

# MULTI-PURPOSE HIGH SHEAR LABORATORY MIXERS

S I L V E R S O N

# Silverson

*For over 50 years Silverson has specialised in the manufacture of quality High Shear Mixers for processing and manufacturing industries worldwide.*

*With customers in over 140 countries and serving industries as diverse as food, pharmaceuticals, cosmetics, chemicals, lubeoils and petrochemicals, Silverson has become a world leader in the field of High Shear Mixing. Time and again companies specify Silverson Mixers as the “standard” equipment for their manufacturing processes.*

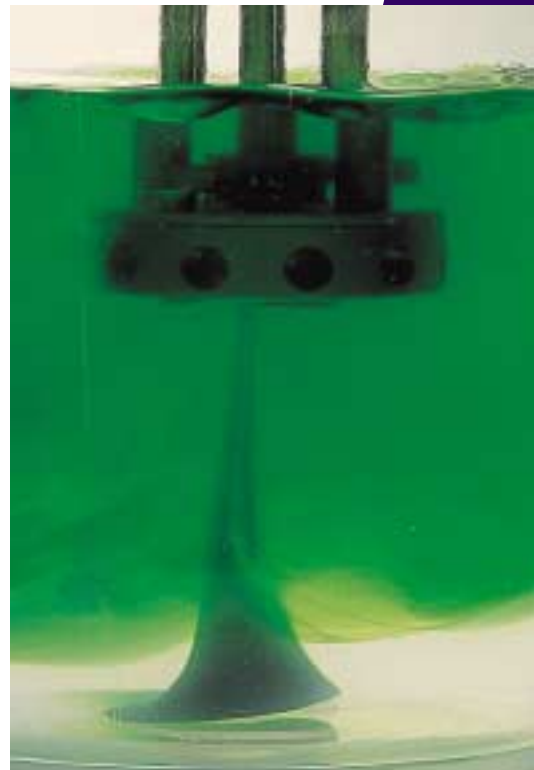


*A truly international company, Silverson is represented by a network of associated companies, distributors and agents in over 40 countries, serving North America, Europe, Asia, Australasia, South America and Africa.*

# The Silverson Advantage

## WHAT ARE THE ADVANTAGES OF A SILVERSON HIGH SHEAR MIXER?

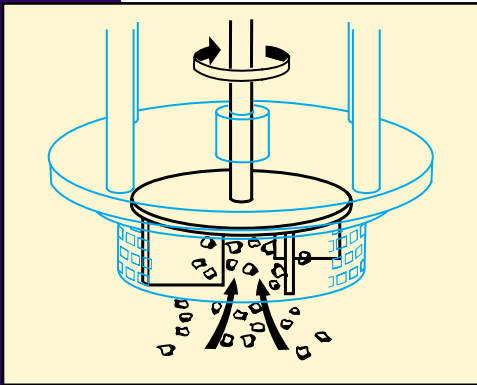
- ▶ Unsurpassed speed and efficiency in day-to-day laboratory work.
- ▶ Unrivalled versatility allowing any machine to be quickly adapted to perform the widest range of mixing applications - mixing, emulsifying, homogenising, disintegrating, dissolving, dispersing, blending, particle size reduction and de-agglomeration.
- ▶ Constant and repeatable results, time after time.
- ▶ Accuracy in forecasting the performance of large machines under full-scale working conditions.
- ▶ Excellent for small scale production work.
- ▶ Robust, simple construction, easy to use, easy to clean.



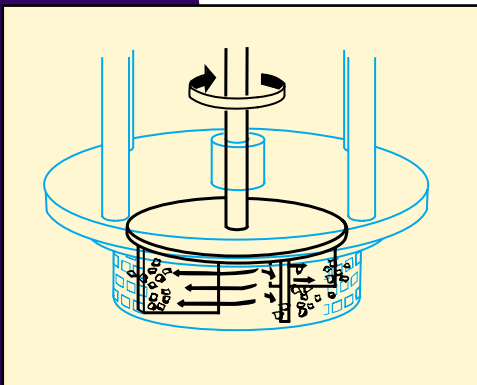
## WHAT WILL THE SILVERSON DO?

- ▶ **BLENDING** In blending liquids of similar or greatly varying viscosities, the unique Silverson mixing action can rapidly produce a guaranteed homogeneous product. Silverson Laboratory mixers outperform all conventional stirrers and blenders in speed, efficiency and product uniformity.
- ▶ **EMULSIFYING AND HOMOGENISING** The special high shear rotor/stator design means that emulsions (typically in the range of 0.5 to 5 microns) can be easily achieved, in many cases dispensing with the need for more costly and complicated equipment such as high pressure homogenisers.
- ▶ **DISINTEGRATION** All Silverson mixers are able to disintegrate matter of animal, vegetable, mineral or synthetic origin in a single operation.
- ▶ **PARTICLE SIZE REDUCTION** For particle size reduction, this same rotor/stator action will ensure the rapid and uniform milling of both solid and semi-solid materials into either solution or fine suspension. Rapid particle size reduction of soluble materials also results in greatly reduced solution times and is ideal when dissolving materials which are only soluble with difficulty.
- ▶ **GELLING AND SOLUBILISING** The solution of gums, alginates, C.M.C., carbopols, etc., can be a slow and difficult process if a conventional stirrer is used. Agglomerates frequently form and these can only be removed slowly by the washing action of the stirrer. With a Silverson mixer, however, the high shear action of the rotor/stator rapidly disperses the material, constantly exposing increasing areas of the solid to the surrounding liquid. The result is an agglomerate-free solution within minutes.

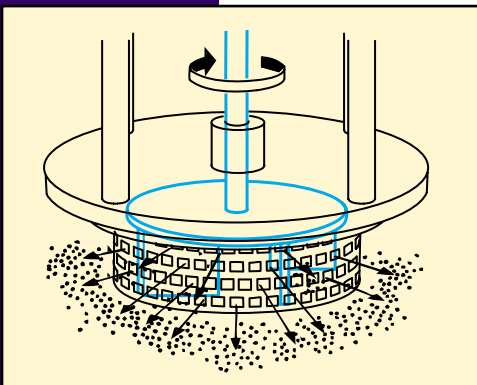
# How the Silverson Works



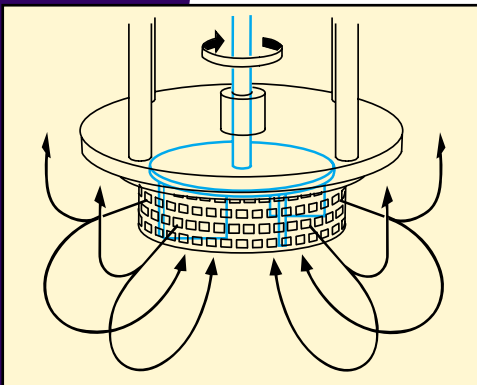
1. The high speed rotation of the rotor blades within the precision machined mixing workhead exerts a powerful suction, drawing liquid and solid materials upwards from the bottom of the vessel and into the centre of the workhead.



2. Centrifugal force then drives materials towards the periphery of the workhead where they are subjected to a milling action in the precision machined clearance between the ends of the rotor blades and the inner wall of the stator.



3. This is followed by intense hydraulic shear as the materials are forced, at high velocity, out through the perforations in the stator and circulated into the main body of the mix.



4. The materials expelled from the head are projected radially at high speed towards the sides of the mixing vessel. At the same time fresh material is continually drawn down into the workhead maintaining the mixing cycle. The effect of the horizontal (radial) expulsion and suction into the head is to set up a circulatory pattern of mixing which is all below the surface. As a result there is no unnecessary turbulence at the surface. So long as the machine is correctly chosen for size and power, the entire contents of the vessel will pass hundreds of times through the workhead during the mixing operation to give uniform progressive processing and homogenisation. A further benefit derived from the controlled mixing pattern is that aeration is minimised.

# Interchangeable Heads and Screens

A comprehensive range of workheads and screens is available for all Silverson high shear mixers. These easily interchangeable

workheads offer great versatility by allowing any machine to be adapted to perform a wide range of mixing operations including emulsifying, homogenising, disintegrating, dissolving, dispersing, blending, particle size reduction and de-agglomerating. Changing from one head or screen to another is quick and simple.



## ► GENERAL PURPOSE DISINTEGRATING HEAD

This is the most versatile of all the heads, giving an exceptionally vigorous mixing action. Ideal for general mixing applications, its uses also include the disintegration of solids and the preparation of gels and thickeners, suspensions, solutions, and slurries.



## ► SQUARE HOLE HIGH SHEAR SCREEN™

Provides exceptionally high shear rates ideal for the rapid size reduction of soluble and insoluble granular solids. It is also suitable for the preparation of emulsions and fine colloidal suspensions.



## ► EMULSOR SCREENS

Suitable for liquid/liquid preparations and especially useful for all emulsions. Available in fine and medium (standard) perforations.



## ► AXIAL FLOW HEAD

This special head expels jets of material vertically upwards parallel to the shaft and is used in certain circumstances where aeration needs to be minimised. It may also be used to maintain heavy insoluble solids in constant circulation.



## ► SLOTTED DISINTEGRATING HEAD

For the disintegration of fibrous materials such as animal and vegetable tissue, as well as the disintegration and solubilisation of "elastic" materials such as rubbers and polymers. Vertical and diagonal slotted heads are available.



## ► PUMPHEAD

This converts the mixer into a non-positive pump which with the use of a flexible hose and valve can be used to fill individual containers.

# Models L4RT and L4R

## L4RT Mixer



L4RT

This is the most popular machine in Silverion's range of laboratory mixers and is ideal for routine laboratory work, research and development, QA analysis and small scale production in all industries.

The L4RT is suitable for the widest range of applications - mixing, emulsifying, homogenising, disintegrating, dissolving - with an efficiency and flexibility unmatched by other machines. With a capacity from 1ml up to 12 litres and the ability to mix in-line with flow rates up to 20 litres/minute, it offers excellent reproducibility when scaling up to full scale production and provides an accurate and easy means of forecasting the performance of larger Silverion machines under full-scale working conditions.

The digital tachometer gives a constant speed readout and is invaluable for applications where process validation and reproducibility are required.

- ▶ **MOTOR UNIT** Robust two-piece casing designed for cool, quiet and continuous operation.
- ▶ **MOTOR** 250W (0.33hp) 220 volt, single phase (110 volt optional), 50/60 Hz. Nominal maximum speed 8000 rpm (6000 rpm under full load).
- ▶ **SPEED CONTROL** Infinitely variable electronic speed control with integral on/off switch.

▶ **ELECTRIC RISE & FALL BENCH STAND** The Mixing unit may be effortlessly raised and lowered using the push-button control on the motor unit.

▶ **CONSTRUCTION** All wetted parts are in grade 316 stainless steel with the exception of the bush which may be bronze alloy or PTFE.

The L4RT is finished in a tough, easy to clean, non-chip white nylon coating. The flat base is covered by a removable non-slip mat which is resistant to most solvents.

## L4R Mixer

Identical to the model L4RT above but supplied without the tachometer.

## Interchangeable Mixing Assemblies

- ▶ **STANDARD ASSEMBLY (TWO ARM)** Illustrated left. Supplied complete with a General Purpose Disintegrating Head, Square Hole High Shear Screen, Standard Emulsor Screen and Axial Flow Head. Slotted Disintegrating Heads, Fine Emulsor Screen, Pump Heads and other special heads are available as optional extras.



L4R

Capacity - depending on viscosity - up to 12 litres. Mixing unit dimensions - length 290mm (11½"), width 57mm (2¼").

- ▶ **TUBULAR ASSEMBLIES** Suitable for use in narrow-necked containers.

A full range of tubular mixing units for processing volumes from 1ml - 500ml is available for the models L4RT and L4R - see page 8.

## Duplex Assembly

The Duplex differs from the standard mixing assembly in having two workheads facing in opposite directions; the upper head pulls materials down from the surface of the mix, while the lower head draws material up from the base of the mixing container.

The upper Coarse Tooth Disintegrating Head is designed to chop solid materials into small pieces and then expel them beneath the shroud. The lower workhead simultaneously draws in these partially disintegrated solids and reduces their size further.

This combined use of two workheads makes the Duplex ideal for applications where light or buoyant material (powders, rubbers and polymers etc.) needs to be drawn down from the surface of a mix and rapidly dispersed. Because of the added movement afforded by the two workheads, the Duplex is also ideal for use on high viscosity materials.

Supplied complete with upper Coarse Tooth Disintegrating Head and lower General Purpose Disintegrating Head.

► **OPTIONS** Lower Slotted Disintegrating Heads, Square Hole High Shear Screen, Emulsor Screens and upper General Purpose Disintegrating Head.

► **TYPICAL APPLICATIONS** Rapid solution of rubbers and polymers into lubricating oils, solvents and asphalt for the production of luboils, adhesives and bituminous compounds.

Disintegration and dissolving solid resin for the production of varnish.

Vegetable and meat purée/slurries.

Addition of powders into high viscosity liquids.



## In-Line Mixing Assembly

The In-Line assembly fits onto the model L4R Laboratory range and converts it into an in-line mixer/homogeniser.

The centrifugal action of the rotor in the high shear rotor/stator workhead generates a non-positive pumping action which gives a throughput on low viscosity liquids of approximately 20 litres/minute, reducing as the viscosity increases.

The pumping rate can be lowered by reducing the motor speed but it is better to insert a valve in the pipeline on the output side as reducing the speed also reduces the mixing efficiency. The unit is suitable for use at atmospheric pressure only. It is not recommended for use on abrasive, corrosive or flammable materials. For operation on these types of materials or for operation under pressure, please refer to the model 150L In-Line Mixer/Homogeniser - see page 13.

► **CONSTRUCTION** All product contact parts in 316 stainless steel except the bushing (PTFE) and mechanical shaft seal (carbon/stainless steel with viton elastomers).

Viton body O-ring.

Supplied complete with General Purpose Disintegrating Head and Square Hole High Shear Screen.

► **OPTIONS** Slotted Disintegrating Head, and Emulsor Screens (fine, standard and coarse perforation).

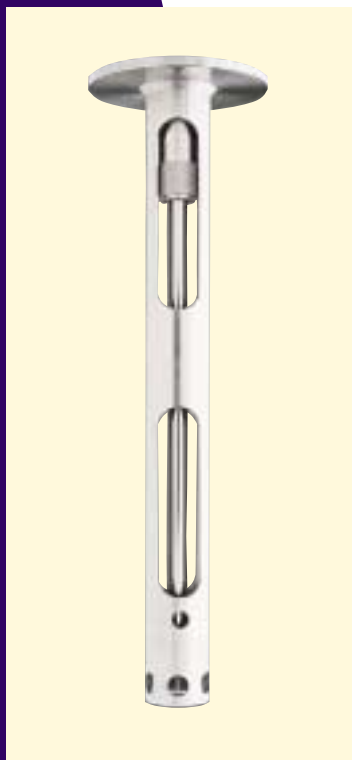
Seal elastomers and body O-ring available in Kalrez/PTFE.

Multiport inlet feed manifold.



# Tubular Mixing Assemblies

A series of interchangeable tubular mixing units is available for the model SL2T, SL2, L4RT, L4R and L2/Air laboratory mixers. The units have capacities from 1 - 500ml and are suitable for use in narrow-necked containers.



1" Tubular



3/4" Tubular

► 1" TUBULAR Supplied with interchangeable screw-on, General Purpose Disintegrating Head and Square Hole High Shear Screen or Integral, Open-ended, Vertical Slotted Disintegrating Head for tissue homogenisation. Interchangeable, screw-on Slotted Disintegrating Heads are available as extras. Capacity, depending on viscosity, 50ml up to 500ml. Mixing unit outside diameter 25mm (1"). Overall length 240mm (9½").

► 3/4" TUBULAR Generally as 1" above. Capacity, depending on viscosity, 20ml up to 250ml. Mixing unit outside diameter 19mm (¾"). Overall length 208mm (8¼"). Length of ¾" diameter section is 151mm (6").



5/8" Micro



3/8" Mini-Micro

► 5/8" MICRO Mixing unit of solid one-piece construction with Integral General Purpose Disintegrating Head or Open-ended, Vertical Slotted Disintegrating Head. Capacity, depending on viscosity, 5ml up to 50ml. Mixing unit outside diameter 16mm (5/8"). Overall length 160mm (6¼"). Length of 5/8" diameter section is 102mm (4").

► 3/8" MINI-MICRO Generally as 5/8" Micro above. Capacity, depending on viscosity, 1ml up to 10ml. Mixing unit outside diameter 10.3mm (13/32"). Overall length 119mm (4 11/16"). Length of 13/32" diameter section is 62mm (2 7/16").

All of the above mixing assemblies are interchangeable and may be purchased separately.  
N.B. Assemblies for the SL2/SL2 are not interchangeable with the L4RT/L4R/L2/Air assemblies.



# Models SL2T and SL2

## SL2T Mixer

This model is designed for routine laboratory work, research and development, QA analysis and sample preparation of low viscosity and low density products. It is supplied with a digital tachometer which gives a constant speed readout and is invaluable for applications where process validation and reproducibility are required.

- ▶ **MOTOR UNIT** Robust two-piece casing designed for cool, quiet and continuous operation.
- ▶ **MOTOR** 75W (0.10 hp) 220 volt, single phase (110 volt optional), 50/60 Hz. Nominal maximum speed 9000 rpm (6000 rpm under full load).
- ▶ **SPEED CONTROL** Infinitely variable electronic speed control with integral on/off switch.
- ▶ **ADJUSTABLE BENCH STAND**
- ▶ **CONSTRUCTION** All wetted parts are in grade 316 stainless steel with the exception of the bushing which may be bronze alloy or PTFE.

The SL2T is finished in a tough, easy to clean, non-chip white nylon coating. The flat base is covered by a removable non-slip mat which is resistant to most solvents.



SL2T

## SL2 Mixer

Identical to the model SL2T above but supplied without the tachometer.

## Interchangeable Mixing Assemblies

- ▶ **STANDARD (TWO ARM)** Illustrated right. Supplied complete with a General Purpose Disintegrating Head, Square Hole High Shear Screen, Standard Emulsor Screen and Axial Flow Head.

Slotted Disintegrating Heads, Fine Emulsor Screen, Pump Heads and other special heads are available as optional extras.

Capacity - depending on viscosity - up to 9 litres. Mixing unit dimensions - length 240mm (9½"), width 57mm (2¼").

- ▶ **TUBULAR ASSEMBLIES** Suitable for use in narrow-necked containers. A full range of tubular mixing units for processing volumes from 1ml - 500ml is available for the models SL2T and SL2 - see page 8.



SL2

# Model L2/Air (Compressed Air)



An efficient, lightweight machine powered by an intrinsically safe air motor suitable for use in Explosion Hazard areas.

The L2/Air Drive Unit is powered by a 0.25 hp, 6000 rpm variable speed motor, which requires 60 psi compressed air supply and consumes 8 cfm (226 litres) at full speed. Fitted with speed regulator muffler, air regulator and gauge, water filter and lubricator. Supplied with manually operated adjustable bench stand.

The L2/Air Motor Unit will accept all of the following L4RT interchangeable mixing assemblies - Standard (2 arm), 1" Tubular, 3/4" Tubular, 5/8" Micro, 3/8" Mini-Micro, In-Line and Duplex.

A specially modified L2/Air Drive Unit can be provided to accept all of the Sealed Unit mixing assemblies (see page11).

# Model RBXL Abramix



The RBXL Abramix Mixer is designed for operation on materials which are highly abrasive in nature such as ceramics, mica, clays, chalk, graphites etc.

With a standard mixing assembly a highly abrasive product can cause excessive wear on the bush and the shaft. In the Abramix the bush has been completely eliminated by the use of a heavy duty shaft which is firmly supported by two precision roller bearings situated above the level of the product being mixed.

The stability and vibration-free operation resulting from this arrangement eliminates the need for an immersed bushing and the resulting shaft wear.

► MOTOR UNIT Robust two piece casing specially designed for quiet running.

► MOTOR 185W (0.25hp) 220 volt single phase (110 volt optional) 50/60 Hz. Nominal maximum speed 4000 rpm.

► SPEED CONTROL Infinitely variable electronic speed control with integral on/off switch.

► ADJUSTABLE BENCH STAND Supplied with spring assisted adjustable bench stand.

► CONSTRUCTION The RBXL Abramix is finished in a tough, easy to clean, non-chip white nylon coating. The flat base is covered by a removable non-slip mat which is resistant to most solvents.

► TYPICAL APPLICATIONS Liquid glazes, ceramic slips, clays and silicas, texture paints.

# Sealed Unit Laboratory Mixers

For working under highly infective or aseptic conditions.



Designed for research and pilot-scale production in the fields of pathology, bacteriology and virology. Complete disintegration and homogenisation of highly infected tissues is accomplished under conditions of absolute safety, since the mechanical seal ensures freedom from the risk of infection by aerosols escaping into the surrounding atmosphere.

Conversely, the Silverson Sealed Unit laboratory mixer/emulsifier may be used for working on sterile materials where it is essential to exclude airborne contamination.

The efficiency of the machine is such that any type of animal or vegetable tissue, bone etc. is reduced to a fine homogeneous suspension in a few seconds, with virtually no heat rise.

The motor unit of this machine is a special modification of the Model L4R motor unit. The bottom of the motor unit is furnished with a Quick-Release mechanism which, by raising the collar shown in the illustration, permits any of the Sealed Unit Mixing Assemblies listed below to be attached or removed. When the Motor Unit and Mixing Assembly are engaged, the collar is lowered and the container attached to the Mixing Unit is then completely hermetically sealed. The Motor Unit will take any type of Sealed Mixing Assembly but will NOT accept mixing units of the Model SL2 or L4R ranges or vice versa.

The Bench Stand does not have the electric rise and fall facility since the Sealed Mixing Assembly is normally attached by hand onto the fixed motor unit, but electric rise and fall can be provided as an extra if required.

## ► MIXING VESSELS

**1.0N** - 1000ml autoclavable polypropylene Nalgene® bottle - Standard (two arm) assembly supplied complete with General Purpose Disintegrating Head, Square Hole High Shear Screen and Standard Emulsor Screen.

**0.5N** - 500ml autoclavable polypropylene bottle - Generally as 1.0N unit above.

Other sizes available up to 3 litres.

**¼" Flexible Tubular** - 225ml glass bottle - supplied with interchangeable screw-on General Purpose Disintegrating Head and Square Hole High Shear Screen or Integral Open-Ended, Vertical Slotted Disintegrating Head.

**⅝" Flexible Micro** - 25ml Universal Vaccine vial - supplied with integral General Purpose Disintegrating Head or Integral Open-Ended, Vertical Slotted Disintegrating Head.

**⅜" Flexible Mini-Micro** - 7ml bijou vial - Generally as ⅝" Flexible Micro above.

## ► STAINLESS STEEL VESSELS

**SS1** - 1 litre stainless steel container - mixing units as 1.0N.

**SS2** - 2 litre stainless steel container - mixing units as 1.0N.

► OPERATION UNDER VACUUM Special SS1 and SS2 sealed mixing assemblies are available for operation under vacuum.



# Model AX Series

This series of mixers is designed for small scale production in pilot plants, research institutes, hospital pharmacies etc. Light and easily operated, it has a capacity of up to 90 litres, depending on product viscosity, density and vessel dimensions.



A complete range of interchangeable workheads is available.

- ▶ **CONSTRUCTION** All wetted parts are in grade 316 stainless steel.
- ▶ **BENCH STAND** A spring assisted adjustable bench stand is available for use with all of the AX Series models. It is finished in a tough, easy-to-clean, non-chip white nylon coating. Available constructed in grade 304 stainless steel as an optional extra.

## Model AXR Variable Speed

- ▶ **MOTOR** 185W (0.25hp) 220 volt single phase (110 volt optional) 50/60 Hz. Nominal maximum speed 3500 rpm.
- ▶ **SPEED CONTROL** Infinitely variable electronic speed control with integral on/off switch.



- ▶ **CONSTRUCTION** The Model AXR is finished in a tough, easy to clean, non-chip white nylon coating.

## Model AX3 TEFV or Flameproof

- ▶ **FIXED SPEED** The Model AX3 is powered by a 0.25kW (0.33hp), 3 phase, IP55/Hoseproof, TEFV or Flameproof industrial motor. It is suitable for pilot scale applications which may require more power than the Model AXR and where IP55/Hoseproof motors are required.

- ▶ **VARIABLE SPEED** As above but supplied with a frequency inverter, giving a variable speed range between 300 - 3000 rpm.

Frequency inverter input 220 - 240 volts single phase, output 220 - 240 volts 3 phase.

The Model AX60 can be supplied with more powerful motors allowing a maximum speed of up to 6000 rpm. The increased rpm provides a much higher rotor tip speed which greatly improves the machine's efficiency in terms of particle size reduction.



## Model AX/AIR Compressed Air

The Model AX/Air is powered by an intrinsically safe air motor suitable for use in Flameproof areas.

- ▶ **MOTOR** 0.33kW (0.5hp), 3000 rpm variable speed. Air consumption 20 cfm at 60 psi.
- ▶ **OPTIONS** Air regulator/lubricator/filter and gauge.

## Model AXV

- ▶ **INVERTED HEAD** For the rapid mixing of light powders into liquids. Used with any of the AX drives listed above.

# Laboratory In-Line Mixers

The 150L and 200L Laboratory In-Line Mixers have been specifically developed for applications where dedicated laboratory In-Line mixers are required.

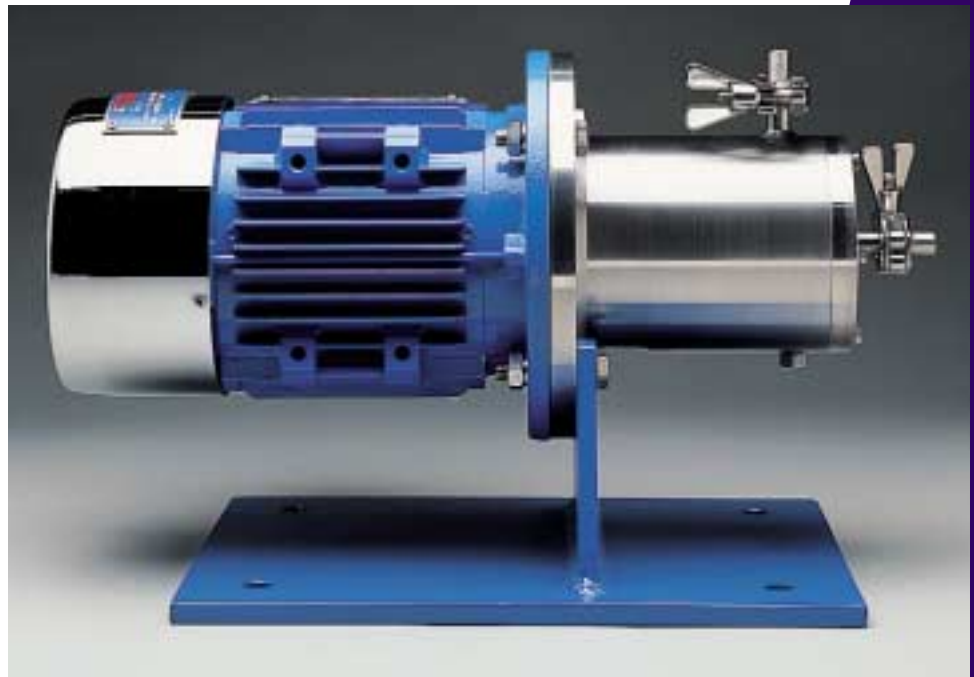
## Model 150L

Ideal for laboratory, pilot and small scale production applications, the Model 150L is suitable for use on abrasive, corrosive or flammable materials. It is also suitable for simulating the performance of production scale In-Line mixers.

The 150L has a 1hp motor and 19mm (¾") inlet/outlet

## Model 200L

The more powerful 200L provides a higher throughput, having a 1.1kW motor and 25.4mm (1") inlet/outlet



Both models have the following features:

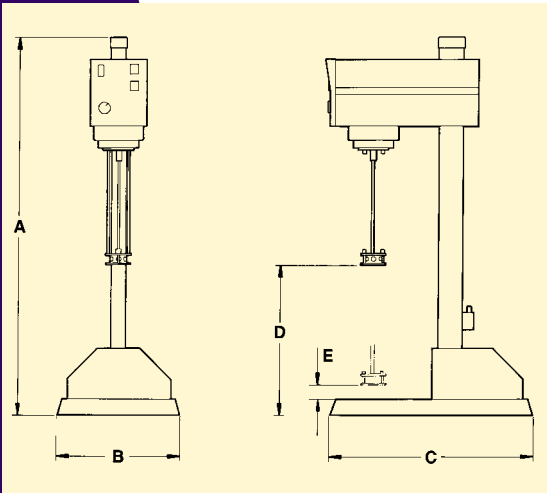
- ▶ **INTERCHANGEABLE WORKHEADS** Interchangeable workheads are available to adapt the machines for varying processes. Changing from one head or screen to another is quick and simple.
- ▶ **NO BY-PASSING** The In-Line mixer's design makes it impossible for materials - liquid or solid - to pass from the inlet to the outlet without being subjected to intense mechanical and hydraulic shear as it passes through the rotor/stator workhead. By-passing is impossible.
- ▶ **SELF-PUMPING** The laboratory and pilot scale In-Line mixers provide a centrifugal pumping action on low viscosity liquids. For medium/high viscosity products an auxiliary pump may be required.
- ▶ **OPERATING PRESSURES** The Model 150L is designed for operation on pressures not in excess of 100 psi (7.6 bar), but can also be supplied with higher pressure ratings on request.
- ▶ **INLET AND OUTLET CONNECTIONS** Standard sanitary and other fittings are available on request (e.g. NPT, Tri-Clamp etc.)
- ▶ **SEALING** The In-Line mixer shaft is normally sealed by a single mechanical shaft seal with carbon versus ceramic faces and viton elastomers.

Double mechanical shaft seals are available when processing products that are abrasive, sticky or viscous, or when the system is under vacuum.

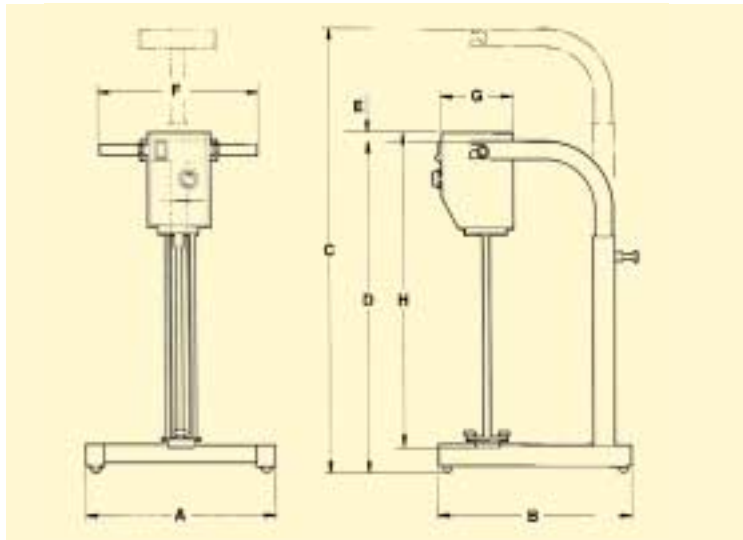
Other elastomers, PTFE and hard faces are available as optional extras.

- ▶ **CONSTRUCTION** All wetted parts are in grade 316 stainless steel. Other materials are available on request.
- ▶ **HEATING/COOLING JACKET** A heating/cooling jacket is available as an optional extra.

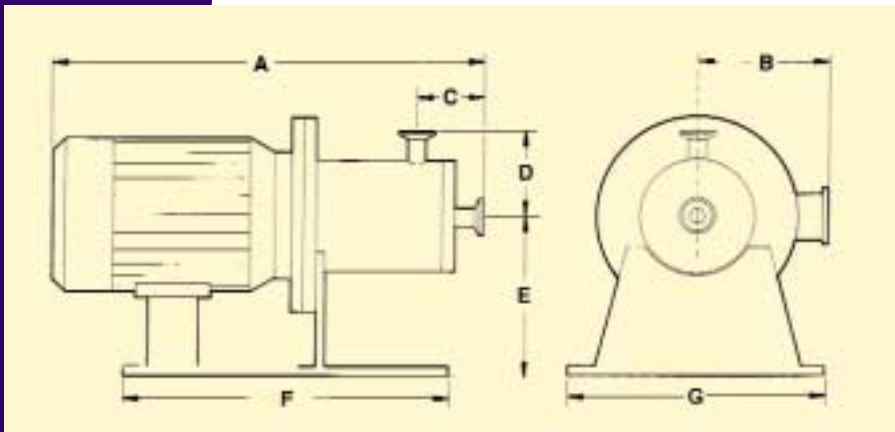
# Diagrams and Dimensions



MODEL	A	B	C	D Max Height	E Min Height
L4R and L4RT	940	305	508	330	30
SL2 and SL2T	765	265	432	290	15
Sealed Unit	810	305	508	-	-
RBXL	924	305	508	260	8



Model	A	B	C	D	E	F	G	H
AXR	410	420	976	731	14	338	150	689



Model	kW	RPM	A Single Seal	A Double Seal	B	C	D	E	F	G	Inlet/outlet
150L	0.75	3000	397	451	133	57	82	165	330	254	19
200L	1.1	3000	445	489	133	57	82	165	330	254	25

All dimensions shown are in mm.

The dimensions shown are approximate only and certified diagrams should be used for installation purposes. Silverson reserves the right to change dimensions and specifications without notice.

# Other Silverson Products

From small laboratory units to 8,000 gallon production scale machines, the Silverson range offers consistently high quality equipment producing uniform and reliable results.

## ► HIGH SHEAR BATCH MIXERS

This highly efficient range of mixers can dramatically improve product quality and offers considerable reductions in processing times. For increased flexibility, small to medium scale machines can be used with a mobile floor stand.



## ► IN-LINE HIGH SHEAR MIXERS

For continuous processing or batch recycling, Silverson has a complete range of high shear In-Line mixers from the 0.25kW laboratory unit to the 125kW Multishear Mill. Throughput from 20 litres/minute up to 200,000 litres/hour

## ► FLASHBLEND

For high speed entraining and instant dispersion of powder into liquid. Designed to produce a homogeneous agglomerate-free solution/dispersion without entraining air, the Flashblend range comprises units capable of incorporating up to 15,000 kilos/hour of powder.



## ► DISINTEGRATOR 2500 SOLID/LIQUID MIXING SYSTEMS

Designed to disintegrate and solubilise whole bales or blocks of rubbers and polymers rapidly without the need for any preliminary crumbing. Other uses include disintegration of large solids in the food industry, dispersion of filter cakes and disintegration of solid gums, resins and varnishes, etc.

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