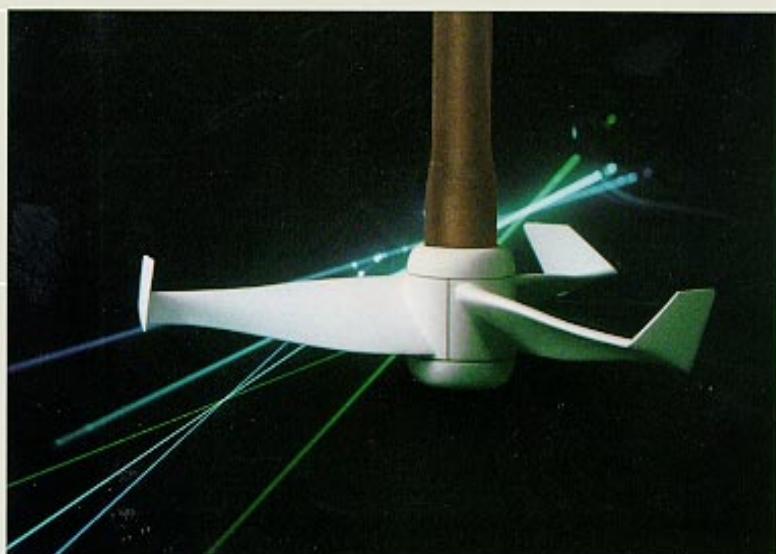


***You're about to enter a  
new dimension in  
mixing technology***



B-632

**LIGHTNIN**

# **Introducing the LIGHTNIN SX™ Mixer:**

***A combination of advanced technologies  
that change the science of mixing.***



The new LIGHTNIN SX Mixer with the A6000™ Impeller is the latest development in axial flow mixing technology. It is a light-weight, chemical-resistant, stronger-than-steel mixing system with unique properties previously unavailable to you. The SX Mixer is ideally suited for a wide range of applications where stainless steel or exotic metal mixers are required.

A substantial improvement over previous designs, the SX Mixer is the result of combining the best of

three technologies:

**1) High Performance Structures -**

New concepts that use structural composites for high strength-to-weight ratios have been applied to the shaft and impeller designs. Already proven in applications ranging from aircraft and space vehicles to skis and tennis racquets, structural composites are preferred where performance is primary, because pound for pound, nothing is stronger.

**2) Chemical Resistance -** For over 30 years, chemical processing

industries have been using fiber-reinforced plastics (FRP) as a cost-effective way to fight corrosion. The standard resin used in the new structural composite of the LIGHTNIN SX Mixer is a premium grade chemical-resistant vinyl ester resin.

**3) LIGHTNIN Laser Research and Mixing Technology -**

The LIGHTNIN SX Mixer is built and backed by Mixing Equipment Company, whose technical and engineering experience has led the mixing field for over 60 years. Today,

# It's time to rethink mixing.

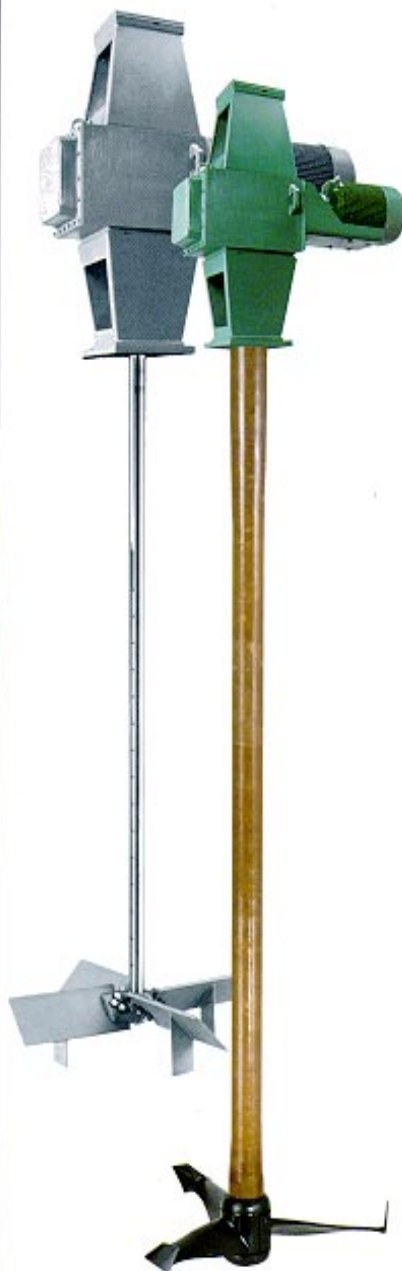
we are the only manufacturer in the world with a laser laboratory dedicated to advanced mixing research. Our Laser Lab made it possible to precisely quantify flow and mechanical loads while developing the A6000 Impeller. In addition, key application data on operating loads and speeds compiled from extensive industry use of our LIGHTNIN A310 Laserfoil™ metal impeller, helped determine design needs.

The product resulting from this fusion of technologies—the new LIGHTNIN SX Mixer—is a strong, durable, efficient, chemical-resistant product that gives you unsurpassed performance and will help you reduce capital, installation, operating and maintenance costs.

Everything about the LIGHTNIN SX Mixer is designed for mixing efficiency and durability. In addition, you save power, installation and maintenance costs. This new system consists of a

structural composite impeller and shaft, the reliable LIGHTNIN gear drive, and high efficiency motor. Because of its chemical resistance, the SX Mixer is suitable for many applications that normally require stainless steel or exotic metal mixers. Other advantages include:

- **Excellent Strength-to-Weight Ratio.** The shaft and impeller weigh less but can handle demanding applications because structural
- **Longer Allowable Shaft Lengths.** Weight reduction combined with tailored shaft stiffness permits longer shafts. The impeller position can be specified to operate at any level in a tank, even close to



This diagram compares the SX Mixer with a conventional pitched blade turbine to demonstrate size reductions in right-angle gear drive and longer shaft lengths made possible by our new design and composite structures.



the bottom of the deepest mixing vessels.

- **Excellent Chemical Resistance.** The premium, high temperature vinyl ester resin is standard with the LIGHTNIN SX Mixer. It offers you outstanding resistance to acids and caustics and good resistance to organic solvents. Overall, it has the best chemical resistance of any thermoset material.

- **High Efficiency A6000 Impeller\*.** Its advanced hydrodynamic design allows you to achieve equal process results at only 30-50% of the power required by a conventional pitched blade turbine.

- **Equipment Savings.** You can save on plant costs because of efficient design and lightweight materials. You need lighter support structures; less total electric service; and three baffles versus the standard four. Shipping costs are also lower.

- **Installation Savings.** The A6000 Impeller has only seven lightweight parts. Your installation will be fast, simple and safe, even in a closed tank.

- **The LIGHTNIN Guarantee.** This mixer has the same guarantee as all LIGHTNIN products—it will do the job we said it will do—*guaranteed*. The SX Mixer also carries a warranty covering both parts and labor.

\*NOTE: The A6000 Impeller is a direct descendant of the LIGHTNIN A310 Impeller, the most efficient metal impeller in its class. In those applications where the A6000 is not appropriate, the metal A310 Impeller is the suitable alternative for you.



***The unsurpassed  
chemical resistance you expect.***



**Why the vinyl ester  
resin system is  
the best choice.**

Over the past three decades, fiber-reinforced plastics (FRP) have gained wide acceptance in chemical processing as a proven method of fighting corrosion.

Currently, vinyl ester is the resin of choice in demanding applications when good chemical resistance is required in addition to strength.

The high temperature vinyl ester resin system was selected as the

standard resin for the LIGHTNIN SX Mixer. This premium thermoset material combines excellent chemical resistance with superior strength and durability under cyclic loads.

Broad application experience and extensive suitability studies are available for this vinyl ester. A comprehensive corrosion guide has been prepared and we GUARANTEE performance at the specified condi

tions for the chemicals listed. However, not every combination has been tested. In questionable cases, we recommend coupon testing to assure suitability.

Our LIGHTNIN technical staff will help you perform these tests and select the appropriate material. The LIGHTNIN SX Mixer will work for you.

#### Laser Lab

LIGHTNIN is the only manufacturer in the world with engineering and testing capabilities that include a fully integrated laser laboratory dedicated to mixing technology. It was used to develop the LIGHTNIN A310 Laserfoil Impeller which won the prestigious Vaaler Award and has proven successful in tens of thousands of applications.

This test facility allows LIGHTNIN engineers to guarantee successful results.

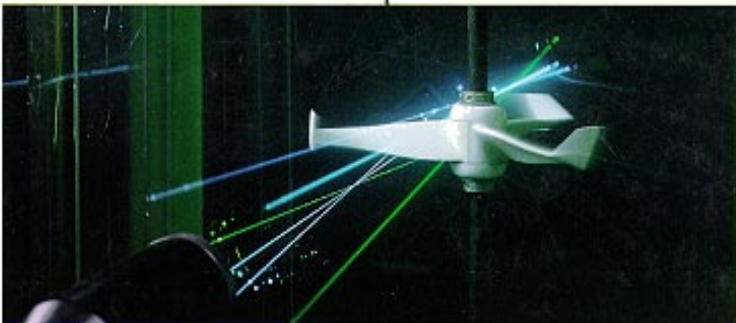
The Laser Lab was designed to test mixer performance by simultaneous measurement of flow, power, and mechanical loads. Two components of the fluid flow velocity vector are measured at the intersection of the laser light beams. Because the laser is mounted on a triple axis-traversing, computer-controlled mechanism, flow throughout the tank is measured quickly and precisely. Measurements of power and mechanical loads are obtained using strainage technology.

Many test runs have been made on full-sized equipment. Predicted loads, based on laser lab shaft and blade bending data, were *within 10%* of the full-scale measurements.

# LIGHTNIN Laser Technology for Advanced Design



CAD/CAM—Computerssisted design and manufacture helps create accurate tooling to duplicate the design concept



Laser Lab—The laser in the LIGHTNIN fully integrated laboratory system measures fluid velocity at the point in the mixing vessel where the beams cross.

#### A6000 Design

The A6000 research program focused on the effects of blade angle, airfoil cross section, and propeller tips.

By striking a balance between optimum efficiency and operational demands, selection of the blade angle allows high efficiency throughout a broad range of operating conditions. The impeller has been designed to deliver high efficiency when operated close to the tank bottom. Or it can be located high off the bottom, and with its strong axial velocity, provide excellent turnover of the tank contents.

Airfoil cross-sectional design allows for flow efficiency. Tapered thickness from root to tip provides strength where it is needed.

The LIGHTNIN Propeller tip was developed from wingless first used on advanced aircraft. Various sizes, shapes and configurations were tested. The resulting design was optimized for the mixer appli-

cation. The Propeller tips give a 10-15% boost in operating efficiency.

#### CAD/CAM

Once the impeller was designed, it was critical to precisely translate it to full scale. The impeller blade is a complex, three-dimensional shape with streamlined cross sections and variations in thickness, cord length and angle along the blade. The CAD/CAM system assured proper specifications of the tool shape in order to duplicate the research impeller over the full spectrum of mixer sizes.

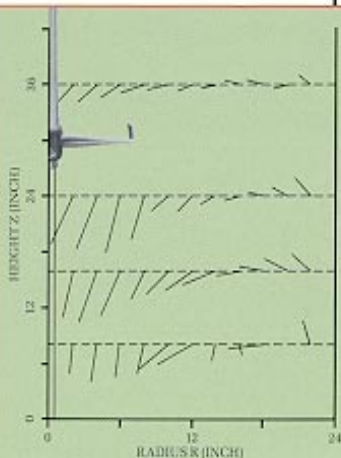
#### Full Scale Testing

The full-size A6000 Impellers have been thoroughly tested. Full scale power and flow measurements have substantiated the laser lab results. Field applications have also successfully demonstrated the expected process results.

#### VELOCITY VECTORS IN R-Z PLANE

SPEED N	FLUID FORCE=F
TORQUE T	QPRIM=2900 GPM
POWER P	QTOT=4860 GPM
SHEAR	MAX=7.56 1/sec
	AVE=6.54 1/sec

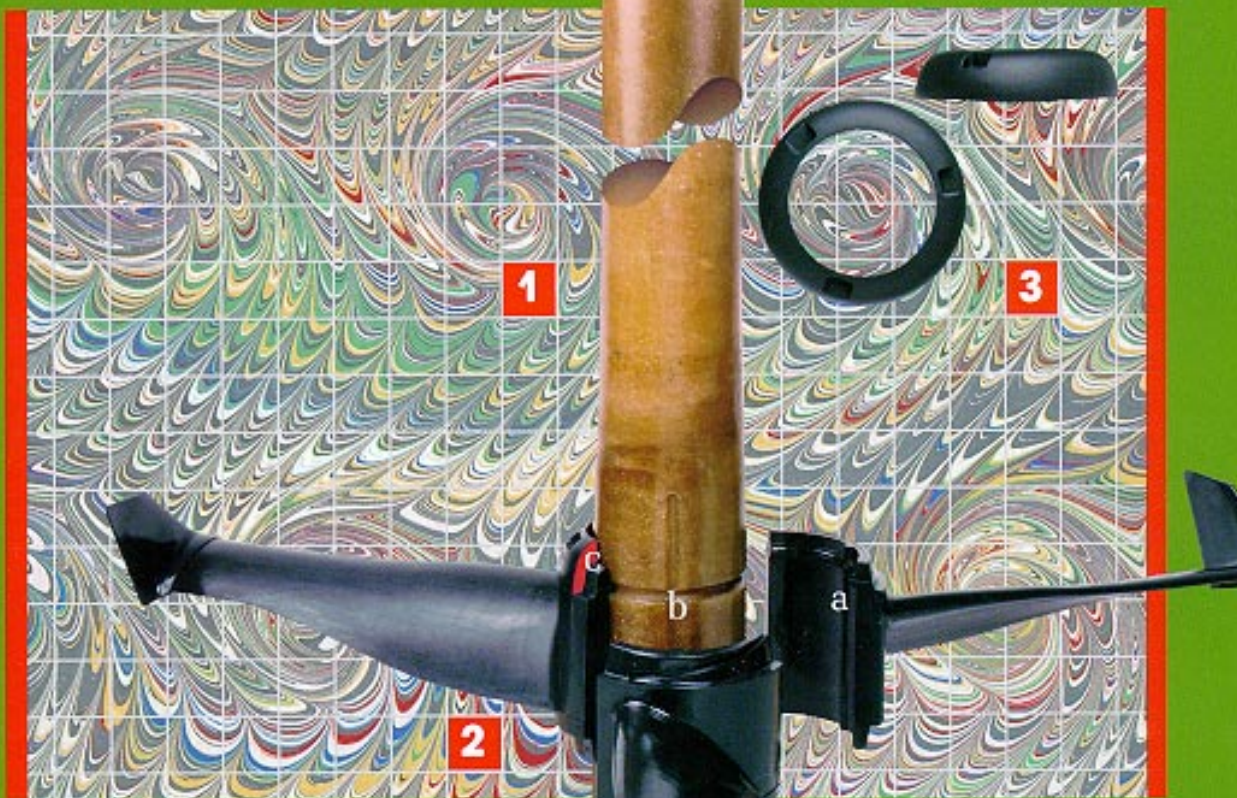
Laser scan - The velocity profile obtained from using a Laser Doppler Velocimeter (LDV) and a computer-controlled plotter is demonstrated here. Velocity lines indicate both magnitude and direction of flow. Note uniform axial flow pattern. By increasing downward (axial) flow, pumping efficiency is increased.





One of its greatest strengths . . .

is strength.



#### Lightnin' SX Mixer

**Speed Reducer.** The high quality, proven LIGHTNIN speed reducer incorporates a matched set of one-pitch helical gears in the primary reduction. Speed changes are easily made. Spiral bevels in the final reduction gears are matched-lapped to assure smoothness. In combination with helical gears, these spiral bevels provide mechanical efficiency in excess of 95%. Splash lubrication provides a constant flow of oil without fail. An oil dam around the mixer shaft prevents leakage from the process vessel.

**High Efficiency Motor.** This complements the high efficiency produced by the impeller.

**Composite Shaft.** This custom-engineered structure is tailored to provide the high stiffness required

for a cantilevered mixer shaft. The LIGHTNIN shaft coupling design (patent pending) accomplishes the complex task of joining structural composites to the speed reducer.

**2. A6000 Impeller.** The three-blade, hydrodynamic design makes it the most efficient axial flow impeller now available. Blade and hub are a single structure of composite materials which eliminates a joint or bonded connection at the highly stressed

blade root. Blade thickness is tapered to provide greater strength at the root, and a thin, efficient, streamlined shape near the tip. Attached to the end of the blades are Proplet™ tips. Similar in design to aircraft winglets, they reduce unwanted drag and improve mixing efficiency.

**3. Ringlok™ System** (patent pending). This rugged, easy-to-assemble system attaches the impeller to the shaft. Its components include:

- a. Keys molded into hub.
- b. Keyways in the shaft.
- c. Two rings with locking pins.

Blades mount onto the shaft keyways, and rings screw onto the top and bottom. Locking pins prevent the rings from loosening.

The LIGHTNIN structural composite combined with LIGHTNIN engineering expertise make the



LIGHTNIN SX Mixer stronger than steel.

Extensive testing for structural strength, rigidity and long-term fatigue on the structural composite shafts and impellers revealed very positive results—even beyond design loads—loads that caused failure of *metal* hardware. Indeed, it was difficult to create composite failures during testing. We tried to make prototypes fail so that you might never see a failure.

### LIGHTNIN Technology

Three elements are combined to create a successful composite structure: (1) materials, (2) design and (3) manufacturing process. Each of these must be considered in conjunction with the other two. Performance is then proven by testing.

1. The standard material is high temperature vinyl ester resin. It combines high strength with good overall chemical resistance.
2. In developing the SX Mixer components, part design has been optimized in recognition of the structural composite properties. The design of the product incorporates several concepts that reduce localized stresses. The Ringlok™ System and shaft coupling mechanism exemplify two patent pending features that are key elements of the measured structural performance.
3. Manufacturing techniques tailor mechanical strength by controlling resin density in conjunction with fiber orientation, location, density, and selection. The A6000 Impellers and shafts are fabricated with a resin-rich surface to give the best long-term chemical resistance.

The testing process requires an accurate definition of the operating loads. There are two sources for this information. Laser Lab data give blade and shaft loads as a function of speed, diameter, and process fluid. Historical data from the high efficiency A310 Impeller applications show the range of diameters and speeds typically used for industrial applications.

Comprehensive information on operating torque versus diameter is important because over design means extra weight, and under design would eliminate potential applications. The A6000 Impellers are designed to cover 95% of axial flow mixer applications.

# Strength through Composite Technology

### Structural Applications

For the past 25 years, the aerospace applications of composite have been expanding, primarily due to their strength-to-weight ratio. They offer superior strength, fatigue resistance and specific modulus.

Listed here are some of the structural applications of composites.

- The AV-8B/STOL Harrier Jump Jet. Twenty-six percent of the total aircraft structural weight is graphite/epoxy composite used for forward fuselage, horizontal stabilizer, elevators, rudder, overwing fairings, wing box skins and sub-structure, ailerons and flaps.
- The X-29 (advanced-concept aircraft). The forward-swept wings use aeroelastically tailored graphite/epoxy composite to reduce the drag by up to 20% and weight by 25%.
- Helicopters. Nearly all rotors are now made of composites because fatigue resistance is far superior to metal.
- Armor plating on tanks and personnel carriers. Composites have the stopping power of metal but weigh much less.
- Life saving and safety gear. Helmets, hard hats, and bulletproof vests are examples of how composites are used for protection.

### SX Tests

Testing has been conducted for static and dynamic loading of the parts.

Static testing is relatively easy—the part is loaded and deflection is measured. Parts are designed for fatigue strength and can easily endure loading over five times design.

The toughest tests are those dynamic tests necessary to assure long-term fatigue life. Naturally, a 20-year test is unrealistic. Instead, the unit is intentionally overloaded to the point of failure. By combining test data and literature results on fatigue properties, one can extrapolate to determine projected part life. Under dynamic loading, data indicate that unlike metals, there is no infinite life load point, so design is aimed at a finite projected life.

### A6000 Impeller Fatigue Life

Impellers were tested at 2- and 3 1/2-times design. Results were then combined with strength/time curves on composite fatigue. When the impeller is loaded to 100% of allowable torque, projected life is over 20 years. Since most impellers operate at not more than 70% design, *projected endurance life for most parts would exceed 60 years.*

### SX Shaft Fatigue Life

The results of shaft testing are even more impressive than the impeller test data. For a unit operated continuously in the worst possible fluid regime, *the projected endurance life would exceed 100 years.*



Pictured is the dynamic structural test apparatus for accelerated fatigue testing of the impeller. It has been used to independently set the mean and oscillating component of load

# The story of LIGHTNIN - The leaders in mixing technology.

Designing process equipment that will be tailored for a specific job has been the guiding principle of our company for over 60 years. The emphasis on quality has earned LIGHTNIN products an international reputation.

Mixing Equipment Company, manufacturer of LIGHTNIN products, was founded in 1923. We have become the largest company in the world devoted to producing fluid and solids mixing equipment.

During this time we have also earned a reputation as the leader in mixing technology. LIGHTNIN has been at the forefront of mixing research since the pioneering work of Dr. J. Henry Rushton in the early 1940s. In the 1950s, industry leader Dr. James Y. Oldshue joined the company and continued working closely with Dr. Rushton.

In succeeding years, industrial mixing changed with new advances. The relative size of the mixer to the vessel size continued to decrease as the relationships between process result, flow, and power were better defined. The history of impellers for flow-controlled application highlights these developments:

#### Mid 1950's

Axial flow impeller technology for large mixers began more than 30 years ago with the introduction of the LIGHTNIN A200. Prior to 1960, axial flow impellers were limited to small mixers because on scale-up the impeller weight became too great. The development effort led by Dr. J.Y. Oldshue was the first attempt to design an impeller for flow-controlled applications with characteristics approaching the ideal impeller: low cost, weight, power number, and fluid forces, along with a high pumping capacity.

**Your benefits: lower required power and torque.**



#### Late 1960's

In a continuing effort to improve axial flow performance, Mixing Equipment Company introduced the A210. The new design went a step beyond existing technology by providing the same process result at reduced power and reduced torque requirements.

**Your benefits: low cost and efficient flow control.**

#### Late 1970's

Further advances in mixing technology required new tools. Dr. R.J. Weetman, a noted fluid mechanics engineer, designed the LIGHTNIN Laser Laboratory, the most advanced research facility in the industry.

**Your benefit: advanced research tool also used for fast development of systems for specific customer applications.**

#### Early 1980's

Three years later, a new milestone was achieved using the LIGHTNIN Laser Laboratory. The result was the A310, a highly efficient impeller, consuming only 60% of the power and 50% of the torque of a pitched blade turbine while providing the same process result!

**Your benefits: substantial power savings and smaller drive sizes.**

#### Now

The latest development in axial flow mixing technology is the LIGHTNIN SX Mixer. A product which complements the A310, it has extended benefits and features approaching the ideal shaft and impeller system.

**Your benefits: highest efficiency; longer allowable shaft lengths; corrosion resistance; lower capital, installation, operating and maintenance costs.**

Call a LIGHTNIN Sales Engineer for specifics of the LIGHTNIN SX Mixer. And enter the new dimension in mixing technology.

**LIGHTNIN**  
An SPX Process Equipment Operation

135 Mt. Read Blvd.  
Rochester, NY 14611

www.spxprocessequipment.com  
B-632

#### Call the LIGHTNIN experts

For more information, contact your local LIGHTNIN Sales Representative  
Or visit our website at [www.spxprocessequipment.com](http://www.spxprocessequipment.com)  
Or call 1-888-MIX-BEST (US and Canada) or +1 (585) 436-5550 (WW)