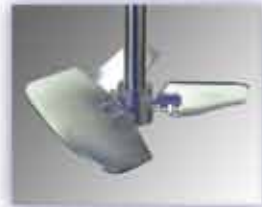


## ← FLOW LIGHTNIN Imp

### AXIAL FLOW



**A200**



**A340**



**A315**



**A100**



**A6000**



**A320**

CO  
IMPE  
TECHN



**C200**



**A312**



**A310 &  
A510**



**A333**

### SPECIALTY



**A620**



**R320**



**A400**



**R400**

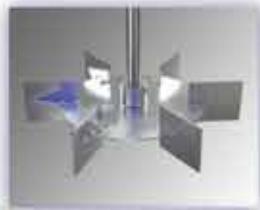


**R300**

## Impeller Spectrum

SHEAR

RADIAL  
FLOW



R100



R200



R130



R600



R510



R135



R500



KT-3

## AXIAL FLOW IMPELLERS



R320D



R335



A245



MBI



## CHEMICALS – PETROCHEMICALS

World class chemical and petrochemical companies around the globe rely on the mixing expertise and experience behind the Lightnin brand to maximize process efficiency and minimize operating costs. Reliability and low cost of ownership are assured from standard equipment of 125 W (0.17 HP) through to custom designed equipment for critical process operations in excess of 2500kW (3350HP).

### Extensive experience from Acetic Acid to VCM

- Blending, high and low viscosity, Newtonian & non-Newtonian
- Polymerization: bulk, condensation, emulsion, solution, suspension
- Crystallization
- Reaction and Mass Transfer: Liquid-Liquid, Liquid-Solid, Gas-Liquid, Gas-liquid-Solid
- Dispersion, Dissolution
- Heat Transfer
- Solids Suspension

## MINERALS PROCESSING

With Lightnin products SPX has pioneered many of the mixing techniques now considered standard for minerals recovery. From individual agitators for simple solids suspension applications; the exacting demands of High Pressure Oxidative leaching to the design of complex systems for counter-current solvent extraction; our unique understanding of mixing requirements coupled with purpose designed agitator drives ensure optimum process performance and long term reliability.

### Process expertise from Alumina to Uranium and Zinc

- Leaching, Conventional Leach, Carbon in Leach, Carbon in Pulp, Bio-Leach (Bio-Oxidation),
- Crystallisation
- High Pressure Oxidative Leach
- Digestion
- Precipitation
- Solvent Extraction Mixer Settlers
- Attrition Scrubbing

## PHOSPHATES & FERTILIZER

Phosphates, Phosphoric Acid and Fertilizer production processes are recognized as some of the most arduous mixing applications requiring exceptionally rugged equipment design and a high level of process expertise. SPX has supplied hundreds of Lightnin brand agitators for general Phosphoric Acid Attack Tank and Reactor duties and is the largest supplier of the highly sophisticated draft tube type circulators for Isothermal reactors.

Working closely with process licensors SPX is a key supplier of agitation systems for both hot and cold crystallizers for the production of Potash and other specialized fertilizers.

## FLUE GAS DESULPHURIZATION

Since the first installation of its kind in the mid 1960's, more than 1000 Lightnin brand Top and Side Entering Agitators for FGD process operations have been successfully applied around the world.

SPX has extensive experience in the design and supply of Gas Sparge Systems for Mass Transfer in many different markets and applications. Specifically a lance system has been developed for the Lightnin brand to provide the required mass transfer for FGD Absorbers. The technology has proven successful in Europe, the US and China, and allows Scrubber suppliers and Utilities to optimize their Oxidation systems for maximum efficiency.



## FOOD & BEVERAGE

Mixing, stirring and blending of products are fundamental operations in Food & Beverage processing. Often a product consists of components that are either dissolved or contain a dispersion of particles of different sizes; such as milk which consists of fat, protein, carbohydrates, minerals and water.

Whether you need a standalone mixer or a complete mixing and blending system, SPX offers market-leading solutions from Lightnin. We help you determine the best solution for your mixing and blending needs to achieve the results you want.

While some manufacturers may consider mixing and blending a 'commoditized process', we know that there is a good deal of engineering that goes into finding the right solution. We have decades of experience and the broadest line of mixing options in the industry to back it up.

You can be confident in Lightnin Mixers for versatility to allow recipe changes and new product formulations, consistency, reduced mixing times, increased production. Lightnin Mixers comply with Food Safety Regulations 3A, FDA and CE standards.

### Common applications include:

- Milk
- Yogurt
- Juice
- Soft drinks
- Vegetable oil
- Chocolate
- Beer & Spirits
- Sauces & Salad dressing

## PHARMACEUTICALS

Utilizing our experience and technical expertise, we engineer products to meet your demands. For virtually any pharmaceutical, biotech, personal care, animal care, or medical application from a few liters to fermentation reactors in excess of 120m<sup>3</sup> (31,700 gal), we have impeller and drive solutions to meet your needs.

We recognize the importance of material traceability and can provide a comprehensive QAD package with the mixer. We can include: MTRs, FDA Conformity, CE Conformity, PMI, Quality Plan, Welder Qualifications and Surface Finish Certificates.

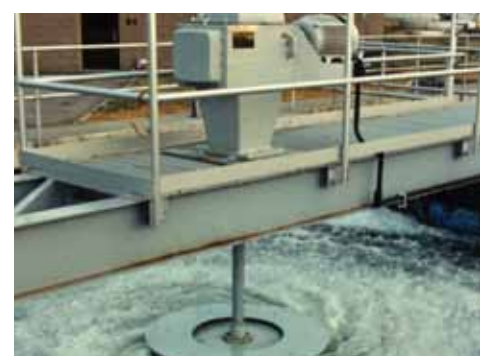
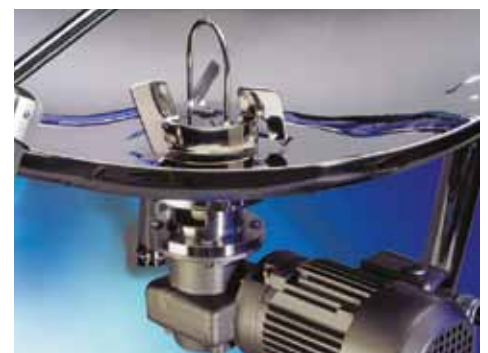
As the world leader in mixing technology, SPX with their Lightnin brand recognizes the need for geometrically accurate lab scale impellers, to allow for precise scale up from lab to plant scale. We have innovative designs which allow full clean-in-place and sterilize-in-place features to be provided.

## ENVIRONMENTAL – WATER AND WASTEWATER TREATMENT

We understand every phase of water and wastewater treatment and apply Lightnin Mixing techniques and process know-how to optimize results. Just about every step in the water and waste water process depends on suspending solids, or flow streams being mixed uniformly with a liquid or gas. The right degree of fluid motion and shear stress is critical during each stage. Highly efficient impeller systems minimize running costs, while purpose built agitator drives minimize maintenance and ensure long term reliability.

### Application expertise includes;

- Aeration
- Equalization
- Flash Mixing
- Flocculation
- Neutralization
- Sludge Mixing & Digestion
- Activated Carbon
- Chemical Makeup and Storage



# Technical Services

The Lightning brand dedicated After Sales support teams are on hand to offer advise and support.

With more than 85 years experience in the manufacture and supply of agitation equipment, we know what parts need to be on hand to support our customer base so that your downtime is minimized.

Our team of highly experienced field service engineers are on call to support the on-site servicing of equipment, or supervise and train your maintenance staff in best practice care of equipment.



## INSTALLATION AND COMMISSIONING

Proper installation of your Lightning mixer is critical to its long term performance and reliability. To ensure that installation procedures are followed, a certified technician will provide the following services:

- Audit the shipment to make sure all equipment is present and meets standards of compliance
- Supervise job-site contractors in accordance with set up procedures
- Perform a final inspection to ensure successful start-up and optimal performance



## SERVICE SUPPORT & REFURBISHMENT

The Equipment audit is specifically designed to identify potential mechanical problems before they occur.

- Detect and predict failure without halting production
- Schedule planned maintenance to minimize downtime
- Eliminate secondary damage
- Reduce operating costs
- Reduce total cost of ownership
- Original warranties can be extended

Using state of the art vibration diagnostic equipment and drawing on our mixer manufacturing experience, our technicians can identify the onset of bearing and gear failures, misalignment and system vibration problems without the need to interrupt production.

Factory gearbox exchange and refurbishment programs offer a fast and cost effective route to extending equipment life.



# Manufacturing Technology for the Future

SPX manufactures and assembles its Lightnin mixing equipment using the latest tooling technology. With locations around the world producing mixers in every region, we know we can meet your mixing requirements and meet your time lines. SPX's Lightnin brand is one of only a few mixer manufacturers that design, machine and assemble their own gearboxes which ensures the drives used in our mixers meet the rigorous demands of arduous agitator duties. CNC machining of our cast gearboxes produces the required accuracy and repeatability required for robust gearbox manufacture.

Machining capabilities allow the production of single piece shafts of 13m (44 ft) in length in solid bar or in pipe , longer shafts can be fabricated.. Mixer shaft production is critical to the performance and reliability of any mixer. SPX uses specially produced machinery to ensure that shaft straightness is maintained during the manufacturing process.

High capacity press tools and specially produced dies ensure accuracy and repeatability of blade forms at any scale. Our accuracy ensures reliability and repeatability in your plant process.

We recognize that process plant operators value quality and mechanical integrity highly when investing in mixing equipment.

Our investment in modern machine tools and specialist equipment enables us to meet these needs and offer the right mixer while meeting your documentation needs for modern plant processes.

SPX is committed to quality. Our ISO9001:2008 accreditation in all our operations assures our customers that our products and documentation will meet all their needs.





## Global locations

### AMERICAS

#### SPX FLOW TECHNOLOGY BRAZIL

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