PIP RESM003
Specification for Mixers and Agitators
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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# PIP RESM003
## Specification for Mixers and Agitators

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## Data Forms

- RESM003-D – Mixers and Agitators Data Sheet (US Customary Units)
- RESM003-DM – Mixers and Agitators Data Sheet (Metric Units)
- RESM003-R – Documentation Requirements Sheet
- RESM003-T – Inspection and Testing Requirements Sheet
1. Introduction

1.1 Purpose
This Practice provides requirements for designing and manufacturing permanently mounted mixers and agitators.

1.2 Scope
This Practice describes the minimum requirements for permanently mounted, top-bottom-, and side-entering mixers and agitators installed in pressurized or unpressurized vessels, with or without mechanical seals.

This Practice does not cover requirements for portable and clamp-on, light duty mixers or agitators, in-line and jet-type mixers, or high-speed dispersers.

2. References

Applicable parts of the following Practices and industry codes and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles will be used herein where appropriate.

2.1 Process Industry Practices (PIP)
- Process Industry Practices (PIP)/American Petroleum Institute (API)
  - PIP REIE 686/API RP686 – Recommended Practices for Machinery Installation and Installation Design
  - PIP ELSMT01 – AC Squirrel Cage Induction Motors (600 Volts and Below) Specification
  - PIP REEE003 – Guidelines for General Purpose Non-Lubricated Flexible Couplings

2.2 Industry Codes and Standards
- American Gear Manufacturers Association (AGMA)
  - AGMA 2015-1-A01 – Accuracy Classification System–Tangential Measurements for Cylindrical Gears
  - AGMA 6013-A06 – Standard for Industrial Enclosed Gear Drives

- American Society of Mechanical Engineers (ASME)
  - ASME B1.1 – Unified Inch Screw Threads (UN and UNR Thread Form)
  - ASME B16.5 – Pipe Flanges and Flanged Fittings (Steel)
  - ASME B16.47 – Large Diameter Steel Flanges

- American Society for Testing and Materials (ASTM)
  - ASTM A269 – Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
• Occupational Safety and Health Administration
  – OSHA 1910.212 – Machinery and Machine Guarding, General requirements for all machines
  – OSHA 1910.219 – Machinery and Machine Guarding, Mechanical power-transmission apparatus
• International Organization for Standardization (ISO)
  – ISO 1940 – Balance Quality of Rotating Rigid Bodies

3. Definitions

agitator: Mechanical device that disperses multiple phase liquids

auxiliary piping systems: Piping supplied with the agitator for various services (e.g., seal flush or buffer fluid, cooling water, gear reducer lubrication oil, and instrument air or nitrogen)

$L_{10}$: Life expectancy of rolling element bearings at which 10% of the bearings fail

mixer: Mechanical device for creating a nearly homogeneous mixture

owner: Party who owns the facility where the agitator or mixer will be used

purchaser: Party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.

sealless agitator: Agitator that does not contain a dynamic seal

shrink disc: Clamping assembly used to secure mechanical shaft seals against rotation on shafts. A shrink disc utilizes a bolted wedge assembly to maintain a friction fit to the shaft.

supplier: Party responsible for furnishing the agitator or mixer assembly

4. Requirements

4.1 Quotation

4.1.1 Mixers and agitators shall be in accordance with this Practice; purchaser’s data sheets PIP RESM003-D, PIP RESM003-DM, PIP RESM003-T, and PIP RESM003-R; and purchaser’s contract documents.

4.1.2 Exceptions to requirements in the documents in Section 4.1.1 shall be provided in writing with the quotation.

4.1.3 An alternate quotation may be provided if either of the following two conditions is met:

a. If significant process or delivery advantage exists, a superior, more reliable mixer or agitator design may be offered. The technical justification for the alternate design shall be provided.

b. Exceptions to requirements in the documents in Section 4.1.1 shall be provided in writing with the alternate quotation. Complete details of the exceptions shall be submitted to purchaser for review.
4.1.4 Documentation required to be submitted with the quotation shall be as shown on purchaser’s PIP RESM003-R Documentation Requirements Sheet.

4.2 General

4.2.1 Mixers and agitators shall be designed in accordance with this Practice and purchaser’s PIP RESM003-D or RESM003-DM Data Sheet.

4.2.2 Design details for mixers and agitators shall be in accordance with the design requirements of the tank or vessel in which the mixer is to be installed (e.g., API 12F or API 650).

4.2.3 Mixers and agitators with dynamic process fluid seals shall be provided complete, including drive motor, speed reducer, mounting flange, coupling and guard, shaft, mixing element, and shaft sealing system if applicable.

4.2.4 Sealless agitators shall be provided complete, including drive motor, necessary controllers, mounting flange, mixing element, speed reducers if applicable, and containment shell.

4.2.5 Expected sound pressure levels in dB for each octave band shall be provided in the quotation. Mixer noise level shall not be higher than specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet.

4.2.6 The need for external cooling for the shaft seal shall be identified and cooling water requirements shall be furnished in the supplier’s quotation.

4.2.7 Cooling water passages in heat exchangers or cooling jackets shall be designed for 7.0 bars (100 psig) minimum working pressure.

4.2.8 Top entry mixers and agitators that operate as the level is lowered or raised through the impeller should be of a stabilized design.

4.3 Installation and Maintenance

4.3.1 Mixers and agitators shall be designed for rapid and economical maintenance.

4.3.2 Detailed procedures for the repair of mixers and agitators shall be provided.

4.3.3 Unless special tools or fixtures are approved by the owner, mixers and agitators shall be designed for routine maintenance using standard shop tools without removing the tank or vessel from service. Requirements for special tools or fixtures shall be listed with the exceptions shown in the quotation. The requirement for routine maintenance using standard shop tools without removing the vessel or tank from service does not apply to sealless mixers and agitators.

4.3.4 Oil-fill openings, grease points, and mechanical seal reservoir fill port shall be extended for access without disassembly. Guards for the extended access points shall be provided.

4.3.5 Rabbeted fits or dowels shall be provided for alignment for all coupling, adapter housing, and gear casing joints, if applicable.

4.3.6 Internal mixer and agitator components shall be designed to fit through tank or vessel manhole openings.
4.4 Materials
4.4.1 Material of minor parts (e.g., bolting, shaft keys, and other attachment hardware) in contact with the process shall have a corrosion resistance equal to or greater than that of material of major parts in the same environment.

4.4.2 Material of pressure-containing parts in contact with the process shall have a corrosion resistance equal to or greater than that of the vessel.

4.4.3 Unless otherwise specified, components in contact with the mechanical seal flush or buffer fluid shall be AISI 300 series stainless steel.

4.5 Mixer and Agitator Assemblies
4.5.1 Shafts shall be designed to withstand torsional loads and bending moments for all specified operating conditions, including cold startup and operation while the tank or vessel is draining or filling.

4.5.2 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, the shaft shall have a removable coupling spacer to permit shaft seal replacement without removing the drive or the mixer or agitator shaft.

4.5.3 For shafts in a vertical orientation, the shaft shall have a removable collar or sleeve that supports the entire shaft assembly when the coupling spacer is removed. Coupling and support sleeve design shall be such that when the coupling bolts are loosened, the support sleeve supports the shaft automatically.

4.5.4 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, a rotor-dynamic analysis of the shaft assembly shall be performed for both dry and wet conditions. The analysis shall verify that any lateral or torsional resonances are separated from the operating speed range by a minimum of 20% of the normal operating speed. These resonances shall not be within 10% of any vane pass frequencies (including baffle effects) or electrical excitation frequencies (e.g., frequencies caused by variable frequency drives). The analysis results shall be provided with the equipment documentation.

4.5.5 Shaft assemblies that operate at greater than 100 rpm and less than 300 rpm shall be statically balanced to the purchaser’s tolerance as specified on RESM003-D or RESM003-DM Data Sheet.

4.5.6 Shaft assemblies that operate at 300 rpm or greater speed shall be dynamically balanced to G40 tolerance or better in accordance with ISO 1940.

4.5.7 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, shaft run-out tolerances shall be in accordance with the supplier’s standard values. The tolerance values shall be shown on purchaser’s Data Sheet.

4.5.8 Internal bolts or attachments shall be secured by lock-wire or other positive locking method such as bent tabs or spot welding. For top entry agitators, the drive assembly frame bolts shall also be secured by one of the above methods.

4.5.9 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, mixer and agitator element hub-to-shaft attachments shall be key driven.
4.5.10 Agitators Only

4.5.10.1 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, the agitator shaft shall have extended key seats for adjustment of the agitation elements.

4.5.10.2 For agitator shafts with multiple agitation elements, the key seats shall be circumferentially staggered around the shaft.

4.5.10.3 Bolting of agitator blades shall be in accordance with ASME B1.1.

4.5.10.4 Bolted connections of the agitation elements to the hub shall have a maximum diametral clearance of 0.8 mm (0.03 inch).

4.5.10.5 Blades shall be fastened to the hub with a minimum of three (3) bolts. Bolt-threaded length in hub and blade joint shall be minimized.

4.5.10.6 Total allowable variation in the radial sweep of the blade tips shall be 13 mm (0.5 inch). Radial sweep shall be measured without use of a steady bearing. Maximum tolerance for axial location of blades and hubs shall be plus or minus 13 mm (0.5 inch).

4.5.10.7 If the agitator drive input shaft can be turned by hand, run-outs of the assembled shaft and agitation elements shall not be greater than the following limits of total indicator run-out:
   a. 0.05 mm (0.002 inch) at the gear reducer output shaft
   b. 0.13 mm (0.005 inch) above and below the mechanical seal housing
   c. 0.25 mm/m (0.003 inch/ft) of shaft length measured from the agitator mounting flange at the first in-vessel coupling, at the agitator hubs, and at the shaft end without the support of a steady bearing
   d. 0.025 mm (0.001 inch) perpendicular run-out at the coupling face

4.5.10.8 Steady Bearings

Comment: A steady bearing design is typically a less expensive option than a cantilevered design that requires rotor dynamic analysis and a significantly larger shaft.

1. Unless approved by purchaser, steady bearings shall not be permitted.

2. If use of steady bearings is approved by purchaser, the steady bearing design shall be in accordance with the following criteria:
   a. Quotations for agitators that have a steady bearing shall include sufficient detail for evaluation of the steady bearing design.
   b. Bearing design shall provide sufficient clearance for the differential radial and axial thermal expansion of the shaft and the bearing support.
   c. Bearing support shall have provisions for lateral and axial adjustment of the bearing assembly for alignment purposes.
   d. Agitator shaft shall have a replaceable sleeve at the bearing. Shaft sleeves for abrasive services shall be hard coated.
e. Bearing shall have a replaceable liner. Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, liner shall be made of glass-filled Polytetrafluorethylene.

f. Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, bearing liner and shaft sleeve shall be field-replaceable without removing the agitator shaft or the bearing support.

4.6 Shaft Sealing Systems

4.6.1 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, a shaft sealing system shall be provided.

4.6.2 Seals shall be designed to be hydraulically balanced and of single cartridge construction.

4.6.3 The inner seal of dual seals shall have a reverse balance feature designed and constructed to withstand reverse pressure differentials without opening.

4.6.4 Seal cartridge shall be field-removable without removing the shaft or speed reducer, if installed.

4.6.5 Seal cartridge design shall be adequate for stand-alone static bench testing before installation.

4.6.6 Seal cartridges shall be self-venting through the seal circulation return line. Centerline of the seal flush return port shall be a minimum of 3 mm (0.13 inch) above the seal faces.

4.6.7 Seal cartridges shall have leak detection ports. Leak detection ports shall have a tapped connection and shall be permanently labeled by stamping.

4.6.8 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, the rotating seal element shall be setscrew driven.

4.6.9 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, the rotating seal element shall be key or shrink disc driven.

Comment: The use of setscrews to drive large or high-pressure mechanical seals requires the use of several setscrews, which creates the possibility of uneven setscrew tightening and distortion or improper installation of the seal. Mechanical damage to the shaft and possibly to the shaft O-rings can result from the setscrews upsetting the shaft metal when tightened. The use of key or shrink disc driven seal elements eliminates these possible problems. Use of a shrink disc imposes lower stresses on a shaft than key drives, and does not damage the shaft surface.

4.6.10 Pressure joints in the seal cartridge housing shall be sealed with O-rings. Use of gaskets shall not be permitted.

4.6.11 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, the seal cartridge shall not have cooling jackets.
4.6.12 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, dual seals shall have a seal reservoir with a minimum capacity of 20 liters (5 gallons).

4.6.13 Seal reservoir shall have a level gauge, a fill connection, and vent and drain connections. Level gauge shall be sized to indicate a range of plus or minus 50 mm (2 inches) of normal operating level.

4.6.14 Systems with dual seals shall have a device that provides positive circulation of buffer fluid from the seal reservoir to the seal. Circulation device may be a pumping ring or a separate circulation pump.

4.6.15 If a dead-ended seal lubrication system is specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, a cooling jacket may be required, and a circulation device shall not be provided.

4.6.16 An anti-friction bearing shall be mounted in or near the mechanical seal cartridge to minimize shaft motion at the seal. For continuous service, the bearing shall have a minimum L10 life of 40,000 hours. Calculation of bearing life shall be based on the operating conditions specified in the contract documents. If approved by the purchaser, dual seals with an integral bearing may be furnished.

4.6.17 If specified, a separate lifting device for seal maintenance shall be provided.

Comment: A separate lifting device for mechanical seal maintenance (typically a small bolt on trolley and hoist assembly) is recommended if no permanent overhead lifting capacity is available and the weight of any item in the seal system exceeds 20 kg (45 lb).

4.6.18 For toxic fluids, fluids operating near autoignition temperature, and for flammable fluids with vapor pressure greater than atmospheric pressure at operating temperature or maximum ambient temperature, the shaft sealing system shall have pressurized dual mechanical seals.

4.6.19 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, the sealing system shall have a positive shutoff device that permits maintenance of the sealing system without clearing the tank or vessel. The positive shutoff device shall have the following features:

a. Capable of sealing at two times the pressure exerted by the liquid when the tank or vessel is at maximum liquid level

b. The mixer or agitator shall have a method of positively locking the shaft while the positive shutoff device is in service.

c. The mixer or agitator design shall provide for testing the effectiveness of the shutoff device before actual operation, and/or maintenance.

Comment: Partial depressurization of a vessel is permitted for maintenance; therefore the positive shut-off device may have a lower pressure rating than the mechanical seal.

4.7 Agitator Supports

4.7.1 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, agitators shall have a through-bolted connection flange with
dimensions, drilling, and pressure rating in accordance with \textit{ASME B16.5} or \textit{ASME B16.47}, whichever applies.

4.7.2 Connection or mounting flange shall match the tank or vessel flange in all respects.

4.7.3 Agitators shall be supported by the vessel or tank nozzle, If required, adjustable connecting rods shall be provided. Independent external support or base shall not be permitted.

4.7.4 The center of gravity of side-entering agitators shall be located as close to the mounting flange face as practical.

4.7.5 Mounting flange shall match the vessel or tank flange in all respects.

4.8 \textbf{Shaft Couplings and Guards}

4.8.1 The coupling between the motor and gear reducer shall be of non-lubricated flexible design.

4.8.2 The coupling service factor shall be a minimum of 2.0 based on the motor nameplate power.

4.8.3 Couplings for motors 35 kW (50 hp) and greater shall be flexible disk type.

4.8.4 If applicable, couplings for gear reducer output shaft and mixer or agitator shaft shall be of rigid design.

4.8.5 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, agitator shaft coupling hubs shall be keyed, welded in place, or of integral flange type. The arrangement shall be shown on the outline dimension drawing. Threaded coupling mounts shall not be permitted.

4.8.6 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, shaft ends for mixer or agitator shaft coupling hubs above mechanical seals shall be tapered for ease of disassembly.

\textit{Comment:} Tapered coupling hubs are used at coupling joints if the coupling is required to be easily field removable and also have a moderate interference fit to transmit torque. The coupling located just above the mechanical seal is an example of this.

4.8.7 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, cylindrical bore couplings shall be mounted using an interference fit of 0.0005 mm/mm (0.0005 inch/inch) of shaft diameter. Puller holes shall be provided in couplings hubs that are installed with interference fit.

4.8.8 A coupling guard, in accordance with \textit{OSHA 1910.212} and \textit{OSHA 1910.219}, shall be provided for the motor driver coupling area.

4.9 \textbf{Speed Reducers}

4.9.1 \textbf{General}

4.9.1.1 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, speed reducers shall be designed for mixer or agitator service.

4.9.1.2 Output shaft and bearings shall be designed to support the weight of the mixer or agitator assembly.
4.9.1.3 Speed reducers shall be designed to withstand all torsional, bending, and thrust loads so that significant deflections are not transmitted to the gears, belts, and bearings.

4.9.1.4 Except for services specified in Section 4.9.1.5, minimum speed reducer service factor shall be 1.4.

4.9.1.5 For services in which polymerization or solidification can occur in a vessel or tank, the minimum speed reducer service factor shall be 2.0.

4.9.2 Gear Reducers

4.9.2.1 Gear reducer shall be furnished in accordance with AGMA 6013-A06.

4.9.2.2 Gears shall be spiral bevel and/or helical. Use of worm gears, hypoid gears, or herringbone gears shall not be permitted. Double helical gears are not permitted for vertical applications.

4.9.2.3 Gears shall be provided to Quality Level 12, as a minimum, in accordance with AGMA 2015-1-A01 and AGMA 2015/915-1-A02 SUPP.

4.9.2.4 For continuous duty mixers and agitators, gear reducer anti-friction bearings shall be designed for an \( L_{10} \) life of 40,000 hours. Loads on bearings shall be based on nominal driver rating and agitator shaft loads transmitted to the gear reducer.

4.9.2.5 Thermal rating of a gear reducer shall be calculated in accordance with AGMA 6013-A06 using a factor of 0.75 for the ambient modifier, T4.

4.9.2.6 Gear reducers shall be oil lubricated.

4.9.2.7 Gear reducer lubrication system shall operate automatically without operator intervention.

4.9.2.8 Gear reducer housing shall have lifting lugs that are sized and located to lift the mixer assembly for installation and maintenance.

4.9.2.9 Gear reducer housing shall have an oil level sight glass. Normal oil levels for static and operating conditions shall be plainly marked on the housing.

4.9.2.10 If specified, a plugged connection shall be furnished for installation of temperature indicator by the purchaser.

4.9.2.11 Gear reducer housing shall have direction-of-rotation arrows cast in or attached with corrosion-resistant fasteners. Arrows shall indicate direction of rotation of input and output shafts.

4.9.2.12 Gear reducer housing shall have a gear reducer nameplate securely attached to the outside of the housing. Nameplate shall be made of AISI 300 series stainless steel and shall be attached with corrosion-resistant fasteners.

4.9.2.13 The following information shall be permanently marked on the nameplate.
   a. Size and type or model
   b. Rated power
   c. Service factor
d. Ratio  
e. Input and output rpm  
f. Manufacturer’s name  
g. Serial number  
h. Purchaser’s equipment number  
i. Size and type of bearings  
j. Recommended lubricant  
k. Lubricant quantity in liters (quarts)

### 4.9.3 Belt-Driven Mixers

4.9.3.1 Synchronous belt speed reducers shall be provided in accordance with the mixer manufacturer’s recommendations.

4.9.3.2 The mixer manufacturer shall provide operating speed and load limitations or requirements on the RESM003-D or RESM003-DM and nameplate.

4.9.3.3 Belt-driven mixers shall show the belt drive information on a nameplate securely attached to the outside of the mixer housing. The nameplate shall be made of AISI 300 series stainless steel and shall be attached with corrosion-resistant fasteners.

4.9.3.4 The nameplate shall be permanently marked with the following information:

a. Size and type or model  
b. Rated power  
c. Service factor  
d. Ratio  
e. Input and output rpm  
f. Manufacturer’s name  
g. Serial number  
h. Purchaser’s equipment number  
i. Speed/load limitations or requirements

### 4.9.4 Cooling and Lubrication

4.9.4.1 If the driver nominal nameplate power is greater than the thermal rating of the gear reducer, an external cooling system shall be provided.

4.9.4.2 If fan cooling is sufficient, the cooling system shall consist of ducting and a fan mounted on the input shaft.

4.9.4.3 If fan cooling is insufficient, forced-oil circulation through an external cooler shall be provided and shall include the following:

a. Replaceable element filter  
b. Motor-driven oil pump
c. Cooler (water or air cooled)
d. Pump discharge pressure gauge
e. Low oil pressure alarm switch
f. Sump and cooler exit temperature gauges
g. Unless otherwise specified, oil piping shall be stainless steel piping.

4.9.4.4 Bearing housings shall be equipped with replaceable labyrinth type end seals and deflectors.

4.9.4.5 Bearing housings for oil lubricated non-pressure fed bearings shall be provided with constant level oilers.

4.10 Drive Motors

4.10.1 Drive motors shall be in accordance with PIP ELSMT01.

4.10.2 Drive motors shall have a 1.15 service factor.

4.10.3 The motor nameplate power shall not be less than 115% of maximum agitator power requirements, including drive losses. Motor service factor shall not be used to meet this requirement.

4.10.4 Vertical motors shall have a rain shield.

4.10.5 The motor shall be mounted on a rigid bracket attached to the gear reducer if applicable.

4.10.6 Foot-mounted motors shall have stainless steel shims with a minimum thickness of 3 mm (0.125 inch) to support the motor feet. The shim pack shall consist of not less than three and not greater than five shim pieces.

4.10.7 Motor mounting adapter runouts, measured from the gear reducer input shaft for flange mount motors, shall not exceed 0.05 mm (0.002 inch) concentricity (i.e., radial runout) and 0.13 mm (0.005 inch) perpendicularity (i.e., face runout).

4.10.8 If specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, positioning screws to aid in driver alignment shall be provided for both foot- and flange-mounted motors as follows:

a. For foot-mounted motors, horizontal positioning screws for both transverse and longitudinal directions
b. For flange-mounted motors, positioning screws to adjust motor alignment in two directions normal to the shaft axis
c. Any part of the positioning screw assembly above the plane of the mounting surface shall be removable without cutting, burning, or grinding.

4.10.9 Motors shall be provided with a grounding lug on the frame.

4.11 Auxiliary Piping

4.11.1 Piping connections to purchaser’s systems NPS 3/4 or larger shall be flanged.

4.11.2 The seal flush system shall be stainless steel tubing in accordance with ASTM A269. Minimum size of tubing shall be 12 mm (0.5 inch).

Comment: Use of 20 mm (0.75-inch) tubing is preferred.
4.12 Inspection and Testing

4.12.1 Requirements for inspections and testing shall be in accordance with purchaser’s *PIP RESM003-T* Inspection and Testing Requirements Sheet.

4.12.2 If specified on purchaser’s *PIP RESM003-T* Inspection and Testing Requirements Sheet, a final inspection shall be conducted by the purchaser before the mixer or agitator is shipped.

4.12.3 Required data from shop inspections and tests shall be provided for purchaser’s review and acceptance before shipment of the mixer or agitator.

4.12.4 If specified on purchaser’s *PIP RESM003-T* Inspection and Testing Requirements Sheet, the purchaser shall be notified a minimum of 5 days before any scheduled shop tests and before the equipment is to be ready for final inspection.

4.12.5 If specified on purchaser’s *PIP RESM003-T* Inspection and Testing Requirements Sheet, additional tests (e.g., part or full load tests or testing to validate agitation element design) shall be performed.

4.13 Preparation for Shipment

4.13.1 Preservation

The interior of a gear reducer shall be treated with corrosion inhibitors in accordance with *API RP686*.

4.13.2 Cleaning and Painting

4.13.2.1 Unless otherwise specified, exterior surfaces shall be painted with the supplier’s standard paint.

4.13.2.2 Stainless steel surfaces shall not be painted unless covered by insulation.

4.13.2.3 Exposed machined surfaces shall be coated with an easily removable rust preventative.

4.13.3 Packing and Tagging

4.13.3.1 The mixer or agitator shall be braced, and small piping shall be secured to prevent damage during shipment.

4.13.3.2 Flanged openings shall be sealed with gaskets and metal covers.

4.13.3.3 Small piping shall be sealed with metal or plastic plugs.

4.13.3.4 Mounting flanges shall be protected with sheet steel covers. Additionally, wooden covers with a minimum thickness of 20 mm (0.75 inch) shall be placed over the steel covers and secured with a minimum of four bolts.

4.13.3.5 Special tools and small accessories shall be boxed and shipped with the mixer or agitator.

4.13.3.6 The following documents shall be enclosed in a waterproof envelope and attached to the mixer or agitator:
   a. Complete set of installation and operation instructions
   b. Certified outline dimension drawing.
4.13.3.7 Material shipped separately shall be identified with the purchaser’s item number on a metal tag.
4.13.3.8 Each separate item, crate, bag, etc., shall be identified with purchaser’s order and requisition numbers and with all special markings specified by the purchase order.

4.13.4 Optional Shop Assembly

4.13.4.1 If specified on purchaser’s PIP RESM003-T Inspection and Testing Requirements Sheet, the mixer or agitator shall be shop-assembled before shipment.

4.13.4.2 Disassembly shall be limited to that required for shipment, rigging, storage, or installation.

4.13.4.3 Components disassembled shall be clearly match-marked for reassembly.

4.14 Documentation

Documentation shall be provided in accordance with purchaser’s PIP RESM003-R, Documentation Requirements Sheet.