

Mixing

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Mixing Technologies





Chemineer agitators can be used in a variety of applications in any chemical plant

Bringing You Excellence in Mixing Equipment

We are a supplier of mixing solutions and products to customers in a variety of industries throughout the world.

Our product brands include:

- Chemineer™ Rotating Mixers
- Kenics™ Static Mixers
- Greenco™ High Shear Mixers
- Prochem™ Belt Driven Mixers

Founded in 1952, we have a wide range of equipment in various markets including chemical and petrochemical, polymers, food and beverage, pharmaceutical, water and wastewater treatment, oil and gas, biotechnology, agricultural processing, mineral processing, and pulp and paper.

We distinguish ourselves from competitors with our pioneering spirit, technological innovations, and willingness to partner with customers on mixer solutions. Our fluid mixing knowledge, supported by the best application software, proprietary mixer designs, and state of the art laboratory, allows us to be the preferred supplier of fluid mixing equipment.

Our leadership position among mixer suppliers is demonstrated by the way we have revolutionized the agitation industry over the years.

The following list describes some of our pioneering events:

- The first static mixer — Kenics
- The first to use Particle Image Velocimetry (PIV) and Computational Fluid Mixing (CFM) to visualize flow patterns
- The first expert design software — AgDesign, AgDraw, AgOrder, Maestro, SmDesign, AgSolver and KmSolver
- The first high efficiency gas dispersion impellers — CD-6, BT-6
- The first manufacturer to produce a gearbox specifically designed for the mixing industry
- Developed ChemScale™ to educate the industry on mixing intensities and publish to users

Customers look to us to solve their mixing challenges. The key to our success is the belief that business prospers as a result of good customer service. The commitment to quality, service and timely response has earned us the trust of our customers.

What do We Offer?

Reliability

We have been at the forefront of the mixing industry since 1952. Many of the original gearboxes are still in service today. We are recognized for producing dependable, heavy duty equipment. As a member of American Gear Manufacturers Association (AGMA), we are known to have time

trusted reliability. If assistance is ever needed with your mixing equipment, we have highly trained field service technicians and multiple service centers available throughout the world to assist with any mixing challenge. Our aftermarket programs and services are designed to solve any problem that may arise on short notice.

Chemineer agitators provide over 20 years of reliable service in most water treatment applications



Diversity

We offer a wide range of Chemineer gearboxes, impellers, seals and more to meet the requirements of any application. Our offering includes a combination of heavy duty large and small top entry mixers with parallel or right angle drives, direct drive or gear reduced. We are more than just rotating agitators. In addition to Chemineer, we offer the Kenics, Greerco and Prochem product lines. Kenics offers a wide variety of static mixers and heat exchangers. Greerco offers many high shear products including pipeline mixers, colloid mills and homogenizers. Prochem offers our belt driven side and top entry mixers suitable for many applications. We have facilities around the world, with locations in Ohio, Massachusetts, United Kingdom, Singapore, China, Austria, Mexico and representatives covering various key territories throughout the world.

Flexibility

Does your process require a customized solution? Let our experienced application engineering team design the equipment to enhance your process. We offer many standard options, and we also have the ability to modify our equipment to meet your specific needs. With over 60 years of agitation

experience, we can customize a solution for any mixing application.

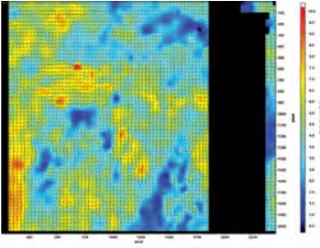
Technology

We use the latest in data evaluation and mixing research to provide customers with the proper equipment. Computational Fluid Dynamics (CFD), Laser Induced Fluorescence (LIF) and Digital Particle Image Velocimetry (DPIV) assist our engineers to better predict the performance of any mixing process. We use our state of the art on site laboratory to develop and test proper agitation systems for even the most complex processes.

Innovation

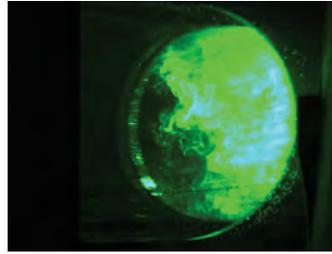
Our application engineers and representatives use technologically advanced proprietary software to design a customized mixing solution for every process. Our website, www.nov.com/mixing, provides customers with direct access to all of our product lines, the latest in mixing technology, and our rep locator. Our company does not merely sell fluid mixing equipment, we sell process solutions and answers to suit all of your needs.

Technology



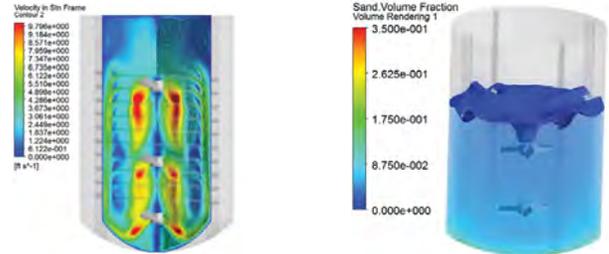
Digital Particle Image Velocimetry (DPIV)

DPIV keeps us on the forefront of mixing technology. DPIV uses a pulsed YAG laser to illuminate neutrally buoyant fluorescent particles. The result is a visual description of the agitated system, allowing engineers to see the actual flow patterns within the system. When used in conjunction with Computational Fluid Mixing, DPIV provides the most accurate application evaluation possible.



Laser Induced Fluorescence (LIF)

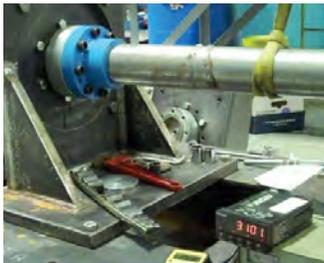
LIF is a measurement technique which enables the direct measurement of the degree of mixing. A laser beam is spread into a sheet light and projected through a clear pipe or vessel to illuminate a fluorescent dye. Images of the mixing are analyzed for blend time for agitators or COV for static mixers. This is used in product development, process research and application validation.



Computational Fluid Mixing (CFM)

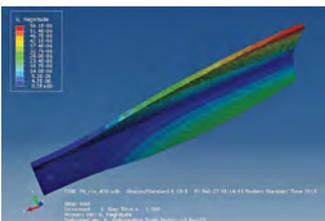
CFM is a powerful fluid flow modeling tool that provides visual analysis of agitated systems. CFM uses mathematical fluid flow models to analyze blending and motion, solids suspension, chemical reaction and heat transfer processes.

Our application engineers can produce two dimensional CFM simulations for rectangular and cylindrical tanks as well as turbulent and laminar flow static mixers. Three dimensional CFMs can be designed for non-symmetrical applications such as multi-reaction designs. The Chemineer Expert Design System (CEDS) can produce CFM simulations in as little as 15 seconds.



Mechanical Testing

Continuous research is important for process response and mechanical design. Using full scale vessels with strained gaged shafting and impeller, hydraulic forces are studied. These results are used in static and fatigue based FEA simulations as well as design calculations.



Design Tools and Lab Capabilities

R&D Facility

Our laboratory is located on the same campus as our Ohio manufacturing facility. Our laboratory provides research and development support as well as application specific customer testing.

The facility strives to keep Mixing Technologies at the forefront of innovation. Laboratory and research studies are used to enhance the Chemineer Expert Design System (CEDS) to provide continuous improvements to existing designs, to develop new products and application solutions, and to improve your process results. Our cutting edge technical research is presented at mixing seminars and conferences throughout the world.

Customer Test Facility

Many applications require a more in-depth analysis of the fluid mixing challenge. We have a

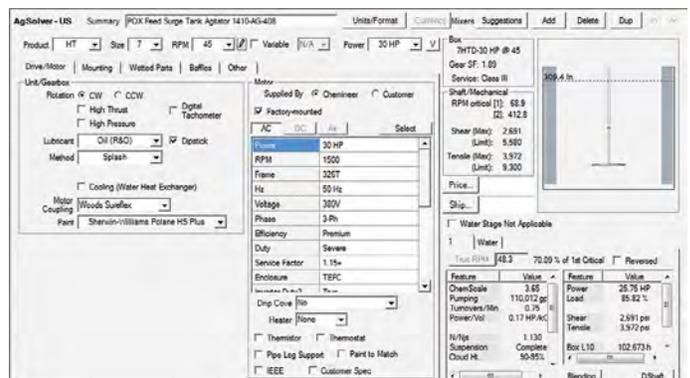
dedicated customer testing center inside our R&D facility. This center has the capability to scale down a process and model it with our various mixing technologies.

Chemineer Expert Design System (CEDS)

Our design program consolidates fluid flow system design and mechanical agitator design into one program. We treat every single inquiry as a unique application. Our revolutionary

software gives your local representative the power to simultaneously evaluate your process, propose a mixing solution, and verify the mechanical integrity of the design with a single program.

We apply CEDS, CFM, LDA, and DPIV to consistently improve our product line and application design procedure. The result is a more efficient, reliable, and economical mixing solution that is backed by years of experience.



We maintain high quality control by manufacturing all products in house. In house manufacturing capabilities include welding, machining, forming, testing, and assembly.



We take pride that we are the only mixing company that designs and manufactures its own gearbox specifically suited for mixing applications. The Chemineer brand has earned a reputation over the years for its expertise in process design for all mixing applications and wet end technology. Those components coupled with the gearbox, form the basis for the production of quality, durable and reliable agitators, which are the trademark of Chemineer equipment.

Our manufacturing locations are strategically located to support the four brands we produce.

- Dayton, Ohio—our flagship factory where we produce all four brands under the Mixing Technologies name. Here we produce Chemineer top and

side entering agitators and impeller systems, Prochem belt driven top and side entry agitators, Kenics static mixers and Greerco high shear mixers

- Harvey, Louisiana—produces some of the Kenics static mixer projects and our Kenics heat exchangers, utilizing their ASME code welding capabilities
- United Kingdom—this is the location of our European manufacturing facility. In this location, the Chemineer, Kenics and Greerco brands are produced and distributed throughout the world including Europe, Middle East, Far East, Australia, and Africa.
- China—our manufacturing facility in China manufactures the Chemineer branded products and serves the Chinese market.

Our high quality standards are enforced at all of our manufacturing facilities. Our reliability and technology are achieved and maintained through the following programs:

- Quality assurance provides formal written procedures that guide the manufacturing processes
- Standard industry practices are employed to assure compliance with customers' specifications
- Material inspection and vendor qualification are in place to eliminate defects and rework
- NC machining is utilized for precise fit and tolerance
- Each rotating piece of equipment is run tested
- Every component is dimensionally checked before shipment

Application Capabilities



Chemicals/Polymers/Plastics

We have designed agitators for thousands of different applications over the past 60 years. This experience along with our advanced design programs allow us to effectively size equipment in any application. With dozens of alloys available for use as wetted parts, and a large variety of sealing options, our agitators can be adapted to work with nearly any process. Continuing advancements allow us to stay ahead of the competition. Our XE-3 impeller provides an efficient design that produces the same flow characteristics at lower power levels. We are also able to provide complex impeller system using various impeller technologies to optimize your specific application.



Water and Wastewater Treatment

We are able to offer both rotating and static mixers for Water and Wastewater Treatment applications. We can supply an entire package using a combination of these different style mixers that will give the most efficient design and effective results. We offer a wide range of options like the RL-3 ragless impeller, up pumping designs or the space saving UltraTab™ to provide you the latest technology and most optimized designs.



Pulp and Paper

We use a thorough, specific, design process for all applications in the Pulp & Paper industry using the basis of a process number. The process number design method has proven to efficiently size our agitators for complex Pulp and Paper applications. Chemineer and Prochem branded products can offer belt or gear driven side entry or top entry options. Developed in our R&D facility, the WSE-3 impeller has the highest efficiency of any side entry impeller on the market. Using the WSE-3 will lower capital and operating costs since it draws less horsepower than competitive designs at equal mixing intensities.



FGD

Gas dispersion is extremely important in SO₂ removal and oxidation processes of FGD plants. Our vast installation base in FGD and gas phase chemical reactors provides a wide array of experience in all industries pertaining to gas dispersion. This leads to a more efficient and more reliable process solution to any oxidation system. Our solids suspension procedures, based on particle settling velocities, are second to none in the mixer industry.



Biotech/Pharmaceutical

Our biotech products are suited to work in the most sterile environments. Highly polished wet ends and debris catching mechanical seals are provided on most applications. Steam-in-place and clean-in-place capabilities can be provided as standard options as well as FDA approved mechanical seal components.

The most critical component to certifying your process lies in the documentation package submitted with purchased equipment. We can provide a submittal package structured around the ASME BPE 2012 code to meet all necessary requirements. This equipment turnover package includes material certifications, elastomer and seal component certifications, polishing test reports, quality assurance testing and more—everything you need to certify your new mixer!



Mineral Processing

Our industry leading drive, impeller, static mixer and heat exchanger technology allows us to design and optimize the best solutions for your specific requirements. Whether you have a high temperature, high pressure autoclave or a general purpose blend tank, we have the equipment to handle these drastically different applications with confidence and reliability. Our products will withstand the harshest conditions, delivering the consistent performance you need.



Oil and Gas

We have equipment installations and experience throughout various upstream, midstream and downstream processes. Our expertise allows us to provide optimized and reliable mixing equipment for these often demanding applications. From exploration to downstream processing, our equipment blends materials and suspends solids into homogeneous mixtures. Our equipment is often required for accurate measurement in transfer applications or mixing drilling mud.

Services and Aftermarket



Highly trained field service technicians can install your mixing equipment to quickly get your process up and running

We utilize a comprehensive network of manufacturing resources, inventory investment, suppliers, support personnel, and service centers to maximize the uptime of our customers' mixing processes.

We offer fast delivery of standard components through on site and supplier inventory, including gearboxes and components, mechanical seals, bearings, and gears. Many of these standard components are available for same day shipment or even same day delivery when required. Raw materials are generally available for planned outages or emergency breakdowns.

Our field service technicians are available to assist with agitator installations and repairs. Training seminars are available to educate our customers on agitator operation, evaluation, maintenance, and repair.

All field service technicians are trained in lockout/tagout, confined space entry, and fall protection by an OSHA certified safety instructor. Condition monitoring and vibration analysis services are also available.

As more local services are required, an authorized service center is located near you. Authorized service centers are fully trained and certified to provide agitator evaluations and repair and replacement services backed by the factory, providing the assurance that your agitators will be repaired to our new equipment standards and specifications.

Technical sales specialists are available during normal business hours, providing over the phone technical support for any of your mixing equipment needs.

Emergency services are available 24/7 by calling (937) 926-1724.

We offer trade in credits for select Chemineer and competitive gearbox models when a replacement is purchased. Certified refurbished gearboxes are available, offering a cost effective alternative when replacing and upgrading existing equipment.

Retrofits for obsolete Chemineer and competitive drive units are available. Modernizing your agitator fleet greatly increases the availability of replacement parts. Retrofits for wetted parts are also available. Upgrading impeller systems to newer technologies will prevent or delay equipment failures, and may also maximize the efficiency or capacity of your processes.



Model 20 HT/GT Mixer

With a high efficiency gearbox in right angle and parallel shaft configurations, modular design and a wide range of speeds, these agitators provide outstanding application versatility.



MR Mixer

Metric unit that combines quality, durability, and economy to supply unbeatable value in mixing equipment for the chemical, water and general processing industries.



HT Mixer

Known for its reliability and flexibility, the HT can be used for any top entry application, simple or complex, up to 1000 HP. We have over 75,000 in service today.



HTM Mixer

Available for extremely large applications in a right angle or parallel drive with all the same options as the HT.



HS and SB Mixers

Side entry agitator consisting of gear-driven (HS) and belt-driven (SB) agitators which provide an alternative to top entering selections for large volume vessels especially in storage tank applications such as oil and gas, chemicals, and edible oils.



BT Mixer

Biopharma mixer used in any sanitary application. We offer an extensive submittal package to meet the latest FDA requirements.



XP Mixer

Portable mixer that is available in a bung or clamp mounting arrangement. Most standard designs can be shipped within 48 hours.



DT Mixer

Small mixer that has many sealing, drive, and wetted parts options and provides long term, trouble free service. These units are also readily available with right angle or parallel drives.



QC Tote Mixer

Tote mixer with a quick connect drive that can be modified to fit any tote.

Kenics™ Products



KM Static Mixer

With the longest list of installations in the industry, the detailed design capabilities of this mixer offer guaranteed mixing results.



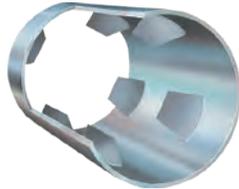
KMX-V Static Mixer

Cross-stream mixing and flow splitting allow this unit to handle even the most extreme viscosities and volumetric ratios in the laminar flow regime.



UltraTab Static Mixer

Designed for low viscosity mixing such as chemical dosing, water treatment and desalination applications.



HEV Static Mixer

With the lowest pressure drop per degree of static mixing available, this is ideal for low viscosity liquid or gas blending applications.



Heat Exchanger

Edge-sealed elements dramatically improve heat transfer coefficients in high viscosity applications.

Greerco™ Products



Colloid Mill

Specifically designed to disperse solids and liquids into a carrying fluid, producing stable emulsions to the sub-micron particle range.



Homogenizer

High speed high shear batch mixer ideal for fast blending and homogenizing of materials through a wide range of viscosities.



Pipeline Mixer

Designed for inline, continuous high shear homogenizing, mixing, emulsifying and rapid dispersing.

Prochem™



MD Mixer

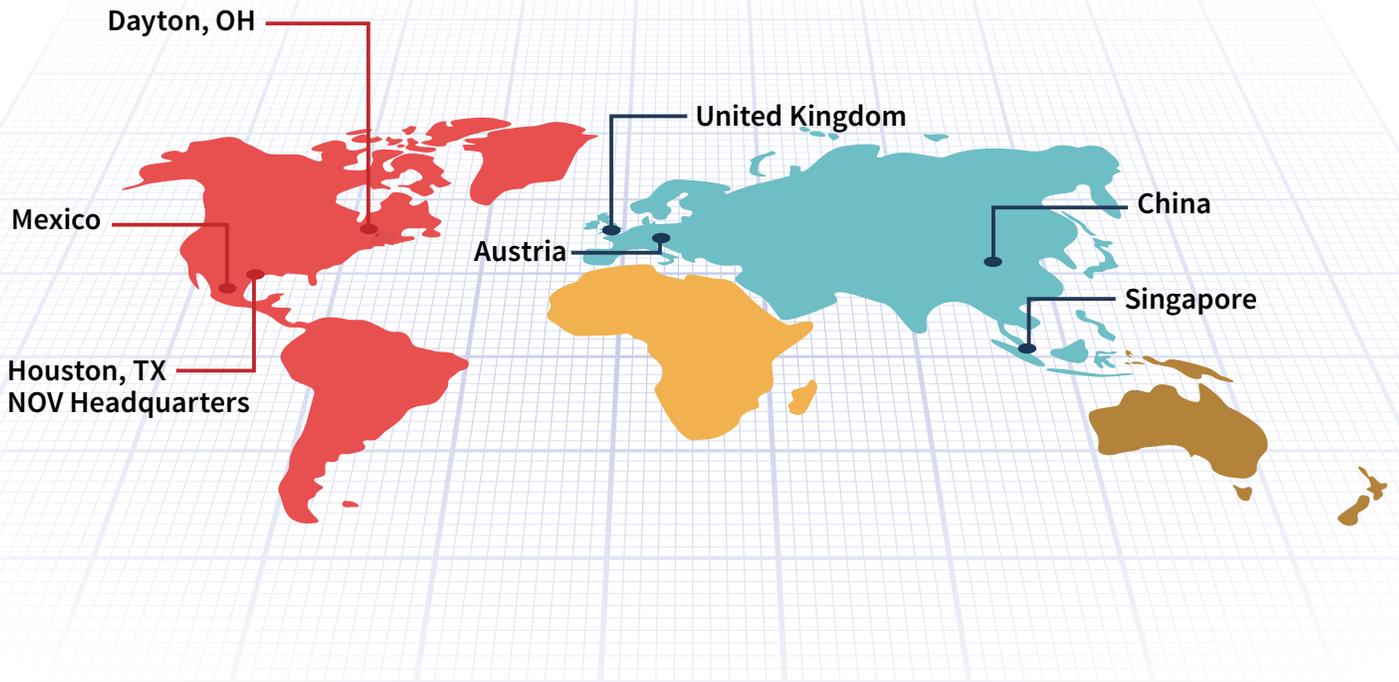
Side entry belt driven with a modular bearing cartridge design allowing longer operating runs between maintenance periods.



PB Mixer

Combines the proven features of the MD series with the simplicity of the pillow block bearing design.

Sales representatives have territories throughout the world and are supported from these facilities:



Product Support

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For more information on our services, visit www.nov.com/mixing

For more information on our solutions, visit www.nov.com/mixing

For more information on our equipment, visit www.nov.com/mixing

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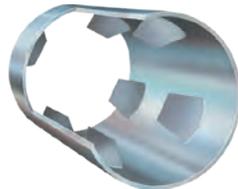
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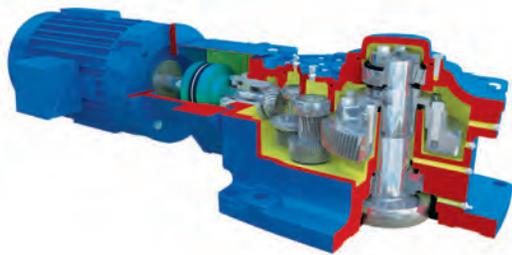
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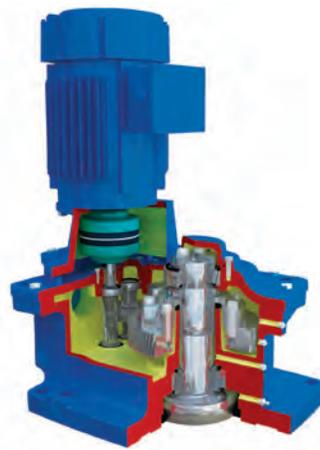


Chemineer™
Model 20 HT/GT
Agitators





Model 20 HT



Model 20 GT

Premium Performance

The Model 20 HT/GT units feature a gearbox designed specifically for agitator service. Available in right angle (HT) and parallel shaft (GT) configurations, this rugged performer can be tailored to meet virtually any process, from critical chemical reactor systems to storage applications.

Combining the benefits of the HT and GT time proven agitators into a modular design package,

we provide solutions to optimize your mixing applications today and flexibility to handle your changing requirements in the future.

The Model 20 HT/GT is designed to meet AGMA, OSHA, ANSI, IEC, DIN, EU and ATEX standards and requirements.

How is the Chemineer Model 20 HT/GT Gearbox Superior?

Output Shaft Requirements

Commercial gearboxes usually have smaller output shafts that are poorly suited for agitator duties, leading to higher gear deflections, more noise and lower reliability. For optimum mechanical integrity, it is beneficial to design the low speed shaft so that the shaft diameter between the bearings is large and the distance between the bearings is small.

Commercial gearboxes tend to use smaller shaft diameters, resulting in the need to select larger and more expensive units to handle the bending moments associated with overhung loads.

The Chemineer Model 20 HT/GT also has an oversized output shaft, which reduces gear deflection and noise, with a true cast dry well seal to avoid the risk of leaking lubricant down the shaft.

AGMA Ratings when Applied to Agitators

The Chemineer Model 20 HT/GT gearbox is unique and superior because it is designed specifically for agitator duties.

AGMA established a general purpose standard intended to be applied to gearboxes used in a wide range of industrial applications. Agitators have particular duties that make reliance on AGMA service factors inappropriate.

A standard commercial gearbox tends to use smaller shafts and larger bearing spans that result in higher deflection, wear and shorter lifespan. To obtain adequate drive life a high service factor must be applied. In comparison with a general purpose gear drive of the same nominal AGMA torque rating, the Model 20 HT/GT has much longer bearing and gear lives, which translate to lower maintenance costs and greater productivity.

Drive Features and Benefits

	Features	Benefits
Internal Shafting	Oversized low speed shaft diameter and short bearing span	<ul style="list-style-type: none"> • Time proven design to handle shaft/impeller bending loads • Reduces deflection and gear misalignment • Extends bearing and gear life
	Recessed low speed coupling half	<ul style="list-style-type: none"> • Simplifies installation with no requirement to install the extension shaft up through the gearbox
Gearing	Double and triple reduction options	<ul style="list-style-type: none"> • Double/triple reduction decreases gear loads • Lowers noise levels • Allows for non-synthetic lubrication over competitive single reduction designs
	Helical/spiral bevel (HT) and all helical (GT)	<ul style="list-style-type: none"> • Most efficient gearing available • Reduces energy costs
	Case carburized gearing	<ul style="list-style-type: none"> • Reduces wear rate for 20+ year service life
	Reverse rotation capability	<ul style="list-style-type: none"> • Available option for process flexibility
Housing and Lubrication	Cast gearbox housing	<ul style="list-style-type: none"> • Modular design with right angle (HT) and parallel shaft (GT) configurations • Reduces noise level
	Standard R&O oils and grease	<ul style="list-style-type: none"> • No synthetic lubrication is required • Saves installation and maintenance costs
	Bath lubrication	<ul style="list-style-type: none"> • Ensures vital lubrication to gears and bearings at all operating speeds • Eliminates internal/external lubrication pumps
	Cast dry well seal	<ul style="list-style-type: none"> • Eliminates lubrication leaks which are common in commercial gearboxes with no dry well or bolt on designs
	Extra seal over dry well	<ul style="list-style-type: none"> • Keeps oil out of dry well while moving gearbox
Bearing Design	Tapered roller output bearings with short bearing span, grease lubricated	<ul style="list-style-type: none"> • High capacity to handle bending and thrust loads • Provides long life
	Tapered roller/cylindrical roller bearings, oil lubricated	<ul style="list-style-type: none"> • Ensures cool operation • Ensures long life and low maintenance



Installed Model 20 GTs at a wastewater treatment facility

Seal Features and Benefits

Features	Benefits
Drop collar shaft support during seal change	<ul style="list-style-type: none"> • Shaft drops easily by loosening coupling bolts, and engages by tightening the coupling bolts • Shaft only drops 0.5" eliminating steady bearing disengagement • Allows for wetted parts to remain in place for seal change out
Optional throttle bushing and debris well design	<ul style="list-style-type: none"> • Clean fluid flush eliminates process build up in seal area improving seal life • Eliminates particle shedding from entering tank
Swing out or spacer spool seal change designs	<ul style="list-style-type: none"> • No need to pull shaft up through gearbox or in-tank shaft supports • No additional labor or parts required for special shaft support system • No lifting and removing of gearbox, saving labor and downtime
Variety of seal options from major mechanical seal vendors such as John Crane, Flowserve, Chesterton and AES	<ul style="list-style-type: none"> • Cartridge double and single seals, cartridge ChemSeals and stuffing box designs provide performance and flexibility to meet agitator sealing needs
Seal designs include cartridge single and double seals and split seals	<ul style="list-style-type: none"> • Reduces seal change out time and shaft wear as compared to non-cartridge (shaft mounted) designs
Low height pedestal (swing out) and seal bearing (spacer spool) design options	<ul style="list-style-type: none"> • Seal located close to shaft support bearings (swing out) and integral seal bearing (spacer spool) reduces shaft deflections at seal, improving life
Optional seal shut off device	<ul style="list-style-type: none"> • Eliminates operator exposure to hazardous vapors without draining the vessel
Jacks-n-Rails assembly available for large diameter seals	<ul style="list-style-type: none"> • Reduces labor time for seal change out with no extra hoists required
Optional lip seals and stuffing boxes	<ul style="list-style-type: none"> • Low cost lip seals available for low pressure applications • Self lubricating packing offers low maintenance sealing options for pressures up to 100 psi



Swing out seal change

Sealing and Mounting Options

Open Tank

• Drive Mounted to Beams

Using a heavy duty, cast housing capable of handling maximum loads, the agitator mounts readily to support beams or similar structures for common open tank applications. Auxiliary seals are an option.

• Pedestal Mounted to Beams

The rugged, cast iron pedestal of the agitator raises the gear drive 10 to 14 inches away from the support structure to prevent exposure of the drive to the fluid and to facilitate service.

Closed Tank—Seal Options

• Lip Seal

The spring loaded, nitrile rubber lip seal protects process fluid from contamination in lower pressure applications.

• Stuffing Box

The six ring stuffing box utilizes standard PTFE/graphite-braided packing requiring no lubrication. Optional packing materials are available.

• Single Mechanical Seal

The single dry running mechanical seal is the economical choice where a pressurized barrier between the tank contents and the outside environment is not necessary.

• Single Mechanical Cartridge ChemSeal

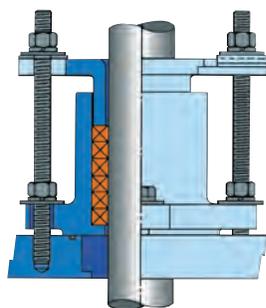
The single mechanical seal offers dry running capability with an easily replaceable cartridge.

• Split Mechanical Seal

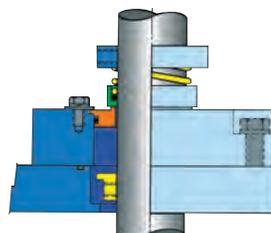
The two piece design simplifies installation and maintenance.

• Double Mechanical Cartridge ChemSeal

Double mechanical cartridge seals offer excellent sealing capabilities, long life and minimum maintenance. An appropriate barrier fluid keeps tank contents from escaping.



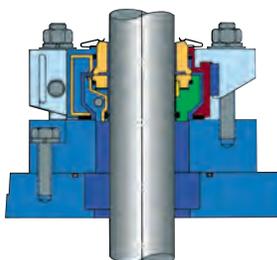
Stuffing Box



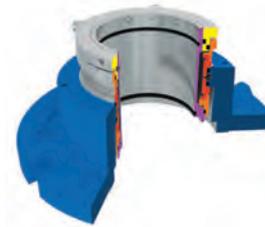
Single Mechanical Seal



Single Mechanical Cartridge ChemSeal



Split Mechanical Seal



Double Mechanical Cartridge ChemSeal

Shaft Design

Both process and mechanical considerations determine shaft design. Shafts are sized to resist torsional loads and bending moments induced by hydraulic forces acting on the impeller, as well as to avoid excessive vibration due to the coincidence of critical frequencies and operating speed.

Shafting is straightened to tight tolerances for long seal life and smooth operation — less than 0.003 inches total run out per foot of shaft length (0.25 mm per meter).

Custom couplings, impellers, shafts and steady bearings are available upon request, including sanitary designs.

Types

Shafting is supplied in a single piece design or in rigidly coupled sections for easy installation. For large diameter shafts, pipe shafting is a viable option with couplings and impeller hubs welded to the shafting. A wide range of materials and coating options are available.

Couplings

To facilitate assembly in the field, extension shafts are attached to the drive shaft with flanged rigid couplings, eliminating the need for shafts to be installed through the gearbox. Optional in-tank couplings can either be removable tapered bore or welded simplifying installation of long shaft agitators.

Steady Bearings

Steady bearings are available to help support extremely long shafts when requested or required. Tripod, bracket and pad type steady bearings are standard design options.

Extended Keyways

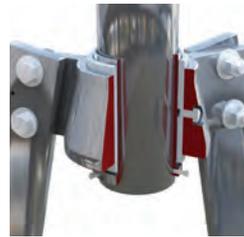
Extended keyways for adjusting impeller location offer process and design flexibility.



Welded Coupling



Removable Coupling



Tripod Steady Bearing



Bracket Steady Bearing

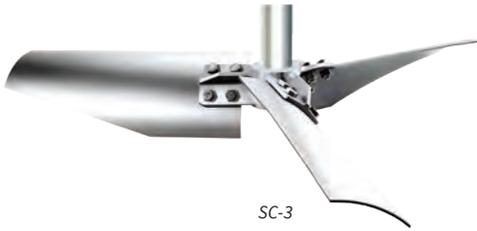


Installed Model 20 agitators on an oil rig

Impeller Technology

Our impeller technology is effectively applied across any spectrum of applications ensuring successful, repeatable results from lab scale to full scale operations.

Our mixing expertise includes high flow, low shear liquid-liquid agitation, solids suspension, gas dispersion, high shear blending and viscous mixing. Whether it is R&D or production phase, we have the expertise to solve your mixing challenges.



SC-3



HE-3



Helix



Maxflo W



BT-6



XE-3



P-4



RL-3



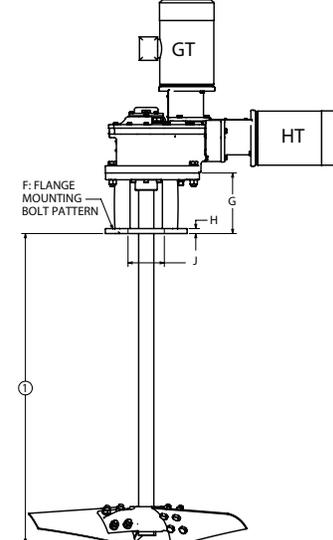
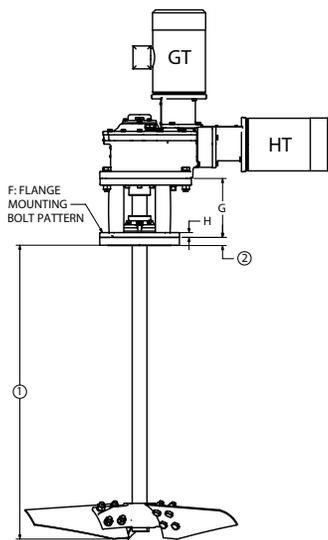
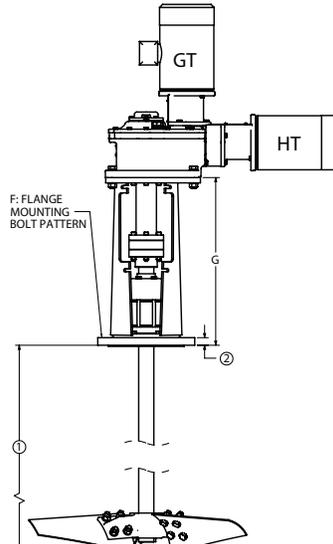
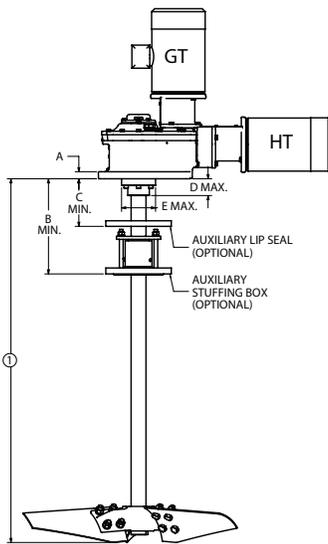
JT-2

Dimensions

Agitator Dimensions

Case Size	A	B	C	D	E	Bolt Pattern		Spacer		Swivel	
						F	G	H	J		
21GT	1.18"	13.94"	6.94"	2.94"	5.71"	8" — 150# ANSI (holes straddle center line)	26.19"	10.00"	0.75"	9.50"	
22GT	1.38"	18.00"	8.00"	4.00"	7.48"	10" — 150# ANSI (holes on center line)	29.82"	12.50"	0.88"	10.00"	
23GT	1.58"	18.63"	8.63"	4.63"	9.45"	12" — 150# ANSI (holes straddle center line)	33.94"	N/A	1.18"	10.83"	
						14" — 150# ANSI (holes straddle center line)	N/A	14.06"	1.46"	12.80"	
21HT	1.18"	13.94"	6.94"	2.94"	5.71"	8" — 150# ANSI (holes straddle center line)	26.19"	10.00"	0.75"	9.50"	
22HT	1.38"	18.00"	8.00"	4.00"	7.48"	10" — 150# ANSI (holes on center line)	29.82"	12.50"	0.88"	10.00"	
23HT	1.58"	18.63"	8.63"	4.63"	9.45"	12" — 150# ANSI (holes straddle center line)	33.94"	N/A	1.18"	10.83"	
						14" — 150# ANSI (holes straddle center line)	N/A	14.06"	1.46"	12.80"	

- 1 Agitator output speed, shaft diameter and extension, impeller design and other optional features to suit application
- 2 Alternate flange sizes are available

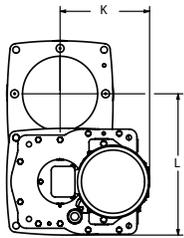


Swivel Dimensions

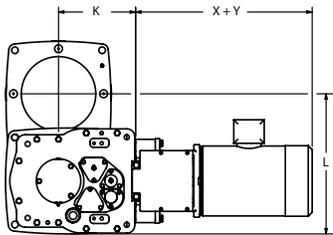
Case Size	K	L
21GT	11.18"	17.57"
22GT	17.50"	22.61"
23GT	21.90"	28.31"
21HT	9.84"	17.57"
22HT	12.56"	22.61"
23HT	16.61"	28.51"

Typical Drive Assembly Swivel Dimensions

Drive assembly pivots at top of pedestal to allow change out of mechanical seals. See IOM for special motor conduit instructions.



GT

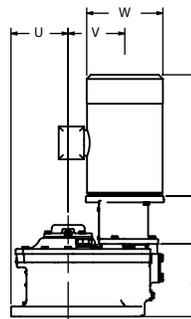
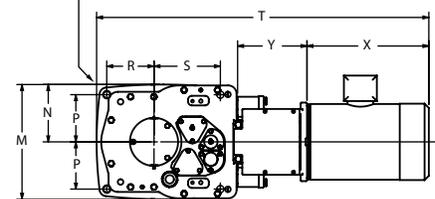
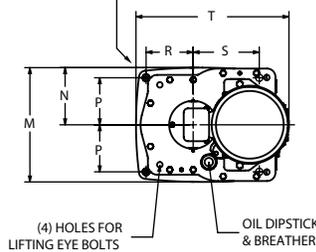


HT

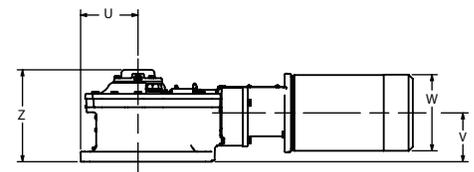
Motor Dimensions

Frame Size	W	X	Y						
			21GT	22GT	23GT	21HT	22HT	23HT	
NEMA	140	7.75"	13.11"	3.98"	—	—	6.46"	—	—
	180	9.25"	16.24"	5.51"	6.02"	—	7.99"	9.41"	—
	210	11.00"	17.96"	5.51"	6.02"	—	7.99"	9.41"	—
	250	12.75"	22.25"	—	6.85"	7.01"	—	10.24"	11.43"
	280	14.50"	24.24"	—	7.76"	7.01"	—	11.14"	11.43"
	320	16.88"	27.00"	—	8.23"	8.27"	—	11.61"	12.69"
	360	18.50"	27.63"	—	—	9.49"	—	—	13.91"
	400	20.88"	31.75"	—	—	10.83"	—	—	15.25"
IEC	80	6.61"	10.66"	3.85"	—	—	6.06"	—	—
	90	7.40"	11.18"	4.13"	—	—	6.62"	—	—
	100	7.72"	13.15"	4.92"	5.35"	—	7.40"	8.74"	—
	112	9.45"	13.03"	4.92"	5.35"	—	7.40"	8.74"	—
	132	10.61"	16.73"	5.39"	6.22"	6.10"	7.88"	9.61"	10.52"
	160	12.52"	21.26"	—	7.87"	7.48"	—	11.26"	11.90"
	180	14.37"	23.31"	—	7.87"	7.48"	—	11.26"	11.90"
	225	17.64"	30.51"	—	—	9.53"	—	—	13.95"
	250	20.00"	35.04"	—	—	9.53"	—	—	13.95"
280	22.17"	38.39"	—	—	9.53"	—	—	13.95"	

(4) "O" DIAMETER MOUNTING HOLES LOCATED AT DIMENSIONS P, R & S



GT



HT

Drive Assembly Dimensions

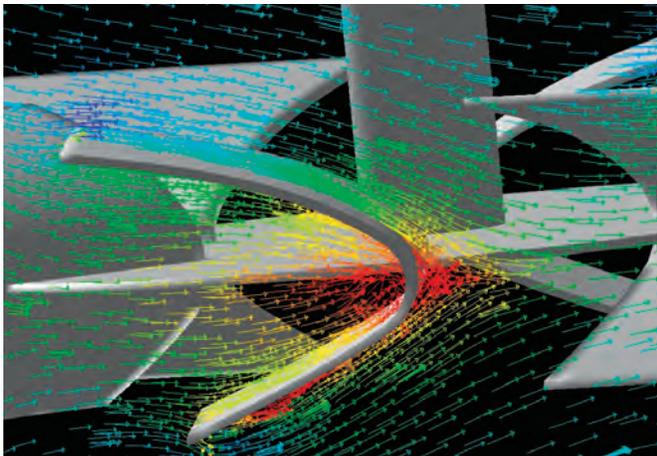
Case Size	M	N	O	P	R	S	T	U	V	Z
21GT	12.77"	6.45"	0.84"	5.56"	5.56"	7.81"	17.91"	6.73"	6.69"	8.47"
22GT	16.97"	8.48"	1.00"	7.06"	7.06"	10.06"	26.00"	8.50"	9.06"	10.75"
23GT	21.97"	10.99"	1.00"	9.65"	7.68"	2.17"	31.15"	9.25"	11.41"	14.80"
21HT	12.77"	6.45"	0.84"	5.56"	5.56"	7.81"	38.75"	6.73"	5.75"	10.83"
22HT	16.97"	8.48"	1.00"	7.06"	7.06"	10.06"	59.70"	8.50"	7.23"	12.91"
23HT	21.97"	10.99"	1.00"	9.65"	7.68"	2.17"	73.47"	9.25"	9.77"	16.50"

Chemineer Advanced Design Initiative

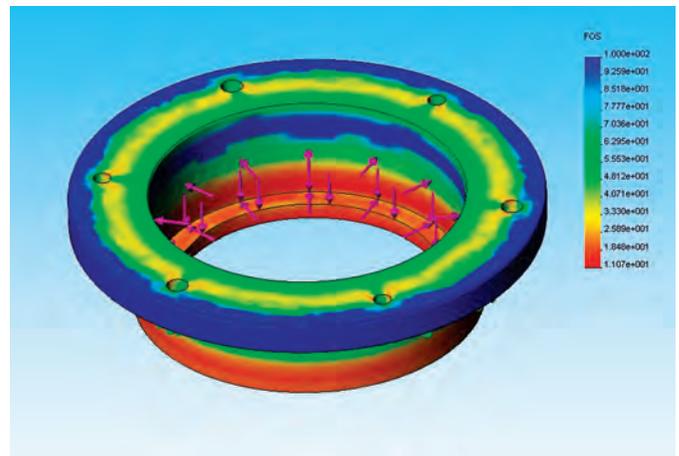
The Chemineer Advanced Design Initiative brings proven technical expertise to each mixing solution, from basic mixer and impeller design through complex process application analysis. Continuing research in both mechanical and process aspects of mixing allows us to provide high quality and high value products and services. Combined with proprietary data evaluation methodology and extensive field experience, we provide the most accurate application evaluation possible. Let us optimize your application, saving you time and money, by applying our experience and state of the art tools, such as:

- High tech customer test laboratory—offers the most advanced testing techniques in the industry specific to your process

- R&D laboratory—provides advanced process and mechanical research which is incorporated into custom design packages to optimize your application
- Computational Fluid Dynamics (CFD)—provides visual projections of mixer performance by generating a series of mathematical models of fluid flows
- Digital Particle Image Velocimetry (DPIV)—provides instantaneous flow visualization and quantitative measurement of the fluid velocity field
- Laser Doppler Anemometry (LDA)—corroborates time averaged DPIV data, especially for velocity fields in the vicinity of the impeller
- Laser Induced Fluorescence (LIF)—enables the user to gain a fundamental understanding of mixing by tracking the path and diffusion of injectants in agitated vessels and static mixers
- CEDS™ (Chemineer Expert Design System)—the industry leader in agitator design and analysis software. This proprietary program suite optimizes process performance, in addition to mechanical integrity, strength and reliability
- ChemScale™—the industry standard method for effective mixer selection that helps to optimize the agitator design for your specific process needs
- Finite Element Analysis (FEA)—dynamic vibrational and stress analysis of vessel and agitator support structures ensures proper design to handle agitator loads. Product design tool for stress and deformation analysis ensures product safety and reliability
- CAD and SolidWorks 3D Design—state of the art product and job design software, with customer specific mixer drawings available
- A library of technical articles—available on our website



Example of CFD modeled flow fields



Example of FEA analysis

Aftermarket Parts and Services

At NOV we offer customers immediate assistance to help achieve operating performance goals for agitation and mixing processes. This is accomplished in two ways: ensuring replacement parts and services are available in a timely manner to increase the “uptime” of your systems, and ensuring customers are offered the latest technology to improve the performance of agitation and mixing systems.

The Right Part Every Time

We provide drop in replacement parts of standard and custom Chemineer agitator components, minimizing installation problems like improper fit up or alignment. Chemineer replacement parts are made to original equipment specifications to ensure maximum reliability of your mixing equipment.

Technical Support

Our technical support is just a phone call away. Whether you need assistance with installation, startup, maintenance, or replacement parts, our technical experts are ready to help.

Field service technicians are ready to assist your crew with installation, troubleshooting, reliability audits, or maintenance and operator training in your facility.

Installation

We offer expert help on installation, whether your application requires one or multiple agitators. Field service technicians can quickly and efficiently supervise the installation and start up of your agitator or complete the installation from start to finish.

Authorized Service Centers

We offer multiple options to get your process back up and running. Highly trained field service technicians are ready to deploy for assisting maintenance crews in repair, diagnostic, and/or maintenance work. An authorized service center is located near your plant for quick responsiveness backed by the full support of our manufacturing facility.

Our field service technicians can also perform repairs and maintenance on site. Service agreements are available for routine maintenance services to keep your equipment operating at optimum performance levels. While on site, our team can perform reliability audits to review your current mixing equipment and provide recommendations

for mechanical and process improvements and critical spares planning.

The service centers located at our manufacturing facilities are utilized for more extensive failure analysis, fast replacement parts assemblies, and the most reliable agitator repair service in the world. New and refurbished parts options are available to suit your business requirements and get equipment back into operation.

We offer customer service plans tailored to fit your needs. Contact your local representative or call us directly at 937-454-3200.

Parts

Our large inventory supports your stock and provides quick fulfillment of maintenance and repair needs. Emergency stocked parts are shipped within 24 hours. In addition to a wide selection of standard replacement items such as bearings, seals and motors, we stock complete drives and internal subassemblies. Our drive exchange program offers a replacement drive for rapid conversion for Chemineer and competitive drives.

Warranty

For added peace of mind the Model 20 HT/GT agitator is backed by a comprehensive product warranty.

Emergency Hotline:
+1 937 926 1724



Experienced field service technician repairing equipment on site to minimize downtime

NOV

NOV Chemicals

NOV Chemicals Mixing

NOV Chemicals Mixing

NOV

NOV Chemicals

NOV Chemicals Mixing

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NOV

NOV Chemicals

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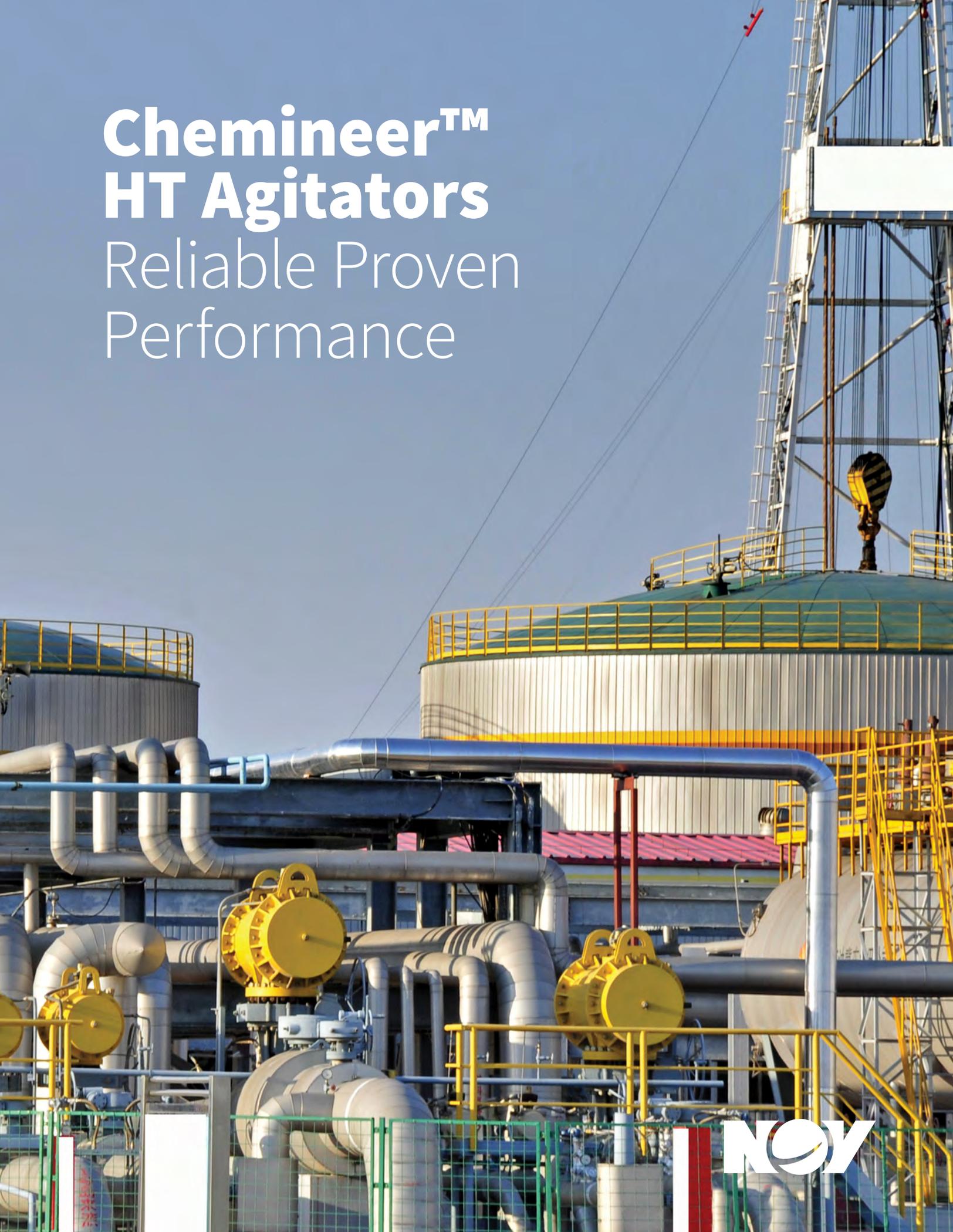
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Chemineer™ HT Agitators

Reliable Proven
Performance



NOV

Proven Performance

The HT agitator is a premium product featuring a gearbox specifically designed for mixing applications. Available in both bottom and top entering designs, this rugged performer can be tailored to meet virtually any process from critical chemical reactor systems to routine storage applications. Its superior design offers high strength, low wear, quiet operation, and minimum maintenance.

The reliable and rugged HT agitator has provided long, trouble free service in harsh, demanding applications. For open or closed tanks, the HT agitator is the industry standard of reliability and technology in mixing.



Large or small, Chemineer HT agitators can be used in various applications throughout any chemical plant

Drive Features

Internal Shafting

- Oversized, low speed internal shaft with a short bearing span reduces deflection and harmful gear misalignment
- Low speed shafts have extra large cross sections for maximum rigidity

Protective Finish

External surfaces are protected with a catalyzed polyurethane finish suitable for indoor or outdoor installations.

Quiet Performance

The high quality of the gears and other internal components, and precise machining of the drive housing contribute to quiet performance well below maximum recommended noise levels of 85 dbA.

Positive Lubrication

- Splash lubrication continuously protects gearing and high speed bearings
- A dry well low speed shaft seal prevents oil leakage
- Lubrication options for high temperature service or low speed applications include an external oil pump and an oil cooling system
- Oil heaters are available for extremely low temperature environments

Extra Capacity Tapered Roller Bearings

- The tapered roller design handles both the radial and axial loads common to agitator drive service
- Standard tapered roller bearing service rating of over 100,000 hours L-10 life throughout the drive
- For simplified maintenance and prevention of housing wear, low speed bearings are carrier mounted and can be replaced without special tools

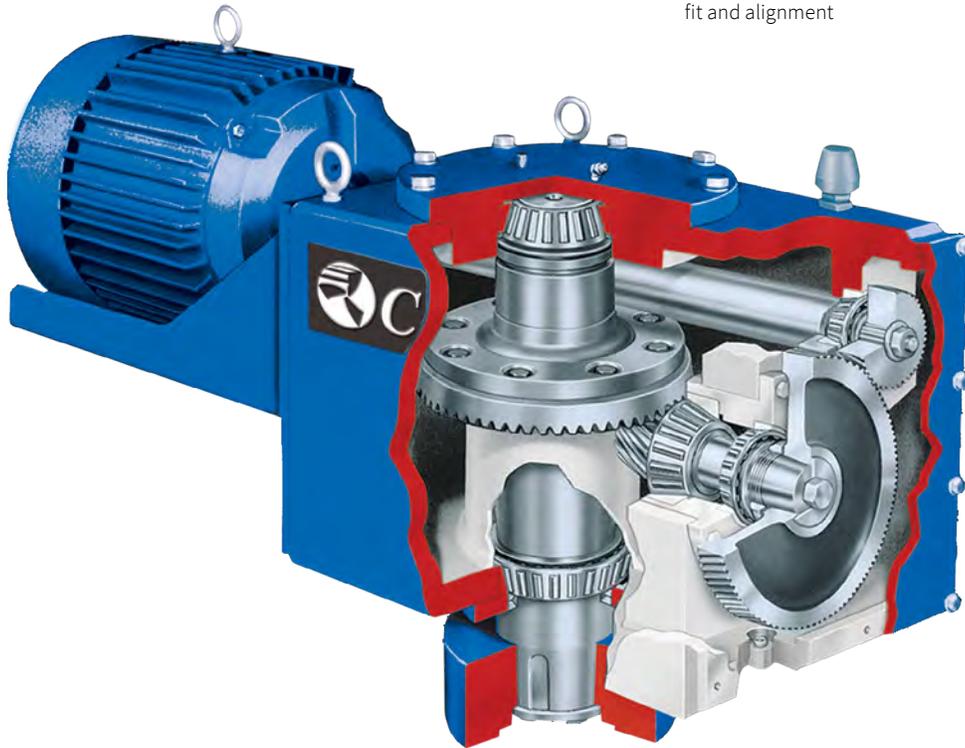
Drive Internals

The first reduction helical change gears are spline or taper hub mounted for easy removal and replacement. Removing the change gear cover provides direct access to the change gears

without the need to disturb other internal parts or the motor. Second reduction spiral bevel gearing offers low wear for long service, and provides superior efficiency for right angle power transmission.

- Magnetic drain plug is included as standard
- Hardened helical gears precision hobbled and shaved to exact tolerances for proper contact and wear
- Spiral bevel gearing is precision generated, matched, lapped, and individually marked for accurate fit and alignment

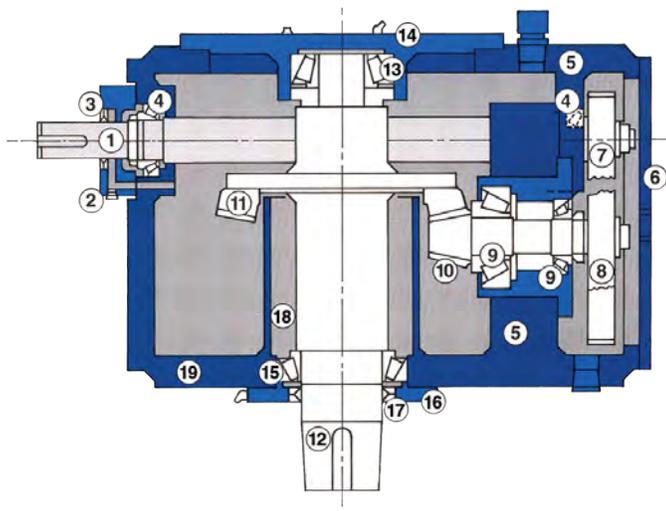
- Easily accessible grease fittings lubricate low speed shaft bearings
- The chemical duty paint finish protects against water, acid, or caustic environments, and is extremely resistant to wear and abrasion
- Rugged, fabricated gear drive housing
- Dry well seal prevents process fluid contamination
- All shafts are precision turned on lathes for dimensional consistency and straightness



Additional Features

- Standard foot mounted motor
- Compact, high efficiency, right angle double reduction drive

All internal drive components are specific to the HT drive and meet Chemineer's exceptional quality standards



Gearbox Components

- | | |
|-----------------------------------|--------------------------------|
| 1 High speed shaft | 11 Spiral bevel gear |
| 2 High speed bearing cap | 12 Low speed shaft |
| 3 Lip seal | 13 Upper low speed bearing |
| 4 High speed shaft bearings (2) | 14 Bearing cap |
| 5 Bearing support blocks (2) | 15 Lower low speed bearing |
| 6 Change gear cover | 16 Lower low speed bearing cap |
| 7 Change pinion | 17 Lip seal |
| 8 Change gear | 18 Dry well |
| 9 Bevel pinion shaft bearings (2) | 19 Housing |
| 10 Spiral bevel pinion | |

Shaft Seals

Seal Mounting

Shaft seals attach directly to the integral ANSI mounting flange on pedestal mounted agitators. All shaft seals are also available as auxiliary units with beam mounted gearbox.

Shut Off Systems

Optional shaft shut off systems allow seal change without the leakage of process fluid or pressure loss.

Types of Seals

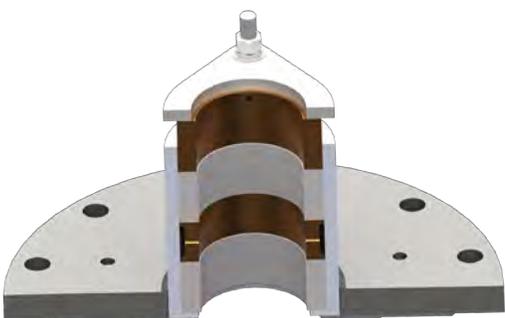
A wide selection of shaft seals are available for closed tank processes.

• Lip Seal

The spring loaded elastomeric lip seal protects process fluid from dust or atmospheric contamination in low pressure, lower temperature applications.

• Stuffing Box

A six-ring stuffing box incorporates a lantern ring and grease fitting to maintain lubrication. A three-ring design is available for low pressure applications.



Stuffing Box

• Mechanical Seals

Mechanical seals are offered in a variety of materials to design specifically for your process. The seals are supplied from well known seal manufacturers. Special seals are available for high pressure and/or temperature applications.

– Single Mechanical Seal

The single dry running mechanical seal is a suitable choice for applications where a pressurized barrier between the tank contents and the outside environment is not necessary.

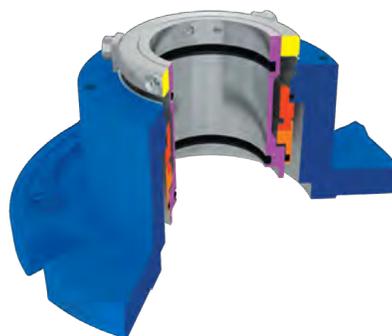
– Split Mechanical Seal

Split mechanical seals feature a two piece design that simplifies installation and maintenance.

– Double Mechanical Cartridge Seal

Double mechanical seals can offer the most complete protection against leakage of hazardous or flammable fluids, as well as long life and minimum maintenance.

The cartridge construction greatly simplifies seal removal and installation. The seal cartridge removes as a unit, without disturbing the agitator drive. The cartridge unit can be rebuilt and statically or dynamically bench tested prior to installation. Our standard cartridge includes an integral bearing in the cartridge to reduce shaft deflection and increase seal life.



Mechanical Seal



Field service technicians are readily available to help maintain your equipment as shown in this large chemical plant in the UK



Step 1



Step 2



Step 3

Seal Change Procedure

The double mechanical seal cartridge is removed in four simple steps requiring no special tools or blocking:

1. Unbolt the spacer spool between the reducer output and agitator extension shaft. The extension shaft drops less than 0.5" into a catcher bracket in the mounting flange to support the shaft and impeller weight.
2. Remove spacer spool.
3. Remove tapered shaft coupling half located above the seal cartridge.
4. Unbolt and slide the entire seal assembly off the extension shaft.

Benefits

- The gearbox does not need to be removed or disturbed during a seal change
- The seal arrangement allows for a seal to be changed faster and more consistently than any other system, regardless of agitator size or age
- A Jacks-n-Rails system is available to simplify removal and installation of large cartridge seals
- Seal shut off available
- Shaft will not disengage from steady bearing
- Drop collar supports wetted parts to leave in the vessel during seal change out



Model 6HTN-20 with double mechanical cartridge seal pedestal mounted to a closed tank

Mounting Options

Adaptable to Any Tank

HT agitators are adaptable to any vertical mounting configuration on open or nozzle mounted closed tanks.

On Open Tanks

Steel plate feet or mounting plates are included on the gear drive to mount the agitator to beams or other supporting structures.

On Closed Tanks

HT agitators can be supplied with a fabricated steel support pedestal to mount the agitator directly to the vessel nozzle.

- The pedestal design includes a standard ANSI 150 lb flange
- High pressure and custom flanges are available

Bottom entry applications can be flange mounted, or independently mounted with a separate seal assembly.



Top entering HTN agitator with pedestal mounted arrangement



Bottom entering HBN agitator with a double mechanical seal and independently mounted drive

Shaft Design

Both process and mechanical considerations determine shaft design. Shafts are sized to resist torsional loads and bending moments induced by hydraulic forces acting on the impeller, as well as to avoid excessive vibration due to coincidence of critical frequencies and operating speed.

Shafting is straightened to tight tolerances—less than 0.003 inches total run out per foot of shaft length (0.25 mm per meter)—for long seal life and smooth operation. Custom couplings, impellers, shafting, and steady bearings are available upon request, including sanitary designs.

Types

Shafting is supplied in a single piece design or in rigidly coupled sections for easy installation. For large diameter shafts, pipe shafting is a viable option with couplings and impeller hubs welded to the shafting.

Couplings

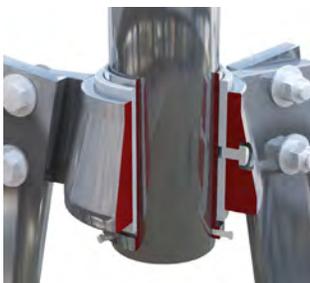
To facilitate assembly in the field, extension shafts are attached to the drive shaft with flanged rigid couplings, therefore shafts do not need to be installed through the gearbox. The couplings can either be removable tapered bore coupling halves or welded coupling halves. In tank couplings simplify installation of long shafts.

Steady Bearings

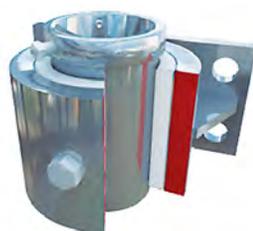
Steady bearings are available to help support extremely long shafts. Cup tripod, bracket, and pad type steady bearings are standard design options.

Extended Keyways

Extended keyways for adjusting impeller location offer process and design flexibility.



Cup Tripod Steady Bearing



Bracket Steady Bearing

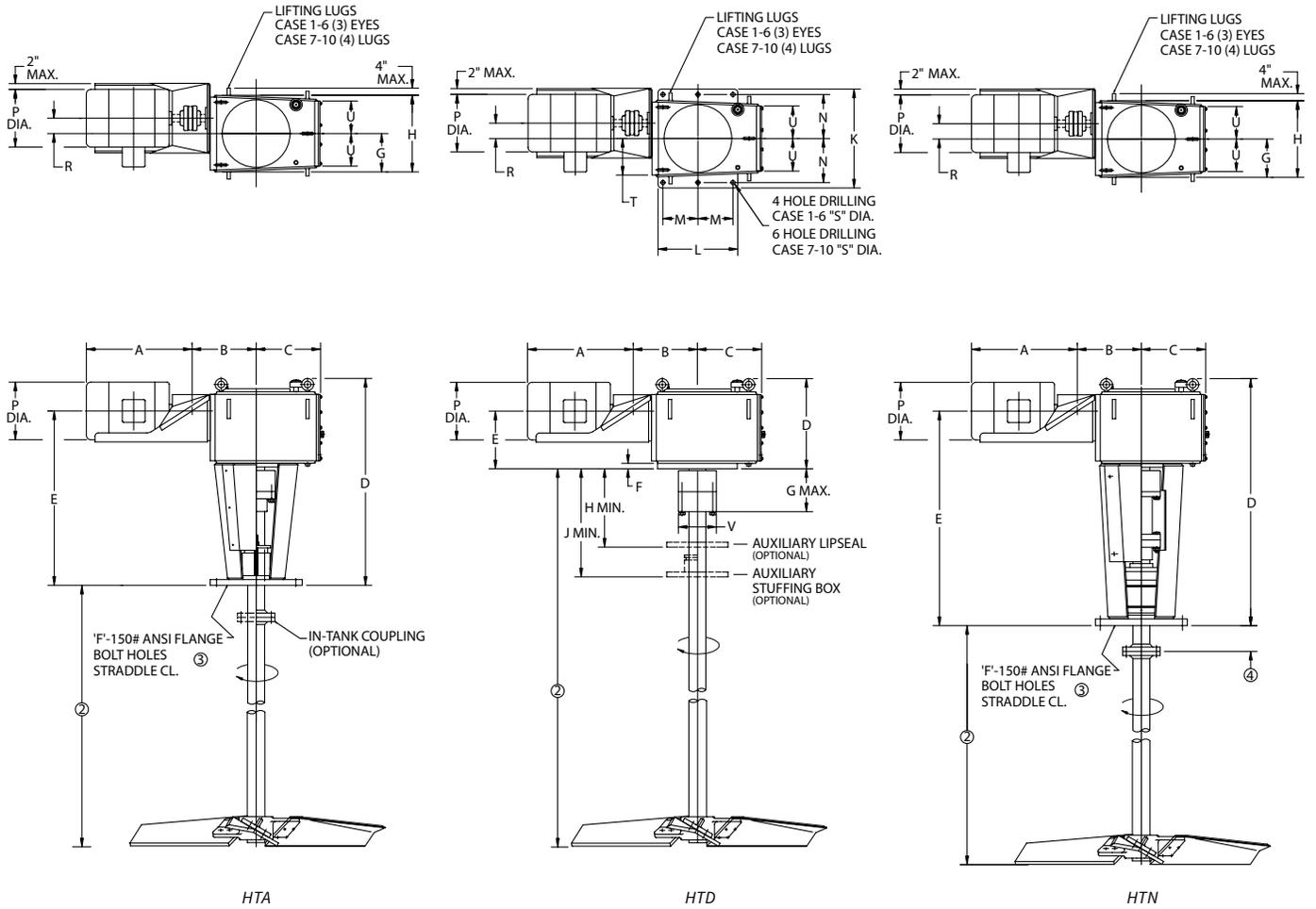


Welded Coupling



Removable Coupling

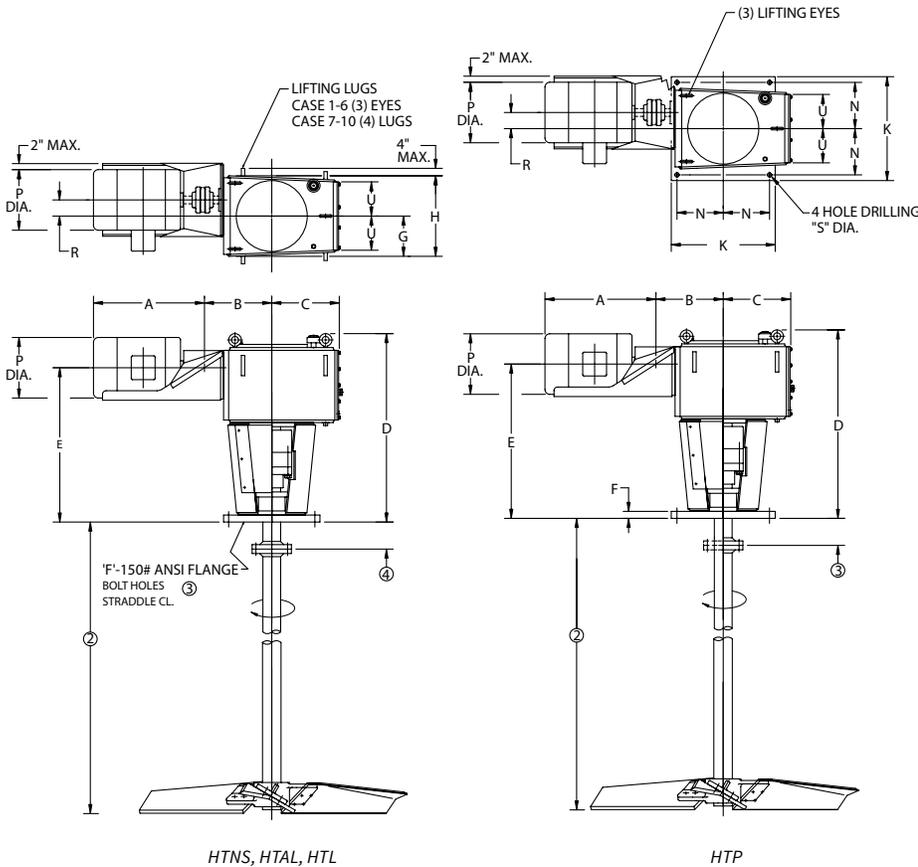
Dimensions



Agitator Dimensions

Case Size	1					2					3					4					5				
Model	HTA	HTD	HTN	HTNS, HTAL, & HTL	HTP	HTA	HTD	HTN	HTNS, HTAL, & HTL	HTP	HTA	HTD	HTN	HTNS, HTAL, & HTL	HTP	HTA	HTD	HTN	HTNS, HTAL, & HTL	HTP	HTA	HTD	HTN	HTNS, HTAL, & HTL	HTP
B	7.5" for all models					9" for all models					10.5" for all models					14" for all models					15" for all models				
C	9" for all models					10" for all models					11.5" for all models					13.5" for all models					15.5" for all models				
D	31.5"	13"	40"	25.5"	25.5"	35"	15"	43.5"	29.5"	29.5"	39.5"	16.5"	47.5"	32.5"	32.5"	43"	19"	51.5"	37.5"	37.5"	46.5"	20.5"	55.5"	40.5"	40.5"
E	26"	7.5"	35"	20.5"	20.5"	29"	9"	38"	23.5"	23.5"	33"	10.5"	41.5"	26.5"	26.5"	37"	12"	45"	31.5"	31.5"	39.5"	13.5"	48"	33.5"	33.5"
F	8"	0.75"	10"	8"	1"	8"	1"	10"	8"	1"	8"	1"	10"	8"	1"	12"	1.125"	12"	12"	1.25"	12"	1.125"	12"	12"	1.25"
G	5"	6"	5"	5"	—	6.5"	7"	6.5"	6.5"	—	7"	8.5"	7"	7"	—	8"	10"	8"	8"	—	9.5"	11"	9.5"	9.5"	—
H	10"	10"	10"	10"	—	12.5"	11"	12.5"	12.5"	—	14"	12"	14"	14"	—	16"	13"	16"	16"	—	18.5"	14"	18.5"	18.5"	—
J	—	17"	—	—	—	—	18.5"	—	—	—	—	21.5"	—	—	—	—	23"	—	—	—	—	25"	—	—	—
R	2" for all models					2.5" for all models					3" for all models					3.5" for all models					4" for all models				
T	—	5"	—	—	—	—	6.5"	—	—	—	—	7"	—	—	—	—	8"	—	—	—	—	9.5"	—	—	—
U	4.5" for all models					6" for all models					6.5" for all models					7.5" for all models					8.5" for all models				
V	—	5.5"	—	—	—	—	6.5"	—	—	—	—	7.5"	—	—	—	—	8"	—	—	—	—	9"	—	—	—

Dimensions



Motor Dimensions

HP		Frame	A ^①	P ^①
1150 rpm	1750 rpm			
1	—	145T	13"	7.75"
1.5	3	182T	14.375"	9.25"
2	5	184T	15.375"	
3	7.5	213T	18"	11"
5	10	215T	19.5"	12.75"
7.5	15	254T	22.875"	
10	20	256T	24.625"	14.5"
15	25	284T	26.625"	
20	30	286T	28.125"	16.875"
25	40	324T	29.625"	
30	50	326T	31.125"	18.5"
40	60	364TS	30.75"	
50	75	365TS	31.75"	20.875"
75	100	405TS	35"	
100	125	444TS	38.5"	23.875"
125	150	445TS	40.5"	
150	200	447TS	47.5"	25"
200	250		47.5"	25"
250	300	449TS	51.5"	29"

Mounting Dimensions

Case Size	1HTD	1HTP	2HTD	2HTP	3HTD	3HTP	4HTD	4HTP	5HTD	5HTP	6HTD	6HTP	7HTD	8HTD	9HTD	10HTD
K	13"	16.5"	16"	16.5"	18"	16.5"	20.5"	25"	22.5"	25"	25"	16"	34"	38.5"	41"	45"
L	8"	—	10"	—	11.5"	—	16.5"	—	16.5"	—	18.5"	—	21"	22"	26"	33"
M	3.25"	—	4.25"	—	4.75"	—	7.25"	—	7.25"	—	8.25"	—	9.25"	9.5"	11.5"	15"
N	5.625"	7.25"	7"	7.25"	8"	7.25"	9.125"	11.25"	10"	11.25"	11.25"	18"	15.75"	17.75"	19"	21"
S	0.625"	0.75"	0.625"	0.75"	0.75"	0.75"	0.875"	0.875"	0.875"	0.875"	0.875"	0.875"	1"	1.125"	1.125"	1.125"

Agitator Dimensions

Case Size	6					7				8			9			10		
	HTA	HTD	HTN	HTNS, HTAL, & HTL	HTP	HTA	HTD	HTN	HTNS, HTAL, & HTL	HTA	HTD	HTN	HTA	HTD	HTN	HTA	HTD	HTN
B	16" for all models					18.5" for all models				21.5" for all models			23.5" for all models			26.5" for all models		
C	18" for all models					22.5" for all models				25" for all models			28.5" for all models			36" for all models		
D	48.5"	21.5"	58.5"	42.5"	42.5"	56.5"	28"	67.5"	50.5"	59"	30"	72"	68"	32"	78.5"	74"	37"	88.5"
E	41"	14"	51"	35"	35"	45.5"	17.5"	57.5"	40.5"	48.5"	19.5"	61.5"	52.5"	22"	68"	61"	24"	75.5"
F	12"	1.25"	12"	12"	1.25"	16"	1.5"	16"	16"	16"	1.75"	16"	20"	1.75"	20"	24"	1.75"	24"
G	10.5"	11"	10.5"	10.5"	—	12.5" for all models			—	14.5"	13.5"	14.5"	16.5"	14.5"	16.5"	18.5"	17.5"	18.5"
H	20.5"	15"	20.5"	20.5"	—	24.5"	16"	24.5"	24.5"	29"	17"	29"	32.5"	18"	32.5"	37"	21"	37"
J	—	25.5"	—	—	—	—	27"	—	—	—	28"	—	—	29.5"	—	—	35.5"	—
R	4" for all models					5" for all models				5.5" for all models			6.5" for all models			7.5" for all models		
T	—	10.5"	—	—	—	—	12.5"	—	—	—	14.5"	—	—	16.5"	—	—	18.5"	—
U	8.5" for all models					11" for all models				13" for all models			14.5" for all models			16.5" for all models		
V	—	9.5"	—	—	—	—	10"	—	—	—	11"	—	—	12"	—	—	13.5"	—

① Dimensions are for totally enclosed and explosion proof motors.

② Agitator output speed, shaft diameter and extension, impeller design and other optional features to suit application.

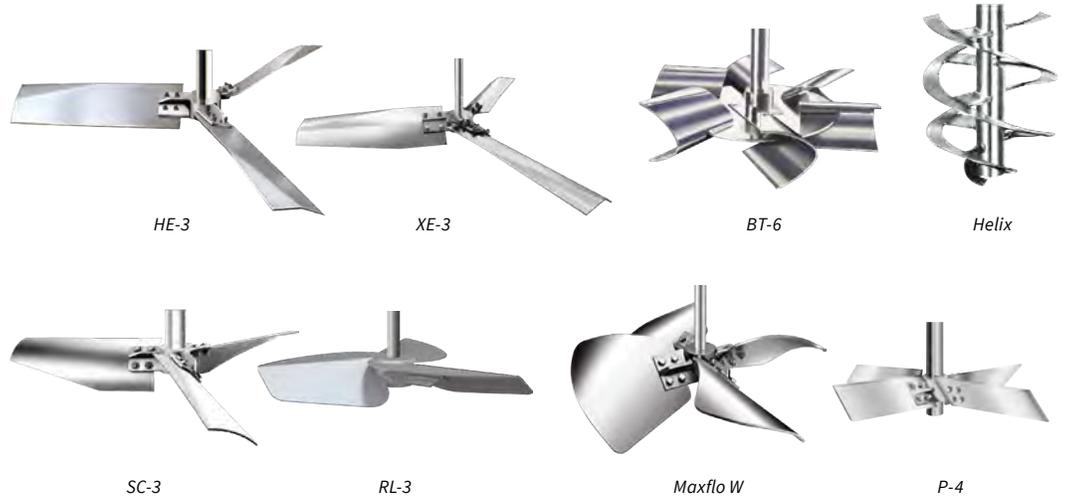
③ Larger and smaller flanges available, however in most cases, the smaller than standard flange dictates on centerline bolt holes and studs.

④ Varies per case and shaft diameter selection. Refer to certified assembly drawing for actual dimension.

Impeller Technology

Chemineer's impeller technology is effectively applied across your spectrum of applications ensuring successful, repeatable results from lab scale to full scale operations.

Chemineer's mixing expertise includes high flow, low shear liquid-liquid/solids blending, gas dispersion, high shear blending and viscous mixing. Whether it is R&D or production phase, we have the expertise to solve your mixing challenges.



Authorized Service Centers

Our mission is to offer customers immediate assistance to help achieve operating performance goals for agitation and mixing processes. This is accomplished in two ways: ensuring replacement parts and services are available on a timely basis to increase the "uptime" of your systems, and ensuring customers are offered the latest technology to improve the performance of agitation and mixing systems.

We are always ready to help in any capacity you may need:

- Drop in replacement parts of standard and custom Chemineer agitator components
- Emergency parts are shipped from stock in 24-48 hours
- Service centers for analysis and repairs
- Highly training field service technicians to assist with any of the following
 - Full installation services
 - Troubleshooting
 - Start-up assistance
 - Reliability audits
 - Training



Refurbished Mixer Gearbox Program

Refurbished HT gearboxes are stocked for an economical, quick replacement for units in disrepair. All refurbished gearboxes meet the same high quality standards as new Chemineer gearboxes. Additional features of the refurbished mixer gearbox program include:

- Delivery on HT gearboxes in 24 to 48 hours
- High quality refurbishments built in house to NOV and AGMA standards
- A credit toward the purchase of any refurbished gearbox upon returning your old gearbox
- Accepting worn out gearboxes from any original mixer manufacturer
- One year warranty against material defects and workmanship

Chemineer

Chemineer is a leading provider of process solutions for the oil and gas industry.

Our products and services are designed to improve efficiency, reduce costs and increase safety.

For more information, please contact your local Chemineer representative.

Visit our website at www.chemineer.com for more details.

Chemineer is committed to providing the highest quality products and services.

Our dedication to customer service is our top priority.

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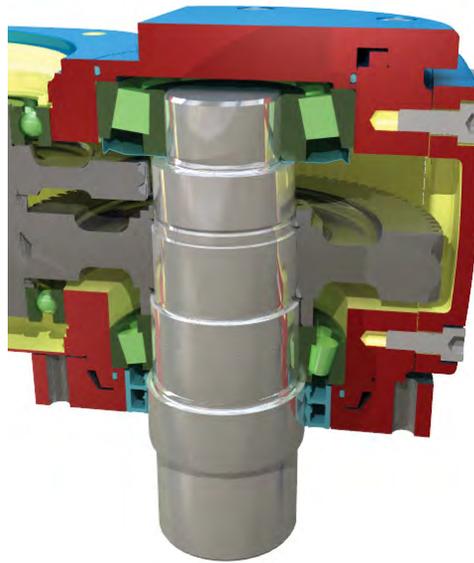
USA

Chemineer™ MR Agitators



Reliability, Performance and Value

The MR agitator's gearbox is a proprietary, parallel shaft, helical gear design that features minimum 30,000 hour L-10 bearing life and an oversized output shaft for optimal performance and extended service life. Shaft speed selections are available from 7 to 380 rpm without the use of auxiliary reducers or electronic drives. When the MR gearbox is expertly matched with a wide variety of Chemineer impellers and other system components, MR agitators are capable of economically meeting your blending, dispersion, and other mixing needs.



Gearbox proprietary internals for optimum service life

Gearbox Designed for Agitator Duty

Commercially available gearboxes for agitators in this size range normally have low speed output shafts and bearing designs that are poorly suited to agitator duty. Commercial gearboxes typically use smaller diameter output shafts, resulting in the need to select larger and more expensive units to handle the torsional loads and bending moments produced by the hydraulic loads on agitator systems. These smaller output shafts and less robust bearing designs of commercial gearboxes also contribute to higher gear deflections, excessive vibration, higher maintenance costs, and a reduced life of many

critical agitator system components. The MR gearbox addresses these concerns by incorporating a larger output shaft straightened to exact tolerances and high capacity tapered roller bearings into its design. The rugged cast iron housing of the MR gearbox features a double lip seal to effectively contain the gearbox lubricant as well as a swing out seal change design that saves maintenance labor and reduces downtime. These design features reduce the overall initial cost of the gearbox and other agitation system components and reduce the maintenance costs of the agitator.

Versatile Modular Design

The modular design of MR agitators makes them well suited for a variety of mixing applications. MR agitators are designed to meet AGMA, OSHA, ANSI, IEC, DIN, EU and ATEX standards and requirements. They may be supplied with integral gearmotors, standard NEMA and IEC motors or explosion proof motors. A variety of stuffing boxes or mechanical seals and many custom pedestals, couplings, impellers, shafts, and steady bearings can be incorporated into the MR design as well. This product can be mounted to support

beams or similar structures for open tank operation or to pedestals, plates or flanges for closed tank operation. The MR agitator and all of its system components are included in the Chemineer Expert Design System (CEDS), the industry leading agitator design and analysis software program. CEDS helps insure that MR components are selected and configured for optimal system performance and value.

Global Availability

To support the global manufacturing footprint of our customers, MR agitators are available in all major global markets. MR agitator gearboxes, mountings and system components are also interchangeable with the Chemineer Model 20 HT and GT agitators enabling customers to readily adapt or upgrade their agitator drives

and system components to changes in application requirements or operating environments.

With all of its versatility, MR agitators can become your global process system standard helping drive efficiencies in procurement and reduce maintenance costs and replacement part investment.

Impeller Technology

Chemineer impeller technology is effectively applied across your spectrum of applications ensuring successful, repeatable results from lab scale to full scale operations.

Our mixing expertise includes high flow, low shear liquid-liquid agitation, solids suspension, gas dispersion, high shear blending and

viscous mixing. Whether it is R&D or production phase, we have the expertise to solve your mixing challenges.

An impeller bulletin is available with additional information.



P-4



RL-3



HE-3



BT-6



XE-3

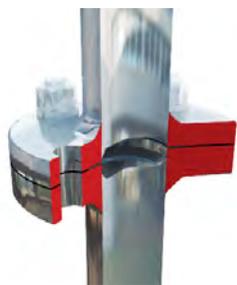


Maxflo W

Features and Benefits

	Features	Benefits
Internal Shafting	<ul style="list-style-type: none"> • Oversized low speed shaft diameter and short bearing span reduce deflection and gear misalignment 	<ul style="list-style-type: none"> • Extends seal and bearing life • Lowers initial costs • Lowers maintenance costs
Gearing	<ul style="list-style-type: none"> • Double and triple reduction gearing for low gear loading and quiet operation 	<ul style="list-style-type: none"> • Smooth operation • Long service life
	<ul style="list-style-type: none"> • Helical gearing 	<ul style="list-style-type: none"> • Lowers energy costs
Gearbox Lubrication	<ul style="list-style-type: none"> • Bath lubrication ensures adequate lubrication to gears and bearings at all operating speeds 	<ul style="list-style-type: none"> • Lowers initial costs • Eliminates need for internal/external lubrication pumps
	<ul style="list-style-type: none"> • Standard R&O oils and greases 	<ul style="list-style-type: none"> • Lowers installation and maintenance costs
	<ul style="list-style-type: none"> • Double lip seal 	<ul style="list-style-type: none"> • Lowers capital cost • Maintains process fluid integrity
Bearing Design	<ul style="list-style-type: none"> • Output shaft features tapered roller bearings and a short bearing span that provides greater capacity to handle bending and thrust loads 	<ul style="list-style-type: none"> • Extends service life • Lowers maintenance costs
	<ul style="list-style-type: none"> • Ball bearings, oil lubricated 	<ul style="list-style-type: none"> • Ensures cool operation and low maintenance

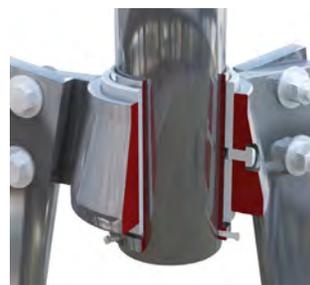
In-Tank Coupling and Steady Bearing Options



Welded Coupling



Removable Coupling



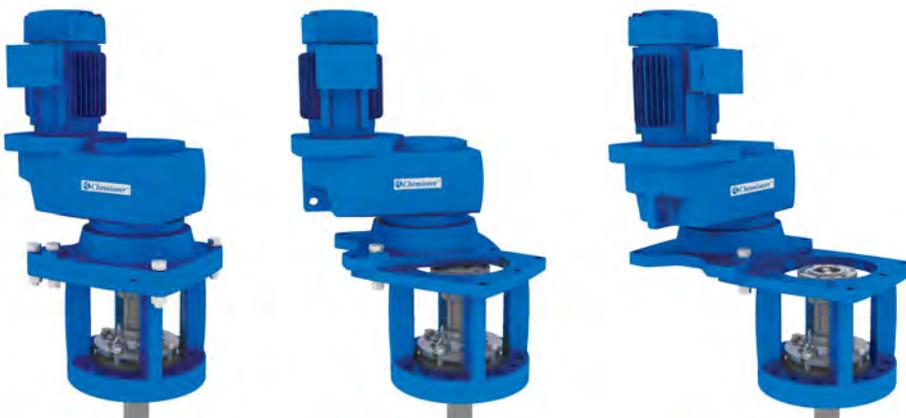
Tripod Steady Bearing



Bracket Steady Bearing

Features and Benefits

	Features	Benefits
Seals	<ul style="list-style-type: none"> • Drop collar shaft support during seal change 	<ul style="list-style-type: none"> • Shaft drops easily by loosening coupling bolts, and engages by tightening the coupling bolts • Shaft only drops 0.5" eliminating steady bearing disengagement
	<ul style="list-style-type: none"> • Optional throttle bushing and debris well design 	<ul style="list-style-type: none"> • Clean fluid flush eliminates process build up in seal area improving seal life • Eliminates particle shedding from entering tank
	<ul style="list-style-type: none"> • Swing out seal change design 	<ul style="list-style-type: none"> • No need to pull shaft up through gearbox or in-tank shaft supports • No labor or parts required for special shaft support system • No lifting and removing of gearbox, saving labor and downtime
	<ul style="list-style-type: none"> • Variety of seal options from major mechanical seal vendors such as John Crane, Flowserve, Chesterton and AES 	<ul style="list-style-type: none"> • Cartridge double and single seals, low pressure single seals, and cartridge ChemSeals provide performance and flexibility to meet agitator sealing needs
	<ul style="list-style-type: none"> • Low height pedestal design reduces shaft deflection at the seal 	<ul style="list-style-type: none"> • Extends service life • Minimizes downtime
	<ul style="list-style-type: none"> • Optional seal shut off device 	<ul style="list-style-type: none"> • Eliminates operator exposure to hazardous vapors without draining the vessel
	<ul style="list-style-type: none"> • Optional lip seals and stuffing boxes 	<ul style="list-style-type: none"> • Value lip seals for low pressure applications • Self lubricating packing offers low maintenance sealing options for pressures up to 100 psi



Swing out seal change



ChemSeal

Dimensions for 11-16 MR

Agitator Dimensions

Bolt Pattern

Case Size	A	B	C	D	E	F [Ⓢ]	G	H	J	Seal/Mount Type
11MR	1.12"	16.00"	8.00"	2.81"	5.71"	8" — 150# ANSI (holes straddle center line)	10.00"	0.75"	9.50"	All
12MR										
13MR	1.50"	20.00"	8.00"	4.00"	7.48"	10" — 150# ANSI (holes on center line)	12.50"	0.88"	10.00"	All
14MR										
15MR	1.59"	18.63"	8.63"	4.63"	9.45"	12" — 150# ANSI (holes straddle center line)	14.06"	1.18"	10.83"	All
16MR										

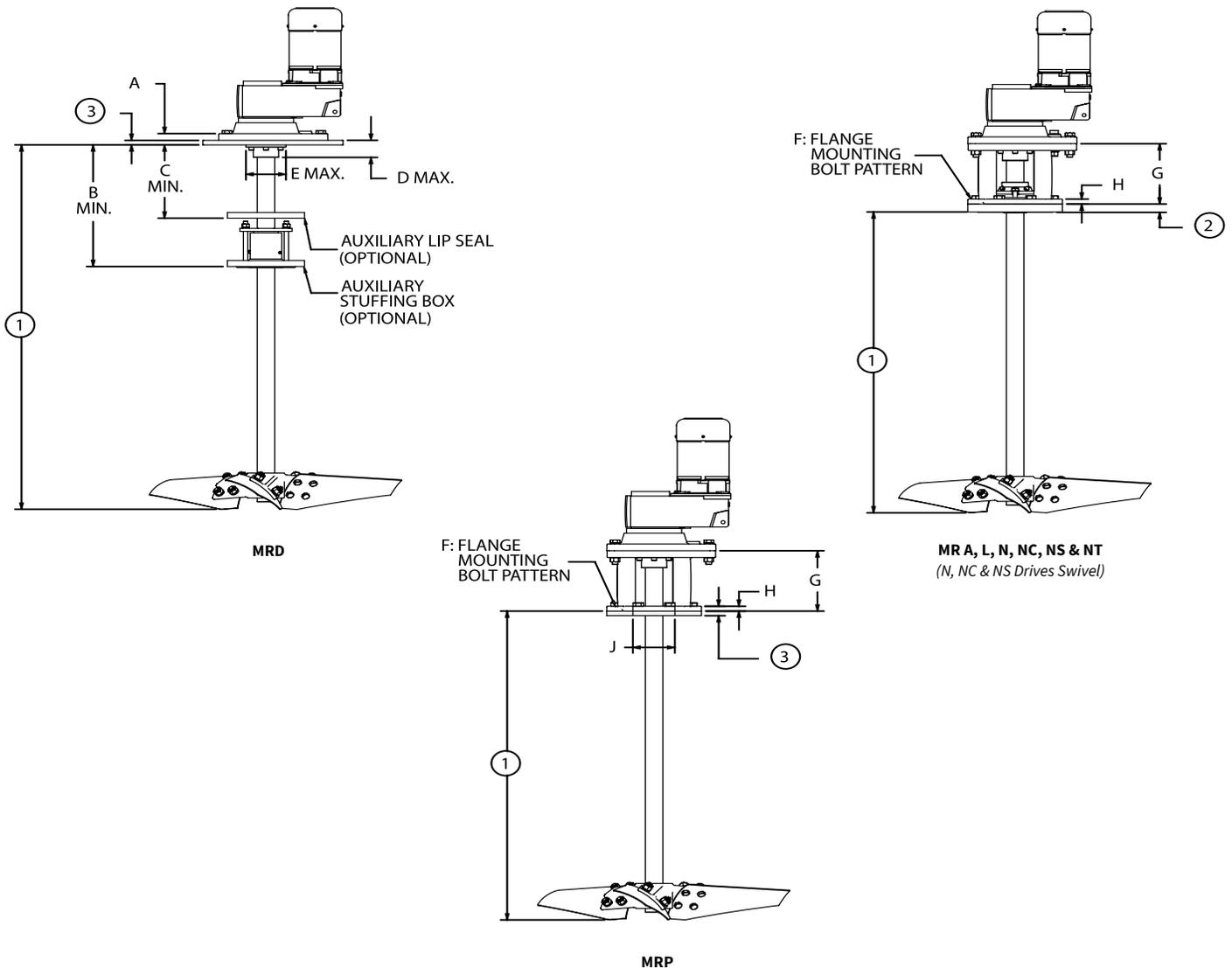
Dimensions are for reference only. See assembly drawing.

1 Agitator output speed, shaft diameter and extension, impeller design and other features not shown built to suit application.

2 Alternate flange sizes are available.

3 Both the D and P style agitators come with a steel base plate as an option. See IOM for base plate dimensions.

4 These dimensions are only approximations, and may vary slightly depending on the motor options and the motor supplier chosen.



Dimensions for 17 and 18 MR

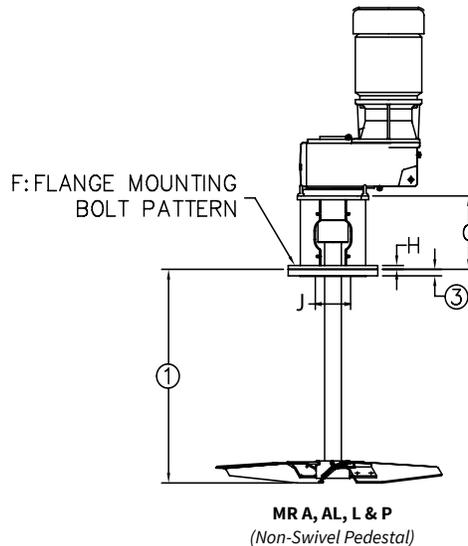
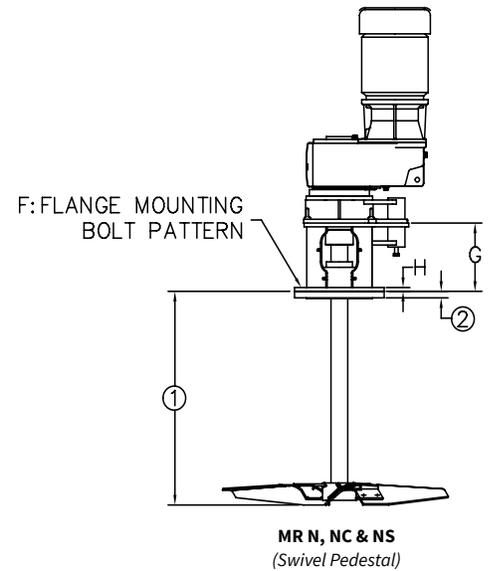
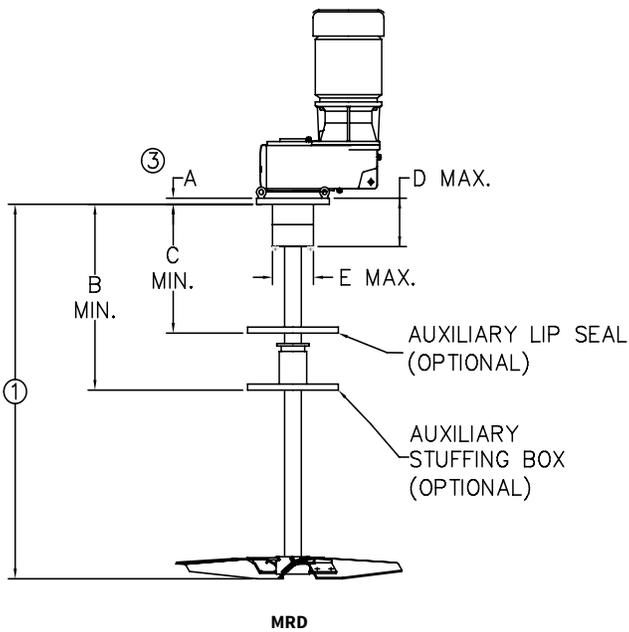
Agitator Dimensions

Bolt Pattern

Case Size	A	B	C	D	E	F ^②	G	H	J	Seal/Mount Type
17MR	1.50"	27.00"	16.00"	11.95"	5.71"	16" — 150# ANSI (holes straddle center line)	16.88"	0.94"	14.57"	D, N, NC, NS
							20.25"			AL, L, P
							24.56"			A
18MR	1.75"	28.00"	17.00"	13.97"	7.48"	16" — 150# ANSI (holes straddle center line)	16.88"	0.94"	14.57"	D, N, NC, NS
							22.00"			AL, L, P
							26.06"			A

Dimensions are for reference only. See assembly drawing.

- 1 Agitator output speed, shaft diameter and extension, impeller design and other features not shown built to suit application.
- 2 Alternate flange sizes are available.
- 3 Both the D and P style agitators come with a steel base plate as an option. See IOM for base plate dimensions.
- 4 These dimensions are only approximations, and may vary slightly depending on the motor options and the motor supplier chosen.



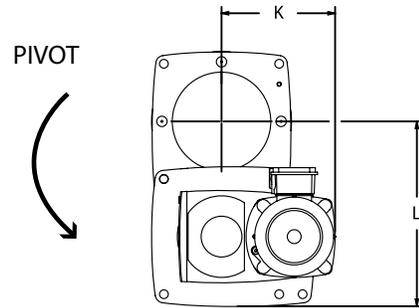
Dimensions for 11 and 12 MR

Swivel Dimensions

Case Size	K [Ⓞ]	L
11MR	9.72"	17.57"
12MR	11.04"	

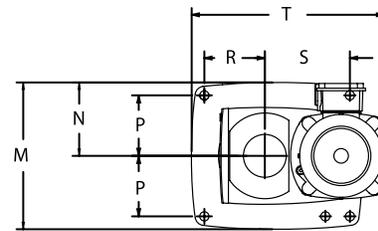
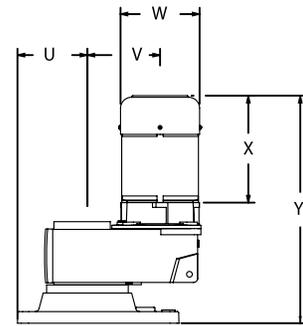
Typical Drive Assembly Swivel Dimensions

Drive assembly pivots at top of pedestal to allow change out of mechanical seals. See IOM for special motor conduit instructions.



Motor Dimensions

Frame Size		W [Ⓞ]	X [Ⓞ]	Y [Ⓞ]	
				11MR	12MR
NEMA	56C	7.75"	13.11"	25.75"	26.84"
	140TC	7.75"	13.11"	25.75"	26.84"
	180TC	9.25"	16.24"	30.03"	31.97"
	210TC	11.00"	17.96"	—	33.69"
	250TC	12.75"	22.25"	—	—
	280TC	14.50"	24.24"	—	—
	320TC	16.88"	27.00"	—	—
	360TC	18.50"	27.63"	—	—
IEC	71	5.69"	9.25"	20.85"	21.84"
	80	6.61"	10.66"	23.05"	24.04"
	90	7.40"	11.18"	23.57"	24.56"
	100	7.72"	13.15"	26.21"	27.20"
	112	9.45"	13.03"	26.09"	27.08"
	132	10.16"	16.73"	—	32.00"
	160	12.52"	21.26"	—	—
	180	14.37"	23.31"	—	—
	200	15.67"	27.09"	—	—
	225	17.64"	30.51"	—	—
	250	20.00"	35.04"	—	—
	280	22.17"	38.39"	—	—
315	26.05"	50.28"	—	—	
Integral	71	5.43"	9.06"	17.20"	18.18"
	80	6.14"	10.04"	18.18"	19.17"
	90	6.92"	11.65"	19.79"	20.78"
	100	7.63"	12.84"	20.98"	21.96"
	112	8.58"	13.74"	21.88"	22.87"
	132	10.16"	17.12"	—	26.25"
	160M/LMH	12.60"	18.86"	—	—
	160LH	12.60"	20.42"	—	—
	180MX/LX	12.60"	20.42"	—	—
	180MH/LH	14.09"	24.52"	—	—
	200/225S/M	15.67"	27.15"	—	—
	225SH/MH	17.52"	27.03"	—	—
	250M	19.49"	30.55"	—	—
	250MH	19.49"	33.31"	—	—
	280S/SH	22.64"	34.69"	—	—
	280M	—	—	—	—
	280MH	—	—	—	—
	315S/SH	—	—	—	—
	315Ma/Mha	—	—	—	—



Drive Assembly Dimensions

Case Size	M	N	P	R	S	T [Ⓞ]	U	V
11MR	13.50"	6.75"	5.56"	5.56"	7.81"	16.47"	6.75"	5.79"
12MR	—	—	—	—	—	17.79"	—	7.01"

Dimensions are for reference only. See assembly drawing.

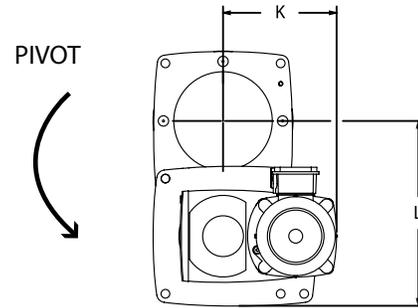
Dimensions for 13 and 14 MR

Swivel Dimensions

Case Size	K [Ⓞ]	L
13MR	13.03"	22.61"
14MR	15.02"	

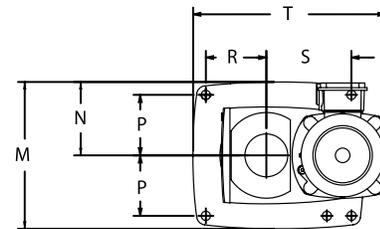
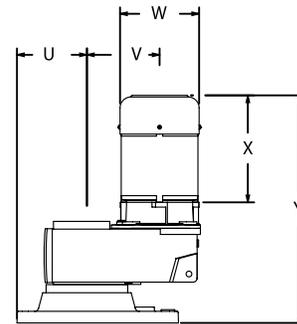
Typical Drive Assembly Swivel Dimensions

Drive assembly pivots at top of pedestal to allow change out of mechanical seals. See IOM for special motor conduit instructions.



Motor Dimensions

Frame Size	W [Ⓞ]	X [Ⓞ]	Y [Ⓞ]		
			13MR	14MR	
NEMA	56C	7.75"	13.11"	28.78"	29.78"
	140TC	7.75"	13.11"	28.78"	29.79"
	180TC	9.25"	16.24"	35.51"	36.51"
	210TC	11.00"	17.96"	37.23"	38.23"
	250TC	12.75"	22.25"	41.52"	42.53"
	280TC	14.50"	24.24"	—	45.15"
	320TC	16.88"	27.00"	—	—
360TC	18.50"	27.63"	—	—	
IEC	71	5.69"	9.25"	—	—
	80	6.61"	10.66"	—	—
	90	7.40"	11.18"	26.84"	27.85"
	100	7.72"	13.15"	29.76"	30.77"
	112	9.45"	13.03"	29.64"	30.65"
	132	10.16"	16.73"	35.58"	36.59"
	160	12.52"	21.26"	40.27"	41.28"
	180	14.37"	23.31"	57.40"	58.40"
	200	15.67"	27.09"	—	—
	225	17.64"	30.51"	—	—
	250	20.00"	35.04"	—	—
Integral	71	5.43"	9.06"	—	—
	80	6.14"	10.04"	—	—
	90	6.92"	11.65"	22.28"	23.27"
	100	7.63"	12.84"	23.46"	24.45"
	112	8.58"	13.74"	24.37"	25.36"
	132	10.16"	17.12"	27.75"	28.75"
	160M/LMH	12.60"	18.86"	30.23"	31.23"
	160LH	12.60"	20.42"	31.81"	32.80"
	180MX/LX	12.60"	20.42"	—	32.80"
	180MH/LH	14.09"	24.52"	—	36.90"
	200/225S/M	15.67"	27.15"	—	—
	225SH/MH	17.52"	27.03"	—	—
	250M	19.49"	30.55"	—	—
	250MH	19.49"	33.31"	—	—
	280S/SH	22.64"	34.69"	—	—
	280M	—	—	—	—
	280MH	—	—	—	—
315S/SH	—	—	—	—	
315Ma/Mha	—	—	—	—	



Drive Assembly Dimensions

Case Size	M	N	P	R	S	T [Ⓞ]	U	V
13MR	17.00"	8.50"	7.06"	7.06"	10.06"	21.53"	8.50"	8.11"
14MR						23.52"		9.88"

Dimensions are for reference only. See assembly drawing.

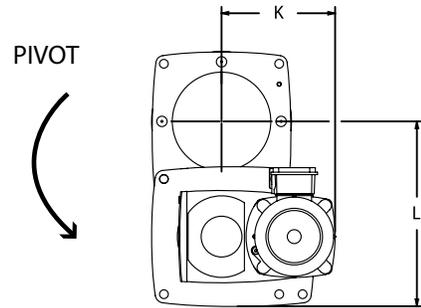
Dimensions for 15 and 16 MR

Swivel Dimensions

Case Size	K [Ⓞ]	L
15MR	22.17"	28.31"
16MR	23.55"	

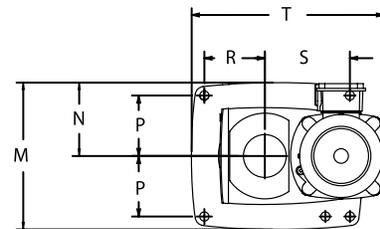
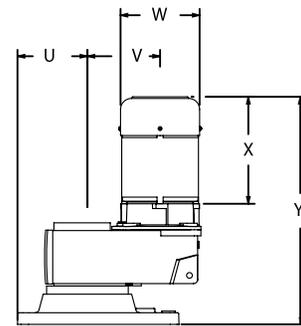
Typical Drive Assembly Swivel Dimensions

Drive assembly pivots at top of pedestal to allow change out of mechanical seals. See IOM for special motor conduit instructions.



Motor Dimensions

Frame Size		W [Ⓞ]	X [Ⓞ]	Y [Ⓞ]	
				15MR	16MR
NEMA	56C	7.75"	13.11"	34.65"	—
	140TC	7.75"	13.11"	34.65"	—
	180TC	9.25"	16.24"	41.38"	41.86"
	210TC	11.00"	17.96"	47.39"	43.58"
	250TC	12.75"	22.25"	50.02"	51.76"
	280TC	14.50"	24.24"	54.59"	53.74"
	320TC	16.88"	27.00"	58.14"	55.48"
	360TC	18.50"	27.63"	—	59.03"
IEC	71	5.69"	9.25"	—	—
	80	6.61"	10.66"	—	—
	90	7.40"	11.18"	32.71"	—
	100	7.72"	13.15"	35.63"	36.28"
	112	9.45"	13.03"	35.52"	36.16"
	132	10.16"	16.73"	41.46"	41.83"
	160	12.52"	21.26"	48.97"	49.86"
	180	14.37"	23.31"	51.02"	51.91"
	200	15.67"	27.09"	53.35"	54.24"
	225	17.64"	30.51"	59.68"	60.57"
	250	20.00"	35.04"	64.21"	65.10"
		280	22.17"	38.39"	67.56"
	315	26.05"	50.28"	—	—
Integral	71	5.43"	9.06"	—	—
	80	6.14"	10.04"	—	—
	90	6.92"	11.65"	27.15"	—
	100	7.63"	12.84"	29.35"	28.54"
	112	8.58"	13.74"	30.13"	29.32"
	132	10.16"	17.12"	34.43"	35.30"
	160M/LMH	12.60"	18.86"	36.12"	36.99"
	160LH	12.60"	20.42"	37.69"	38.56"
	180MX/LX	12.60"	20.42"	37.69"	38.56"
	180MH/LH	14.09"	24.52"	41.00"	41.87"
	200/225S/M	15.67"	27.15"	44.39"	45.26"
	225SH/MH	17.52"	27.03"	44.27"	45.14"
	250M	19.49"	30.55"	—	—
	250MH	19.49"	33.31"	—	—
	280S/SH	22.64"	34.69"	—	—
	280M	—	—	—	—
	280MH	—	—	—	—
	315S/SH	—	—	—	—
	315Ma/Mha	—	—	—	—



Drive Assembly Dimensions

Case Size	M	N	P	R	S	T [Ⓞ]	U	V
15MR	22.05"	11.03"	9.65"	7.68"	2.17"	31.42"	9.25"	11.08"
16MR						32.80"		12.46"

Dimensions are for reference only. See assembly drawing.



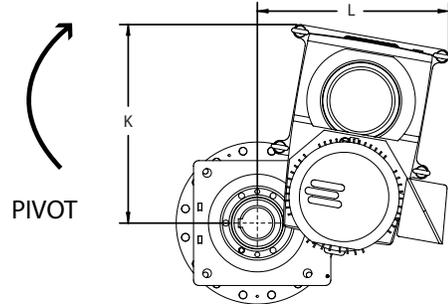
Dimensions for 17 and 18 MR

Swivel Dimensions

Case Size	K [Ⓞ]	L
17MR	28.78"	27.77"
18MR	31.60"	35.60"

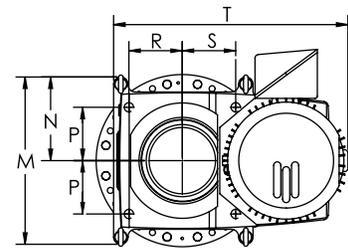
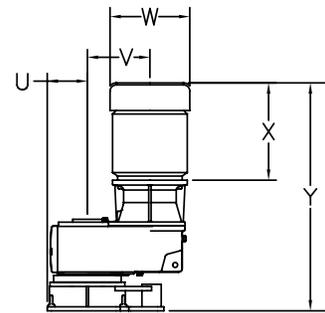
Typical Drive Assembly Swivel Dimensions

Drive assembly pivots at top of pedestal to allow change out of mechanical seals. See IOM for special motor conduit instructions.



Motor Dimensions

	Frame Size	W [Ⓞ]	X [Ⓞ]	Y [Ⓞ]	
				17MR	18MR
NEMA	56C	7.75"	13.11"	—	—
	140TC	7.75"	13.11"	—	—
	180TC	9.25"	16.24"	43.73"	45.92"
	210TC	11.00"	17.96"	45.45"	47.64"
	250TC	12.75"	22.25"	53.62"	55.81"
	280TC	14.50"	24.24"	53.61"	57.80"
	320TC	16.88"	27.00"	57.34"	59.53"
	360TC	18.50"	27.63"	60.89"	63.08"
IEC	71	5.69"	9.25"	—	—
	80	6.61"	10.66"	—	—
	90	7.40"	11.18"	—	—
	100	7.72"	13.15"	38.10"	40.33"
	112	9.45"	13.03"	37.98"	40.21"
	132	10.16"	16.73"	43.65"	45.88"
	160	12.52"	21.26"	51.68"	53.91"
	180	14.37"	23.31"	53.73"	55.96"
	200	15.67"	27.09"	53.06"	58.29"
	225	17.64"	30.51"	62.39"	64.62"
	250	20.00"	35.04"	66.92"	69.15"
	280	22.17"	38.39"	70.27"	72.50"
	315	26.05"	50.28"	85.27"	87.50"
Integral	71	5.43"	9.06"	—	—
	80	6.14"	10.04"	—	—
	90	6.92"	11.65"	—	—
	100	7.63"	12.84"	32.04"	—
	112	8.58"	13.74"	32.82"	—
	132	10.16"	17.12"	37.12"	39.31"
	160M/LMH	12.60"	18.86"	38.81"	41.00"
	160LH	12.60"	20.42"	40.38"	42.57"
	180MX/LX	12.60"	20.42"	40.38"	42.57"
	180MH/LH	14.09"	24.52"	43.69"	45.88"
	200/225S/M	15.67"	27.15"	47.08"	49.27"
	225SH/MH	17.52"	27.03"	46.96"	49.15"
	250M	19.49"	30.55"	50.50"	52.69"
	250MH	19.49"	33.31"	53.26"	55.45"
	280S/SH	22.64"	34.69"	54.64"	56.83"
	280M	—	—	—	55.05"
	280MH	—	—	—	59.38"
	315S/SH	—	—	—	60.96"
	315Ma/Mha	—	—	—	66.47"



Drive Assembly Dimensions

Case Size	M	N	P	R	S	T [Ⓞ]	U	V
17MR	22.83"	11.42"	7.28"	7.28"	7.28"	31.41"	9.37"	14.17"
18MR	24.80"	12.40"	8.27"	8.27"	8.27"	36.56"	10.35"	18.27"

Dimensions are for reference only. See assembly drawing.

NOV

NOV Mixing Solutions

NOV Mixing Solutions

NOV Mixing Solutions is a leading provider of mixing solutions for the oil and gas industry. We offer a wide range of products and services to meet your needs.

Our products are designed to improve efficiency, reduce costs, and increase safety. We have a proven track record of success in the industry.

Our services include design, engineering, construction, and maintenance. We work closely with our customers to ensure they get the most out of their equipment.

Our team of experts is available to provide technical support and training. We are committed to helping our customers achieve their goals.

Our products and services are used in a wide range of applications, from offshore drilling to onshore production. We have a global presence and can provide support wherever you are.

Our products and services are designed to meet the most demanding conditions. We use high-quality materials and advanced manufacturing techniques to ensure our products are built to last.

Our products and services are designed to be easy to use and maintain. We provide comprehensive documentation and training to help our customers get the most out of their equipment.

Our products and services are designed to be cost-effective. We offer a range of options to meet your budget and provide excellent value for money.

Our products and services are designed to be reliable. We have a proven track record of success in the industry and our products are built to last.

Our products and services are designed to be safe. We follow strict safety standards and provide comprehensive training to ensure our customers are safe at all times.

Our products and services are designed to be sustainable. We use eco-friendly materials and manufacturing processes to reduce our carbon footprint.

Our products and services are designed to be innovative. We are constantly developing new products and services to meet the changing needs of the industry.

Our products and services are designed to be flexible. We can provide custom solutions to meet your specific requirements.

Our products and services are designed to be scalable. We can provide solutions for small-scale operations as well as large-scale projects.

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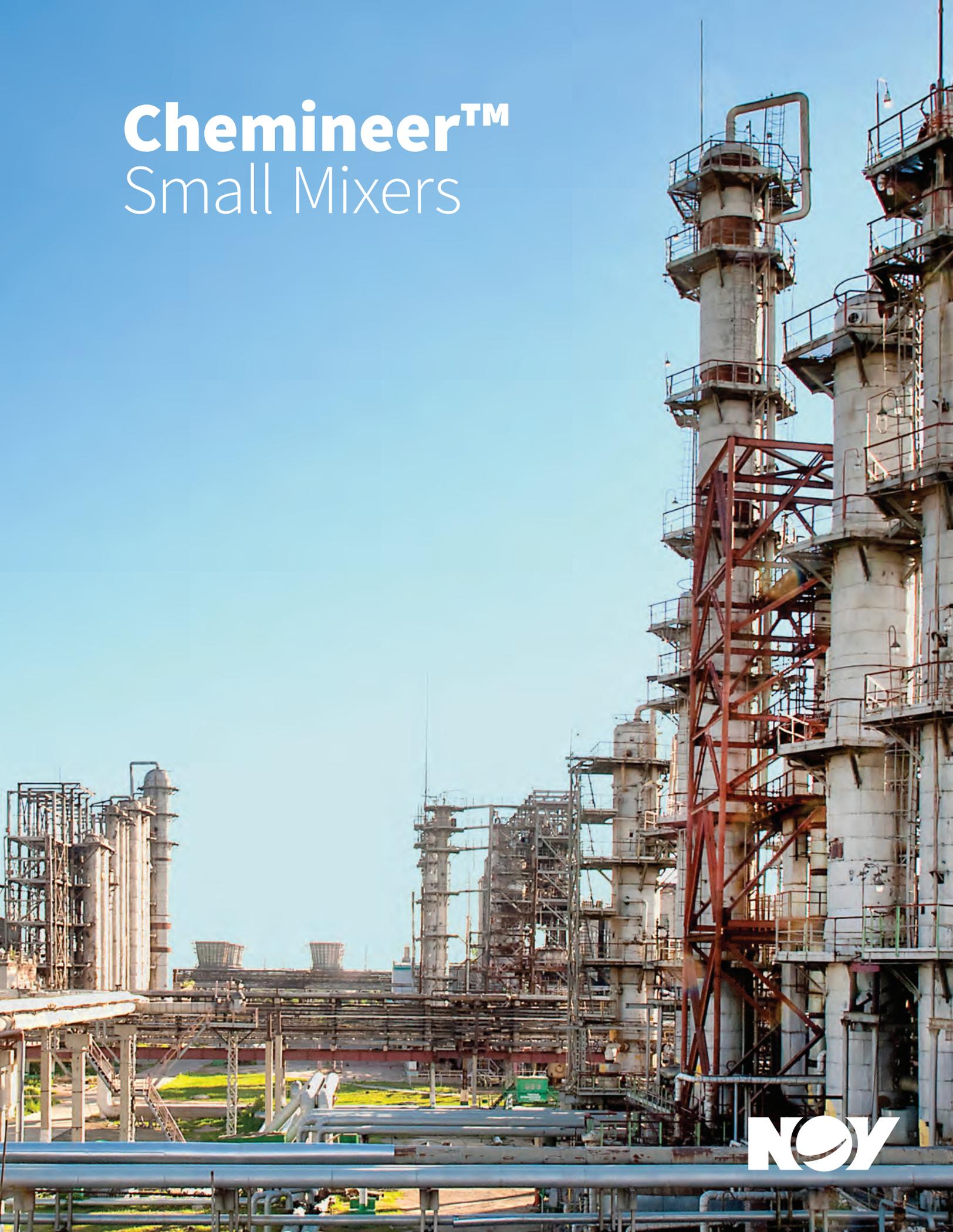
Corporate Headquarters

7909 Parkwood Circle Drive

Houston, Texas 77036

USA

Chemineer™ Small Mixers



Optimum Agitation Design... for Batch and Continuous Processing

Successful mixing applications come in a variety of sizes, from small lab scale to full size, multimillion gallon vessels. We offer a wide range of agitation equipment to serve any of your process needs. We are able to provide standard, off the shelf

small mixers within 24–48 hours or to completely custom engineer smaller units specific to your process and mechanical requirements.

Industry leading, sophisticated process and mechanical design software quickly generates

solutions complete with quotations, custom assembly/ dimension drawings and design loads in paper or electronic formats. Computational Fluid Mixing and Laser Doppler Anemometry can also be used to address process challenges.

Mechanical Spectrum

- Continuous or batch mixing
- Flexible selection of output speeds
- Mixers up through 5 HP
- Shaft diameters 0.625", 1", 1.5"
- Positive shaft attachment eliminates inherent problems with grip spring designs
- 316/316L stainless as standard, high alloys, finishes and coatings available upon request
- Full range of impellers available
- Electric and air (dry or lubricated) motors
- Controls and monitoring devices available



Gear Reduced DT Mixer

- 1 Industry standard, off the shelf, NEMA electric or air motor
- 2 Advanced, heat treated helical gearing
- 3 Gear drive is permanently lubricated with high performance, synthetic grease
- 4 Sealed gear drive prevents both product and lubricant contamination
- 5 Helical, AGMA quality gears provide smooth, quiet operation
- 6 Elastomeric lip seal
- 7 Heavy duty, permanently lubricated and sealed for life bearings
- 8 Chuck coupling with dual set screws or bolted flange coupling (also available), allow for shaft removal without disassembling the unit



Gear reduced mixers are available with clamp, cup plate, vibration insulation plate, or 10° angle riser



Open Tank Models

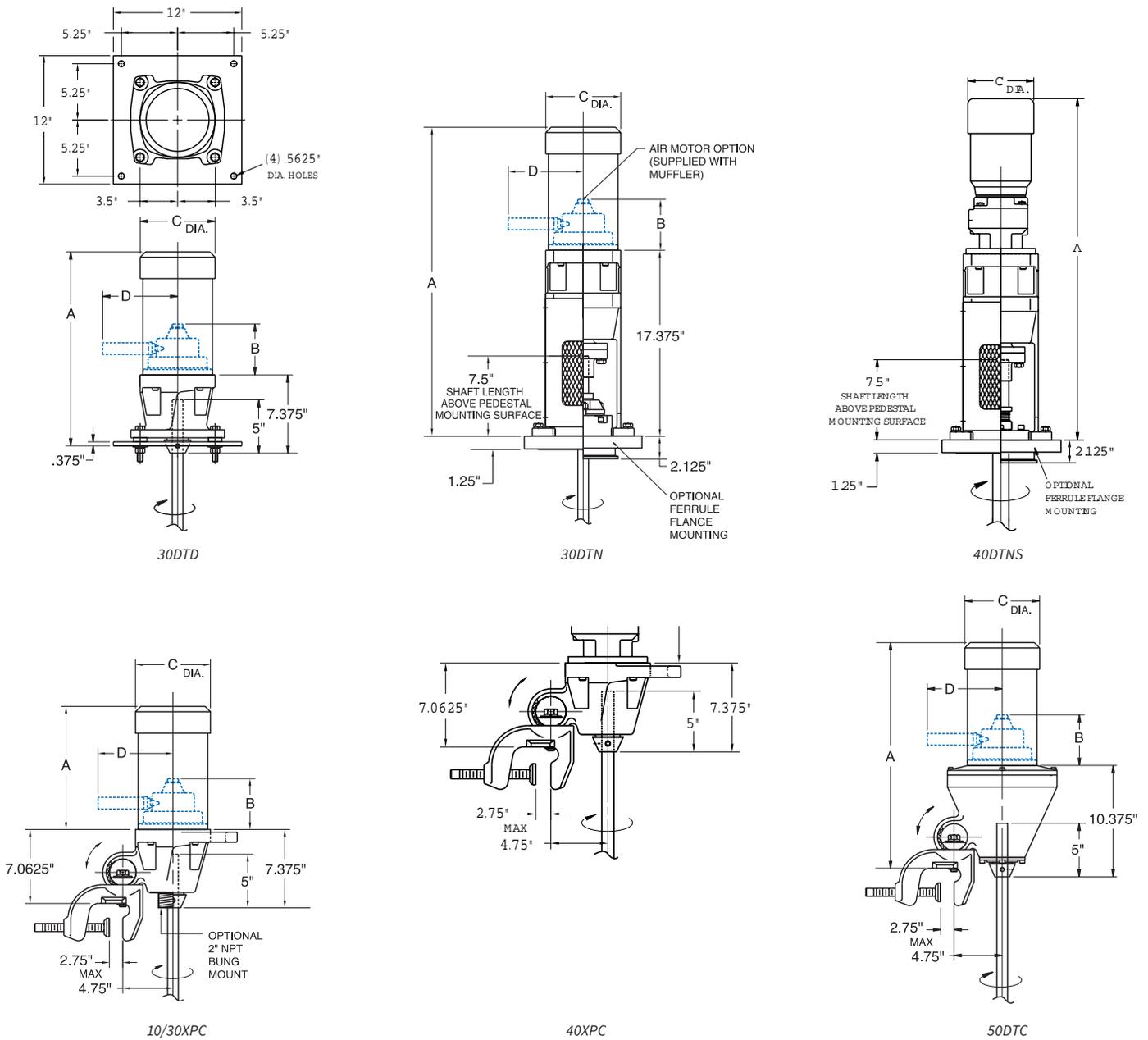
- DTD models
- Flexible configurations to meet your requirements
- Easy installation
- Low maintenance
- Direct or gear drive capability
- Shaft attachment: chuck, flanged or threaded couplings
- Operating speed flexibility: ask for designs below first critical speed as they eliminate the need for programming speed avoidance ranges
- Right angle drives offer low head room for tight spaces
- Small footprint for minimum interference with nozzles and process piping



Sealed Tank Models

- DTNS, DTN, DTA, DTL models
- Mechanical seals
 - Dry or wet running
 - Single, double or gas lift off designs
 - Others available upon request
- Optional shaft drop collar to facilitate seal removal
- Lip seals and stuffing boxes
- Shaft attachment: Flanged or threaded couplings
- Operating speed flexibility: Request designs below the first critical speed as they eliminate the need for programming inverter speed lock outs
- Mounting flanges: ANSI, ferrule (tri-clamp), DIN, special

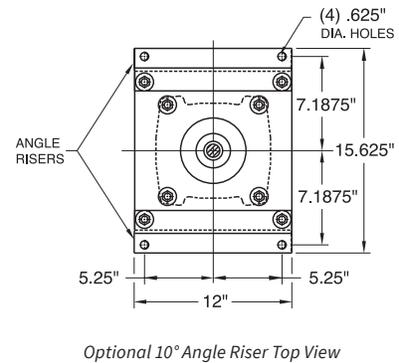
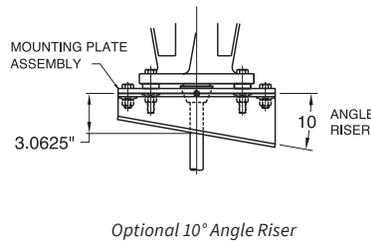
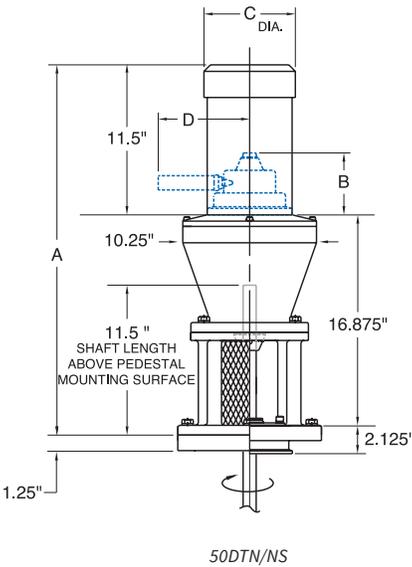
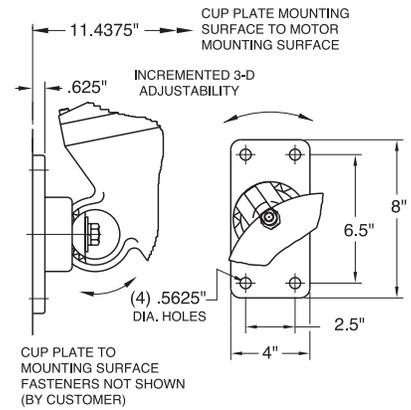
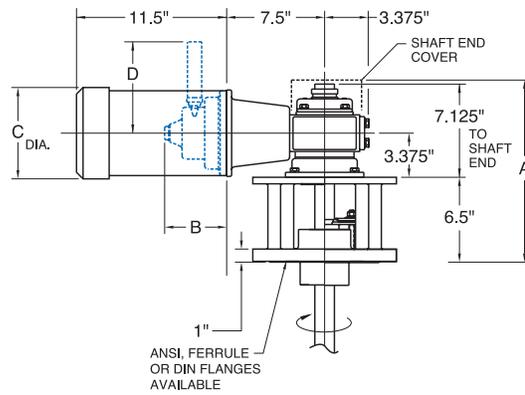
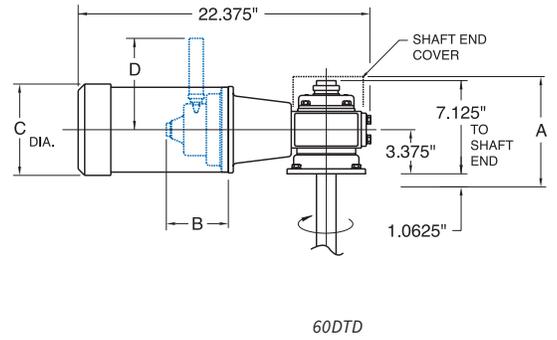
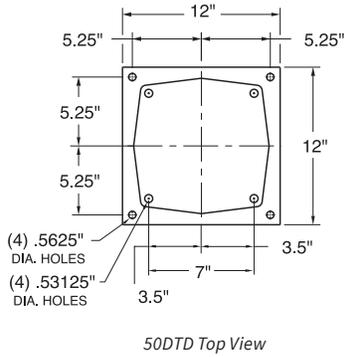
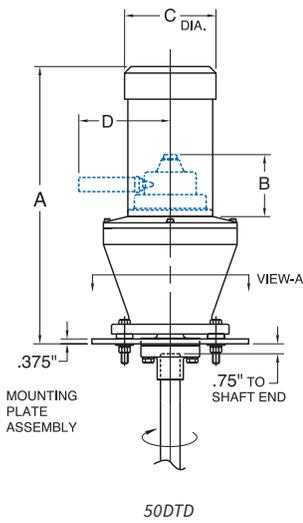
Dimensions



Quick Selection Chart

Typical Product	Viscosity (CP)	Volume (Gallons)								
		25	50	100	200	500	1,000	2,000	3,000	5,000
Water, Kerosene	1	10XP-0.5	10XP-0.5	10XP-0.5	10XP-0.5	30XP-1.5	30XP-1.5	40XPC-1.0	40XPC-1.0	50DTC-2.0
Olive Oil	100	10XP-0.5	10XP-0.5	10XP-0.5	30XP-1.5	40XPC-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0
Glucose, Latex Paint	250	10XP-0.5	10XP-0.5	30XP-1.5	40XPC-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0	50DTC-2.0
Glycerin	500	10XP-0.5	30XP-1.5	40XPC-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0	50DTC-2.0	50DTC-2.0
Castor Oil	1,000	30XP-1.5	40XP-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0	50DTC-2.0	50DTC-2.0	50DTC-2.0

Dimensions



Dimensions Chart

Dimensions in Inches	Model									
	30XPC	30DTD	30DTN	40XPC	40DTNS	50DTC	50DTD	50DTN/NS	60DTA	60DTD & DTL
A	13.25"	19.875"	30.625"	14.5"	31.875"	25.125"	25.25"	28.375"	14"	8.4375"
B	4.75"	6.25"	6.25"	—	—	6.25"	6.25"	6.25"	4.75"	4.75"
C	7"	7"	7"	6.5"	6.5"	9.5"	9.5"	7"	7"	7"
D	7"	4.5"	4.5"	—	—	4.5"	4.5"	4.5"	7"	7"



Portable Models

- Rugged cast aluminum housing
 - High strength, low weight design
 - Integral handle for ease of positioning
- Multi-directional clamp for horizontal and vertical adjustment
- Optional mounts
 - Cup plate mounting for increased stability
 - Threaded bung mount for drum mixing with collapsible impeller that fits through a standard opening
- Shaft attachment: Chuck or flanged couplings
- All stainless housings and motors available for superior cleanliness and corrosion protection
- Standard designs available in 24–48 hours



Optional cup plate allows for periodic shaft angle adjustment while still permanently affixed



An optional 2" NPT bung mount is also available for mixing the contents of standard drums

Impeller Process Technology

Our impeller process technology is effectively applied across your spectrum of applications ensuring successful, repeatable results from lab scale to full scale operations.

Our mixing expertise includes low shear liquid-liquid/solids blending, gas dispersion, high shear blending and viscous mixing. Whether it is

R&D or production phase, we have the expertise to solve your mixing challenges.

An impeller bulletin is available with additional information.



XE-3



BT-6



SC-3



JP-3



Anchor



Maxflo W



Dispersion Blade



Collapsible

NOV

NOV
NATIONAL OILWELL VARCO

NOV

NOV
NATIONAL OILWELL VARCO

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Top entering portable mixers offer strength, flexibility and reliability.

Today's applications demand high performance process equipment accompanied by total support for customers' mixing needs. To address these requirements, we offer a line of top entering and portable mixers. Superior materials of construction throughout, along with advanced modular designs give each one the strength, flexibility and reliability to perform to the same standards as all Chemineer agitators.

- DTC/XPC (clamp/cup mount) or XPB (bung mount)
- Standard models ship in 24–48 hours
- Bung mount available for 55 gallon drums
- High strength, low weight cast aluminum housing
- 60+ years experience in mixing technology
- Multi-directional clamp for horizontal and vertical adjustment

Features and Benefits

- Direct drive: Models 10XPB, 10XPC & 30XPC; Industry standard, off the shelf, NEMA electric or air motors
- Gear reduced: Model 40XPC/50DTC low maintenance drive offers 350 rpm nominal output speed
- Cast handle: Integral cast aluminum handle for easy maneuverability and positioning
- Mount: High strength cast aluminum clamp or cup plate mount offers 3-dimensional positioning with positive lock adjustability, bung mount mixer designed to fit 2" NPT openings
- Shaft: Rugged, heavy duty shafting manufactured from 316 SS, 0.625" or 1" diameter shafting straightened to .002" per foot to reduce vibration and extend unit life



Bung Mount



Clamp Mount



Cup Plate Mount

Chemineer Portable Mixers



SC-3



JP-3



Collapsible

Impeller Options

Our impeller designs are the result of over six decades of research and applied application experience. Proprietary technologies are applied to thoroughly analyze all process parameters, ensuring proper impeller selection for optimal performance in every application. Carbon steel, 316/316L stainless steel, high alloys and coatings are available.

The SC-3 impeller features an advanced design that produces flow characteristics of larger impellers without added weight or loss of efficiency. The SC-3 is a high pumping axial flow impeller with low shear used for blending and motion or solids suspension.

The JP-3 impeller is a marine style energy efficient design ideal for small batches and is able to handle high viscosities. It is a high efficiency axial flow impeller used for liquid blending on our smallest turbine agitators.

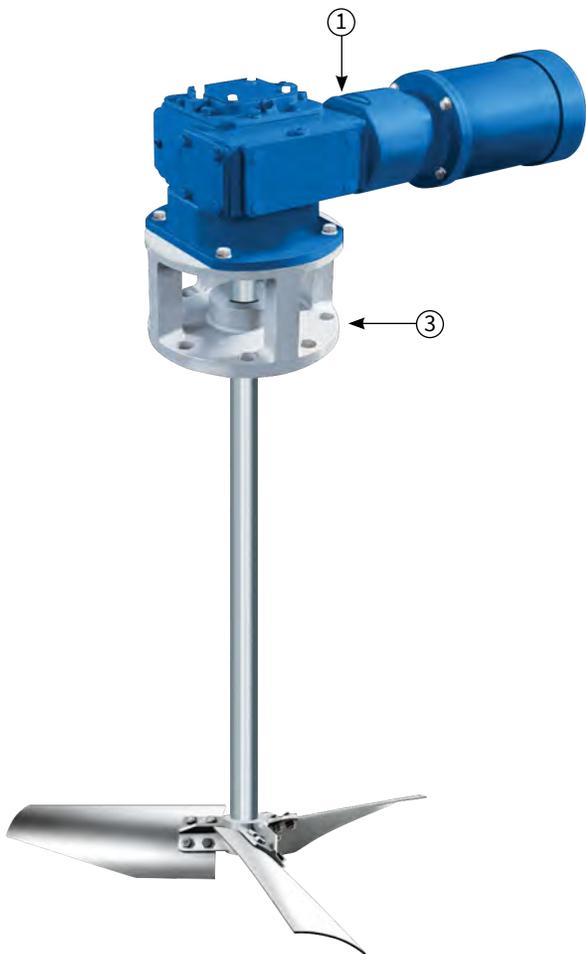
The Collapsible impeller is used when the mixer opening is too small for a conventional impeller. Collapsible impellers allow larger impeller diameters and increased mixing in vessels that have only a small opening such as 55 gallon drums and IBC totes.

Small Mixer Sizing Chart

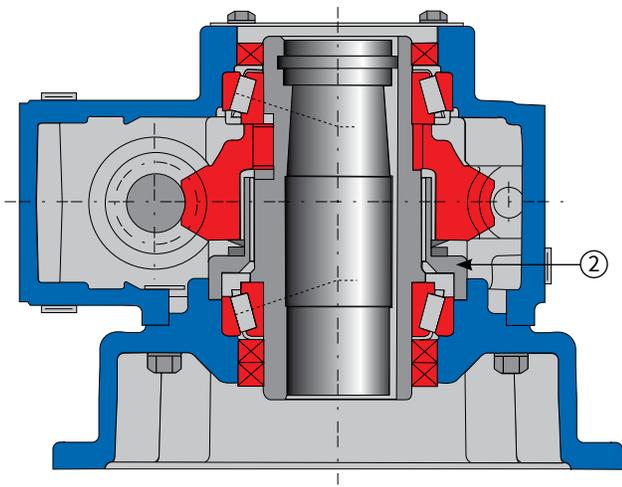
Product	Process Situation Viscosity (cP)	Volume (gallons)								
		25	50	100	200	500	1000	2000	3000	5000
Water, Kerosene	1	10XPC-0.5	10XPC-0.5	10XPC-0.5	10XPC-0.5	30XPC-1.5	30XPC-1.5	40XPC-1.0	40XPC-1.0	50DTC-2.0
Olive Oil	100	10XPC-0.5	10XPC-0.5	10XPC-0.5	30XPC-1.5	40XPC-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0
Glucose, Latex Paint	250	10XPC-0.5	10XPC-0.5	30XPC-1.5	40XPC-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0	50DTC-2.0
Glycerin	500	10XPC-0.5	30XPC-1.5	40XPC-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0	50DTC-2.0	50DTC-2.0
Castor Oil	1000	30XPC-1.5	40XPC-1.0	40XPC-1.0	40XPC-1.0	40XPC-1.0	50DTC-2.0	50DTC-2.0	50DTC-2.0	50DTC-2.0



Chemineer™ QED^{Plus} Top Entry Mixer



The proof is in
the performance.



The QED^{Plus} top entry mixer line is the optimum performer for mid-range fluid mixing applications. This robust design can handle blending, solids suspension and high viscosity applications. The QED^{Plus} is well suited for processes demanding performance and value.

The QED^{Plus} is ideal for your mixing requirements where:

- Applications require higher mid-range torque than the traditional small mixer can provide
- The Model 20 is larger than your application requires
- Overhead limitations or withdrawal heights are a concern

To ensure rapid response to your requests, we utilize our industry leading, process and mechanical design software to quickly generate solutions, complete with quotations, custom assembly/dimension drawings and design loads in either paper or electronic formats.

Exceptional engineering resources, including Computational Fluid Dynamics and Laser Doppler Anemometry, are applied to provide superior custom designs that address your process challenges.

The QED^{Plus} provides these high performance features:

- Selections through 5 HP
- Flexible selection of output speeds: 17 to 175 rpm
- Shaft diameters through 2.5 inches
- NEMA or IEC frame motors
- Multiple sizes for continuous or batch mixing
- Full selection of impellers for blending, solids suspension, viscous and gas dispersion applications.
- Right angle, heavy duty worm gear drive for low head room installations (see ① at left)
- Gear drive dry well seal that prevents output shaft leakage (see ② at left)
- Rugged cast iron drive housing for long service life
- 316L stainless pedestal for maximum corrosion resistance (see ③ at left)
- Open tank (beam mount), stuffing box and lip seal options
- Steady bearing designs available for deep tanks
- Optional in-tank shaft coupling for ease of installation/ maintenance
- Carbon steel or 316 stainless steel wetted parts as standard; high alloys, polish and coatings provided upon request
- ANSI or DIN flanges
- Controls and monitoring devices available
- Engineered solutions upon request



Dimensions

Dimensions Chart

Case Size	B			C	D	E	F	G	H	J	K	L	R	T	U
	140TC	180TC	210TC												
1	9.75"	—	—	4.625"	8.9375"	5"	1"	1.5"	4.375"	6.5"	1.75"	3.75"	3"	5.5"	3.5"
2	10"	11.125"	—	5.0625"	8.6875"	5"	1"	2"	5.375"	6.5"	1.75"	3.75"	3.5"	6.125"	4"
3	10.8125"	11.9375"	13.0625"	5.875"	10.3125"	5.75"	1.125"	2.5"	5.75"	6.625"	1.75"	4.25"	4.25"	7.125"	4.375"

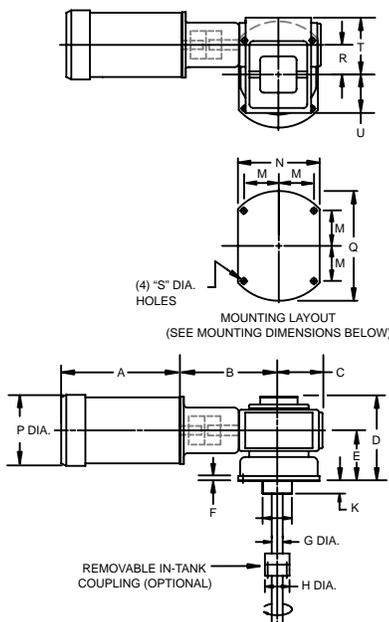
Motor Dimensions

(for totally enclosed and explosion proof, 1750 rpm motors)

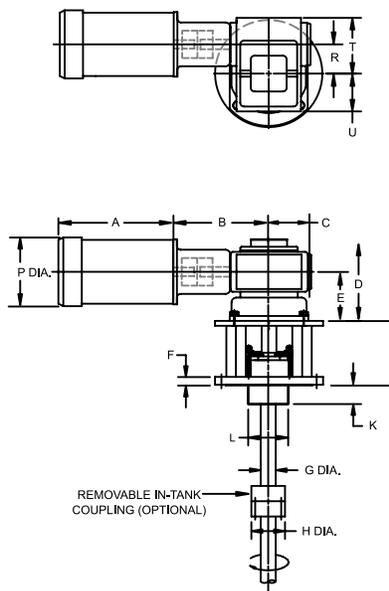
HP	Frame	A	P
1, 1.5, 2	140TC	12"	8"
3 & 5	180TC	14"	10"
7.5	210TC	18"	12"

Mounting Dimensions

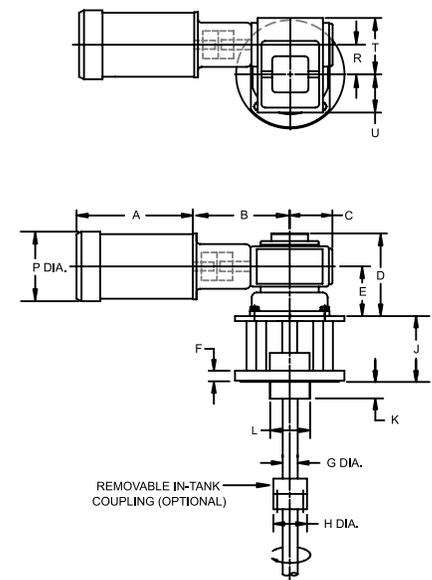
Case Size	M	N	Q	S
1	3.25"	8"	10.75"	.5625"
2	3.53125"	9"	11"	.5625"
3	4.0625"	10.5"	13"	.5625"



QED-D
Open Tank



QED-A
Flange Mount with Stuffing Box



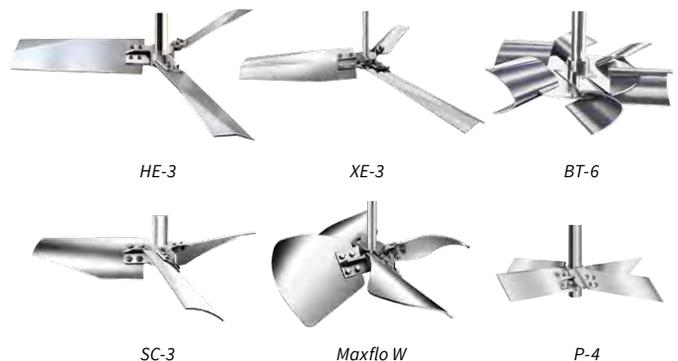
QED-L
Flange Mount with Lip Seal

Impeller Technology

Chemineer impeller technology is effectively applied across your spectrum of applications ensuring successful, repeatable results from lab scale to full scale operations.

Our mixing expertise includes high flow, low shear liquid-liquid solids blending, gas dispersion, high shear blending and viscous mixing. Whether it is R&D or production phase, we have the expertise to solve your mixing challenges.

An impeller bulletin is available with additional information.



Kenics™

Static Mixer Technology



Product Innovation

Since 1965, in thousands of installations worldwide, Kenics static mixers have set the standard for inline mixing and heat transfer performance. We incorporate advanced technology into every static mixer to give you reliable, uninterrupted performance that you can depend on for the long term. The result: maximum operating efficiency and overall cost savings.

Principles of Operation

In the KM static mixer, a patented helical mixing element directs the flow of material radially toward the pipe walls and back to the center. Additional velocity reversal and flow division result from combining alternating right and left hand elements, increasing mixing efficiency. All material is continuously and completely mixed, eliminating radial gradients in temperature, velocity and material composition.

In the HEV and UltraTab™ static mixers, the element geometry maximizes the conversion of turbulent energy into efficient mixing. The static mixers produce complete stream uniformity through controlled vortex structures generated by the mixing elements. The element geometry takes advantage of the naturally occurring vortices induced by the element edges.

In the KMX-V, this static mixer utilizes cross-stream mixing and flow splitting to achieve a very rapid blend. This mixer is ideal for laminar flow and high viscosity ratio blending.

These mixing principles result in an application technology that can be easily reproduced and reliably scaled. Numerous independent studies have shown Kenics static mixers maximize mixing efficiency—without the wasted energy and material blockage typically found in more restrictive motionless mixers.



Thermogenizers



UltraTab



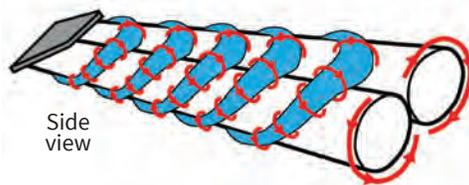
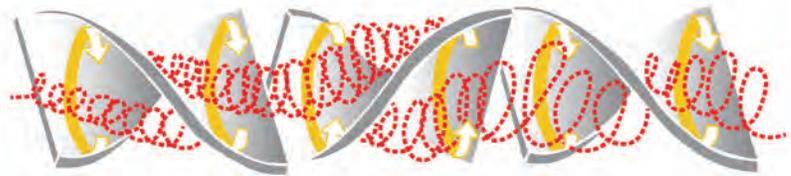
KMX-V



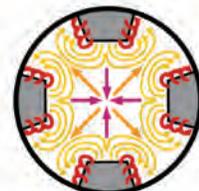
KM



HEV



Side view



Front view

Mixing Applications



Turbulent Blending HEV and UltraTab

Each tab of the HEV generates a pair of streamwise counter rotating vortices, while the UltraTab, with upstream injector, provides rapid incorporation of additives. Both mixers produce vigorous cross-stream mixing and rapid uniformity.



Laminar Blending KMX-V

The intersecting blades of the KMX-V create cross-stream mixing and flow splitting to achieve rapid mixing even in the most demanding applications such as those with extreme viscosity and volume ratios.



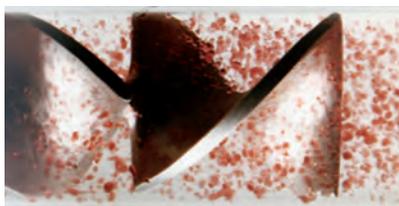
Laminar Blending KM

The alternating helical elements of the KM continually divide, stretch and reorient the flow stream to produce complete mixing with minimum pressure drop.



Turbulent Blending KM

The KM produces rapid mixing by inducing circular patterns that reverse direction at each element intersection.



Liquid/Liquid Dispersion

The uniform turbulent shear field of the KM quickly disperses immiscible liquids and produces a narrow droplet size distribution.



Gas/Liquid Dispersion

Gases can be incorporated into turbulent liquids using the KM. Mass transfer rates are dramatically enhanced to maximize absorption or reaction.

Our static mixers provide precise blending and dispersion of all flowable materials, without utilizing moving parts. Mixing is achieved by redirecting the flow patterns already present in empty pipe. Kenics static mixers are currently being used in numerous processing applications, in order to reduce overall cost and significantly improve efficiency, speed and control. They can be found in a wide range of markets including chemicals, refining, polymers, food, pulp and paper, and water and wastewater treatment. These high efficiency mixers also handle other critical processes, such as:

Heating/Cooling

Kenics static mixers dramatically boost heat transfer rates over those typically found in open pipe under both laminar and turbulent flow conditions.

Residence Time Control

By eliminating the parabolic velocity profile characteristic of laminar flow in open pipes, the helical element of Kenics static mixers promotes plug flow in continuous processes.

Temperature Uniformity

The radial mixing action of the KM elements rapidly eliminates temperature gradients, reducing fouling and thermal degradation.

KM Static Mixers

KM static mixers feature a patented helical mixing element which produces complete radial mixing and flow division for any combination of liquids, gases, or solids.

Adapts to Any Piping System

Mixer dimensions match all standard pipe sizes. Mixer housings feature plain, threaded, weld prep or flanged ends for easy installation. Flange styles

include raised face slip-ons, weld neck, lap joint, ring joint and Grayloc type hubs in all standard pressure ratings. Mixers are available in carbon steel, 304SS, 304LSS, 316SS, 316LSS, Alloy 20 Cb-3, Titanium, Monel 400, Nickel 200, Inconel, Hastelloy C-276, Hastelloy B-2, FRP, PVC, CPVC, PTFE, Kynar, PVDF, Tantalum, Zirconium and other high alloys.



Fixed Element—KMS

- Used for laminar, transitional, and turbulent flow applications; suitable for most blending or dispersion problems involving liquids or gases
- Mixing elements are attached to the housing wall



Removable Element—KMR

- Used for laminar, transitional, and turbulent flow applications where periodic cleaning or inspection is required; suitable for most blending or dispersion problems involving liquids or gases
- Mixing elements are easily removed from housing



Element Assembly—KMA

- Mixing elements are inserted in the customer's existing housing
- Precisely controlled to assure proper fit and ease of installation in any standard or custom pipe size



Edge-Sealed Element—KME

- Used for maximum heat transfer, polymer reactors, certain fibrous applications, and mixing liquids with wide viscosity ratios
- Mixing element edges are furnace brazed to the housing wall eliminating dead areas
- Continuous joining of elements to the housing eliminates wall clearance to maximize heat conduction and minimize thermal degradation or fouling
- Available with internal surface finishes down to 8 microinches

Construction Options

- ASME/B31.3 certification and testing
- Design pressures to over 10,000 psi
- Jackets, nozzles, fittings
- Complete custom fabrication
- Diameters to over 8 feet

UltraTab Static Mixers

The UltraTab provides rapid mixing in circular pipe turbulent flow applications. The integral injector allows upstream injection of additives to produce a 0.05 CoV (coefficient of variation) in as little as two pipe diameters downstream from the exit of the mixer. This upstream injector ensures that the highest energy dissipation zone is not missed. The compact tab design minimizes the length required for mixing and optimizes piping layout.

Typical applications include pH Control, Chlorination, Chemical Dosing/Flash Mixing, Disinfection, and Polymer Blending in Water Treatment Applications. Additional applications include Desalination Processes, Chemical Processing, and any low viscosity blending processes.

UltraTab Static Mixer Features

- Available in carbon steel, stainless steel, coated carbon/316ss and FRP materials
- Multi-injection ports available
- Spool piece with flanged or weld prep ends
- Element extension for lower CoV requirements
- Sizes range from 2" to 60" +



HEV Static Mixers



HEV high efficiency static mixers handle all turbulent flow mixing applications regardless of line size or shape. Mixing is accomplished by controlled vortex structures generated by the patented low profile tab geometry. This provides uniform blending while limiting mixer length to less than 1-1/2 pipe diameters. Complete mixing is achieved with pressure losses 75% less than conventional static mixers.

Typical applications for the HEV include all low viscosity liquid-liquid blending processes, as well as gas-gas mixing. The HEV is ideal for processes where pressure drop and length are critical.

HEV Static Mixer Features

- Lowest pressure drop available
- Unlimited sizes and shapes
- Short mixer length
- Easy retrofit to existing lines
- Available in all metals and alloys, FRP, PVC, PFA, and epoxy coated steel
- Low cost, wafer design is available for installation between flanges

HEV static mixers provide installation flexibility and can be configured to square, rectangular or 3-sided ducts. They are adaptable to open channels typically found in water treatment systems.

KMX-V Static Mixers



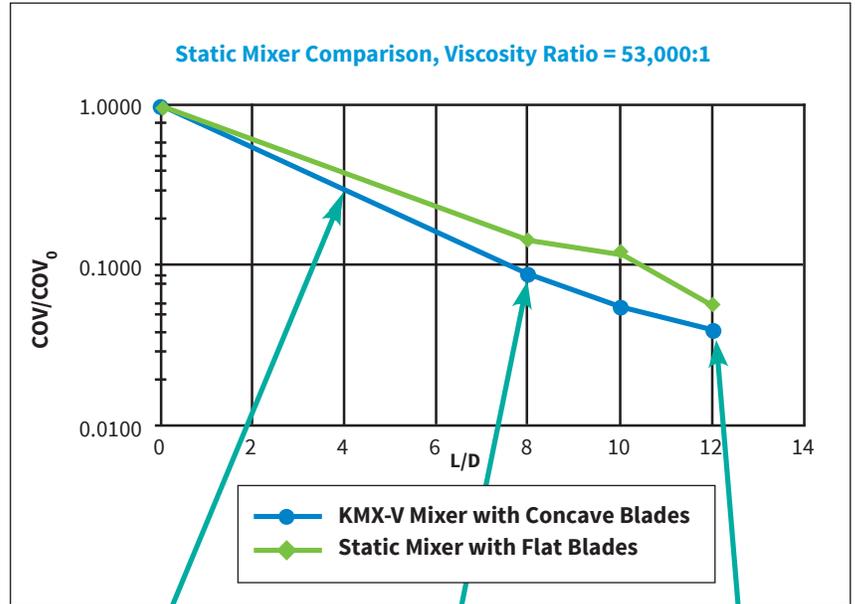
The KMX-V is the choice for demanding mixing applications, such as those involving fluids with extreme viscosity or volumetric ratios. The common limiting factor in static mixer design is the allowable mixer length and the patented element design offers a short length and the most efficient mixing performance.

Exclusive Mixing Principle

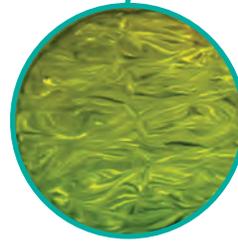
The KMX-V utilizes cross-stream mixing and flow splitting to achieve very rapid blending. Each element is approximately one pipe diameter in length and consists of multiple intersecting blades, which generate fluid layers as the mixture flows downstream.

KMX-V Static Mixer Features

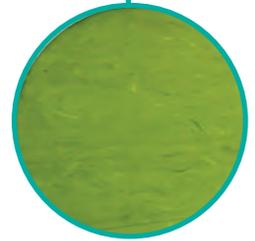
- Superior mixing performance
- Laminar flow and high-low viscosity mixing
- Cost effective solution
- Short length
- Standard diameters up to 24"



KMX-V-4



KMX-V-8



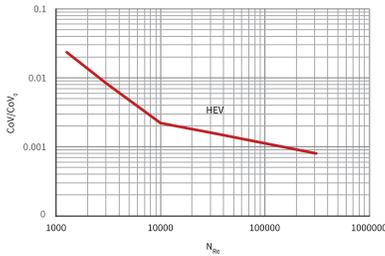
KMX-V-12

Laser induced fluorescence (LIF) images showing cross-sectional uniformity



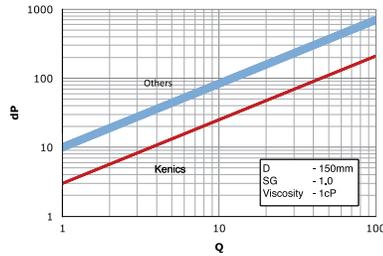
Low viscosity additives are driven along the trough of each blade and abruptly sheared by strong cross-stream velocity gradients as they pass around the upstream surface

Technology Application



Mixing Uniformity

By analyzing the inlet stream conditions, final mixture quality can be predicted for all Kenics static mixer designs.



Pressure Drop

The pressure drop through Kenics static mixers is the lowest in the industry resulting in reduced operating costs and increased process capacity.

Guaranteed Mixing Uniformity

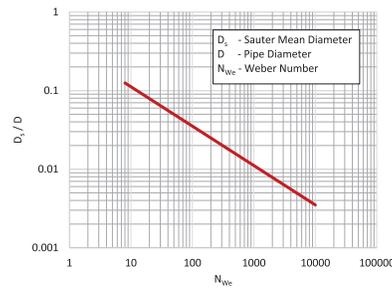
The standard technique used for measuring the degree of mixing in pipe flow is the coefficient of variation, CoV. The coefficient of variation is the ratio of the standard deviation of component concentration to its mean concentration. The coefficient of variation achieved at the mixer discharge is dependent on the inlet coefficient of variation (CoV)⁰. The initial coefficient of variation is defined as:

$$(CoV)_0 = \left[\frac{1-V_a}{V_a} \right]^{1/2}$$

where V_a is the volume fraction of the stream added. To allow plotting against geometrical factors such as element style, as well as Reynolds number, a normalized coefficient of variation is defined as:

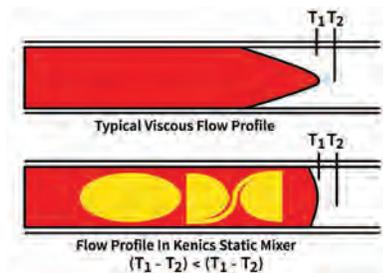
$$\frac{CoV}{(CoV)_0}$$

The correlations we have developed through fundamental research, as well as years of operating experience, allow us to accurately predict mixer performance and offer you 100% guaranteed results.



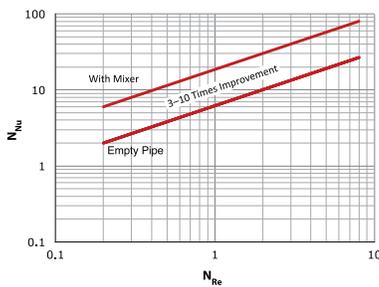
Droplet Size Prediction

Accurate droplet size prediction allows optimization of mass transfer controlled processes while avoiding problems with downstream separation equipment.



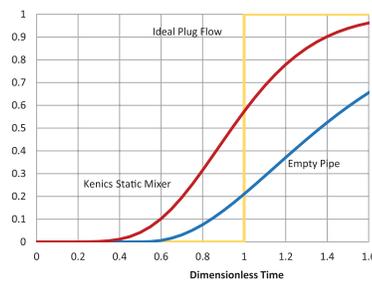
Temperature Uniformity

Kenics static mixers eliminate hot or cold spots typical of flow in open pipes. Improved thermal uniformity optimizes process performance.



Heat Transfer

Exclusive edge-sealed mixing elements give Kenics static mixer heat transfer rates 3 to 10 times greater than open tubes.



Reactor Engineering

By interrupting the parabolic velocity profile characteristic of open pipe, Kenics static mixers produce residence time distributions approaching plug flow.

Special Purpose Products

In addition to our standard static mixer line, we manufacture a range of products designed to meet your specialized process requirements.



Sanitary Mixers

- Polished internal and external surfaces
- Removable element assemblies for fast, easy cleaning
- Fitted with tri-clamp style ferrules
- Available in five diameters from 0.5" to 4"
- 316L construction materials
- 3A certified design/construction
- BPE option available
- CIP models available

Tube Mixers

- Used for applications with low flow rates in full scale and pilot plant operations
- Exclusive edge-sealed mixing elements attached to housing wall
- Plain ends accommodate a wide variety of common fittings
- Standard 22-gauge 316SS housings available in diameters from 0.1875" to 0.5"

Heat Exchangers

- Used for process applications, including Polymers, Plastics, Adhesives, Hydrocarbon Processing, and Food Industries
- Effective for both heating and cooling of viscous fluids
- Three to ten times greater transfer rates than empty tubes
- Boosts heat transfer with minimal flow disruption
- Designed and constructed to ASME Pressure Vessel Code; Section VIII, Div 1
- TEMA standards used for manufacturing and assembly techniques
- Chinese boiler and pressure vessel license

Thermogenizers

- Delivers uniformly mixed melt for extrusion applications
- Offers improved gauge control
- No radial temperature gradients
- Reduced color concentrate usage by improving mixture uniformity
- One piece design for easy installation and cleaning



No matter what your process needs or system considerations, Kenics static mixers can handle your mixing requirements.



Pilot Plant Heat Exchangers

- Standard off the shelf design for immediate shipment
- Direct scale up with 100% process warranty
- All stainless steel construction
- Can be used in pilot plants or slip streams to full scale process

Tubular Reactors

- Continuous plug flow performance
- Single or multi-tube construction
- Continuous solution phase reactions and polymerizations
- High heat transfer rates with low pressure drop

Service and Support



Commitment to Quality

We manufacture Kenics static mixers at our Dayton, Ohio facility and heat exchangers at our facility in Harvey, Louisiana. Our UK facility is ISO certified and can provide CE markings on our products allowing us to offer customers 100% guaranteed quality products, and represents our ongoing commitment to customer satisfaction.



Computerized Process Optimization

CEDS™ (Chemineer Expert Design System) is a comprehensive computer program developed by Mixing Technologies that interprets process design data and selects only those mixers that it has verified for process and mechanical design integrity specific to your application. Mixing Technologies application engineers use this technology to provide you with immediate design solutions.



Factory Services and Field Engineering

Every Kenics static mixer is backed by product and application engineering, a fully equipped mixing laboratory, and complete in house manufacturing and quality control. Our process engineers combine hands on experience with fundamental technology to provide you with optimal, cost effective mixer performance.



Sharing Our Technology

Our team is ready to bring the latest static mixing technology right to your front door. Your process and development engineers are introduced to mixing principles for blending, dispersion, heat transfer and reactor design allowing them to optimize plant operating performance. Contact your local representative to arrange an in house seminar.

Worldwide Distribution

Kenics static mixers are marketed globally through locations in the United States, United Kingdom, Mexico, Singapore, Austria and China. Kenics worldwide distribution is ready to serve your mixing needs, anywhere, anytime.

Product Applications

Kenics static mixers are used in numerous industries for a variety of blending, dispersion, heat transfer and residence time control applications.

Typical Applications

Agricultural Chemicals

- Fertilizer and Pesticide Preparation
- Gas/Liquid Dispersion
- Dilution of Feed Concentrates

Chemicals

- Chlorination and Oxidation
- Organic/Aqueous Dispersions
- Dilution of Acids and Bases

Cosmetics

- Heating Slurries and Pastes
- Additive Blending
- Dispersion of Oils

Energy

- Chemical Addition for Enhanced Oil Recovery
- Injection of Geothermal Steam
- Preheating Coal/Oil Slurries
- NOX/SOX Control

Foods

- Blending Food Constituents
- Washing Fats and Oils with Acid
- Heating and Cooling Sugar Solutions
- Starch Slurry Cooking

Pharmaceuticals

- Nutrient Blending
- pH Control
- Sterilization

Grain Processing

- Starch Conversion
- Chemical Addition
- Mud Dilution
- Steam Injection

Minerals Processing

- Metals Recovery by Solvent Extraction
- Chemical Addition and pH Control
- Oxidation and Bleaching

OEM

- Adhesive and Epoxy Dispensing Systems
- Adhesives Heating
- Monitoring and Sampling Systems

Paints & Resins

- Dilution of TiO₂ Slurries
- Coloring and Tinting
- Solvent Blending
- Petrochemical & Refining
- Blending Gaseous Reactants
- Washing Hydrocarbon Streams
- Gas Scrubbing
- Lube Oil Blending
- Crude Oil Sampling

Polymers & Plastics

- Blending Reactants & Catalysts
- Thermal Homogenization
- Plug Flow Finishing Reactors
- Preheating Polymers Prior to Devolatilization

Pulp & Paper

- Stock Dilution and Consistency Control
- Chemical and Coatings Preparation
- pH Control
- Pulp Bleaching

Rubber Processing

- Blending Latex Compounds
- Adding Pre-polymers and Activators
- Heating and Cooling Adhesives

Textiles

- Blending Additives
- Eliminating Thermal Gradients
- Heating and Cooling Polymers
- Achieving Uniform Heat History

Water & Waste Treatment

- Polymer Dilution
- pH Control
- Chemical Addition and Flash Mixing
- Disinfection and Aeration





With experienced, customer focused engineers, our Kenics products satisfy a wide range of mixing applications worldwide



Quality is designed and built into every Kenics product to ensure performance and long service life



The versatility of Kenics static mixers allows customers to design around existing pipe layout

Chemineer

Chemineer is a leading provider of mixing solutions for the oil and gas industry.

Our products are designed to provide reliable, efficient mixing solutions for a wide range of applications.

For more information, please contact your local Chemineer representative.

Visit our website at www.nov.com/mixing for more details.

Chemineer is committed to providing the highest quality products and services to our customers.

Thank you for your interest in Chemineer.

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KM static mixers feature a patented helical mixing element which produces complete radial mixing and flow division for any combination of liquids, gases, or solids.

Design

The KM static mixer's helical mixing element directs the flow of material radially toward the pipe walls and back to the center. Additional velocity reversal and flow division result from alternating right and left hand elements, increasing mixing efficiency. All material is continuously and completely mixed, eliminating radial gradients in temperature, velocity and material composition.

Application

KM static mixers provide precise blending and dispersion of all flowable materials, without utilizing moving parts. Mixing is achieved by redirecting the flow patterns already present in empty pipe. Kenics static mixers are currently being used in numerous processing applications, in order to reduce overall costs and significantly improve efficiency, speed and control. KM mixers can be found in a wide range of markets including chemical, refining, oil and gas, polymer, food, pulp and paper, and water and wastewater treatment. These high efficiency mixers also handle other critical processes, such as:

Heating/Cooling

KM mixers dramatically boost heat transfer rates over those typically found in open pipe under both laminar and turbulent flow conditions.

Residence Time Control

By eliminating the parabolic velocity profile characteristic of laminar flow in open pipes, the helical element of KM mixers promotes plug flow in continuous processes.

Temperature Uniformity

The radial mixing action of the KM elements rapidly eliminates temperature gradients, reducing fouling and thermal degradation.



Fixed Element — KMS

- Used for laminar, transitional, and turbulent flow applications; suitable for most blending or dispersion problems involving liquids or gases
- Mixing elements are attached to the housing wall



Element Assembly — KMA

- Mixing elements are inserted in the customer's existing housing
- Precisely controlled to assure proper fit and ease of installation in any standard or custom pipe size



Removable Element — KMR

- Used for laminar, transitional, and turbulent flow applications where periodic cleaning or inspection is required; suitable for most blending or dispersion problems involving liquids or gases
- Mixing elements are easily removed from housing
- 3A certification available



Edge-Sealed Element — KME

- Used for maximum heat transfer, polymer reactors, certain fibrous applications, and mixing liquids with wide viscosity ratios
- Mixing element edges are furnace-brazed to the housing wall eliminating dead areas
- Continuous joining of elements to the housing eliminates wall clearance to maximize heat conduction and minimize thermal degradation or fouling

Kenics KM Static Mixer

Kenics Static Mixer Quick Selection Guide

Viscosity (cP)

Flow Range (gpm)	Line Size	1	10	100	500
0.5 to 2	0.5"	1/2-KMS-4	1/2-KMS-6	1/2-KMS-12	$\Delta P > 10$ psi
	0.75"	3/4-KMS-4	3/4-KMS-6	3/4-KMS-12	3/4-KMS-18
	1"	1-KMS-4	1-KMS-6	1-KMS-12	1-KMS-18
2 to 5	0.5"	1/2-KMS-2	1/2-KMS-4	1/2-KMS-6	$\Delta P > 10$ psi
	0.75"	3/4-KMS-2	3/4-KMS-6	3/4-KMS-12	$\Delta P > 10$ psi
	1"	1-KMS-2	1-KMS-6	1-KMS-12	1-KMS-12
	1.5"	1.5-KMS-4	1.5-KMS-6	1.5-KMS-12	1.5-KMS-18
5 to 7.5	0.5"	1/2-KMS-2	1/2-KMS-4	$\Delta P > 10$ psi	$\Delta P > 10$ psi
	0.75"	3/4-KMS-2	3/4-KMS-4	3/4-KMS-6	$\Delta P > 10$ psi
	1"	1-KMS-2	1-KMS-4	1-KMS-6	$\Delta P > 10$ psi
	1.5"	1.5-KMS-2	1.5-KMS-6	1.5-KMS-12	1.5-KMS-12
7.5 to 10	0.75"	3/4-KMS-2	3/4-KMS-4	3/4-KMS-6	$\Delta P > 10$ psi
	1"	1-KMS-2	1-KMS-4	1-KMS-6	$\Delta P > 10$ psi
	1.5"	1.5-KMS-2	1.5-KMS-4	1.5-KMS-6	1.5-KMS-12
10 to 15	0.75"	3/4-KMS-2	3/4-KMS-4	$\Delta P > 10$ psi	$\Delta P > 10$ psi
	1"	1-KMS-2	1-KMS-4	1-KMS-6	$\Delta P > 10$ psi
	1.5"	1.5-KMS-2	1.5-KMS-4	1.5-KMS-6	1.5-KMS-12
	2"	2-KMS-2	2-KMS-4	2-KMS-6	2-KMS-12
15 to 20	0.75"	3/4-KMS-2	3/4-KMS-2	$\Delta P > 10$ psi	$\Delta P > 10$ psi
	1"	1-KMS-2	1-KMS-4	$\Delta P > 10$ psi	$\Delta P > 10$ psi
	1.5"	1.5-KMS-2	1.5-KMS-4	1.5-KMS-6	1.5-KMS-12
	2"	2-KMS-2	2-KMS-4	2-KMS-6	2-KMS-12
20 to 30	1"	1-KMS-2	1-KMS-2	$\Delta P > 10$ psi	$\Delta P > 10$ psi
	1.5"	1.5-KMS-2	1.5-KMS-4	1.5-KMS-6	$\Delta P > 10$ psi
	2"	2-KMS-2	2-KMS-4	2-KMS-6	2-KMS-12
	3"	3-KMS-2	3-KMS-4	3-KMS-6	3-KMS-12
30 to 40	1"	1-KMS-2	1-KMS-2	$\Delta P > 10$ psi	$\Delta P > 10$ psi
	1.5"	1.5-KMS-2	1.5-KMS-2	1.5-KMS-6	$\Delta P > 10$ psi
	2"	2-KMS-2	2-KMS-4	2-KMS-6	$\Delta P > 10$ psi
	3"	3-KMS-2	3-KMS-4	3-KMS-6	3-KMS-12





The UltraTab is designed for turbulent flow applications where a high degree of mixing is required in a compact space.

Superior Performance

In turbulent flow mixing/blending applications, the UltraTab provides a combination of compact installation space, complete blending in short distances downstream of the mixer, and low pressure drop through the element.

Independent studies from the British Hydraulic Research Group (BHR) shows the UltraTab produces a Coefficient of Variation (CoV), which is a measure of mixing degree, lower than 0.05 at a distance of 3D downstream from the mixer. The UltraTab provides the lowest pressure drop per degree of mixing of all models tested by BHR.

Efficiency

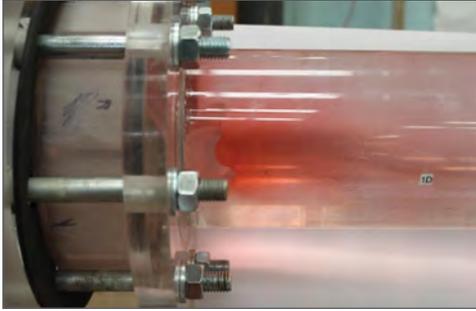
- Integral wall injector upstream of the mixing element forces the additive through the high energy dissipation region created by the mixing element which provides superior mixing efficiency
- Low pressure drop through the UltraTab element enhances energy efficiency of the process and saves pump energy
- Compact design and short mixing length saves pipe lengths and optimizes plant layout

Application Versatility

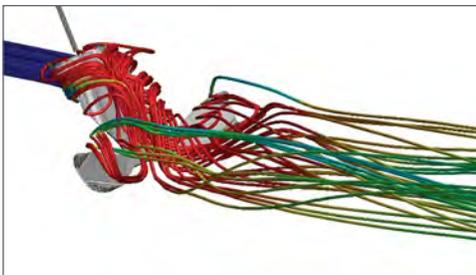
- Additive ratios from 1:3 to greater than 1:10,000
- Turbulent eddies from the single element produce intense and rapid mixing of the bulk flow
- Integral wall injector provides simple and effective means for additive injection compared to centerline injectors which can impede the main flow, increase pressure drop, and increase in fouling
- Multi-point injectors are optional for mixing several additives to the main flow
- Increased mixing performance in comparable space as “wafer” type designs with substantially lower pressure drop
- Correlations supported by third party verification and optimized by internal Application Engineers for your process

Typical Applications

- | | |
|---|---|
| <ul style="list-style-type: none">• Water Treatment Applications- pH Adjustment- Chemical Injecting- Acid Dilution- Mixing Flocculation Agents- Coagulation Processes- Sodium Hypochlorite- Chlorination Dechlorination | <ul style="list-style-type: none">• Desalination Applications- Brine Mixing and Dilution- Chemical Injection- Anti-Scalant Blending- Flocculation and Coagulation Dosing- pH Adjustment |
|---|---|



Turbulent flow through the UltraTab provides energy efficient mixing in short distances



Chemicals are injected up stream of the UltraTab to guarantee flow through the highest energy dissipation zones as seen in red

Turbulent Blending

Turbulent blending is the mechanism for mixing in many applications such as water treatment and desalination plants. Oftentimes, there are installation space restrictions, pressure drop limitations, and pipe run limitations inherent in the application. The UltraTab mixer optimizes all three of these over competitive designs.

Additives are injected upstream of the element and are charged into the high energy dissipation zone of the mixing. The single tab element provides extremely low pressure drop as compared to other designs, and the mixing is completed to a maximum 0.05 CoV level in less than three pipe diameters downstream of the element. The CFD picture shows the turbulence created by the element and the photo shows the rapid mixing of the additive into the main flow.

Product Specifications

Sizes Available

- Sizes range from 2" to 60"+ (50 to 1500mm+)
- NPT or flanged injectors

Material Selection

- Carbon steel
- Stainless steel
- Coated carbon/316 stainless steel
- FRP

Configuration Options

- Multi-injection ports
- Spool piece with flanged or weld prep ends
- Element extension for lower CoV requirements



High-performance blending for demanding applications.



KMX-V static mixer features include:

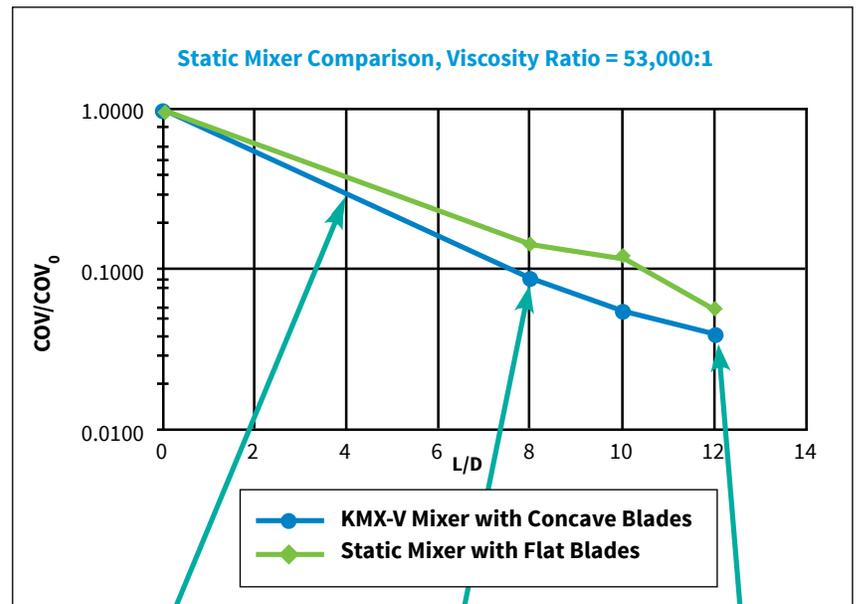
- Superior mixing performance
- Laminar flow and high-low viscosity mixing
- Cost effective solution
- Short length
- Standard diameters up to 24"

For demanding mixing applications, such as those involving fluids with extreme viscosity or volume ratios, the common limiting factor in static mixer design is the allowable mixer length. The KMX-V static mixer is the superior choice for these applications. Its patented element design offers the most efficient mixing performance.

Exclusive Mixing Principle

The KMX-V utilizes cross-stream mixing and flow splitting to achieve very rapid blending. Each element is approximately one pipe diameter in length and consists of multiple intersecting blades, which generate fluid layers as the mixture flows downstream.

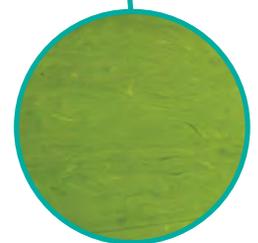
Lab tests have proven that the concave surfaces of the KMX-V element promote more cross-stream flow than competitive designs with flat blades. This feature enhances the performance of the mixer in tough high viscosity ratio applications. Sheets of low viscosity additives are driven along the trough of each blade and abruptly sheared by strong cross-stream velocity gradients as they pass around the upstream surface.



KMX-V-4



KMX-V-8



KMX-V-12

Laser induced fluorescence (LIF) images showing cross-sectional uniformity

Kenics™

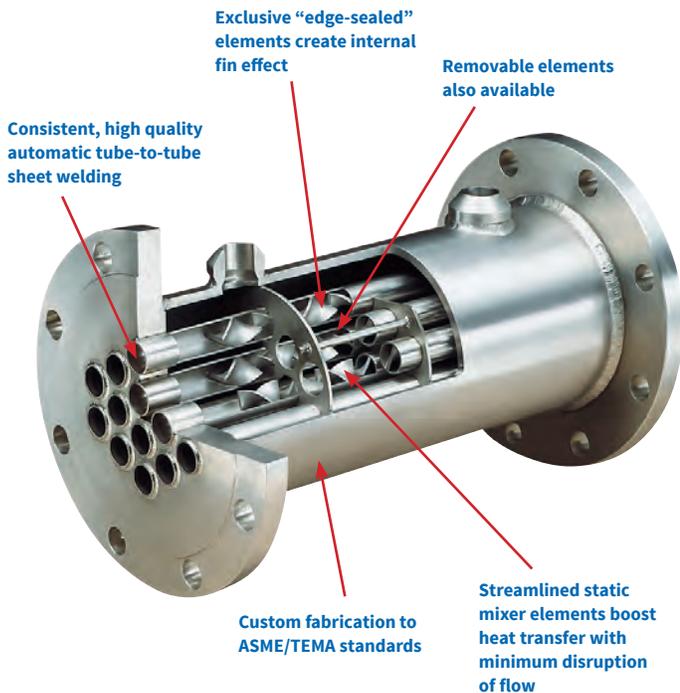
Heat Exchangers



Kenics Heat Exchangers—Custom Built to Save Space, Energy and Time

Kenics heat exchangers, equipped with streamlined Kenics static mixer elements, are the most efficient heat exchangers available today. These high performance thermal units offer maximum transfer rates even with highly viscous, difficult to process materials.

Used for a wide range of process applications, including those in the polymer, plastic, pulp and paper and food industries, our heat exchangers use highly efficient static mixer elements that require less space, less energy and less time to process than standard designs.



Our static mixer technology exclusively offers the highest available heat transfer coefficients for fast, uniform heat transfer. In addition, full technical support is provided from design to manufacturing for meeting even the most stringent applications.

Efficient Heat Exchanger Design

Heat exchangers are commonly made of conventional straight empty tubes. The laminar build up on the tube walls from the process fluid inhibits and creates inefficiencies in the heat transfer process.

Kenics heat exchangers solve these inefficiencies with state of the art static mixer technology. By using static mixer elements in each heat exchanger tube, film build up on the inside walls is greatly reduced. Process fluid is continuously pushed from the center of each tube to the wall and back to the center, eliminating thermal gradients and boosting the inside film coefficient.

Our static mixer elements produce a more uniform, consistent transfer process, with three to seven times greater heat transfer rates than empty tubes alone. Other characteristics include:

- Mixer elements create self cleaning, wiping action
- Fouling is minimized
- Surface renewal at tube wall reduces chance of thermal degradation
- Plug flow characteristics produce uniform heat history
- Temperature gradients are blended out
- Viscous materials can cool to near freezing point

When the static mixer elements are bonded to the tube walls via furnace brazing, the enhanced surface area and internal fin effect augments the mixing action. Transfer rates are increased dramatically. Removable elements are also available for applications requiring periodic cleaning during product changeovers.

With either design, a Kenics heat exchanger will be smaller than a conventional heat exchanger to handle the same job.

Thermal Performance Comparison

Kenics heat exchangers are more effective than conventional empty tubes by a substantial margin. Consider the following example:

Problem: Cool 5,000 lbs/hr of a polymer with thermal conductivity (.09 BTU/Ft - Hr - °F), specific heat (.36 BTU/# - °F) and average viscosity (60,000 cps) from 356° to 104° using cooling water at 75° F.

	Conventional Empty Tube	Kenics Heat Exchanger
Shell Diameter	29"	18"
Tube Length	192"	30"
Surface Area	1600 ft ²	160 ft ²
Transfer Coefficient	3 BTU/FT - Hr - °F	30 BTU/FT - Hr - °F

Applications

Polymers	Styrenics, Ethylenes, Polyesters, Nylons, Silicones, Adhesives and Sealants, De-volitization
Plastics	Extruded Foam
Foods	Chocolates, Dairy Products, Salad Dressing, Sugar Syrups and Corn Syrup
Energy	Coal-Oil Mixtures, Power Alcohol, Petrochemicals and Fuel Oil
Pulp and Paper	Black Liquor, Tall Oils and Kraft Soaps
Miscellaneous	Asphalts, Slurries, Agri-Chemicals, Rubber Sealants, Paint and Waste Treatment

Static Mixing Element Technology

The Kenics heat exchanger consists of a continuous string of static mixer elements within each heat exchanger tube. Static mixing is an inline mixing and processing technology with no moving parts, requiring no external power and no maintenance.

A unique, non-moving mixing element with a patented helical form directs the flow of material radially toward the pipe walls and back to the element, regardless of velocity. By combining alternating right and left hand elements, additional actions of momentum reversal and flow division contribute to the mixing efficiency.

Rotational motion and turbulence are generated in an inherently predictable way to provide the required process result. Thus, all processed material is continuously and completely intermixed to eliminate radial gradients in temperature, velocity and material composition.

Kenics static mixer technology produces homogeneous mixing, blending, and dispersion in any flow regime in a short length of pipe. By utilizing these mixing characteristics, Kenics heat exchangers provide predictable, controlled mixing, and the most efficient form of thermal transfer available.



The Kenics heat exchanger directs the flow of material radially toward the pipe walls and back to the element for the most efficient thermal transfer

Advanced Engineering and Fabrication

As the leaders in static mixing technology, our trained professionals analyze your specific process requirements and utilize advanced computer technology to design solutions for your heat exchanger needs. Highly skilled engineers provide full technical support, including computer process simulation techniques, to develop a custom heat exchanger that matches specific requirements.

Demanding quality testing procedures ensure mechanical integrity and strict adherence to industry standards. An ASME code certified vessel shop, located in Harvey, Louisiana, serves as the manufacturing base for Kenics heat exchanger operations.

As custom built, individually crafted units, our heat exchangers are built to stringent ASME and TEMA codes, requiring the use of

efficient, state of the art equipment in both manufacturing and design operations. Often large and complex, these units require considerable welding and metal joining. Using the most advanced welding techniques and equipment available, fabrication specialists produce a smooth, uniform weld at each tube end.

CAD and SolidWorks 3D design programs are an integral part of the development, manufacturing and quality process which produces Kenics heat exchangers. With CAD based Finite Element Analysis programs, engineers create models of complex static mixer elements. From the resulting pressure and thermal load information, they accurately predict structural design and heat transfer performance for use in developing the most reliable and efficient heat exchanger possible.

Performance Benefits

Kenics heat exchangers range from single jacketed units to large, multi-tube designs, consisting of over 3,000 individual tubes and approaching 2.5 linear miles of static mixer elements. Yet, because of the increased efficiency of the internal mixing elements, a Kenics heat exchanger will be smaller than a conventional heat exchanger used to handle the same job. Features include:

- Design pressures to 10,000 psi
- Construction from all metals and alloys
- Special connections and fittings
- X-ray, hydro, dye penetrant and halogen testing ASME/TEMA compliance

- Heating viscous fluids without degradation—the mixing action of the Kenics static mixer element constantly moves the process material away from the tube wall therefore eliminating scorching and thermal degradation
- Cooling viscous materials without freezing—by minimizing the laminar sublayer next to the tube wall, the Kenics heat exchanger can cool materials to near freezing temperatures without plugging the tubes; and generate transfer coefficients equivalent to scraped surface units without the problems associated with moving parts

Chemineer

Chemineer is a leading provider of mixing solutions for the oil and gas industry.

Our products are designed to provide reliable and efficient mixing solutions for a wide range of applications.

For more information, please contact your local Chemineer representative.

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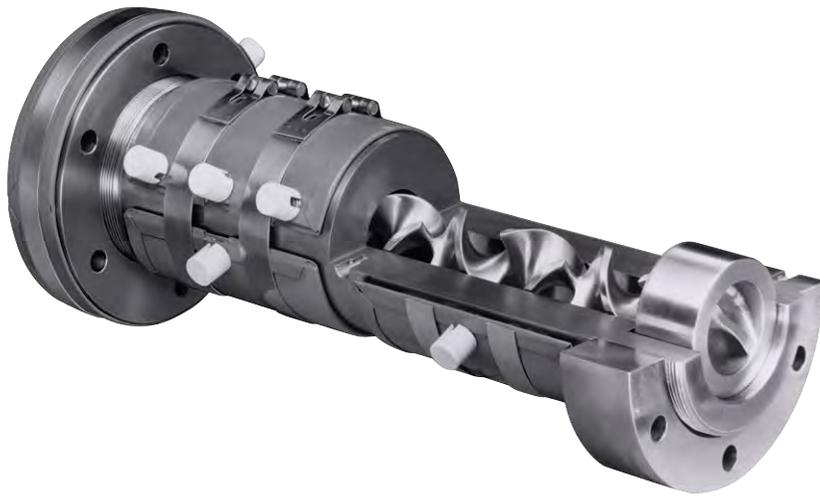
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Corporate Headquarters

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Houston, Texas 77036
USA





All material is continuously and completely mixed, eliminating radial gradients in temperature, velocity and material composition.

The Thermogenizer delivers a homogenized melt stream to your processing die. Distributive mixing is complete once through the mixing elements. A Thermogenizer installation assures near perfect color and additive distribution and uniform temperatures over a broad range of thermoplastics, including nylons, polyethylenes, styrenes, acrylics, cellulose and vinyl resins. The Thermogenizer virtually eliminates melt stream temperature gradients created by either the extruder or other process equipment. A thermally homogenized melt stream provides uniform viscosity and precise gauge control, resulting in increased output (up to 20% for some customers), increased yields and proven reductions in pigment and additive requirements.

Benefits

- Furnished with flanges suitable for coupling with transition sections
- Five basic diameters are available for immediate delivery: 1", 1.5", 2", 3", and 4"
- All units are equipped with special non-moving Kenics mixer element assemblies which are easily removed for cleaning
- Uniform cross section to the melt stream throughout the unit's entire length
- Mixing element surfaces are highly polished to eliminate material hang up and avoid thermal degradation
- Can be supplied with electrical band heaters of the correct watt density and with thermocouple ports for wall temperature control
- Production increases of 10% to 20%
- Elimination of temperature gradient
- Consistent physical properties
- Quicker color change over

Materials

- Styrene, PVC, Polypropylene
- Polyethylene
- Nylon, acrylic
- Polycarbonates
- ABS
- Vinyl resins

Applications

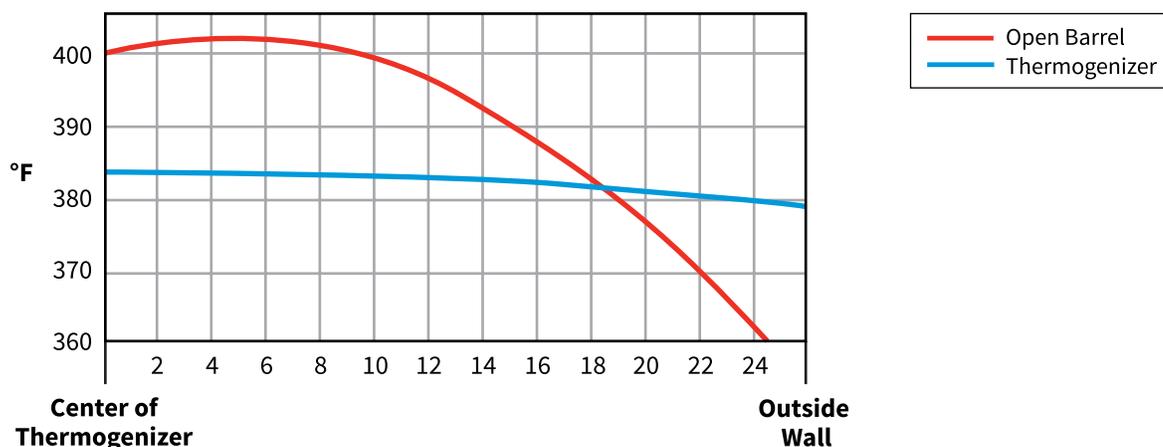
- Sheet
- Profiles
- Blown Film
- Pipe
- Wire Coating
- Extrusion Blow Molding
- Compounding

Principles of Operation

The Thermogenizer is a non-moving part, post-extrusion mixing device which is designed to provide distributive mixing of additives (color, flame retardants, etc.) in the melt stream and to eliminate radial temperature gradients. Mixing is accomplished by a series of stationary helical blades (elements) which induce flow divisions in

the melt stream. This flow splitting is combined with axial rotation of the stream which assures continuous transfer of material from the wall to the center of the stream and vice versa (radial mixing). Two basic models are available: 6 element and 9 element.

Thermogenizer Temperature Profile



Operating Characteristics

The Thermogenizer allows you to accurately control die inlet melt temperature by providing a flat temperature profile (see chart). Thus, the temperature measured at virtually any point on the melt stream cross section is representative of the bulk average temperature. Because temperature and melt viscosity variations are eliminated, the process can be operated at higher output with improved dimensional control of the extruded product.

The energy requirement of the Thermogenizer is simply the minimal pressure drop across the unit. This is offset by the increased output possible due to the improved flow characteristics of the melt stream.

Improved color mixing permits the operator to reduce color concentrate “let-down” without sacrificing product opacity, surface finish, etc. Color changes are faster because the previous color left in the screw is more quickly distributed in the new color due to the additional downstream mixing of the Thermogenizer.

Other benefits such as uniform product density, freedom from color streaks, reduction or elimination of melt lines in the machine direction, etc., vary in significance from process to process. However, the principle benefits of increased productivity, higher yield from raw material and improved physical characteristics of the product amply justify the investment in a Thermogenizer.

Greerco™

High Shear Mixers



NOV



Batch or Continuous Flow High Shear Mixers



Mixing Mechanism

- High speed rotor spinning in close proximity to a fixed stator
- The first mixing zone utilizes sharp stator teeth to mill the fluid
- Next, fine serrations accelerate the fluid between the ultra smooth, hardened surfaces of the spinning rotor and stator gap
- Finally, centrifugal forces impinge fluid on the stator wall for additional refinement

Applications

- Emulsification
- Solids Incorporation
- Homogeneous Dispersions
- Solids Deagglomeration
- Rapid Blending
- Particle Size Reduction
- Prepackaging Product Refinement

Versatility

The Greerco Colloid Mill is the most versatile high shear mixer available. With a simple turn of the wheel, you can achieve the process results you have been looking for.

- The rotor-stator gap can be adjusted on the fly by turning a hand wheel
- Changing the gap setting allows the user to modify the shear rate applied to the fluid and achieve the desired process results
- Indicator dial defines gap setting position and ensures process repeatability
- This machine is designed to handle a wide range of applications and empowers the user to make simple adjustments to achieve the precise product qualities they require
- Vertical or horizontal mounting position makes our mill ideal for batch, batch-continuous or inline applications

Cost Effective Solution

Initial Investment

Unlike competitive designs, the versatility of the Greerco Colloid Mill eliminates the need for the costly additions typically offered to achieve optimal process results.

Process

Easy installation and operation maximizes process productivity while reducing cost.

Longevity

Time tested design has been proven to provide years of continuous operations with minimal maintenance costs.



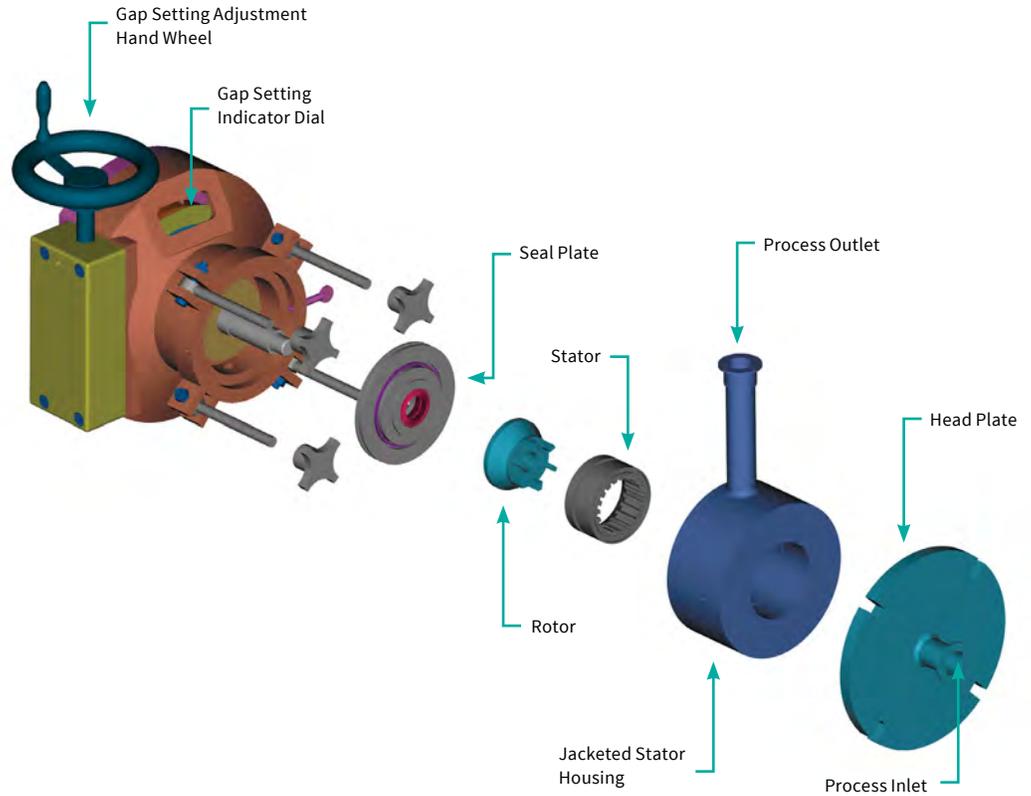
W200V

Standard Mill Construction

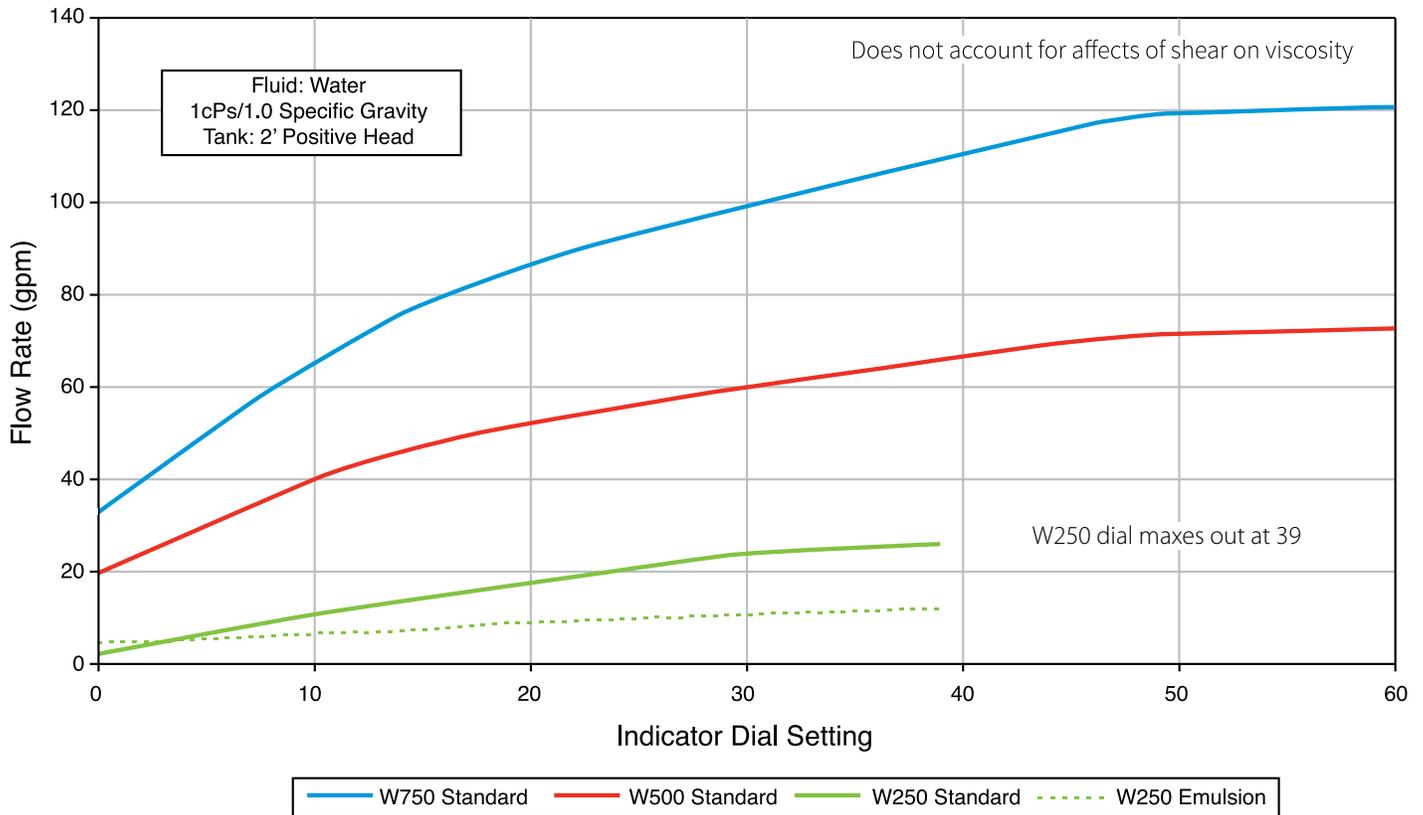
- 316 SS wetted parts impregnated with Stellite® for high wear resistance
- Jacketed stator housing with SS connections
- Lip seal shaft sealing
- Explosion proof motors
- Painted base and supports
- Viton® elastomers
- Sanitary, tri-clamp connections

Optional Features

- Alternate rotor-stator design
- Mechanical seals
- 440 hardened SS rotor-stator
- Alternate motor enclosures
- Sanitary all stainless steel supports and base
- Push cart with casters for mobility
- Macerating knife



Flow Rate vs. Gap Setting—Horizontal Colloid Mills





Continuous Flow Inline High Shear Mixers

Mixing Mechanism

- Versatile body design allows for the use of either a single rotor-stator or tandem rotor-stators to meet desired process results
- High speed turbine running in close proximity to a fixed stator creates intense hydraulic and shear forces
- Tightly held tolerances on machined components allow for consistent and predictable performance

Applications

- Solids Incorporation
- Homogeneous Dispersions
- Solids Deagglomeration
- Rapid Blending
- Particle Size Reduction
- Prepackaging Product Refinement

Reliability

The Greeco Pipeline mixer is engineered and proven to provide many years of dependable service. The design exceeds the high quality standards necessary to achieve optimal process results and withstand the rigors of difficult processes that require high shear mixing.

- Available in industrial and sanitary models
- Single or multi-stage heads for process customization
- The robust stator design handles severe duty better than competitive designs that utilize screen technology
- The axial in-axial out flow path results in higher throughputs with lower horsepower requirements
- The entire process stream is directed through the mixing head, eliminating any chance of bypassing the shear zone
- With over six decades of successful installations, the Pipeline mixer has earned its reputation as an excellent solution for high shear applications

Cost Effective Solution

Low Horsepower

Reduces initial investment and energy consumption

High Throughput

Faster processing rates improve productivity

Robust Design

Minimal downtime and maintenance costs



Greeco Pipeline mixers can easily be placed into an existing system to increase efficiency



Industrial Model

- 316SS wetted parts
- Stellite® bushings
- Single mechanical seal
- Explosion proof motors
- Painted base, guard and supports
- NPT inlet with flanged outlet



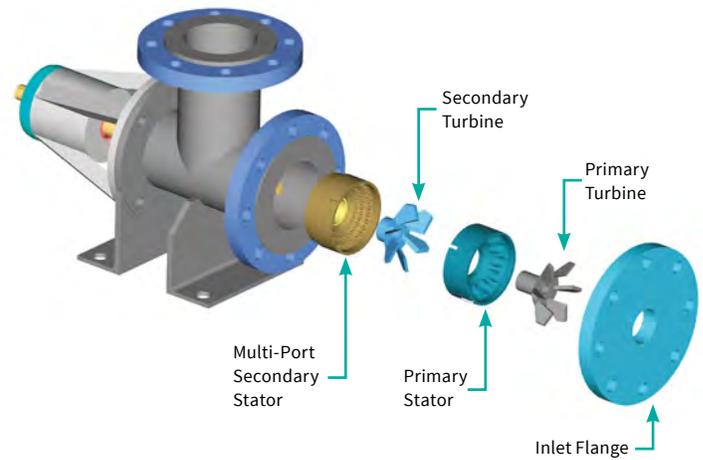
Sanitary Model

- 316SS wetted parts
- FDA Teflon stator bushing
- Sanitary, tri-clamp connections
- Single mechanical seal
- Easy clean, washdown motors
- 304SS base, guard and supports

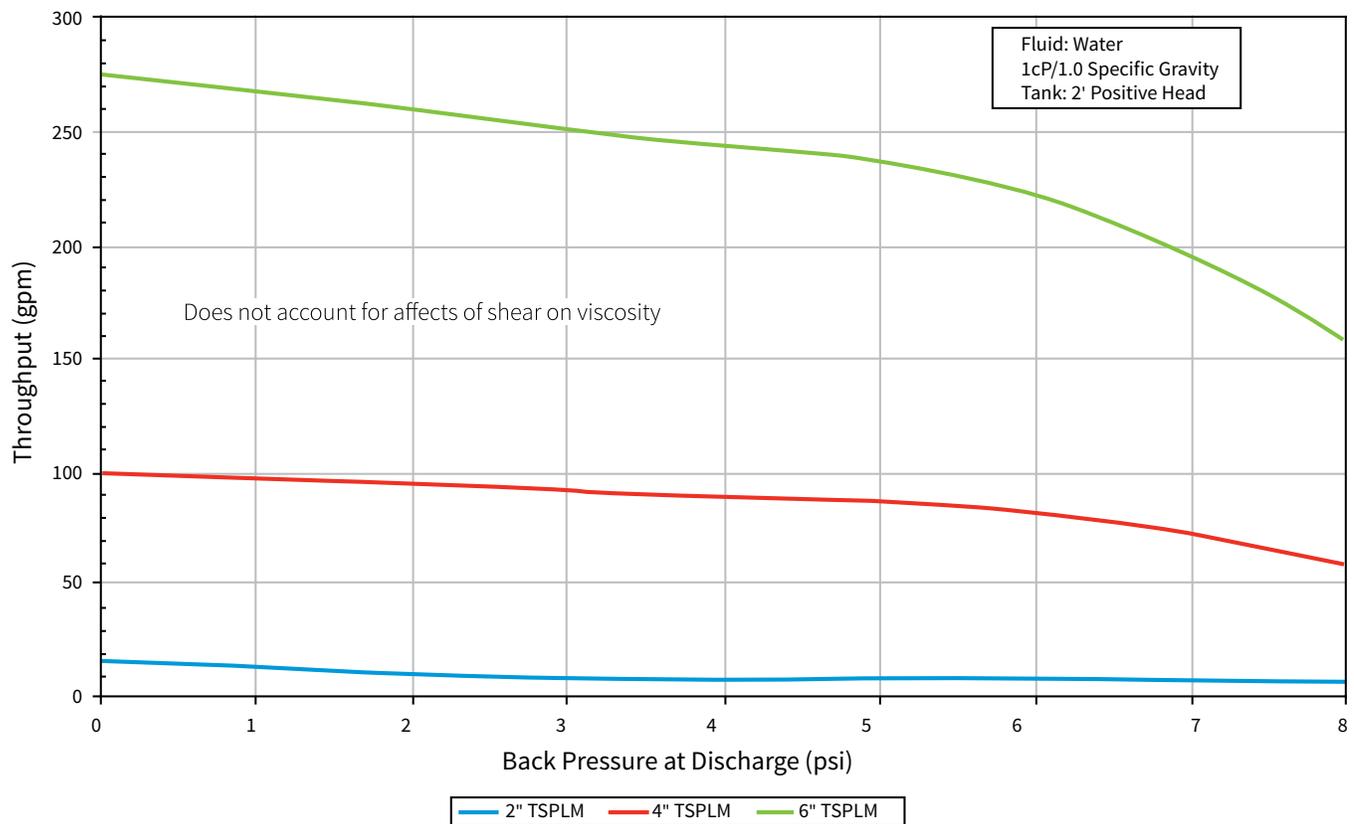
Optional Features

- Alternate stators
- Double mechanical seal
- 440 hardened SS rotor-stator
- Alternate motor enclosures
- Push cart with casters for mobility
- Jacketed body
- Alternate seals and seal faces

Standard Tandem Shear Configuration



Tandem Shear Pipeline Mixer Throughputs





Batch or Continuous Flow Tank Mounted High Shear Mixers

Reliability

The Greerco Homogenizer series offers a full range of tank mounted, high shear mixers from laboratory to production scale. The design exceeds the high quality standards necessary to achieve optimal process results and withstand the rigors of difficult processes that require high shear mixing.

- High speed turbine running in close proximity to a fixed stator creates intense hydraulic and shear forces where the product is broken down into its primary particle size or dispersed throughout the carrier phase
- Tightly held tolerances on machined components allow for consistent and predictable performance
- The robust stator design handles severe duty better than competitive designs that utilize screen technology
- The axial in–axial out flow path results in higher throughputs with lower horsepower requirements

Greerco Processing Advantages

Vs. Traditional Agitator Impeller Systems

The Homogenizer offers operating speeds and shear rates not available in traditional impeller systems. This allows our Homogenizer to dramatically reduce process times for difficult applications as well as complete complex operations where standard impeller technology is not an option (see application section for examples).

Vs. Alternate High Shear Mixing

Head Designs

The unique axial in–axial out flow pattern of our rotor-stator design allows for reversible operation. When operated in the forward direction, the Homogenizer creates an up pumping umbrella flow pattern as opposed to the localized radial-out pattern offered by competitive technology. In the reverse direction, a vortex is created that can be used to incorporate solids directly into the mixing head for immediate dispersion.

Cost Effective Solution

Low Horsepower

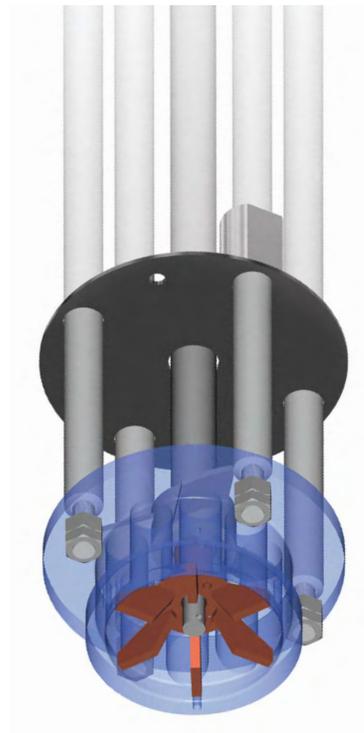
Reduces initial investment and energy consumption

High Throughput

Faster processing rates improve productivity

Robust Design

Minimal downtime and maintenance costs



Applications

- Solids Incorporation
- Homogeneous Dispersions
- Solids Deagglomeration
- Rapid Blending
- Particle Size Reduction
- Prepackaging Product Refinement

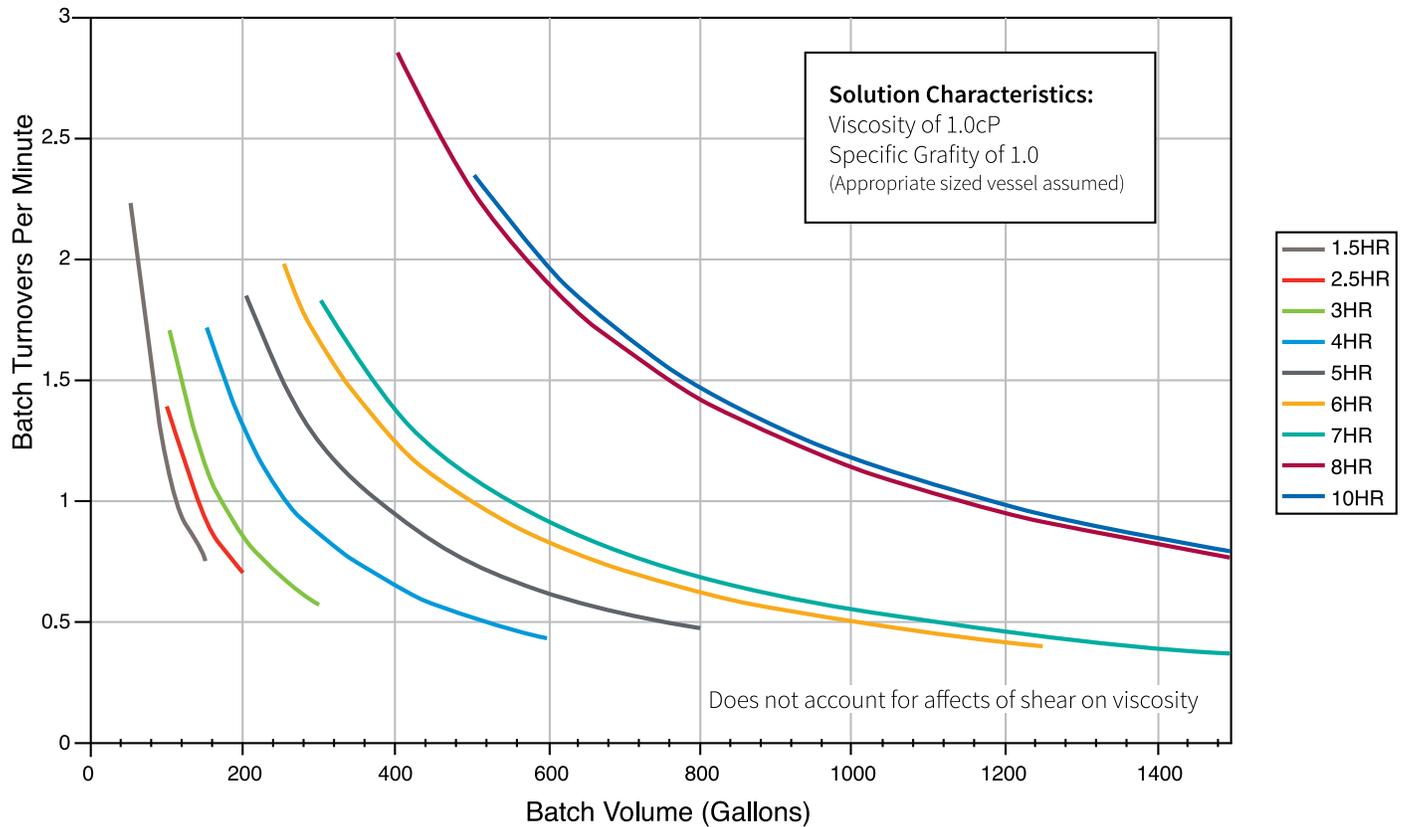
Standard Features

- 316SS wetted parts
- Stellite® bushings
- Lip seal shaft sealing
- Explosion proof motors
- Reversible operation
- SS cross supports

Optional Features

- Flange mounted units
- Double mechanical seal
- 440 hardened SS rotor-stator
- Alternate motor enclosures
- Polished wetted components

Greenco Homogenizer Tank Turnover



NOV

NOV is a leading provider of wellhead and completions services for the oil and gas industry.

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Corporate Headquarters

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USA



Mixing Technologies

Side Entering Agitators



The Proof is in the Performance

Innovative Solutions to Satisfy Your Needs

We have the capabilities, knowledge and experience to effectively evaluate application requirements and apply and/or customize our high quality mixing equipment to provide innovative mixing solutions that:

- Perform consistently
- Minimize maintenance costs and downtime
- Provide long service life
- Optimize total cost of ownership

We market our side entering agitators under the Chemineer™ and Prochem™ brand names. Side entering agitators as compared to top entering agitators typically:

- Utilize higher HP at faster rotational speeds
- Mount easily to the side of vessel with a simple pipe leg support on tie rods
- Have shorter shaft lengths and weigh less

The Mixing Technologies Difference

The extensive line of Chemineer and Prochem side entering agitators offers numerous benefits to the customer not often found in competitive equipment including:

- **Application versatility**—proprietary ChemScale™ method for effective agitator selection with both gear or belt driven configurations
- **Proven performance and extended service life**—heavy duty bearings and shafts
- **Optimal mixing efficiency**—high performance impeller options
- **Ease of maintenance**—tank shut off devices and multiple sealing options



Prochem side entering agitators satisfy critical mixing applications worldwide



HS



PB



MD

Drive Choices for Application Versatility

We manufacture and market both gear driven and belt driven, side entering agitators with over 60 years of field proven performance. Designed for demanding applications

in Pulp and Paper, Flue Gas Desulphurization (FGD), Biofuel, Petroleum Blending and Storage, BS&W and CPI vessels to name but a few, these agitators provide rugged dependability, application versatility and easy, economical maintenance.

We offer three side entering agitator designs to meet the specific requirements of your applications. The HS agitators feature a spiral bevel gear driven design for demanding applications that include significant fluctuations in load. The PB agitators feature a belt driven design that incorporates

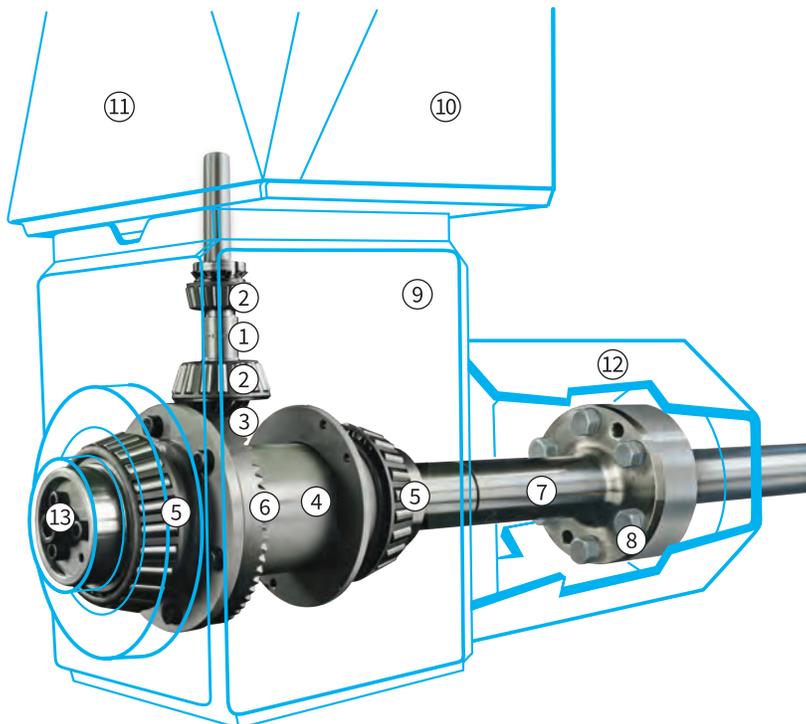
a pillow block bearing configuration for economical performance and easy maintenance. The MD agitators also feature a belt driven design, but incorporate an innovative bearing cartridge configuration that protects the bearings from the process fluids.

Chemineer Gear Driven Agitator Advantages

The HS gear driven, side entering agitators offer ruggedness and dependability in an extensive range of applications. Designed for maximum service life, the HS agitators use precision machined, surface hardened spiral bevel gear sets, high capacity tapered roller bearings and heavy duty output shafts.

Features and Benefits

	Features	Benefits
Design Parameters	<ul style="list-style-type: none"> • Four standard sizes ranging from 1 to 75 HP • Custom designs available for higher HP applications 	<ul style="list-style-type: none"> • Extensive power options to satisfy a variety of applications
	<ul style="list-style-type: none"> • Two standard output speeds <ul style="list-style-type: none"> - 350 and 230 rpm for 60 Hz designs - 290 and 190 rpm for 50 Hz designs 	<ul style="list-style-type: none"> • Application versatility to meet specific requirements
Gearing and Bearings	<ul style="list-style-type: none"> • Hardened spiral bevel gearing 	<ul style="list-style-type: none"> • Higher power transfer efficiency than other types of gearing for heavy duty performance • Generates less heat for long service life
	<ul style="list-style-type: none"> • All gears load rated per AGMA standards and inspected to AGMA Quality 10 levels 	<ul style="list-style-type: none"> • High quality ensures performance to meet all demands
	<ul style="list-style-type: none"> • High capacity, tapered roller bearings used throughout 	<ul style="list-style-type: none"> • Exceptional wear resistance and long service life • Rated at a minimum of 30,000 hour L-10 bearing life • All bearings mounted on carriers for easy maintenance

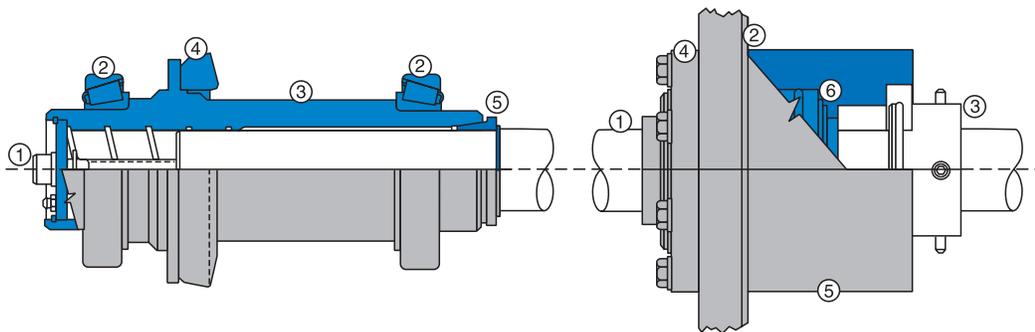


Gearbox Components

- 1 Spiral bevel pinion shaft
- 2 High speed shaft bearings
- 3 Spiral bevel pinion
- 4 Hollow shaft
- 5 Low speed shaft bearings
- 6 Spiral bevel gear
- 7 Drive shaft
- 8 Extension shaft coupling (with mechanical seal only)
- 9 Housing
- 10 Motor bracket
- 12 Coupling guard
- 13 Pedestal
- 14 Retract mechanism

Features and Benefits

	Features	Benefits
Shafts and Seals	• Large low speed shaft	• Resists deflection and prevents gear misalignment
	• Rugged, high quality extension shaft	• Minimizes deflection for excellent sealing and extended seal life
	• Output shafts available in carbon steel, 304 stainless steel, 316 stainless steel and other alloys	• Application versatility to meet a wide range of applications
	• Packed stuffing box and single, split or double mechanical seals and slurry seal are available	• Shaft sealing options provide versatility to cost effectively meet customer preferences
	• Easy seal change out	• Improves uptime of your process
Housing and Lubrication	• Drive housing, motor bracket and pedestals are all fabricated from steel plate, machine welded and precision machined	• Reduces noise level • Rugged protection of gearing for long service life • Accurate bearing alignment
	• Compact, right angle configuration	• Takes up less space • Minimizes overhung load and reduces nozzle reinforcement requirements
	• Splash lubricated	• Ensures vital lubrication to gears and bearings at all operating speeds for long service life
	• Double lip seals on drive shafting	• Prevent oil loss or contaminant infiltration for long service life
Tank Shut Off	• A standard tank shut off device contains vessel contents during routine maintenance	• No need to disassemble the agitator for routine maintenance to minimize downtime and cost



Drive Internals

- | | |
|-------------------------|------------------------|
| 1 Retract bolt assembly | 4 Spiral bevel gear |
| 2 Bearings | 5 Split tapered collar |
| 3 Hollow drive shaft | 6 Spiral bevel gear |

Shaft Seal

- | | |
|-------------------|---|
| 1 Extension shaft | 4 Cartridge seal |
| 2 Mounting flange | 5 Housing (integral with mounting flange) |
| 3 Shut off collar | 6 Throttle bushing |

Gear Driven Agitator Dimensions

Agitator Dimensions

Case Size	1	2	3	4
B	11"	11"	14"	17.25"
C	6.5"	6.5"	8.5"	10.5"
D	25.5"	25.5"	32.125"	38.5"
E	19.75"	19.75"	25"	28.75"
F	8"	8"	12"	12"
G	5.125"	5.125"	7.0625"	9.3125"
H	10.25"	10.25"	14.125"	18.625"
J	26"	26"	33"	38"
V	2"	2"	3"	3.5"

Motor Dimensions

(for totally enclosed and explosion proof, 1750 rpm motors)

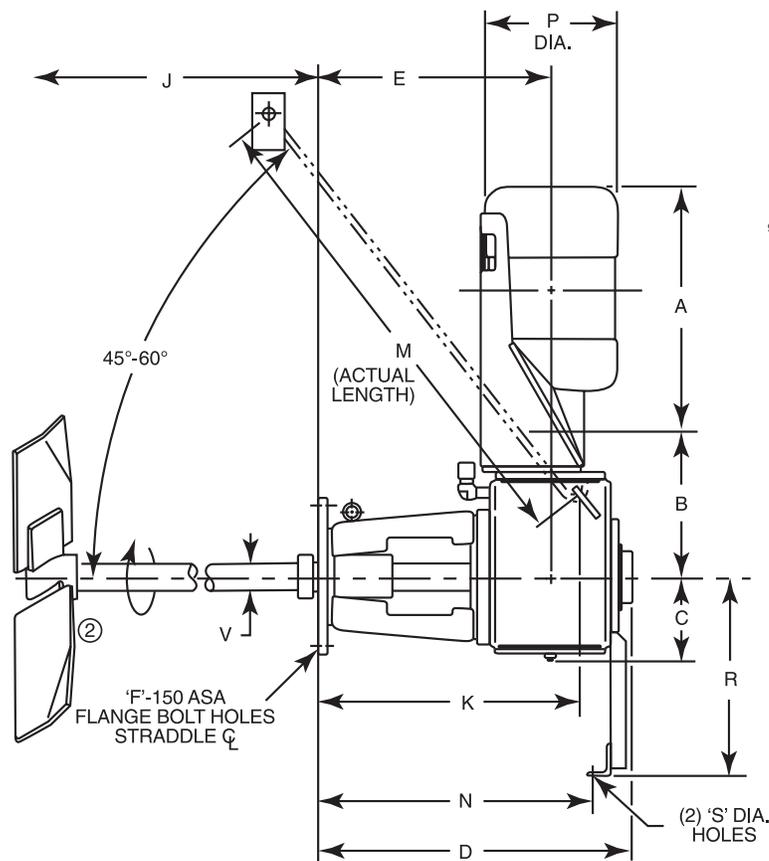
HP ①		Frame	A	P
1150 rpm	1750 rpm			
1	1	143T	12.25"	7.75"
1	1.5, 2	145T	13"	
1.5	3	182T	14.375"	9.25"
2	5	184T	15.375"	
3	7.5	213T	18"	11"
5	10	215T	29.5"	
7.5	15	254T	22.875"	12.75"
10	20	256T	24.625"	
15	25	284T	26.625"	14.5"
20	30	286T	28.125"	
25	40	324T	39.625"	16.875"
30	50	326T	31.125"	
40	60	364T	32.5"	18.5"
50	75	365T	33.5"	

Mounting Dimensions

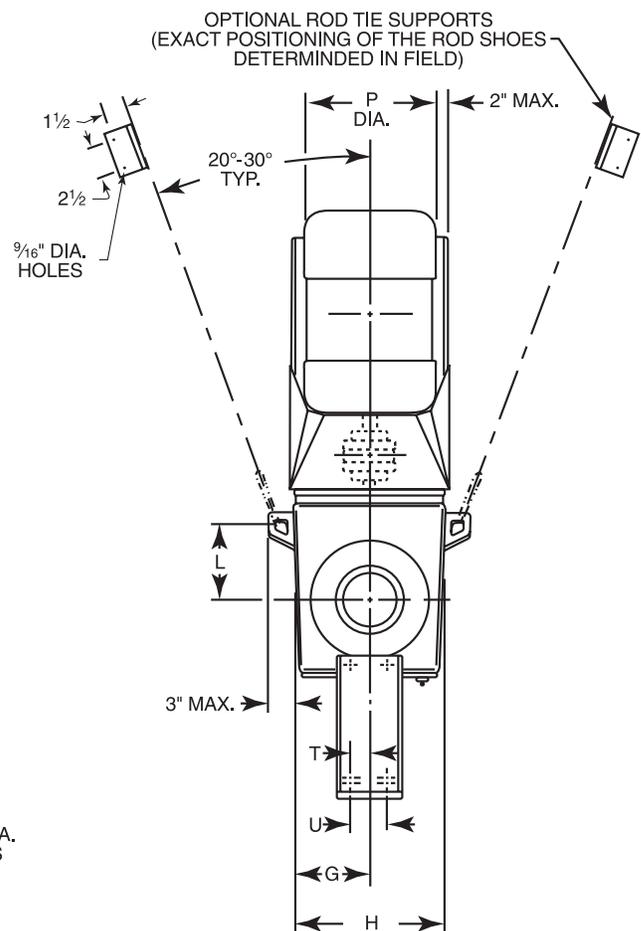
Case Size	1	2	3	4
K	20.75"	20.75"	27.125"	31.625"
L	6.25"	6.25"	7.75"	9.875"
M	66"-72"	66"-72"	78"-84"	90"-96"
N	21.375"	21.375"	27.6875"	33.5"
R	27"	27"	34"	37"
S	0.4375"	0.4375"	0.5625"	0.6875"
T	2"	2"	2.25"	2.5"
U	4"	4"	4.5"	5"

① 230 rpm units use 1150 rpm motors; 350 rpm units use 1750 rpm motors

② Impeller diameter and other options to suit application



HS



Prochem Belt Driven Agitator Advantages

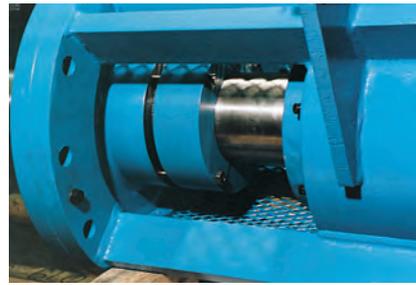
The PB and MD belt driven, side entering agitators provide easy to maintain configurations that minimize downtime and maintenance costs. Field proven performance for over 40 years makes Prochem agitators the ideal choice for a broad range of applications.

Features and Benefits

	Features	Benefits
Design Parameters	<ul style="list-style-type: none"> Standard belt drive service factor is 1.3 with optional 1.5 and 2.0 available 	<ul style="list-style-type: none"> Aligns with customers' equipment specification requirements
	<ul style="list-style-type: none"> Up to 300 HP as standard with designs up to 400 HP available (PB); up to 250 HP as standard with designs up to 500 HP available (MD) 	<ul style="list-style-type: none"> Extensive power options to satisfy a variety of applications
	<ul style="list-style-type: none"> Wetted parts available in many highly corrosion resistant materials including 316 stainless steel, 317L stainless steel, hastelloy C or titanium and other alloys available as needed 	<ul style="list-style-type: none"> Corrosive and abrasive environments can be easily handled Extends service life of wetted parts Can meet a wide range of application requirements
Bearings	<ul style="list-style-type: none"> Pillow block bearing configuration (PB) 	<ul style="list-style-type: none"> No field alignment of bearings or packing needed due to prealignment on integral mounting base Easily accessible bearings access for economical maintenance
	<ul style="list-style-type: none"> Enclosed bearing cartridge configuration (MD) 	<ul style="list-style-type: none"> Innovative design allows quick and easy replacement of bearings as a unit to reduce downtime
	<ul style="list-style-type: none"> Minimum B-10 bearing life of 100,000 hours 	<ul style="list-style-type: none"> Long bearing life for low cost of ownership
	<ul style="list-style-type: none"> Bearing shields and slingers are standard 	<ul style="list-style-type: none"> Protects bearings from the process fluid for long bearing life



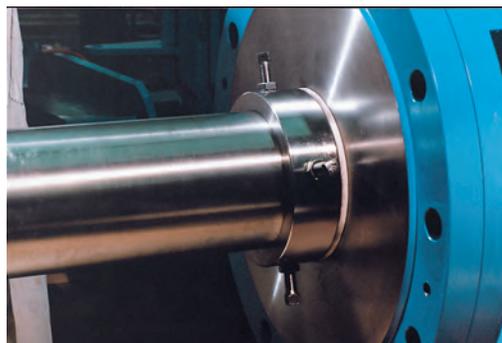
Pillow Block Assembly



Bearing Cartridge

Features and Benefits

	Features	Benefits
Shafts and Seals	<ul style="list-style-type: none"> • Shaft diameters up to 7 inches 	<ul style="list-style-type: none"> • Wide range of shaft options increases application versatility
	<ul style="list-style-type: none"> • Shafts designed to handle up to 10 times the normal operating load at full torque 	<ul style="list-style-type: none"> • Optimal performance and long service life in the most difficult applications
	<ul style="list-style-type: none"> • Packed stuffing box and single, split or double mechanical seals are available 	<ul style="list-style-type: none"> • Shaft sealing options provide versatility to cost effectively meet customer preferences
	<ul style="list-style-type: none"> • Chrome plated shaft sleeves are available 	<ul style="list-style-type: none"> • Extends shaft life in highly corrosive or abrasive applications to minimize costs
Belt Drives and Guards	<ul style="list-style-type: none"> • Ultra VX belts and sheaves are used on both the PB and MD agitators 	<ul style="list-style-type: none"> • Provides economical power transmission with shock absorbing capability for optimal performance and long life
	<ul style="list-style-type: none"> • Made to OSHA standards 	<ul style="list-style-type: none"> • Ensures operational safety of belt driven equipment
	<ul style="list-style-type: none"> • Ample ventilation regulates temperature 	<ul style="list-style-type: none"> • Cooler running agitators extend service life for low total cost of ownership
	<ul style="list-style-type: none"> • Guards on units with 3 inch or larger shafts contain access holes for adjusting belts 	<ul style="list-style-type: none"> • Quick and easy maintenance reduces costs
Housing and Mounts	<ul style="list-style-type: none"> • Designed to withstand severe loads many times that of typical application requirements 	<ul style="list-style-type: none"> • Quality construction extends service life
Tank Shut Off	<ul style="list-style-type: none"> • Optional tank shut off device contains vessel contents during routine maintenance 	<ul style="list-style-type: none"> • No need to disassemble the agitator for routine maintenance to minimize downtime and cost



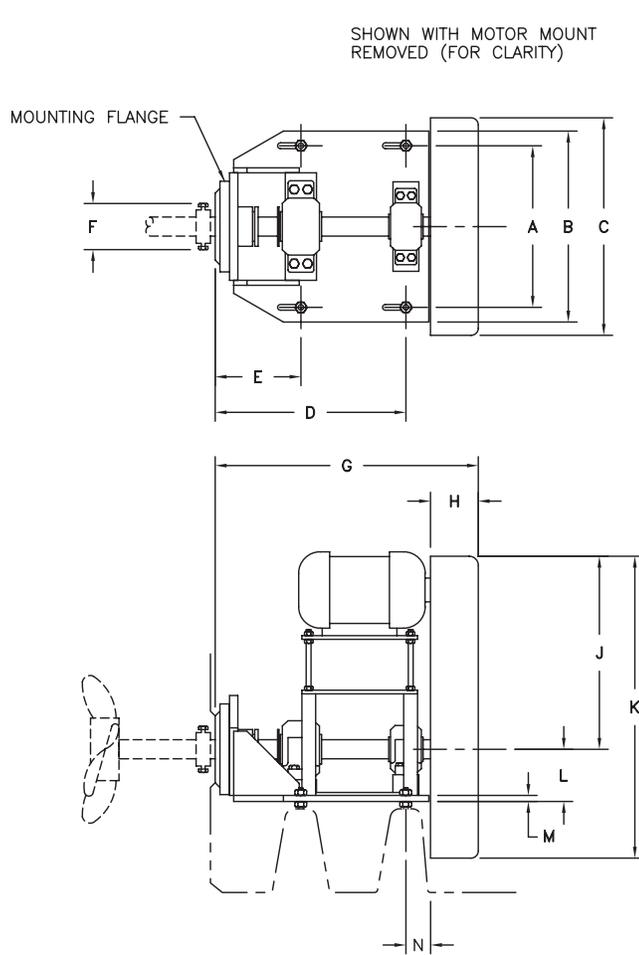
Tank Shut Off

Belt Driven Agitator Dimensions

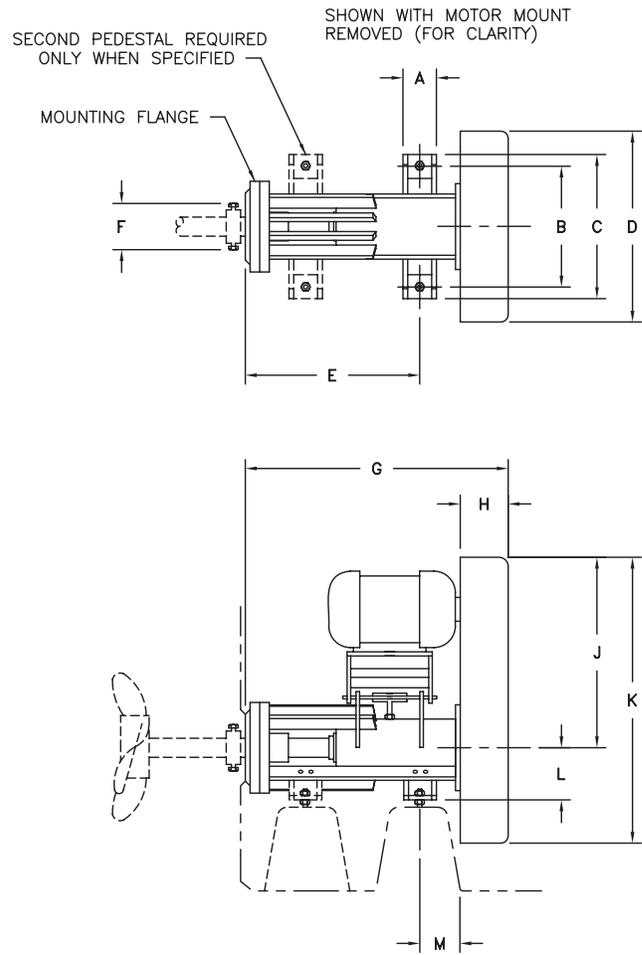
Agitator Dimensions

Model	A	B	C	D	F	F	G	H	J	K	L	M	N	Net Weight
20PB1S	20.5"	23.0"	23.0"	22.3"	8.6"	5.8"	34.3"	8.0"	20.3"	31.8"	4.9"	1.0"	3.8"	400
30PB1S	20.5"	29.0"	32.3"	25.2"	10.5"	6.8"	37.3"	8.0"	28.1"	44.3"	6.6"	1.3"	3.8"	890
40PB1S	30.0"	34.0"	43.8"	33.8"	12.8"	7.3"	48.8"	10.0"	41.9"	63.8"	8.5"	1.3"	4.8"	2000
50PB1S	39.0"	43.0"	56.3"	35.9"	15.4"	9.0"	55.9"	15.0"	50.1"	78.3"	10.3"	1.5"	4.8"	2530
60PB1S	43.0"	47.0"	56.3"	39.8"	15.7"	11.0"	59.8"	15.0"	50.1"	78.3"	13.3"	1.8"	4.8"	3240
20MD1S	4.0"	12.0"	15.0"	23.0"	20.1"	5.8"	32.1"	7.0"	20.3"	31.8"	5.0"	4.8"	—	350
25/30MD1S	5.0"	14.0"	18.0"	32.3"	23.4"	6.8"	34.3"	7.0"	28.1"	44.3"	7.0"	3.7"	—	770
35/40MD1S	6.0"	18.0"	22.0"	43.8"	28.1"	7.3"	45.6"	10.0"	41.9"	63.8"	8.6"	7.4"	—	1740
45/50MD1S	7.0"	24.0"	30.0"	56.3"	36.1"	9.0"	57.1"	15.0"	50.1"	78.3"	10.0"	5.8"	—	2200
55/60/65MD1S	10.3"	23.8"	28.8"	56.3"	34.0"	11.0"	57.5"	15.0"	50.1"	78.3"	11.0"	8.3"	—	2820

1 Net weight does not include motor, impeller or shafting beyond mounting surface, all weights are in pounds and are approximate



PB
S configuration shown
C & Z configurations available



MD
S configuration shown
C & Z configurations available

Advanced Impeller Technology

The premier impeller for our side entering units is the WSE-3 which provides high pumping and low shear rates.

This proven performer offers:

- Reduced wear through lower tip speeds
- Hydrodynamic design for greater cavitation resistance than other impeller designs

- Easier maintenance with bolted blade construction
- High efficiency for maximum pumping action resulting from its hydrofoil design

In addition to the WSE-3 impeller, we also offer the Mark III or HE-3S upon request. Each impeller offers unique performance characteristics for specific application requirements.



HE-3S



WSE-3



Mark III

Industry Leading Aftermarket and Technical Support

Features

Benefits

<ul style="list-style-type: none"> • Extensive network of factory trained field sales representatives and in house application engineers 	<ul style="list-style-type: none"> • Experienced application specialists provide effective fluid mixing solutions
<ul style="list-style-type: none"> • Superior field technical support and an extensive inventory of replacement parts available 	<ul style="list-style-type: none"> • Installation, maintenance and troubleshooting support reduces downtime and costs
<ul style="list-style-type: none"> • 24/7 hotline available 	<ul style="list-style-type: none"> • Call +1-937-926-1724

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Chemineer™ Impellers



NOV

XE-3 impeller installed in a wastewater treatment facility in the United Kingdom



Advanced Technology for Superior Performance

Our impeller designs are the result of over six decades of research and applied application experience, resulting in the broadest range of durable and efficient impeller options. Proprietary technologies are applied to thoroughly analyze all process parameters, ensuring proper impeller selection for optimal performance in every application. Carbon steel, 316/316L stainless steel, high alloys and coatings are available for all impellers.

XE-3



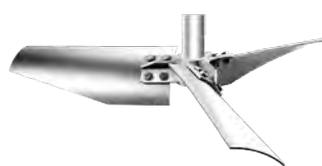
- Most efficient axial flow impeller for heat transfer, blending and solids suspension applications
- Mechanical design reduces weight allowing longer shafts without the need for additional support
- Can replace less efficient impellers and reduce energy costs

HE-3



- An established industry standard for axial flow impellers
- Extremely efficient: creates greater fluid motion with less energy
- Ideal for blending, heat transfer and solids suspension

SC-3



- Engineered for deep tank applications utilizing rolled blade design
- Produces flow of larger impellers without added weight or loss of efficiency

Maxflo W



- Excellent performance in abrasive solids suspension, liquid-solid-gas and boiling or near boiling applications
- High solidity blade design translates into improved mass transfer over other high efficiency designs

Impeller Selection Guide

Application	Impeller Type(s)
Miscible Fluids Blending	High Efficiency (XE-3, HE-3, SC-3, RL-3)
Solids Suspension	High Efficiency (XE-3, HE-3, SC-3, RL-3, Maxflo W)
Three Phase Process	Gas Dispersion (BT-6, CD-6, Maxflo W)
Immiscible Fluids Blending	ChemShear, P-4
High Viscosity	Helix, Anchor, Screw
Transitional Flow	JT-2

Solids Suspension

Intensity	Definition
Solids Motion	Solids are allowed to settle on the vessel bottom, but remain in motion.
Complete Suspension	None of the solids remain on the vessel base for a significant length of time.
Uniform Suspension	Homogeneous distribution of solids throughout the liquid volume.

ChemScale™

The industry standard method for effective mixer selection

ChemScale	Blending Description
1-2	Mild blending and motion. Produces a flat, but moving fluid surface.
3-5	Intermediate/moderate blending of miscible liquids when specific gravity differences are less than 0.6. Produces surface rippling at water-like viscosities.
6-8	Moderate to vigorous agitation for uniform blending of miscible liquids when specific gravity differences are less than 0.6. Produces surface rippling at lower viscosities.
9-10	Very vigorous agitation for uniform blending of miscible liquids when specific gravity differences are less than 1.0. Produces violent surface motion at lower viscosities.



Chemineer agitators can be equipped with a large range of impeller styles and sizes

P-4



- Axial flow design suitable for wide changes in process viscosity
- Efficient for immiscible blending applications where shear and pumping is required
- Excellent for solids incorporation from the liquid surface

JP-3



- Marine style energy efficient design
- Ideal for small batches
- Handles higher viscosities than hydrofoil designs

S-4



- Close clearance design for operation near the tank bottom
- Excellent for low liquid level solids suspension applications
- Designed for use in laminar regime applications

ChemShear



- Customize levels of shear to suit your process
- Proper fluid turnover minimizes the need for auxiliary pumping impellers
- Small particles possible: 2 microns achieved in processes such as micro-encapsulation
- Traditional dispersion blades—such as the BT-6, CD-6, and D-6—can also be used in high shear applications



One of twenty-four Chemineer agitators installed at this facility for water treatment

Double Helical Ribbon



- Proven the best high viscosity, laminar flow impeller
- Highly effective in heat transfer
- Efficiently incorporates surface liquids and solids
- For viscosities over 30,000 MPa

Anchor



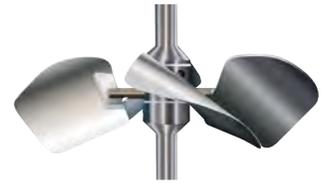
- Most economical laminar flow impeller available
- Horizontal flow well suited for low liquid level geometries
- Solve heat transfer fouling problems with optional wall scrapers

Screw (Auger)



- Ideal for shear sensitive, uniform blending applications (polymers)
- Excellent top to bottom turnover flow characteristics
- Use in mildly pseudoplastic applications with power law indexes as low as 0.5

Smoothline



- Innovative patented design
- Liquid-shedding surfaces and concealed hardware for enhanced CIP performance
- FDA/USP CL VI materials
- Removable components allow ease of installation through small openings
- Axial or radial flow, single or multiple impellers

JT-2



- Transitional flow impeller for superior blending
- The design promotes blending by efficiently moving material in one direction in the center of the tank and the opposite direction on the outside of the tank

BT-6



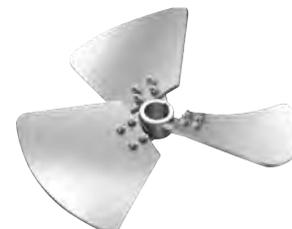
- Parabolic blade design engineered for maximum performance
- Highest gas dispersing capability at nearly six times the D-6 (Rushton) turbine
- Lower power drop in the gassed state improves mass transfer
- Relatively insensitive to viscosity

CD-6



- CD-6: Curved blade design similar to the BT-6
- CD-6 has gas dispersing capability over two times that of the D-6 (Rushton) turbine

WSE-3



- Advanced side entering hydrofoil design with high efficiency for maximum pumping action
- More cavitation resistant than other designs through effective hydrodynamic design
- Reduced wear through lower tip speeds

RL-3



- Engineered to prevent fibrous material build up by eliminating edges and protrusions that would allow fibrous material to agglomerate
- High axial flow impeller for superior mixing performance in blending and solids suspension applications
- Strong central hub and sturdy blades designed to handle the loads related to material and flow impingement to ensure reliable operation and long service life



120" RL-3 impeller shipping to a facility in Florida to be used to prevent fibrous buildup in an application where ragging is a significant issue

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NOV Chemicals

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Chemineer™ XE-3 High Efficiency Impeller



The XE-3 impeller is designed to provide high flow and low shear with an optimized shape to maximize mechanical strength. Designed using high tech Laser Doppler Anemometry, Digital Particle Image Velocimetry, and Computational Fluid Mixing, the XE-3 impeller is always the right choice for flow controlled processes.

The XE-3 high efficiency impeller offers significant performance advantages and cost savings.



Installed XE-3 impeller at a wastewater treatment facility

Process Efficiency

- High axial flow for improved blending and solids suspension applications
- Possible reduction in the horsepower and size of the gear drive required to achieve the desired mixing result

Mechanical Design

- Decreases impeller weight by nearly 40% over other high efficiency impellers
- Longer in-tank shafts can be used without the need for steady bearings

Typical Flow Controlled Applications

- Storage Tanks
- Water and Waste Treatment
- Miscible Fluid Blending
- Chemical and Polymers
- Mining Applications
- Heat Transfer Applications with internal coils or jacketed vessels
- Solids Suspension Applications
- Mud Mixers
- Corn Processing and Ethanol

Upgrade Opportunity

- The impeller weight is similar or less than older, less efficient impeller designs
- The superior performance of the XE-3 high efficiency impeller can almost double a pitched blade impeller pumping rate at an equivalent torque level
- Can retrofit to Chemineer or competitors' older impeller designs



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Chemineer™ HE-3 High Efficiency Impeller



The Chemineer high efficiency (HE-3) impeller provides all of the benefits of more efficient agitation with very few design limitations. Improved agitation efficiency and greater process flexibility are now available with a practical, fabricated impeller.

What is high efficiency agitation? In an engineering sense, high efficiency agitation means that the same process results are achieved with reduced mechanical or energy requirements. On the business side, high efficiency agitation means reduced capital and operating costs.

The Chemineer high efficiency impeller is a result of extensive testing, and is supported by new technology for proper process application. The HE-3 impeller has three specially designed blades, mounted at a shallow angle, to provide a high degree of axial flow with minimal power requirements. Thus, the HE-3 impeller is able to create more liquid motion with less energy.

An extremely efficient turbulent flow impeller for blending, heat transfer and solids suspension developed to minimize the creation of trailing vortices and incorporating the otherwise wasted energy into macro-flow.

Process Efficiency

Any successful agitator design must provide some required level of process performance. Although process performance has many meanings in the chemical process industries, agitator design has been quantified for most typical applications. Our ChemScale™ design procedure is one of the best methods for relating agitation intensity to process performance. The development of a high efficiency impeller does not change the concept of ChemScale; only the size of agitator required for a given process result changes.

Although bulk fluid velocity, as defined in ChemScale, is a convenient means of characterizing agitation intensity, it is just an indirect measure of process performance. Both the magnitude and the direction of fluid velocities are important in agitation, and must be correctly related to process performance. Thus in addition to basic hydrodynamic measurements, extensive experience and testing with a variety of blending and solids suspension problems are behind each application of an HE-3 impeller.

The effects of flow patterns are also important in determining impeller efficiency. The HE-3 impeller creates axial flow with less radial and rotational flow than a standard pitched blade (P-4) turbine. The discharge from the high efficiency impeller spreads less

rapidly, thus allowing the impeller to be successfully placed farther from the bottom of the tank. Consequently, tank geometry is less of a factor in designs using an HE-3 impeller because the strong axial flow will control a wider range of liquid levels.

Different agitator horsepower and speed combinations are capable of providing similar process performance with any one type of impeller in most applications. When different types of impellers are considered, even more equipment combinations will produce similar results.

The agitator selections for two different process situations are shown in the tables on the reverse side. Four different agitators, capable of similar process performance using standard P-4 impellers, are compared with four agitators using HE-3 impellers for each situation. A smaller Chemineer HT agitator drive size is required for the same process results. Similar or lower horsepower motors can be used with the larger diameter HE-3 impellers.

The benefits of a more efficient impeller delivering equivalent process performance are available for both new and existing applications. Many agitators can be updated by replacing standard P-4 impellers with HE-3 impellers to improve blending, heat transfer, or solids suspension.



Chemineer HE-3 High Efficiency Impeller

Agitator Performance Comparison

	45° Pitch Bladed Impeller				High Efficiency Impeller HE-3			
	Case Size	Motor Power	Agitator Speed	P-4 Diameter	Case Size	Motor Power	Agitator Speed	HE-3 Diameter
Process Situation A	3HT	3 HP	30 rpm	64"	2HT	2 HP	37 rpm	68"
	3HT	7.5 HP	68 rpm	44"	2HT	3 HP	56 rpm	57"
	3HT	10 HP	84 rpm	40"	2HT	5 HP	84 rpm	50"
	3HT	15 HP	125 rpm	36"	2HT	7.5 HP	125 rpm	43"
Process Situation B	5HT	15 HP	45 rpm	66"	4HT	5 HP	30 rpm	92"
	5HT	20 HP	56 rpm	64"	4HT	7.5 HP	37 rpm	88"
	6HT	30 HP	68 rpm	62"	4HT	10 HP	56 rpm	71"
	6HT	40 HP	84 rpm	56"	4HT	15 HP	68 rpm	71"

Process Situation Results

For each of two different process situations, eight equivalent ChemScale selections are shown. Each situation shows that several alternative horsepower and speed combinations are capable of similar results, but the efficient performance of the HE-3 impeller consistently reduces the drive size.

Impeller Technology

In some ways the axial flow produced by an agitator impeller is related to the thrust created by a marine or aircraft propeller. To create either axial flow or thrust, an impeller must impart momentum to the fluid. The energy which is not transferred to the fluid as momentum is dissipated as turbulence. In agitator applications where fluid motion is a principle design consideration, as in many blending and solids suspension problems, the efficient conversion of energy to fluid momentum is important.

Impeller design for improved axial flow requires an understanding of the lift and drag characteristics of different blade shapes. The length, width,

and thickness of the blades of our high efficiency impeller are optimized for performance, as well as strength and weight. Careful evaluation of the different impeller design variables in actual agitation situations resulted in an efficient and practical design for the HE-3 impeller.

A special blade contour provides many of the improved performance characteristics of the HE-3 impeller. Reduced drag at the leading edges of the blades efficiently converts mechanical energy to fluid motion. All of these performance benefits are achieved with practical fabrication techniques for economical application of high efficiency agitation to many different process situations.

HE-3 Impeller Features

For many years high efficiency impeller designs required either heavy castings or complicated fabrications. These options severely limited the application of such impellers to small or very special agitation equipment. The HE-3 impeller combines the performance benefits of high efficiency designs with the practical features of fabricated turbine construction.

Standard impeller sizes from 22 to 120 inches in diameter are readily available. Designs requiring smaller or larger impellers have been built for specific applications.

The standard materials of construction are carbon steel and 304 or 316 stainless steel. High alloys are available when required for severe environments. Optional rubber covering offers resistance to both corrosion and erosion.

Blades bolted to standard hubs simplify installation. Smooth and steady impeller performance eliminates the need for stabilizer fins, even with long shafts. HE-3 impellers are available for all sizes and types of Chemineer agitator drives.

For a complete review of your specific process requirements and the most efficient agitator design for your application, please contact your local sales representative.





Superior Performance

The RL-3 ragless impeller is specifically engineered to prevent fibrous material build up. This is accomplished through several key product design features that eliminate any edges or protrusions that would allow fibrous material to agglomerate. Some of the design features include:

- A sweeping leading edge on the impeller blades
- A swept back connection to the central hub
- Welded design or bolted design with non-protruding fasteners
- High axial flow RL-3 impeller for superior mixing performance in blending and solids suspension applications

The RL-3 ragless impeller eliminates expensive maintenance and downtime caused by fibrous material build up on the agitator's impeller.

Safe and Reliable Operation

The RL-3 impeller eliminates the need to frequently raise the shaft and impeller from the fluid in order to remove the fibrous material build up, providing significant benefits that include:

- Increased safety by eliminating frequent handling of the agitator by maintenance personnel
- Reduction in downtime and maintenance costs
- Elimination of fibrous material handling and disposal
- Strong central hub and sturdy blades designed to handle the loads related to material and flow impingement to ensure reliable operation and long service life

Minimal Maintenance and Fast Replacement

- The only maintenance required on the RL-3 impeller is a visual inspection during normal shutdown periods, saving time and reducing maintenance costs
- Existing agitators with impellers that are prone to ragging can be quickly and easily retrofitted with the RL-3 impeller using simple hub to shaft connections
- New installations using the RL-3 impeller can be completed quickly and easily

Application Versatility

- The RL-3 impeller is available in a wide range of sizes for quick and easy scaling to match process requirements
- A variety of materials of construction and impeller coverings are available to ensure application versatility
- High axial flow allows impeller placement higher in the basin and maintains complete basin control

Troubleshooting and Replacement Parts Assistance

- Application engineers are available to review your application requirements and recommend the proper RL-3 impeller to improve overall mixing performance
- Factory trained technicians are available for onsite troubleshooting and service of all your agitators to meet your needs
- Impeller sizing and retrofitting support services are available to ensure optimal performance and economical total cost of ownership



HE-3 impeller ragging after eight weeks in operation at a Florida wastewater treatment facility

Prevents Build Up

In blending and solids suspension applications where the fluid contains fibrous material, the resulting build up on the agitator's impeller can deteriorate performance, increase energy costs and even damage the agitator seals and gearbox causing costly repair. The RL-3 ragless impeller prevents build up to eliminate maintenance costs and downtime, increase performance and extend the service life of the agitator.

Product Specifications

Sizes Available

- Impeller sizes range from lab scale to over 200" in diameter

Material Selection

- Carbon steel
- Stainless steel
- High alloy material
- Rubber, elastomeric or FRP impeller coverings available

Configuration Options

- Hub welded to shaft with welded blades
- Hub keyed to shaft with blades welded to hub
- Available in all bolted construction

Highest Overall Rating

During an independent study of ragless impeller technology, the RL-3 was rated the highest overall when compared against competitors for total suspended solids (TSS), visual ragging, number of installations and value.



Fibrous build up of a competitive ragless impeller

Chemineer™ JT-2 Transitional Flow Impeller

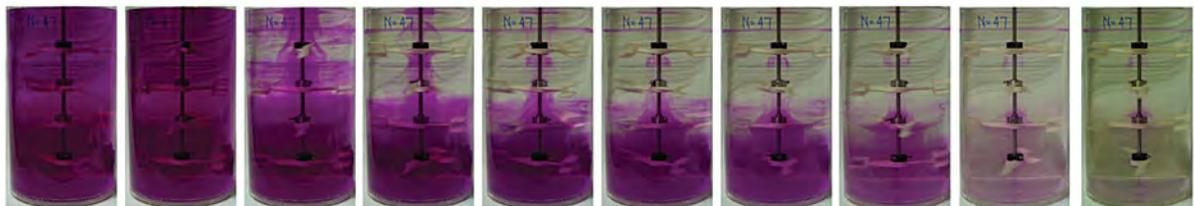


The JT-2 impeller is used for superior blending in transitional flow. High viscosity and non-Newtonian fluids make blending much more challenging. This impeller is used after conventional turbines have lost efficiency due to viscous effects and before the need for close clearance impellers.

The design promotes blending by efficiently moving material in one direction in the center of the tank and the opposite direction on the outside of the tank. The increase in efficiency of this impeller comes from the improved flow pattern that greatly reduces recirculation zones that extend the blend times of other impellers. This flow pattern improves the top to bottom communication in the vessel.

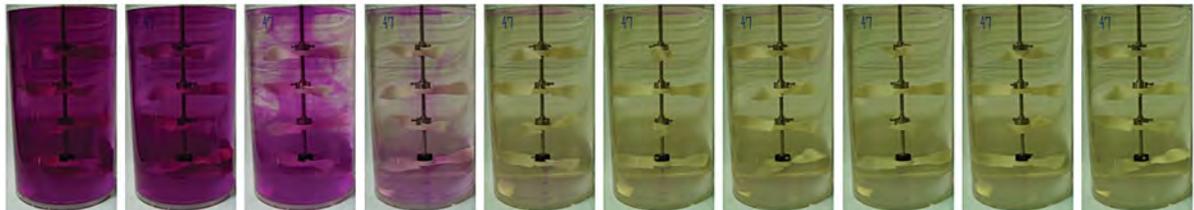
Enjoy superior blending in transitional flow.

Competitive Product



0 sec 10 sec 20 sec 30 sec 40 sec 50 sec 60 sec 70 sec 80 sec 90 sec

Chemineer JT-2 Impeller



Benefits

- Up to 50% reduction in power draw for the same blending performance compared with competitive impellers
- Significantly lower total machine cost compared to competitive designs
- Two bladed impeller for easy installation into vessels
- Design operates in either direction
- Improved heat transfer with impeller between 70% and 90% of the tank diameter
- Larger impeller diameter reduces the need for a close clearance impeller (Helix / Anchor) in the low transitional regime

Applications

- Polymerizations
- Food Processes
- Biopharma Processes
- Fermentations
- Paint Processes
- Heat Transfer and Blending Processes
- High Solid Loading Slurries
 - Coal
 - Catalysts

Efficiency

The improved flow pattern generated by the JT-2 impeller reduces circulation zones and promotes flow between impellers. This accelerates blending, yielding blend time reductions of up to 40% compared to competitive products. Users are able to improve process performance and reduce energy consumption.



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The unique blade geometry of the BT-6 creates optimal flow conditions above and below the disc to efficiently disperse gas at even the highest flow rate.

The BT-6 impeller provides you with state of the art technology in gas dispersion applications. It was developed using the most modern flow measurement techniques and its patented blade geometry efficiently disperses gas at even the highest flow rates.

Due to the efficient dispersion mechanism of the BT-6, this impeller can handle more than five times as much gas as the D-6 impeller (Rushton turbine) before flooding, and more than twice as much as Chemineer's concave blade CD-6 impeller (Smith turbine).

Another benefit of the BT-6 impeller is a very flat power draw curve under gassed conditions. Since its power draw varies little with gas flow rate, the BT-6 impeller is particularly well suited for applications where gas flow rates change during the process, such as Hydrogenators. Another advantage of the more constant power draw is that changes in mass transfer during the process are smaller than with other impellers. The power draw of the BT-6 shows minimal variation when exposed to changes in liquid viscosity; it remains constant for Reynolds numbers well below one thousand, which corresponds to viscosities of several thousand centipoise in typical industrial applications.

The blade design, asymmetric about the plane of the disc, has been optimized to take into account the different flow conditions above and below the disc. The BT-6 impeller's asymmetric design allows the overhang on the top of the blade to capture the rising gas flow. The gas flow is then dispersed from a strong turbulent vortex on the inside of the deep blade. No cavities form on the trailing edges of the blades.

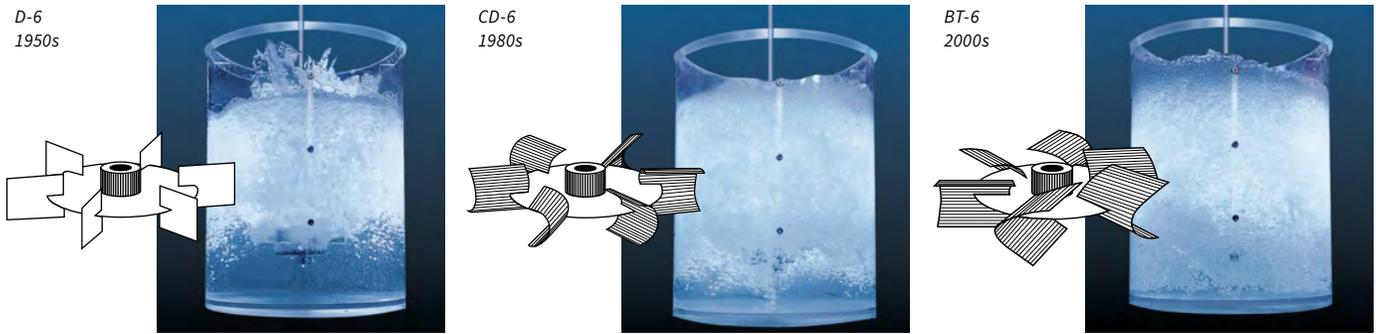
In tall tanks the radial pumping BT-6 is used as the primary gas dispersion impeller mounted directly above the gas sparger in the bottom of the tank. Axial flow impellers, such as the wide blade Maxflo W hydrofoil or the narrow blade XE-3 high efficiency impeller, are used as upper impellers. This impeller configuration combines efficient gas dispersion with good overall top to bottom blending. Uniform dissolved gas distribution is achieved throughout the vessel.

Our BT-6 impeller offers many advantages over conventional gas dispersion technology:

- Greater dispersion capability
- Higher rates of interphase mass transfer
- Minimal power draw sensitivity to changes in liquid viscosity and gas flow rate
- Increased pumping capacity improves blend times and heat transfer

BT-6 impellers are available in the normal configuration of six blades with a choice of welded, bolted, or adjustable blades. Standard materials of construction are carbon steel or 316 stainless steel. Fabrications from special alloys are also available. Please contact your local sales representative for assistance with your specific gas dispersion requirements.

Chemineer BT-6 Gas Dispersion Impeller



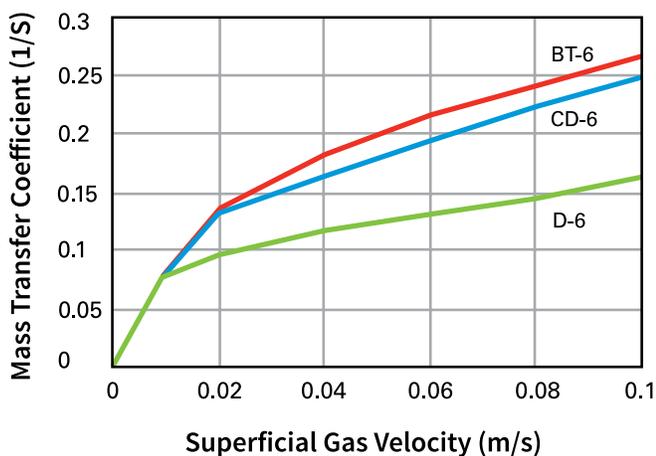
Three Generations of Gas Dispersion Impeller Technology

The BT-6 is the leader in gas dispersion impeller technology. For over thirty years the D-6 disc style turbine with flat blades was the primary choice for gas dispersion applications. The CD-6 impeller, which was developed in the late 1980's, is characterized by its concave blade shape. The CD-6 rapidly established itself as far superior to the D-6 with its capability of dispersing more gas combined with a power draw considerably less sensitive to changes in the gas flow rate. The CD-6 revolutionized the field of gas-liquid agitation and quickly

became the standard design. There is more than 200,000 HP of agitators installed with this impeller. The next generation gas dispersion impeller, the BT-6, is the result of the knowledge gained from our broad CD-6 installation base and our extensive research and development efforts. The BT-6 technology combines the concave blade concept with vertically asymmetric blades that are shaped to make optimum use of the different flow conditions above and below the impeller. The photos above show a comparison

between the dispersion performance of the three impellers at a very high gas flow rate of 13 VVM, corresponding to a superficial gas velocity of more than 0.1 m/s (0.33 ft/s) at this scale. At this high gas flow rate, the D-6 (left) is clearly flooded and cannot disperse the gas. This is apparent from the gas that shrouds the impeller and the surging surface as large gas bubbles jet through the system. The CD-6 (center) disperses the gas, driving it to the vessel wall and producing a smooth surface. The BT-6 (right) not only forces

the gas to the wall, it distributes the gas throughout the entire liquid volume, bottom to top, providing better mass transfer and uniformity. The higher liquid level in the vessel indicates a higher gas holdup, one of the reasons for the improved mass transfer. In studies of dozens of different impeller styles, the BT-6 consistently produced the most uniform gas dispersion. The BT-6, with more than 300,000 HP of installed agitator power, is always the right choice for your gas dispersion applications.



Mass Transfer Comparison

The rate of mass transfer between the gas and the liquid is of critical importance in many processes. The graph shows a mass transfer comparison between the BT-6, the CD-6 and the D-6. The mass transfer coefficient is plotted as a function of the superficial gas velocity. All impellers are operating at the same speed and are designed to draw the same ungasged power. As the gas flow rate increases, so does the mass transfer coefficient. At the highest gas flow rates, the CD-6 impeller provides more than 40% improvement in mass transfer over the D-6. The BT-6 increases the mass transfer rate by as much as 60% when compared to the D-6.





The CD-6 impeller improves the mass transfer rate as much as 50% in gas dispersion operations.

The Chemineer Concave Disc (CD-6) impeller is revolutionizing the field of agitated gas dispersion. In applications of high energy agitation and high gas rates, this impeller will significantly improve the mass transfer factor, $k_L a$. Given the same conditions of power per volume and superficial gas velocity, mass transfer factors can nearly double when the CD-6 impeller is used instead of the conventional flat blade disc impeller.

In addition to significantly improving mass transfer factors, the CD-6 impeller will handle at least 46% more gas before flooding than the flat blade disc impeller. This capability gives added benefit in operations where upset conditions could otherwise flood the flat blade disc style impeller.

Most applications designed with the CD-6 impeller also use our HE-3 or XE-3 high efficiency impeller for pumping within the vessel. This configuration utilizes a combination of impellers; the bottom impeller is the CD-6 and the upper impellers, at times as many as four, are HE-3s or XE-3s.

The CD-6 accomplishes the primary dispersion while the HE-3 or XE-3 high efficiency impeller provides good overall top to bottom flow and rapid blend times. In applications such as Fermentation, this combination results in uniform dissolved oxygen distribution within the fermenter and shorter blend times for additives.

Impeller Development

The original concave blade concept was developed in the 1970s at Delft University by a group led by John M. Smith. Independent testing has been done over the past decade by private research groups and the findings have confirmed that at the high end of gas flow rates and agitator energy density, the concave blade disc impeller can show dramatic improvements in mass transfer factors over the standard flat blade disc design.

The CD-6 impeller was developed by Chemineer as a result of our extensive study of this concept. Parameters which affect power draw, pumping capacity, etc., were investigated thoroughly in addition to the mass transfer characteristics. Testing was done using two different configurations: the CD-6 alone and combined with the HE-3 high efficiency impeller in the upper positions. The testing was done in a clean water mass transfer testing facility in our laboratory. Data collection and analysis was facilitated by a computer based data acquisition system.

Laboratory testing under fixed conditions, however, may not always be a true representation of actual operating conditions. We have verified our laboratory testing by many field proven installations. Our industrial experience includes dozens of installations utilizing the CD-6 impeller in gas dispersion operations, including applications to 1000 horsepower. These installations have confirmed power draws predicted during gassing and have demonstrated improved mass transfer rates by as much as 50% over the flat blade disc impeller.

Chemineer CD-6 Concave Disc Impeller

Process Performance

Fundamentally, the mass transfer rate, normally expressed in engineering terms, is the product of the mass transfer coefficient, the interfacial area per unit volume of liquid and the mean gas concentration deficit.

In agitated gas dispersion, the mass transfer factor, $k_L a$, has been correlated against mixer inputted power per unit volume and superficial gas velocity:

$$k_L a = (P/V)^b (V_{sg})^c$$

where

P/V = power per unit volume

V_{sg} = superficial gas velocity

The degree of mass transfer is directly proportional to the mass transfer factor, $k_L a$. Thus, all other things being equal, a

doubling of the mass transfer factor will result in a doubling of the rate of mass transfer.

It is this mass transfer factor which, under the same conditions of power per unit volume and superficial gas velocity, can nearly double when using the CD-6 impeller.

The CD-6 impeller also improves $k_L a$ by pumping more liquid under gassing conditions. There are two processes in gas dispersion which continually oppose each other: dispersion and coalescence. These two opposing rate processes have dramatic effects on the mass transfer factor, $k_L a$. The CD-6 impeller minimizes the tendency for coalescence by decreasing the probability of bubbles existing in the same incremental flow volume.

Since the CD-6 impeller pumps more liquid, the probability of two bubbles coalescing is reduced. As the gas rate is increased, the advantages of using the CD-6 also increase. Typical performance curves comparing the ratio of $k_L a$ for a CD-6 impeller to a flat blade disc (D-6) impeller are shown in the graph as a function of horsepower per one thousand gallons and superficial gas velocity.

The improvement or "enhancement" increases markedly for power levels of 15 to 20 horsepower per 1000 gallons and superficial gas velocities of 0.2 to 0.3 ft./sec.

CD-6 Impeller Features

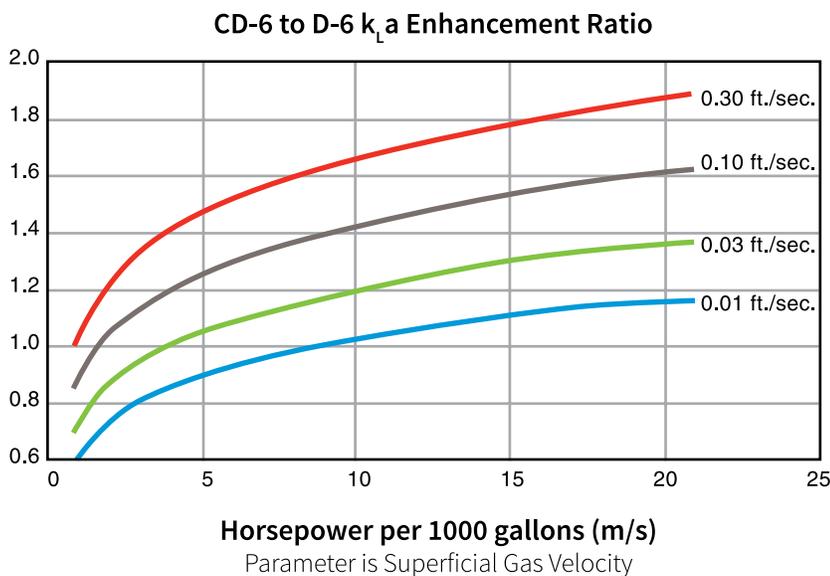
The CD-6 impeller is available in a standard configuration of six concave blades offered in three construction styles: (1) all welded, (2) bolted and (3) adjustable.

The adjustable style permits impeller diameter adjustments of $\pm 6\%$, which translates to a $\pm 25\%$ invested power variation. The adjustable construction style enables the customization of the impeller diameter to achieve maximum performance for the process. It is of particular benefit when processes are undergoing subtle changes or are not fully defined.

Impeller sizes ranging from 18 to 72 inches in diameter are readily available. Designs requiring smaller or larger impellers can be built to your specific application. The usual materials of construction are carbon steel or 316 stainless steel. Fabrications from special alloys are also available.

For a complete review of your specific gas dispersion requirements, whether it is to retrofit existing agitation equipment to improve performance or a new installation, please contact your local representative. They can determine the most efficient agitator design for your process.

Mass Transfer Advantage of a CD-6 Impeller



Chemineer™ WSE-3 High Efficiency Side Entry Impeller



Chemineer's impeller for side entry applications offers greatly improved efficiency and unparalleled process performance.

Side entry agitators typically run faster and draw more power than their top entry counterparts. We have developed the WSE-3 specifically for side entry applications. Its advanced geometry results in decreased operational cost, lower investment costs and proven process performance. The WSE-3 impeller is the most efficient side entry impeller available.

More Efficient

More efficient means equipment can meet process requirements at lower power or with lower initial investment costs. It has been highly difficult to find an impeller that offers both lower equipment costs and lower power requirements. Both items are very important in today's competitive environment; with the WSE-3 they are no longer mutually exclusive. Depending on the impeller configuration, using the WSE-3 can lower power draw between 15% and 40% from existing impellers. This means smaller, less expensive equipment with savings averaging 20% – 30% over machines using existing technology. Installed equipment can benefit from this technology with fast and easy retrofits of operating impellers.

WSE-3 Features

The WSE-3 impeller offers many advantages in demanding services like Pulp and Paper and Flue Gas Desulfurization (FGD). With the increasing energy costs, the lower power draw to accomplish the process requirements is very important, especially in side entry applications where the power draw can be significant. Lower tip speeds result in considerably lower abrasion rates. The lower abrasion rates can reduce or eliminate the need for costly coatings, elastomeric coverings or harder metals. Impeller diameters are available from 12" to over 100". Standard materials of construction are carbon steel or 316/316L stainless steel. High alloys or coverings are available for the most severe environments.

Performance Comparison

Existing Impeller				WSE-3			
Power	Agitator Speed	Impeller Diameter	Machine Shaft Size	Power	Agitator Speed	Impeller Diameter	Machine Shaft Size
200 HP	235 rpm	57"	6"	150 HP	235 rpm	49"	5"
75 HP	300 rpm	42"	4"	125 HP	175 rpm	57"	5"
				60 HP	300 rpm	36"	3"
				50 HP	230 rpm	42"	3"

For each of the two existing impeller cases, there are two WSE-3 variations. The first variation is at constant speed and the second is at constant impeller diameter. Lower power draw and machine size are common when using the WSE-3.





ChemSeal is a true Chemineer mixer seal designed for demanding top entry agitator applications.

Superior Performance

- Available in either single or double configurations, the ChemSeal provides outstanding seal performance and safety
- ChemSeal is designed specifically for agitator duties where shaft movements are larger, speeds are slower and conditions more variable than those encountered by pump seals
- Balanced seal design reduces seal face wear rate and increases the pressure capability by reducing the seal contact pressure as the process pressure fluctuates
- Dual sleeve to shaft o-rings with heavy cross sections make the seals more tolerant of shaft deflections inherent in agitator applications

Safe and Reliable Operation

- Double balanced seal design keeps seal faces closed during a pressure reversal caused by process upset or failure of barrier system, preventing seal failure, containing vessel contents, and improving operator and plant safety
- Permanently installed above the tank drop collar design securely holds the shaft during seal change and improves operator safety by eliminating “on the fly” installation of shaft support, prevents the shaft from falling into the vessel, and eliminates the need for vessel entry or overhead cranes to support the shaft

Simple Maintenance and Fast Replacement

- Industry leading swing-out seal change out procedure with drop collar is simple and can be completed in 30 to 60 minutes, providing increased process uptime
- True cartridge design allows for removal, inspection and replacement of worn seals quickly and easily
- Mixer seal design and heavy duty gearbox bearings eliminate need for a seal bearing and associated installation and maintenance costs
- Provision for jacking screws and setting clips storage is provided to aid in seal removal and future setting of the seal

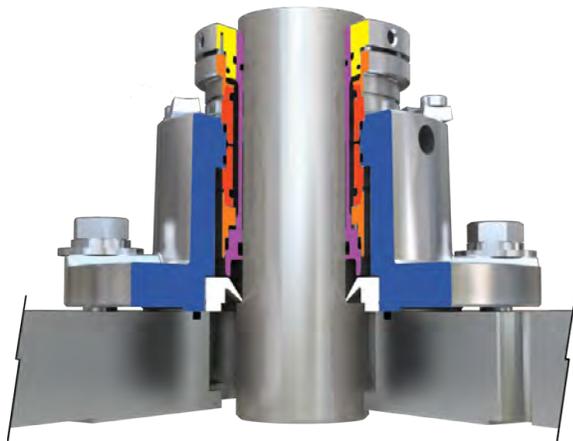
Application Versatility

- Bidirectional rotation enhances process and operational flexibility
- Designed for a wide range of agitator models to allow ChemSeal to be the common plant standard
- Throttle bushing option is available for clean flush below seal
- Debris well option available to eliminate process contamination

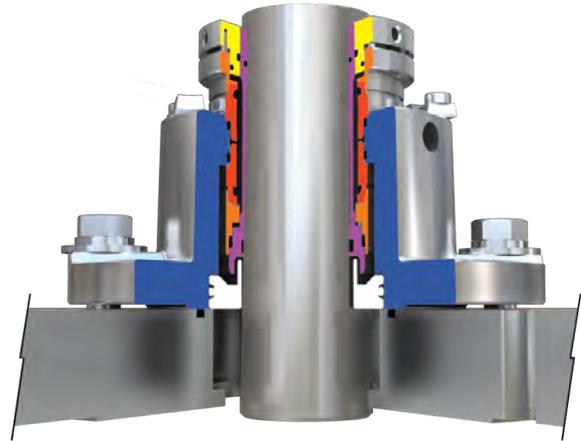
Troubleshooting and Replacement Parts Assistance

- Our service center is available 24 hours a day to diagnose and correct sealing problems
- Factory trained technicians available for in-plant help with installation, operation and maintenance questions
- Replacement parts are readily available to increase uptime and reduce customer inventory requirements

Chemineer ChemSeal Top Entering Mixer Seal



Throttle Bushing



Debris Well

Product Specifications

Sealing Configurations

- Dry running pressure balanced single seal
- Lubricated fully pressure balanced double seal
- Multi-spring rotary pusher seal typical of all seals

Material Selection

- Standard stocked materials
 - Carbon rotating head
 - Silicon carbide stationary seat
 - Viton® o-rings
 - 316SS metal parts
- Optional face combinations
 - Soft versus hard:
 - Carbon/tungsten carbide
 - Hard versus hard:
 - Tungsten carbide/tungsten carbide
 - Tungsten carbide/silicon carbide
 - Silicon carbide/silicon carbide
- Optional o-ring materials
 - Kalrez® (6375)
 - EPR, Aflas®
 - A variety of others
- Special metal materials available

Sealing Sizes and Ratings

- Available in 1.5", 2.0", 2.5", 3.0", 3.5", 4.0", 4.5" and 5.0" sizes
- Temperatures from -20°F (-28.9°C) to 356°F (180°C)
- Pressures from full vacuum to 300 psi (20.7 bar)
- Peripheral speeds to 4,000 ft/minute (20 m/sec)

Technical Data

- Angular misalignment: Up to 1/10th of a degree
- Mechanical face loading: 30 psig (2 bar) — factory set

Lubrication

- 0.25" NPT ports provided for lubrication
- Recommended API plans: Plan 53 and 54
- Supported API plans: Plan 51, 52, 53, 54 and 62
- Recirculating gas panels or dead end gas pressure for dry running single seals
- Barrier pressure to be set 30 to 60 psi (2 to 4 bar) above product pressure for ideal operation



Mixing Technologies

Quality Parts,
Quick Response,
Reliable Service

 Chemineer™

NOV

Authorized Service Centers

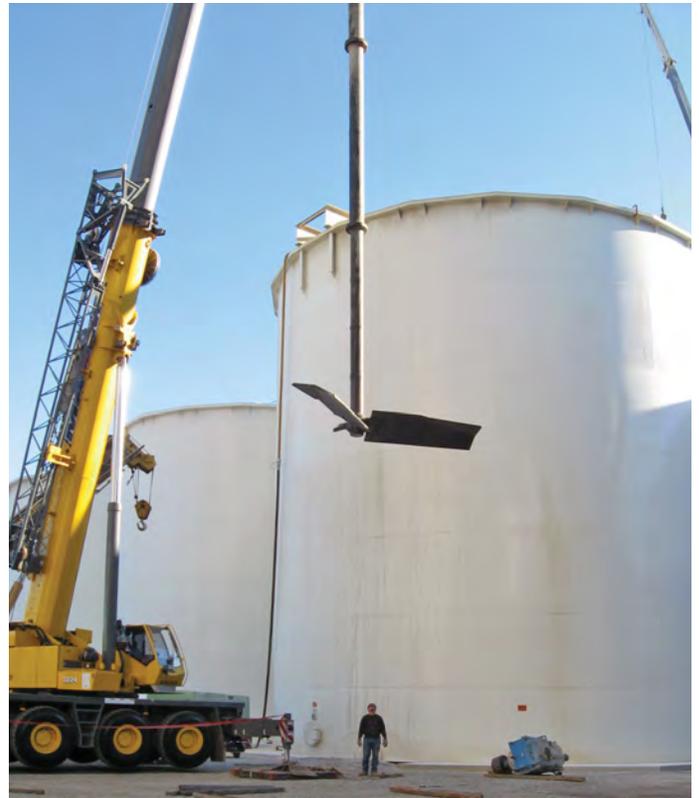
Our authorized service centers offer multiple options to get your process back up and running. Highly trained field service technicians are ready to deploy for assisting maintenance crews in repair, diagnostic, and/or maintenance work. An authorized service center is located near your plant for quick responsiveness backed by the full support of the manufacturing facility.

The Mixing Technologies service centers are located at our manufacturing facilities for more extensive failure analysis, fast replacement parts assemblies, and the most reliable agitator repair service in the world. New and refurbished parts options are available to suit your business requirements and get equipment back into operation.

We offer customized service plans tailored to fit your immediate and future needs. Contact your local representative or our Dayton facility (937-454-3200).

Services Provided by Our Express Field Service Technicians

- **Supervisory:** Guidance provided to your existing maintenance crew on proper installation and maintenance procedures
- **Installation:** Complete installation of Mixing Technologies equipment
- **Service Agreements:** Contract for routine maintenance services
- **Reliability Audits:** Review of current mixing equipment with recommendations for mechanical and process improvements and critical spares planning
- **Condition Monitoring/Trouble Shooting:** Assistance with vibration analysis, CFD modeling and mechanical failure analysis



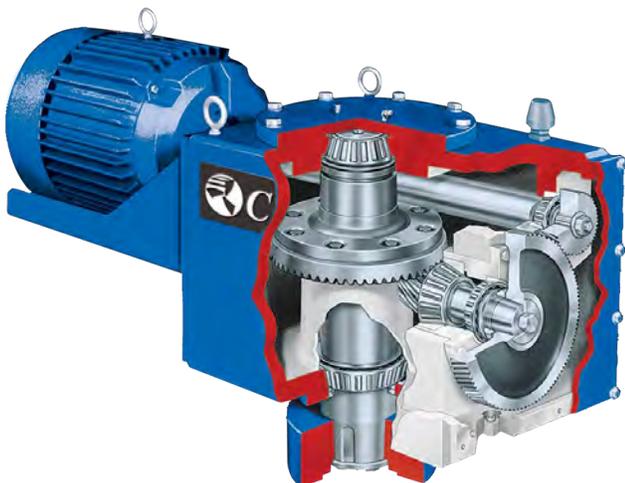
Field service technicians can assist your crew or handle the complete installation for you

Agitator Gearbox Program

We can provide new or refurbished gearboxes to quickly replace units that require frequent maintenance or experience excessive downtime. All refurbished gearboxes meet the same high quality standards as

new Chemineer™ gearboxes. Our refurbished gearboxes enhance performance, extend service life and reduce downtime. Other features of the agitator gearbox program include:

- 48 hour shipment on HT gearbox sizes 1-9 and select Model 20s
- Same day service available
- High quality gearboxes built or refurbished in-house to NOV, AGMA and ATEX standards
- Return your existing gearbox for credit towards the purchase of a new or refurbished gearbox
- Trade in worn out gearboxes from any original mixer manufacturer
- One year warranty against material defects and workmanship



The Reliability You Expect The Responsiveness You Deserve

Our mission is to offer customers immediate assistance to help achieve operating performance goals for agitation and mixing processes. This is accomplished in two ways: ensuring replacement parts and services are available on a timely basis to increase the “uptime” of your systems, and ensuring customers are offered the latest technology to improve the performance of agitation and mixing systems.

Availability

We understand how critical limiting downtime can be to your operation. To minimize the cost and hassle associated with downtime, we have:

- Dedicated inventory for all product lines assuring the availability of critical parts
- Built a network that delivers standard parts right to your door

Right Part Every Time

We provide drop in replacement parts for standard and custom Chemineer agitator components, minimizing installation problems such as improper fit up or alignment, guaranteed. Chemineer replacement parts are made to original equipment specifications to ensure maximum reliability of your mixing equipment.



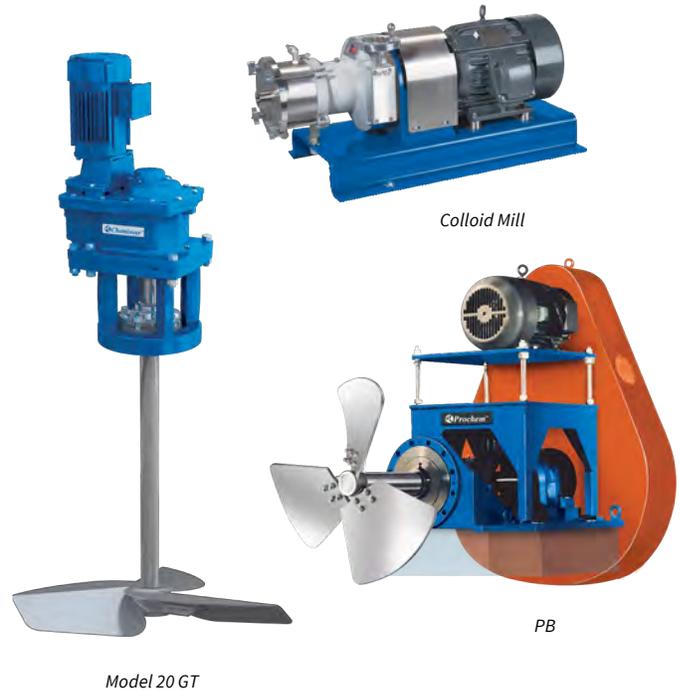
Field service technicians are available for maintenance, troubleshooting and repair to minimize downtime

Response

You don't schedule emergencies, you respond to them. We are ready to respond as well, at anytime. We offer the following:

- Stocked parts for emergency orders, shipped within 24 hours
- Custom replacement parts such as shafts, collars, and impeller components, shipped within 1 to 5 days
- A team of highly experienced field service technicians to deploy to your site
- Local sales technicians capable of early diagnosis of potential problems

Emergency Hotline: +1 937 926 1724



Our Services Enhance Your Performance

With quality replacement parts, your underperforming agitators can be upgraded with new, more efficient components that support your regular PM and process improvement programs.

Process performance improvements with our technology improve efficiency and minimize downtime. Contact your local authorized sales and aftermarket team to learn how we can provide:

- On-site mixing process analysis
- High tech impeller design upgrades
- Preventative maintenance seminars and plant audits

Product Support

For more information on our products, visit www.nov.com or contact your local sales office. For technical support, visit www.nov.com/technicalsupport.

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Mixing Technology for Water & Wastewater Treatment



Reliability and Technology in Mixing

Having designed and manufactured standard and customized fluid agitation equipment and systems for over 60 years, we are recognized as a leader in advanced mixing solutions for the municipal and industrial water and wastewater treatment industries.

Our engineers and field representatives have extensive application expertise in the industry. They apply a breadth of proprietary application evaluation methodologies in analyzing customers' fluid processing requirements to optimize every solution.

Backed by extensive research and a proud heritage for technical innovation, we have a proven reputation for product design and manufacturing quality that ensures outstanding performance and long service life for overall low total cost of ownership.

Through the combination of quality mixing products, application experience and exceptional customer service, we can satisfy all of your water and wastewater treatment applications. For reliability and technology in mixing, we have the solution.



HT agitators working to treat waste and suspend solids at an Arizona treatment facility



Colorado water processing plant utilizing Model 20 GT agitators

Impeller Design and Technology

Our impeller designs are the result of over six decades of research and applied application experience, resulting in the broadest range of durable and efficient impeller options. Proprietary technologies are applied to thoroughly analyze all process parameters, ensuring proper impeller selection for optimal performance in every application. Carbon steel, 316/316L stainless steel, high alloys and coatings are available for all impellers.

Our mixing expertise includes high flow, low shear blending, gas dispersion, solids suspension, high shear blending and viscous mixing. Whether it is R&D or production phase, we have the expertise to solve your mixing challenges.

The RL-3 ragless impeller is specifically engineered to prevent fibrous material build up. This is accomplished through several key product design

features that eliminate any edges or protrusions that would allow fibrous material to agglomerate. Some of the design features include:

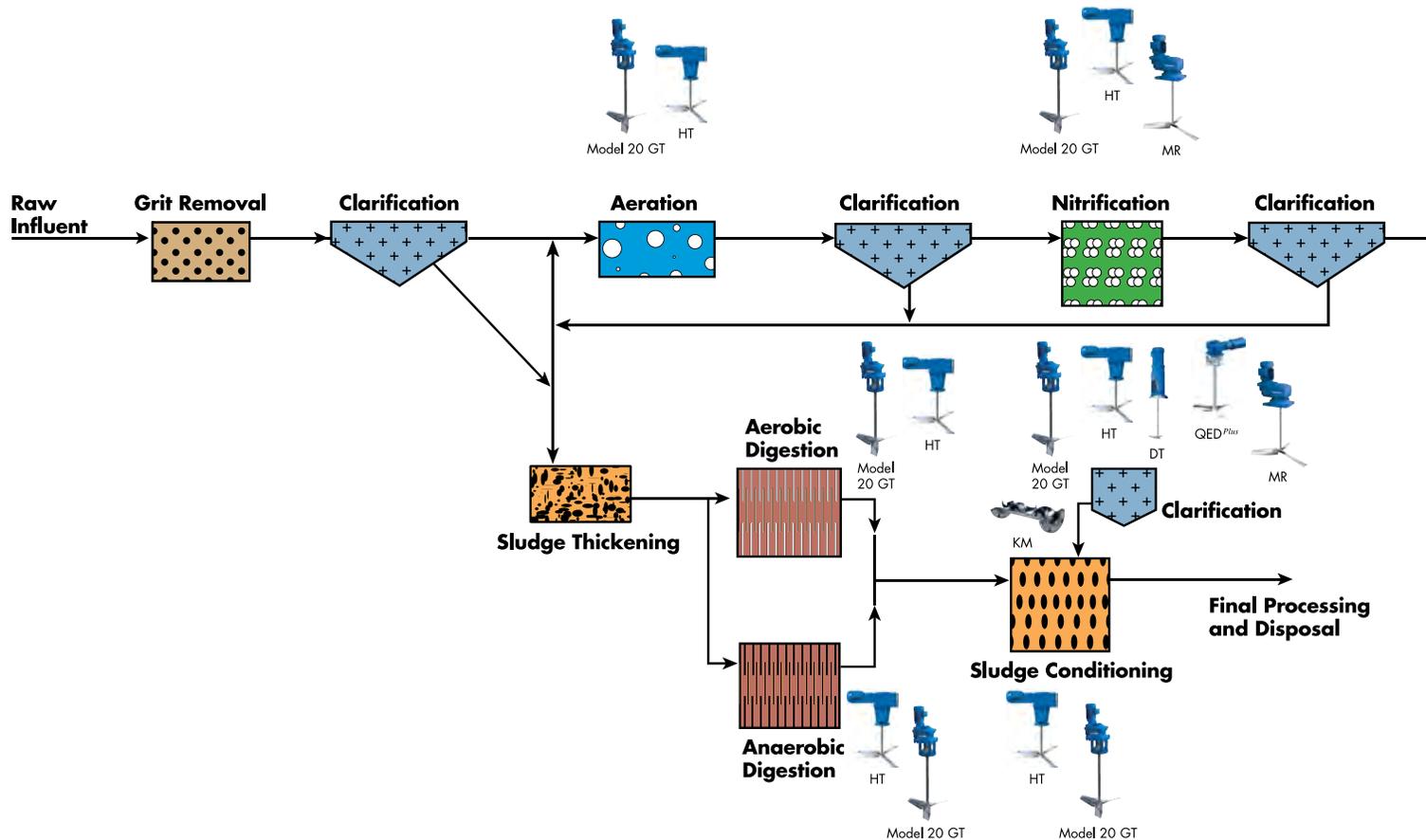
- A sweeping leading edge on the impeller blades
- A swept back connection to the central hub
- Welded design or bolted design with non-protruding fasteners
- High axial flow RL-3 impeller for superior mixing performance in blending and solids suspension applications



RL-3 provides rag free mixing minimizing downtime

Mixing Technologies Provides Solutions Throughout Water

Wastewater Treatment Process Flow



Technical Support and Replacement Parts

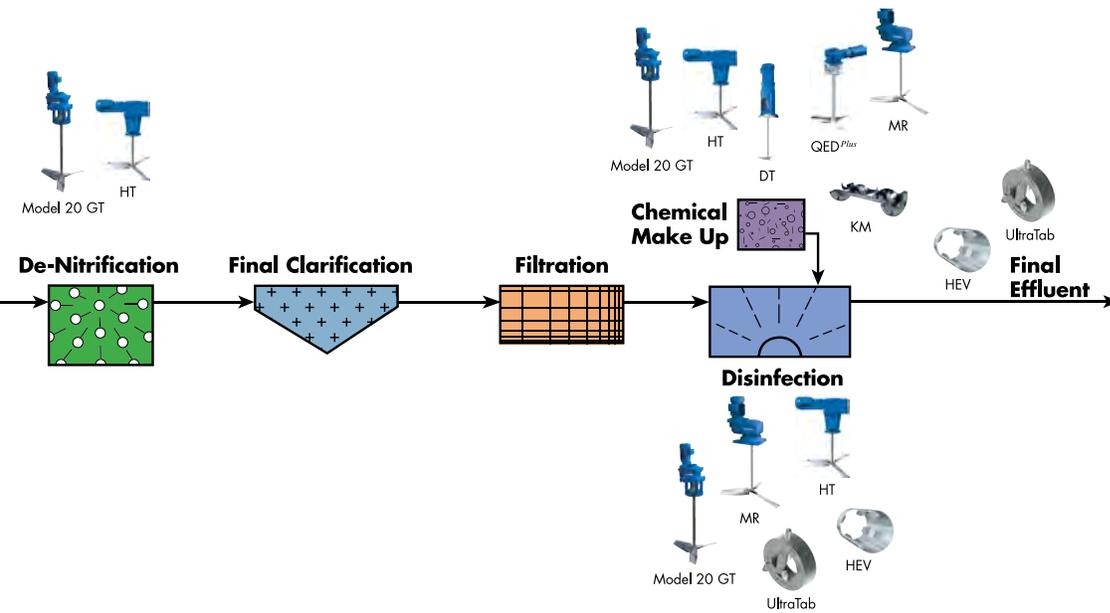
A dedicated team of experienced technical support staff provide a full range of services to help achieve your operating performance goals for your mixing processes. We offer multiple options to get your process back up and running in the event of a breakdown. A network of highly trained field service technicians are ready to deploy to assist your maintenance crews with repairs or troubleshooting. Our staff is also trained and qualified to install your agitation equipment on site if needed.

- We offer a wide variety of services including:
- A large inventory of genuine Chemineer and Kenics replacement components, subassemblies and gearboxes
 - 24 to 48 hour shipment on stocked replacement parts
 - A refurbished gearbox program that allows you to exchange your old gearbox for a completely refurbished unit guaranteed at a cost savings for you
 - Service centers are available for repairs, failure analysis, and replacement assemblies

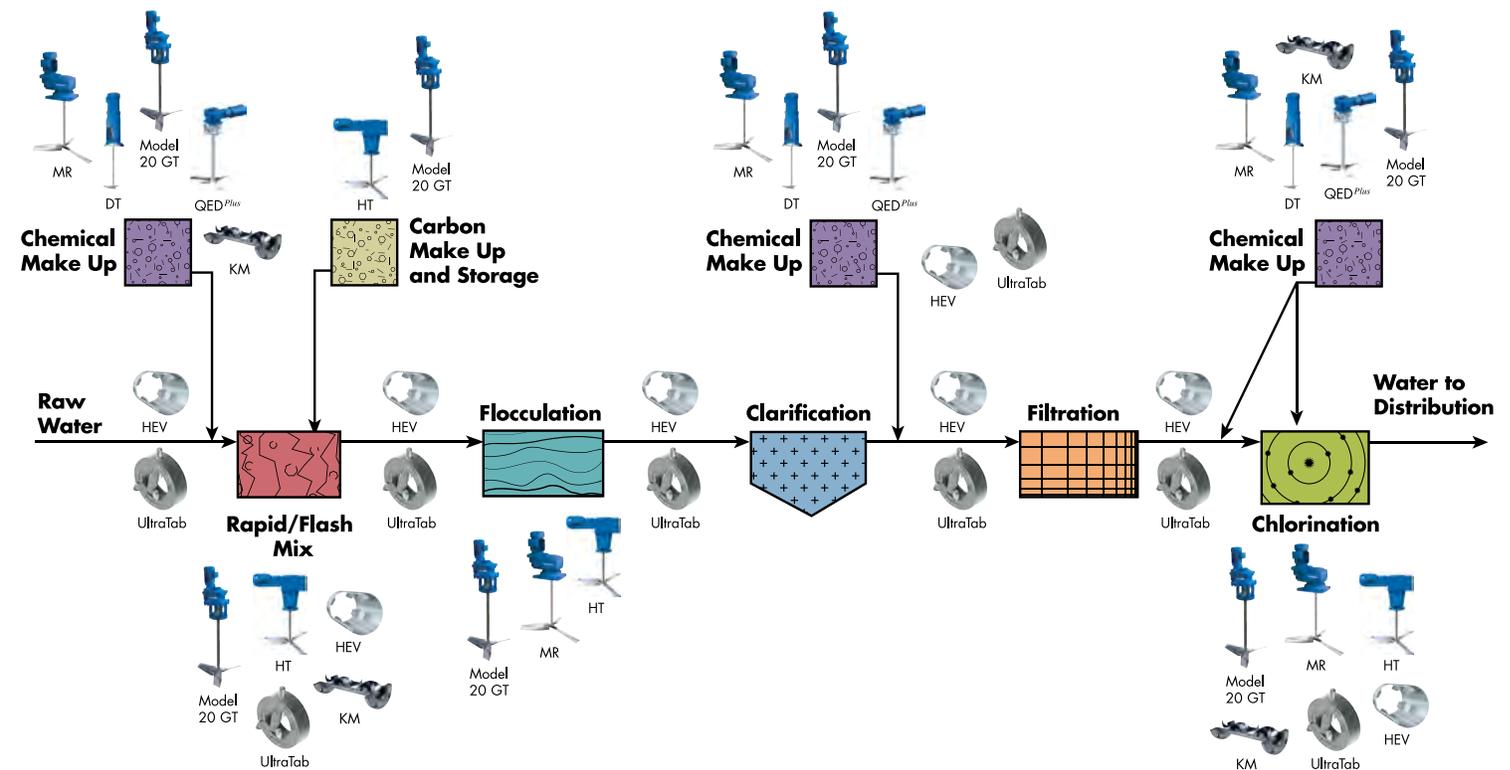


UltraTab mixing alum into water at a Colorado municipality

and Wastewater Treatment Processes



Water Treatment Process Flow



Extensive Product Range

Our extensive line of Chemineer™ agitators, with advanced impeller design options, and Kenics™ static mixers for water and wastewater treatment applications provide unique advantages and extend the range of effective mixing solutions available.

Chemineer™



- HT**
- Rugged, field proven gearbox design with hardened helical and spiral bevel gear sets
 - Drive sizes from 1 to over 1,000 HP
 - Speeds from 5 to 350 rpm



- Model 20 HT/GT**
- Double and triple reduction gear drive designs with hardened helical or spiral bevel gears
 - Right angle or parallel shaft configurations
 - Drive sizes from 1 to 75 HP
 - Speeds from 8 to 350 rpm



- QEDPlus**
- Proprietary worm gear drive
 - Cast iron housing
 - Drive sizes from 1 to 5 HP
 - Speeds from 17 to 175 rpm



- MR**
- Parallel shaft drive with helical gearing
 - Drive sizes from 3/4 to 100 HP
 - Speeds from 7–380 rpm



- DT**
- Top entering fixed mount, right angle drive and portable configurations
 - Drive sizes from 1/4 to 5 HP
 - Flexible selection of output speeds

Kenics™



- KM**
- Provides uniform blending or dispersion for any combination of liquids, gases or solids
 - Eliminates gradients in concentration or temperature across a wide range of flow regimes
 - Alternating helical construction from a wide variety of materials including metal, PVC, FRP, and PTFE



- HEV**
- Tab geometry maximizes the conversion of turbulent energy into efficient mixing
 - Adaptable to a variety of line and open channel shapes and sizes
 - Ideal for applications where pressure loss and length are critical



- UltraTab**
- Compact design and short mixing length saves pipe lengths and optimizes plant layout
 - Low pressure drop through the UltraTab element enhances energy efficiency of the process and saves pump energy
 - Multi-point injectors are optional for mixing several additives to the main flow

NOV

NOV is a leading provider of wellbore and surface equipment and services for the oil and gas industry.

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Mixing Technologies

Solutions
for Sanitary
Applications



NOV

Meeting the Challenges of Aseptic Processes

Successful aseptic processes involve performance on many levels from the design process through construction, validation and onto process operation. With thousands of installations worldwide, we have the proven experience to consistently provide validation based products, services and system solutions.

We apply our extensive application knowledge and high quality equipment to provide the performance you require in a variety of sanitary applications including:

- Suspending, incorporating or dissolving solids with high flow/low shear impellers
- Blending fluids either in line or within process vessels
- High shear mixing, deagglomeration, dispersion and emulsification
- Maximizing heat transfer with even highly viscous or difficult to process materials



Cleanability and removing all possibilities for contamination are vital to these processes

The Mixing Technologies Difference

The extensive line of Chemineer™, Kenics™ and Greerco™ sanitary products coupled with our responsive service provide numerous benefits to the customer not often found in competitive offerings including:

- **Accelerated commissioning/validation documentation** — including product descriptions, assembly and dimensional drawings/data, surface finish data, material certifications, inspection and test reports and much more
- **Efficient order processing** — procedures specifically designed for aseptic applications to ensure timely execution and delivery
- **Application versatility** — proprietary ChemScale™ method for effective product selection
- **Proven performance and extended service life** — sophisticated product design software and heavy duty components
- **Optimal mixing efficiency** — high performance impeller options and unique flow configurations
- **Ease of maintenance** — designed for thorough clean up and simple seal maintenance to minimize downtime and costs
- **Local support** — commissioning and engineering personnel readily available to assist you



Impeller Process Technology

Our impeller process technology is effectively applied across your spectrum of applications ensuring successful, repeatable results from lab scale to full scale operations.

Our mixing expertise includes low shear liquid-liquid/solids blending, gas dispersion, high shear blending and viscous mixing. Whether you are in the R&D or production phase, from API reactors to media/buffer prep, we have the expertise to solve your latest mixing challenges.

An impeller brochure is available with additional information.



Model 20 GT



RBT



DT



SSP

Mechanical technology must be combined with process aspects for a truly complete design. Our thorough understanding of fluid mixing dynamics is combined with current ASME-BPE concepts resulting in cleanable, robust designs.

Cleanability at the Forefront

Mixing surfaces that promote the free draining of liquids, during F.A.T. through to production operations, are vital to having the process validated. We apply this concept to all components in the mixing system including polish, welds, mounting flanges, shafts, in-tank couplings and impellers.

Mechanical Considerations

- Mixing volumes from 10– 40,000+ liters including bioreactors
- Smoothline impellers
- CIP/SIP construction
- FDA or USP Class VI elastomers
- Mobile vessels: Optional right angle drives offer both low head room (14") for doorways and low centers of gravity for tip hazard avoidance
- Small footprint: Inline drive systems for minimum interference with nozzles and process piping
- We will engineer custom size mixers to suit your requirements



Chemineer HT agitators used in a sanitary environment mixing a consumer product

- Bottom entering designs for applications such as bioreactors
- White polyurethane or all stainless motors and gear drives—lab to full scale
- Direct drive or gear drive designs available
- Operating speed flexibility: Ask for designs below the first critical speed as they eliminate the need for programming speed avoidance ranges
- Wash down duty gear reducers
- Optional shaft drop collar to facilitate seal removal
- Aseptic mechanical seals
 - Dry or wet running
 - Single, double or gas lift off designs
 - Others available upon request
- Lip seals and stuffing boxes
- Seal maintenance: Gear drive swings clear for easy access on Model 20 GT
- Sanitary in tank couplings: Threaded or flanged connections
- Mounting flanges: ANSI, ferrule (tri-clamp), DIN, special
- Anchor nuts with washers when bolting is necessary

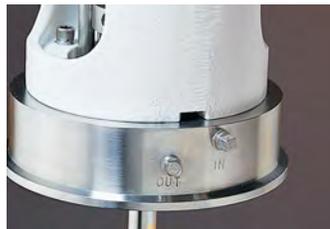


Gear Reduced DT Mixer

- 1 Industry standard, off the shelf, NEMA electric or air motor
- 2 Advanced, heat treated helical gearing
- 3 Gear drive is permanently lubricated with high performance FDA approved grease
- 4 Sealed gear drive prevents both product and lubricant contamination
- 5 Helical, AGMA quality gears provide smooth, quiet operation
- 6 Elastomeric lip seal
- 7 Heavy duty, permanently lubricated and sealed for life bearings
- 8 Chuck coupling with dual set screws or bolted flange coupling (also available), allow for shaft removal without disassembling the unit



Sanitary, single mechanical seal assembly



Single integral steam port in solid stainless steel mounting flange

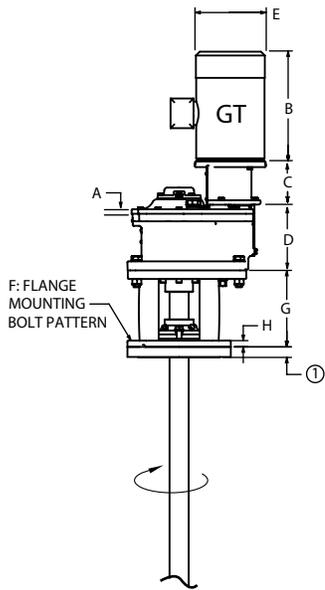
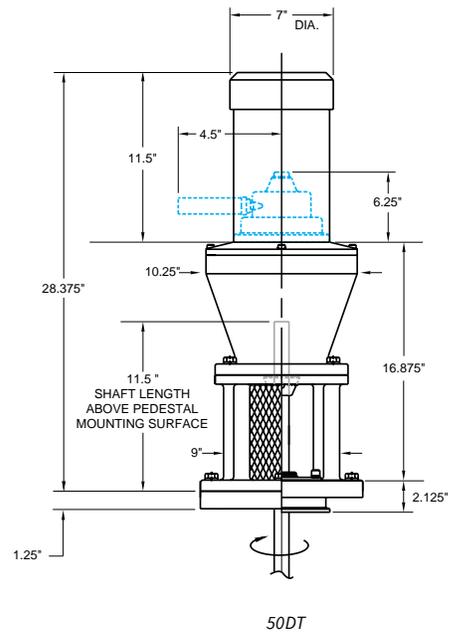
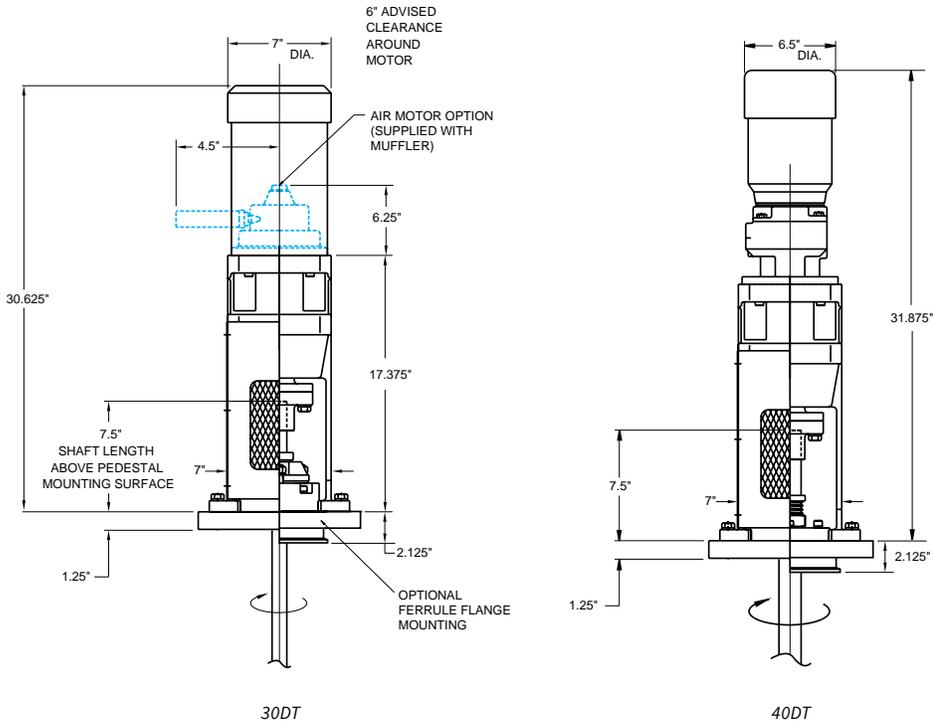


SSN

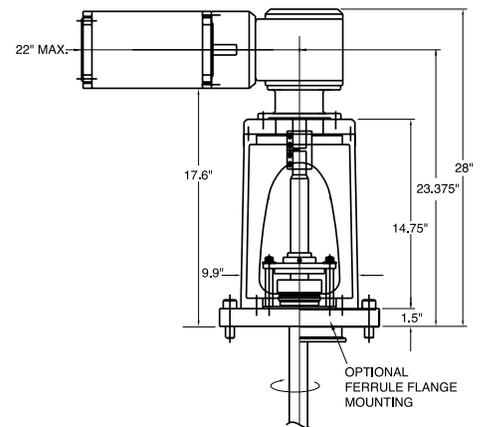
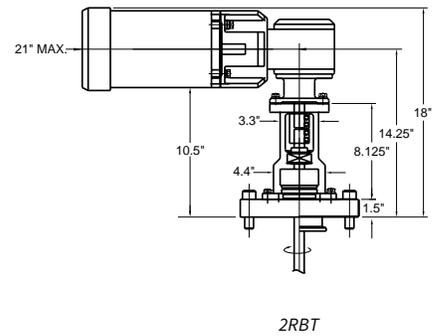
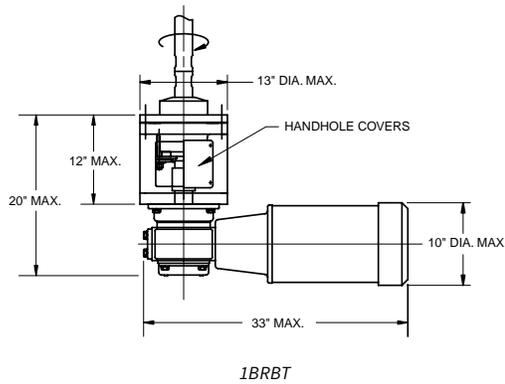


DTN/NS

Dimensions



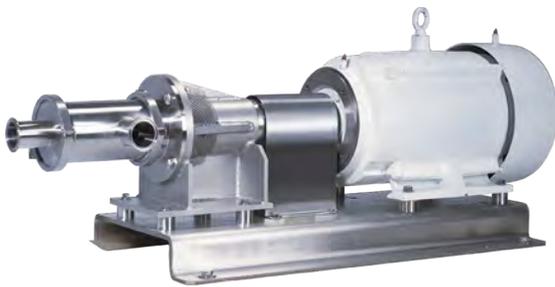
Model 20 GT
N, NC, NS & NT
(N, NC & NS Drives Swivel)



Model 20 GT Dimensions Chart

Case Size	A	B (max)	C (max)	D	E (max)	F	G	H
						Bolt Pattern	Swivel	
21GT	1.18"	17.96"	5.51"	8.47"	11.00"	8" — 150# ANSI (Holes Straddle C.L.)	10.00"	0.75"
22GT	1.38"	27.0"	8.23"	10.75"	16.88"	10" — 150# ANSI (holes on Center Line)	12.50"	0.88"
23GT	1.58"	31.75"	10.83"	14.80"	20.88"	12" — 150# ANSI (Holes Straddle C.L.)	14.06"	1.18"

Greerco products provide flexible, cost efficient inline and batch processing for sanitary, high shear applications. This technology is utilized for a wide range of deagglomeration, dispersion, emulsification and rapid mixing operations. Due to the unique and proprietary nature of the typical high shear application, this equipment is available on a rental basis for lab or full scale trials allowing customers to determine how our technology can be applied to their specific processing needs prior to purchase.



SPLM



WV

WH

Sanitary Pipeline Mixers

The sanitary pipeline mixer (SPLM) may be applied to a wide range of intermediate and final processing operations. Like most high shear devices, the Greerco pipeline mixer employs a high speed turbine running in close proximity to a fixed stator to perform its shearing operation. However, the Greerco product line offers a unique axial in-axial out flow configuration for processing benefits not seen in an axial in-radial out flow configuration. Product is processed as it passes through one (single) or two (tandem) of these shear zones that result in intense hydraulic and shear forces.

- 316 SS wetted parts, other materials available upon request
- Sanitary ferrule connections
- Mechanical cartridge seals
- Stainless steel base
- Washdown motor
- Discharge port with 270° rotation
- Customer specified seals and motor available

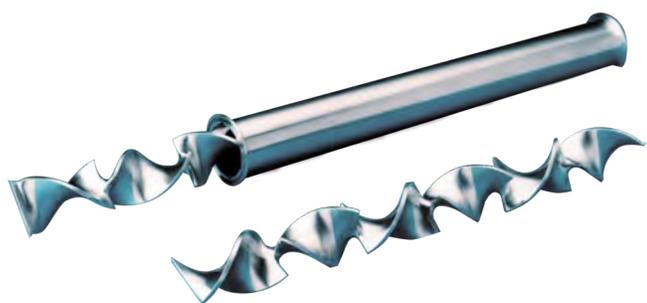
Colloid Mills

The Greerco colloid mill (WV or WH) is a high speed, high shear mixer capable of batch or inline processing. Although a colloid mill is commonly considered a particle destruction unit, it is actually a dispersion piece of equipment. This machine will blend, emulsify, deagglomerate and produce a thorough wetting of dispersed substances resulting in a completely homogeneous product. Like the pipeline mixer, the colloid mill utilizes a high speed rotor spinning in close proximity to a fixed stator. However, instead of varying the number of rotor-stator combinations to vary shear, the Greerco colloid mill offers the user the ability to adjust the gap between the rotor and stator on the fly via an external hand wheel and visible adjustment dial.

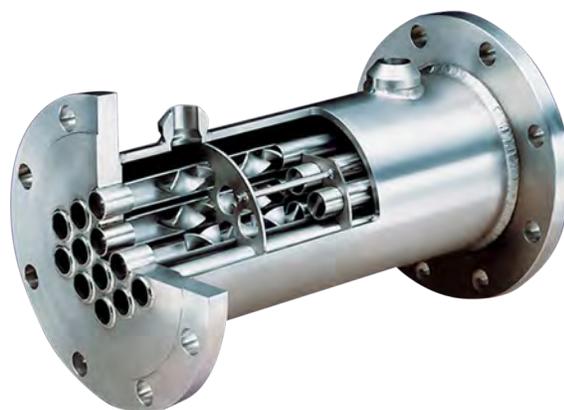
- 316 SS wetted parts, other materials available upon request
- Sanitary ferrule connections
- Jacketed stator housing
- Standard double lip seal shaft sealing (optional mechanical seal configuration)
- Horizontal (inline) or vertical (batch) mounting
- Explosion proof motor
- Several discharge port locations
- Options include stainless bases and white motor paint
- Customer specified seals and motors available

Tabletop colloid mill complete with hopper and recirculation tubing available for small batch and laboratory processing.

Kenics products commonly used in sanitary applications are our inline static mixers and heat exchangers. As the static mixing pioneer, Kenics offers its customers over thirty years experience in the design and manufacture of static mixing products.



KMR



Heat Exchanger

Sanitary Static Mixers

Kenics sanitary static mixers feature an alternating helical element string that creates flow division and a radial mixing mechanism to disperse and blend any fluid introduced to the mixer. Due to the plug flow characteristics of the design, this self cleaning element design is ideal for sanitary operations. The process fluid is continuously and completely mixed within the pipeline, eliminating gradients in temperature, velocity or concentration without moving parts or any additional maintenance requirements.

- 316 LSS construction
- Sanitary ferrule connections
- Removable element assembly
- 3A certified design/construction
- Optional ASME-BPE compliant documentation
- Mirror finish on elements available
- 32Ra housing finish (standard)
- 0.5" to 4" diameters in stock
- Optional electropolishing available
- Custom housing finishes available

Sanitary Heat Exchangers

Kenics sanitary heat exchangers feature the Kenics helical element static mixers to improve the heat transfer in a sanitary shell-and-tube heat exchanger. The increased efficiency of the Kenics design offers maximum heat transfer to highly viscous, difficult to process materials. The plug flow design of the mixing elements increases the inside film coefficient by creating continuous surface renewal at the wall of the exchanger tubes. Benefits of the design include reduced fouling, uniform heat history and elimination of thermal gradients.

- Completely customized construction
- Removable element assemblies
- TEMA and ASME code construction
- 3A certified construction available
- Optional electropolishing and passivation
- Sanitary ferrule connections



Chemineer

Chemineer is a leading provider of process solutions for the oil and gas industry. Our products and services are designed to improve efficiency, reduce costs, and increase safety in a wide range of applications. We have a proven track record of delivering high-quality solutions to our customers around the world.

For more information, please contact your local sales office or visit our website at www.nov.com.

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Mixing Technology for Mining and Mineral Processing



NOY

Reliability in Mining Applications

We are a global supplier of heavy duty products and services for the mining industry and a leading manufacturer for over 60 years. By utilizing industry leading process and mechanical design technology, as well as laboratory testing, we consistently designs optimal mixing systems for hydrometallurgical processes.

Our successful state of the art impeller technology and robust mechanical principles are integrated into the proprietary design software, AgSolver, that is used when designing mixing solutions.

AgSolver was created by, and is continually maintained and optimized by in house experts. This ensures our equipment achieves the process objectives and will withstand the rigorous conditions present in minerals processing environments.

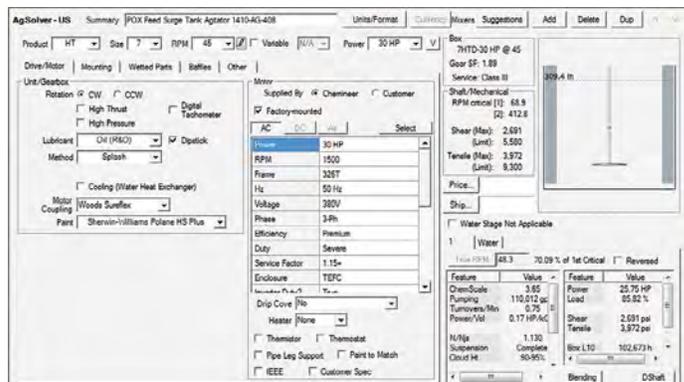
The dedication and focus provided by the Mixing Technologies team to the mining industry goes beyond original equipment supply. With manufacturing and aftermarket sales and service facilities around the world, we provide prompt customer focused service worldwide to meet the timely needs of the mining industry.



Our impeller technology can be used in a variety of applications



Mine processing infrastructure



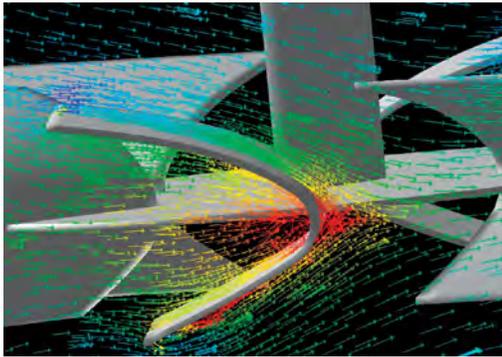
AgSolver software

Process Technology

Application Expertise

Flow controlled applications: Varying degrees of solids suspension and gas dispersion are required when using batch or continuous processes. The desired process results are achieved utilizing high efficiency, axial flow impellers. This technology provides low shear characteristics, critical in maintaining particle size for maximum recovery. Typical applications include leaching and adsorption circuits, slurry make down, pipeline slurry storage and tailings & wastewater disposal applications. Chemineer impellers provide efficiency and the ability to achieve optimal results.

Autoclaves: In conventional leaching circuits, when recovery drops below 80%, the ore is considered refractory in nature. Higher recovery requires a pretreatment process such as pressure oxidation (POX). POX applications involve gas-liquid-solids contacting in a high



*Example of
CFD modeled
flow fields*

temperature/pressure environment. We have the capability to provide optimal solutions that maximize uptime for effective processing of refractory ores.

Solvent extraction: Solvent extraction is usually a countercurrent, multi-stage contacting process used with processes such as heap leaching. Our mixer technology, pumper and auxiliary, is utilized in the mixer settler portion of the solvent extraction circuit.

Process Design Considerations

Over the past 60 years, we have gained tremendous knowledge in the mining industry. Mixing solutions are designed with many variables taken into consideration.

- Agitators are engineered to keep pump suctions and overflow outlets clear, maximizing up time for target metal recovery and restart in high percent solids applications.
- Innovative impeller technology allows for favorable process results in any solids suspension, blending, or gas-liquid-solid contacting application due to the range of process specific impellers available.
- When gas injection for mass transfer is required, we utilize a shaft sparging system integral to the drive and wetted parts.

CFD: Process modeling is possible with Computational Fluid Dynamics (CFD). We can model the fluid flow in your tank through computational fluid dynamics software. This highly visual analysis can provide theoretical representations of blending and motion, solids suspension, chemical reaction, and heat transfer processes. CFD is useful for optimizing flow patterns in mining applications.

Aftermarket Parts and Services

The global NOV Aftermarket Parts and Services team offers customers immediate assistance to help achieve operating performance goals for agitation and mixing processes.

Our aftermarket group offers multiple options to get your process back up and running in the event of a breakdown. A network of highly trained field service technicians are ready to deploy to assist maintenance crews in repair, diagnostic, and/or maintenance work through our emergency service program. These professionals are available 24 hours a day.

Inside several NOV manufacturing facilities are service centers which are utilized for more extensive failure analysis, fast replacement parts assemblies, and the most reliable agitator repair service in the world. New and refurbished parts options are available to suit your business requirements to get equipment back into operation. All replacement parts are made to original equipment specifications to ensure maximum reliability of your mixing equipment.

Field service technicians are available in non-emergency situations to provide analysis of your existing equipment. Complete retrofit of wetted parts and sealing mechanisms

offer increased equipment uptime and improved process performance.

For after-hours emergencies, call +1-937-926-1724.



Our team provides a quick response time on repaired or replacement parts to increase uptime

Products for Mineral Processing

- **GT/HT** feature rich agitators for long, maintenance free operation
- **MR** agitators when heavy duty, parallel shaft gear drives are required
- **VM** top entry belt drive agitators for applications requiring high output
- **Heat exchangers** used in explosives production for cooling (stabilizing) ammonia nitrate to keep micro beads in suspension
- **Static mixers** for continuous processing
- **Mechanical seals** for closed tank applications
- **MD** side entry belt drive agitators used for large vessels
- **Impellers** that can handle any minerals processing application



Model 20 GT



MR



VM



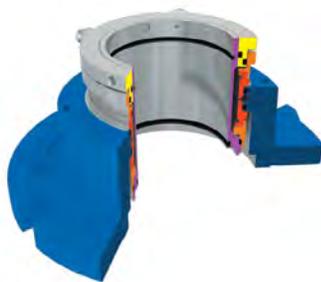
HT



KM



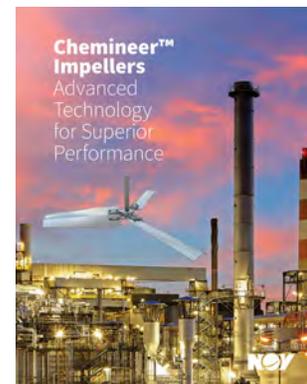
Heat Exchanger



Double Mechanical
ChemSeal



MD



Impeller Bulletin

Reliability in Mineral Processing

Mechanical Design

We provide heavy duty top, side and bottom entering rotating agitators specific to achieving required process results.

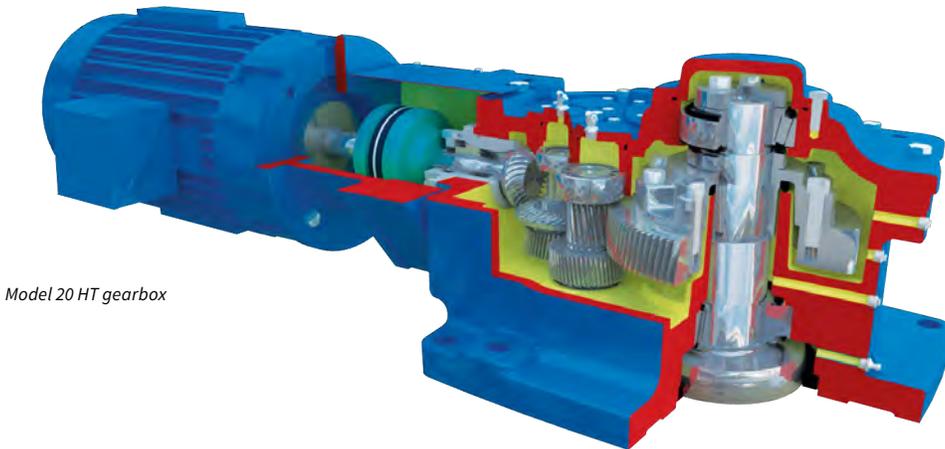
Mechanical integrity is multifaceted and can be complicated with excessive hydraulic forces, solids loading, gas injection or proximity to tank internals. Our designs go

beyond torque transmission alone and are prepared for upset conditions including power outages with resuspension of settled solids. Our mixer gear drives are specifically designed for fluid mixing service.

Chemineer agitators' robust gear and belt drives, large in-tank shaft diameters, and thick bladed impellers are guaranteed to last.

Manufacturing capabilities:

- Gear drives built in house
- Unlimited sizes for shafts and impellers
- Custom designs to your specifications
- Strict quality standards and tolerances
- Round the clock production



Model 20 HT gearbox

Lab Testing

The Dayton facility's Research and Development Laboratory has the capability to model any mining mixing application, including top and side entry agitator orientations. Test capabilities include solids suspension, flow velocity, torque and power draw, resuspension, and mass transfer testing. Actual ore samples or representative solids for scale up purposes can be tested.

The Dayton test facility features a wide variety of tank geometries and sizes available along with a full line of standard and custom impellers. Our test vessels range from 18 inches to 12 feet in diameter and can be modified to duplicate your process. Video recordings of lab tests are available and customers are always welcome to observe.



Installed Chemineer HT agitator

Chemineer

Chemineer is a leading provider of process solutions for the oil and gas industry.

Our products and services are designed to improve efficiency and reduce costs.

For more information, please contact your local Chemineer representative.

Visit our website at www.nov.com for more details.

Chemineer is committed to providing the highest quality products and services.

Our dedication to customer service is our top priority.

Thank you for choosing Chemineer.

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Mixing Technology

Solutions for Flue
Gas Desulfurization



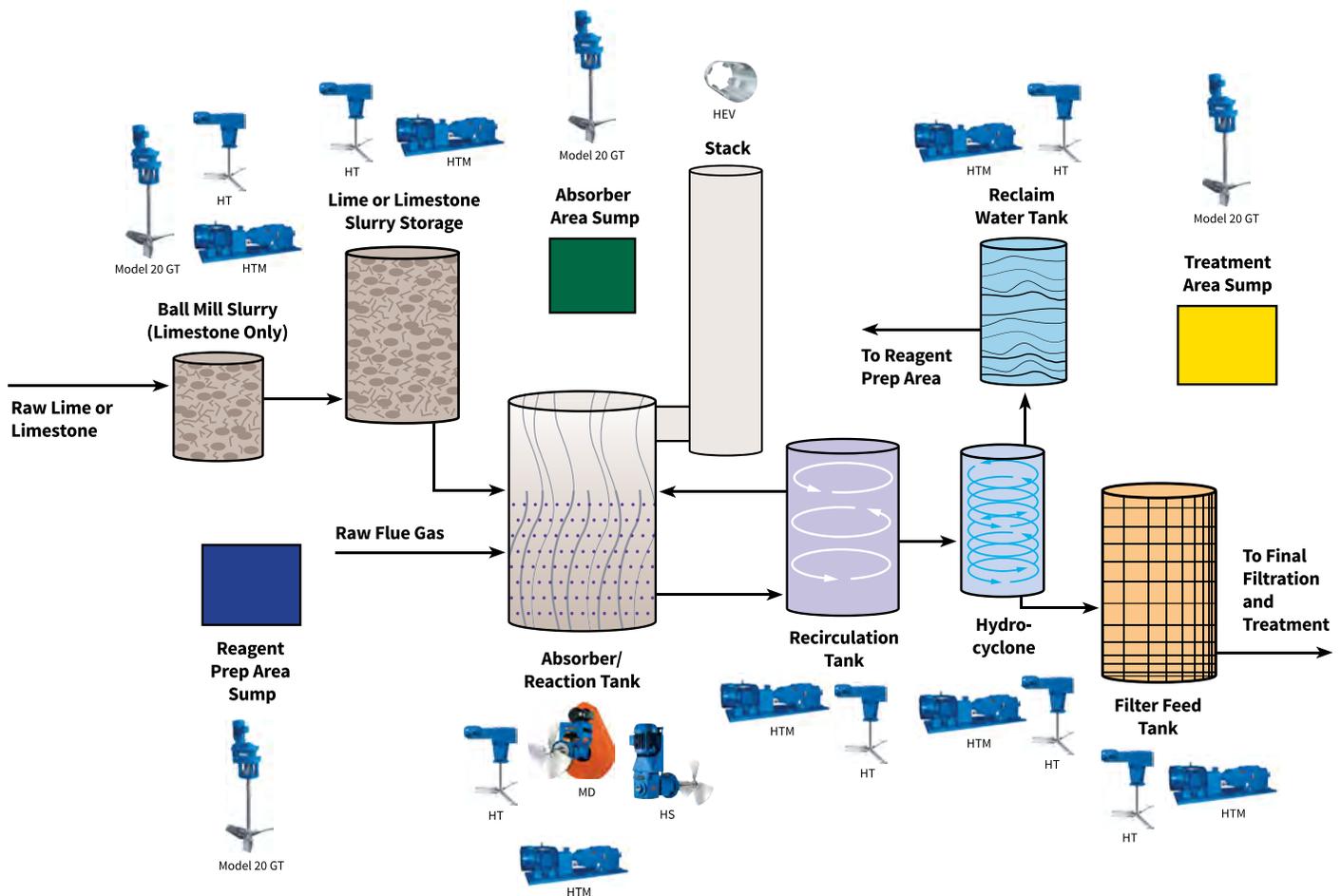
Reliable FGD Mixing Solutions

The Mixing Technologies Group of NOV is a leading supplier of mixing solutions and products for Flue Gas Desulfurization (FGD) systems throughout the world for over 60 years. By utilizing laboratory testing and industry leading technology, we can design the ideal mixing system for your process. Mixing Technologies distinguishes itself from the competition through the use of rugged agitators that are highly efficient and extremely reliable. Thousands of Chemineer™ agitators are currently operating in FGD service and many of these have been in service for decades. Our experience in evaluating FGD applications and supplying equipment specifically engineered for harsh FGD service ensures efficient plant operation and long, reliable service with minimal maintenance.



Exhaust stacks at a power plant in the Midwest

FGD Process Flow



Applied Technology and Innovation

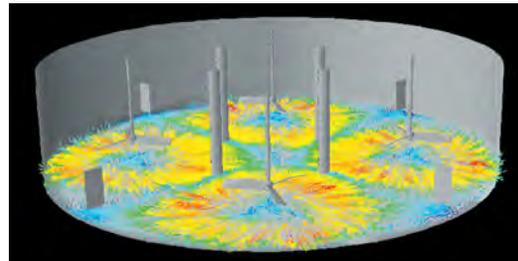
R&D Lab and Test Facility

Mixing Technologies' Research and Development Laboratory has the capability to model any FGD mixing application, including top and side entry agitator orientations. Test capabilities include solids suspension, flow velocity, torque and power draw, resuspension, and mass transfer testing.

The Mixing Technologies test facility features a wide variety of tank geometries and sizes available along with the full line of standard and custom impellers. Our test vessels range from 18 inches to 12 feet in diameter. Side entering test vessels have the flexibility to model mass transfer and oxidation air distribution systems as well as absorber recycle pump locations and flow rates. Our test vessels can be modified to duplicate your process and customers are always welcome to observe. Video recordings of lab tests are also available.

Computational Fluid Mixing (CFM)

We can model the fluid flow in your tank through computational fluid mixing software. This highly visual analysis can provide theoretical representations of blending and motion, solids suspension, chemical reaction, and heat transfer process. CFM is useful for optimizing flow patterns in any application.



3D CFD analysis

Rugged Products for Demanding Applications

Mixing Technologies offers a wide variety of products suitable for FGD applications. We offer top entry and side entry agitators, as well as static mixers and various other products designed for FGD applications. All wetted components are available in a wide variety of steel and alloy materials and elastomeric coatings. Typical materials for FGD processes include stainless steel, high alloys, or rubber covered carbon steel. These materials ensure reliability and corrosion/erosion resistance in abrasive FGD applications.

Top Entry Agitators

The Chemineer HT, HTM and Model 20 GT are durable top entry agitator drives that excel in FGD applications. These units come standard with a dry well shaft seal to prevent oil from leaking into the process. HT and HTM agitators are commonly used in absorber, make up and treatment tanks.



HT with HE-3

HT/HTM Agitator Features

- 1 to 1000 HP
- Helical and spiral bevel gearing
- High capacity bearings throughout the entire gearbox ensure high strength, high efficiency, low maintenance and smooth operation

Model 20 GT Agitator Features

- Highly efficient all helical gearing
- Compact and rugged, designed and manufactured by Mixing Technologies

The Model 20 GT is ideal for sump applications.

The most common impellers used on the top entry mixers are the high efficiency HE-3, XE-3 and SC-3 impellers. These impellers offer superb performance in solids suspension applications. High efficiency impellers produce an axial flow pattern that promotes solids suspension and significantly reduces the wear of the impeller due to abrasion better than a standard pitched bladed impeller.



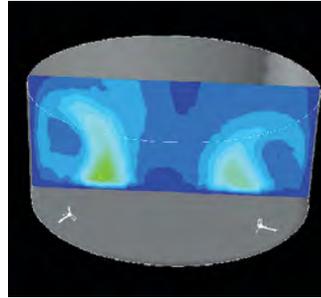
Model 20 GT with XE-3



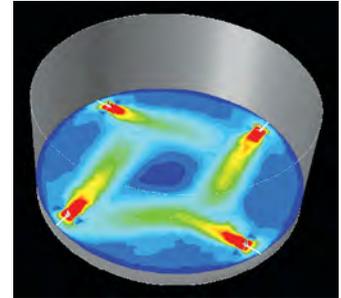
MD with WSE-3



HS with WSE-3



3D CFD analysis of side entering agitation layout



Side Entry Agitators

Our side entry agitators offer the same reliability and durability that top entry agitators provide. Available for side entry applications are the Prochem MD belt driven or Chemineer HS gear driven models.

Side entry agitators for FGD utilize the high efficiency WSE-3 impeller. This variable pitch, high efficiency impeller minimizes abrasion wear and provides superior gas handling ability.

Side Entry Agitator Features

- Retract mechanism and seal shut off for easy maintenance without draining the contents of the tank or removing the drive
- Up to 300 HP
- Single cartridge, slurry lubricated mechanical seal specifically designed for FGD slurry systems can handle up to 25% slurry without requiring a flush

Seals

All of our agitators are available with single or double mechanical seals, stuffing boxes, lip seals, and many other options. All top entry mechanical seal units are provided with a drop collar and easy seal replacement features. The seal cartridge can be removed as a unit without removing the drive, inherently simplifying maintenance and reducing downtime.



Slurry Mechanical Seal



Side Entering Seal Shut Off

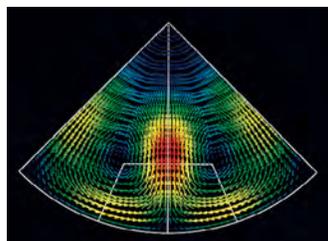
Static Mixers

The Kenics™ High Efficiency Vortex static mixer (HEV) is the ideal device for inline blending applications that occur within FGD and NO_x/SO_x reduction processes for the following reasons:

- By generating controlled and predictable flow patterns within the turbulent process flow, the HEV achieves efficient and guaranteed mixing levels within short piping lengths



HEV



HEV CFD simulation

- In addition to providing excellent mixing, the HEV converts the greatest percentage of its energy consumption into the mixing mechanism
- Designed to provide the best possible mixing along with the lowest pressure drop of any static mixer design
- The HEV mixing design is adaptable to circular, square and rectangular ducts contrary to many competitive designs

Sample applications for the HEV static mixer include:

- **Flue gas recirculation**—Mixing of air and recirculated flue gas in order to provide a uniform feed to a furnace that results in a decreased and more consistent peak flame temperature
- **SCR**—Even distribution of an injected ammonia stream into air prior to a catalyst bed provides a uniform feed to the bed that can increase the catalyst life, but also reduces temperature gradients and improves the flow dynamics of the feed stream
- **SNCR**—The mixer serves a similar purpose to the SCR example above, but is used for blending either ammonia or urea prior to a furnace

Optimized Design

Every Chemineer agitator selection is optimized for your specific FGD process. Equipment selections are optimized for long, reliable operation, reduced maintenance, low parasitic power consumption and optimal process performance.

Mixing Technologies is the industry leader in blending and motion and solids suspension applications. The patented ChemScale™ design procedure assures complete mixing of all process tanks, including those with high slurry concentrations or non-Newtonian characteristics.

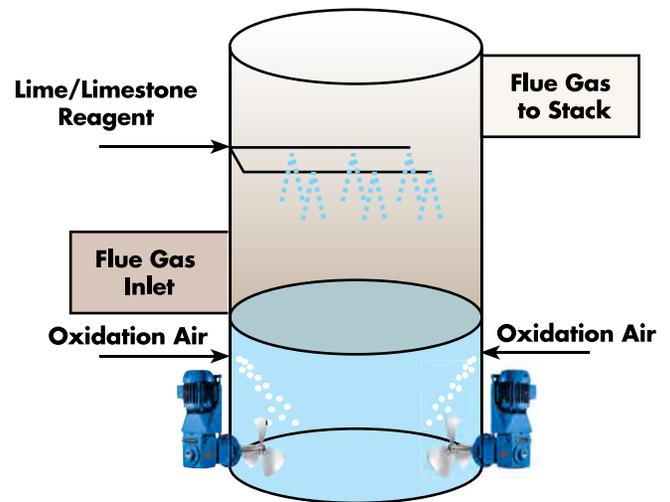
Solids suspension design utilizes particle settling velocities based on actual solid particle size and densities. The procedure has been proven in all FGD installations, as well as many other slurry handling systems.

Slurry Suspension Application Design—Lime, Limestone, and Gypsum Slurries

- Solids suspension design assures complete off bottom suspension
- Selecting the proper ChemScale level eliminates dead zones
- Design procedures have been proven in both the laboratory and production scale
- When necessary impellers are designed for startup in settled solids

Absorber Agitator Design

- All absorber applications are designed for complete, off bottom suspension as a minimum requirement
- Many absorber applications are designed for higher levels of suspension to reduce and eliminate scaling on in-tank components
- Improved blending performance improves oxidation efficiency
- Air dispersion applications
 - Lance aeration systems rely on agitators to improve mass transfer. These applications utilize side entry gear driven Chemineer HS or belt driven Prochem MD agitators for gas dispersion, blending and motion, and solids suspension.
- Grid or jet sparged reaction tanks do not require additional power input to meet mass transfer requirements
 - These applications utilize agitators for solids suspension and blending and motion only
 - Both side entering HS and MD agitators and top entering HT and HTM agitators may be used in these applications

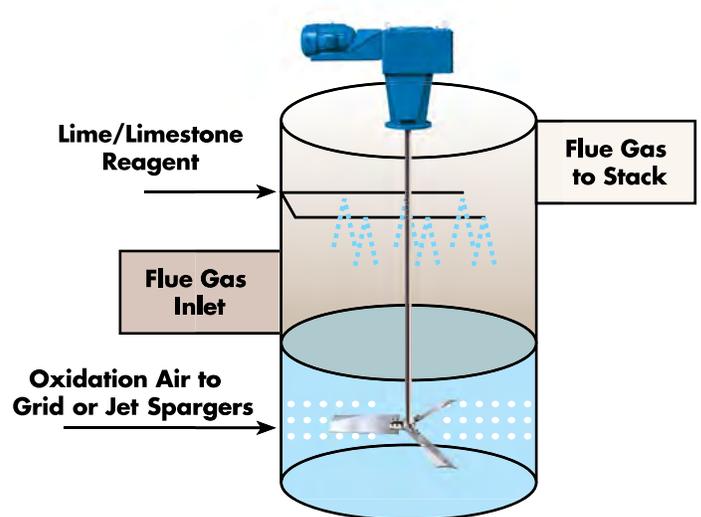


Side Entry Absorber

Aftermarket Parts and Services

We have an extensive aftermarket program designed to extend the service life of mixing equipment. Our program offers upgrades for any existing mixing process through advanced agitator design technology. Complete retrofits of wetted parts and sealing mechanisms offer reduced equipment downtime and improved process performance. Many replacement parts are stocked for quick turnaround and delivery to get your equipment running again as fast as possible.

Our emergency service program consists of a network of skilled in field and in plant aftermarket service professionals to respond to an emergency 24 hours a day. We know how critical downtime can be to your operations and are ready to respond. For after hours emergencies, call +1-937-926-1724.



Top Entry Absorber

Product Support

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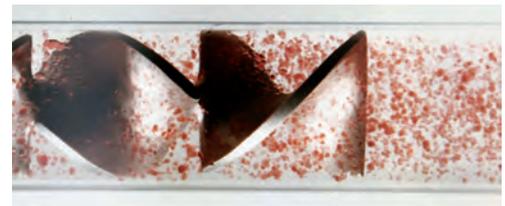
We provide the ideal solution for homogenization of bottom sediment and water prior to sampling in custody transfer pipelines.

Customer Benefits

- Predictable and accurate performance for measurement of crude oil water content
- Low cost to install, operate, and maintain compared to Jet mixing
- Designs comply with industry standards
 - ISO 3171
 - ASTM D4177
 - API 8.2
- Simple and effective operation with no maintenance



Gas into liquid dispersion



Oil into water dispersion

Application

Kenics static mixers are widely used in the oil and gas industry. Solutions and designs are offered to accurately determine the water content in crude oil and hydrocarbon streams.

Determining the amount of BS&W in hydrocarbon streams is an important aspect in custody transfer. Inaccuracies can result in significant financial loss throughout the process in upstream oil production, and also downstream refining, distribution, and transmission.

At \$100/bbl an error of only 0.1% in water content assessment at total flow of 500 bbl/hr (80 m³/h) results in a discrepancy of approximately \$438,000/year.

Mixing of an oil stream is critical if operators want to obtain the highest possible accuracy and repeatability, whether it is in watercut measurement or online sampling of hydrocarbons, spot sampling, or automatic grab sampling.

Design

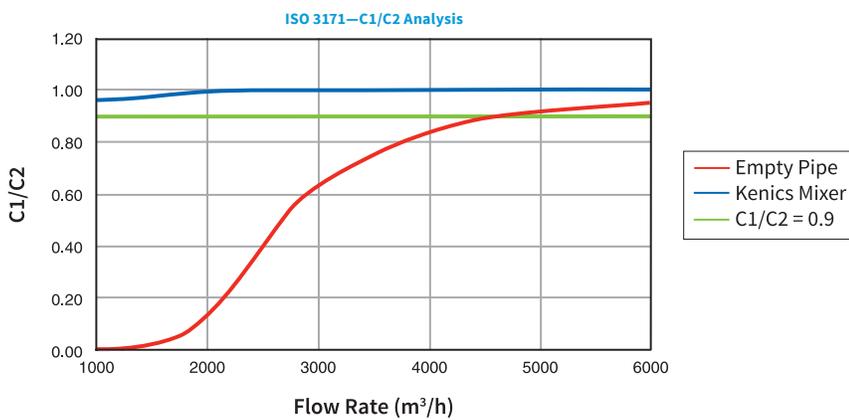
Our static mixers are highly effective at creating homogeneous liquid/liquid or gas/liquid dispersions. Engineers have extensive knowledge and experience to correctly design and specify mixers for fiscal mixing purposes.

Kenics static mixers are available with integral sampling ports for improved accuracy. This results in the elimination of a separate spool piece to incorporate at your sampling point.

Our approach is to engineer our custody transfer solutions to meet the stringent requirements of the ISO 3171, ASTM D4177, and API 8.2 standards. All too often the focus in providing a solution is the manufacturer's performance measure, as opposed to the more objective approach which requires compliance to methods and standards.



ISO 3171—Pipeline Mixing Quality



Comparison Between Kenics Static Mixer and Jet Mixer in Fiscal Mixing Applications

	Kenics Static Mixer	Jet Mixer
ISO 3171 Compliance	Complies	Complies
Capital Cost	Low	High
Lifetime Energy Cost	Low	High
Installation Cost	Low	High
Installation	As Pipe Spool	Multiple Equipment Install
Ancillary Equipment	N/A	Necessary
Performance Range	Fixed	Flexible
Failure/Spares Requirement	N/A	Necessary
Maintenance	None	Regular Requirement
Ease of Operation	Simple and Effective	Specific Monitoring Regime