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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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. **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 mixers, 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
• 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

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)

$L_{10c}$: 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.

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 in addition to the base 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).

Note: Items such as the mounting flange, materials of construction, pressure rating etc should match the design requirements of the tank or vessel.

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 shall not exceed the seal manufacturer’s maximum deflection criteria. This can be done by sufficient stiffness of the shaft or through a stabilized design. Purchaser will indicate which approach is allowable on the datasheet.

4.2.9 The direction of rotation shall be clearly marked on the equipment in a location that can be readily seen when the equipment is installed. Indication shall be cast into the housing or affixed with a 300 series stainless steel tag.

4.2.10 Electrical equipment, wiring, and installation shall be suitable for the electrical area classification specified. Electrical area classification shall be noted on both the mixer and motor data sheets.

4.2.11 All conduit, armored cable, and supports shall be designed and installed so that they can be easily removed without damage and shall be located so that they do not hamper removal of bearings, seals, or equipment internals. Owner and vendor shall review layout to ensure that potential for damage during normal maintenance and operation and personnel hazards are eliminated.

Note: The electrical contractor should provide adequate length of conduit to allow for full articulation of the mixer to ensure proper movement.

4.2.12 The equipment shall perform on the test stand and on the permanent foundation with a maximum shaft vibration level of 3 mils (0.003 inch) as close to the seal face as possible.

Note: The appropriate unit of measurement for this test is mils due to the equipment’s low frequency. This aligns with standard industry practice.
4.2.13 Spare parts for the machine and all furnished auxiliaries shall meet all the requirements of this Standard.

4.2.14 All pressure containing parts shall be designed and fabricated in full conformance with the latest edition of the ASME Boiler and Pressure Vessel Code, Section VIII. All pressure containing parts shall have a corrosion allowance at least equal to the corrosion allowance of the related vessel, but not less than 3.175-mm (1/8-inch).

4.2.15 Welding of piping, pressure-containing parts, other highly stressed parts, weld repairs, and any dissimilar-metal welds shall be performed and inspected by operators and procedures qualified in accordance with Section VIII, Division 1, and Section IX of the ASME Boiler and Pressure Vessel Code. Welding of rotating elements shall not be permitted. All welds shall be made by operators qualified on the materials being welded. Only Purchaser-approved weld procedures shall be used.

4.2.16 The Purchaser shall specify the equipment’s normal operating point. The Purchaser shall specify alternate conditions sufficient to cover the expected range of operation.

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 Major parts such as casing components and bearing housings shall be designed and manufactured to ensure accurate alignment on reassembly. This may be accomplished by the use of shouldering, cylindrical dowels, or keys. The vendor shall show dimensions of space required for removal of major components such as casing covers, bundles, and rotors on the first issue of the general arrangement drawings.

4.3.5 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.

4.3.6 Rabbeted fits shall be used, when required, to maintain alignment for all joints, seal chambers, bearing housing mountings, gear reducers, and drivers.

4.3.7 Internal mixer and agitator components shall be designed to fit through tank or vessel manhole openings. If approved by Owner, larger blades may be accepted for top entry mixers.

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. The use of carbon steel
bolting shall be limited to mixers that operate at 10.5 bar (150 psig) or less. At fluid temperatures exceeding 232°C (450ºF) or pressure exceeding 10.5 bar (150 psig), suitable high temperature alloy bolting shall be used. For temperatures below −29°C (−20ºF), suitable low temperature alloy bolting shall be used.

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.

4.4.4 The details of threading shall conform to ASME B1.1 (external and internal) and shall be consistent with the data sheet units.

4.4.5 Owner shall specify positive material identification requirements.

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. The Purchaser shall specify if the equipment will be used for startup in a settled bed of solids.

4.5.2 Unless otherwise specified on purchaser’s PIP RESM003-DM or RESM003-D 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-DM or RESM003-D 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 Rotating 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 Rotating assemblies that operate at 300 rpm or greater speed shall be dynamically balanced to G16 tolerance or better in accordance with ISO 1940.

4.5.7 Shaft run-out at the seal shall not exceed 0.05-mm (0.002-inch) total indicated reading (T.I.R.). All other shaft-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. 0.08 mm (0.003 inch) above and below the mechanical seal housing as close as possible to the seal faces
   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 simpler 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 polytetrafluoroethylene.

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 The seal chamber shall be designed to accept single seals or dual seals. The seal chamber shall be integrally constructed to accept single and dual cartridge seals with universal mounting glands. 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 unless otherwise specified by the Purchaser or recommended by the supplier.

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 The rotating seal element drive type requires purchaser review and approval.

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

4.6.10 Unless otherwise specified on purchaser’s PIP RESM003-D or RESM003-DM Data Sheet, the seal cartridge shall not have cooling jackets.

4.6.11 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).

4.6.12 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.
4.6.13 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.

4.6.14 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.

4.6.15 An anti-friction bearing shall be mounted 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.

4.6.16 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).

4.6.17 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.

4.6.18 Seal gaskets shall be protected from tank or vessel deposits. Drains shall be provided to allow removal of all leakage from mechanical seals.

4.6.19 Connections for external lubrication shall be provided on any mechanical seal not lubricated by the process fluid or if the process fluid is non-lubricating.

4.6.20 Seal area design shall include a close clearance device that will prevent excessive leakage in the event of seal failure. Close clearance components shall not be constructed of low melting point materials such as plastic.

4.6.21 A leak detection system shall be installed that is capable of containing the initial release in a vessel with a sight glass. The system shall have remote alarm and shutdown capabilities in the event of a leak.

4.6.22 Run-out (TIR) of the seal chamber face shall not exceed 0.5-µm/mm (0.0005-in/in) of seal chamber bore.

4.7 Positive Shutoff Devices

4.7.1 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.

d. Sealing faces of the shutoff device shall be of corrosion-resistant material. Seal should also be of a non-clogging design.

4.8 Mixer and Agitator Supports

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

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

4.8.3 Mixers and 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.

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

4.9 Shaft Couplings and Guards

4.9.1 The coupling between the motor and gear reducer shall be of non-lubricated flexible design in accordance with PIP REEE003.

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

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

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

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

4.9.6 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.

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.

4.9.7 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.

4.9.8 A coupling guard, in accordance with OSHA 1910.212 and OSHA 1910.219, shall be provided for the motor driver coupling area.
4.10 Speed Reducers

4.10.1 General

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

4.10.1.2 Output shaft and bearings shall be designed to support the weight of the mixer or agitator assembly.

4.10.1.3 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.

4.10.1.4 Except for services specified in Section 4.10.1.5, minimum speed reducer service factor shall be 1.4.

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

4.10.2 Gear Reducers

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

4.10.2.2 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.

4.10.2.3 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.

4.10.2.4 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.

4.10.2.5 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.

4.10.2.6 Gear reducers shall be oil lubricated.

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

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

4.10.2.9 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.

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

4.10.2.11 Gear reducer housing shall have direction-of-rotation arrows cast in or shall be made of AISI 300 series stainless steel and shall be attached with corrosion-resistant fasteners. Arrows shall indicate direction of rotation of input and output shafts.
4.10.2.12 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.

4.10.2.13 The following information shall be permanently marked on the nameplate.

- Size and type or model
- Rated power
- Service factor
- Ratio
- Input and output rpm
- Manufacturer’s name
- Serial number
- Purchaser’s equipment number
- Size and type of bearings
- Recommended lubricant
- Lubricant quantity in liters (quarts)
- Maximum temperature
- Maximum pressure

4.10.3 Belt-Driven Mixers

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

4.10.3.2 The mixer manufacturer shall provide operating speed and load limitations or requirements on the RESM003-D or RESM003-DM and nameplate. Minimum belt service factor shall be 1.5 based on the rated output of the driver.

4.10.3.3 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.

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

- Size and type or model
- Rated power
- Service factor
- Ratio
- Input and output rpm
- Manufacturer’s name
g. Serial number
h. Purchaser's equipment number
i. Speed/load limitations or requirements
j. Maximum temperature
k. Maximum pressure

4.10.3.5 Belt transmissions shall be protected by a weatherproof guard made preferably of a spark-proof material. The guard shall meet the requirements of OSHA in addition to any regional standards, such as ISO, etc. Belt guards shall be coated internally with anti-static paint. All fasteners required to hold the guard assembly together shall be mechanically retained within the guard.

4.10.4 Cooling and Lubrication

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

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

4.10.4.3 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. Oil piping and tubing shall be stainless steel.
   h. Indication of required gpm
   i. Indication of required pressure

4.10.4.4 Bearing housings shall be equipped with replaceable bearing isolators where the shaft passes through the housing; lip-type seals shall not be used. The seals shall be made of non-sparking materials. The design of the seals shall effectively retain oil in the housing and prevent entry of foreign material into the housing.

4.10.4.5 Bearing housings for oil-lubricated non-pressure-fed bearings shall be provided with tapped and plugged fill and drain openings at least DN 15 (NPS 1/2) in size. The housings shall be equipped with constant-level sight-feed oilers, at least 120 ml (4 ounces) in size, with a positive level positioner (not a set screw), heat-resistant glass containers (not subject to sunlight- or heat-induced opacity or deterioration), and protective wire cages. When specified, the oilers
shall meet the Purchaser’s preference. A permanent indication of the proper oil level shall be accurately located and clearly marked on the outside of the bearing housing with permanent metal tags, marks inscribed in the castings, or another durable means.

4.11 **Drive Motors**

4.11.1 Drive motors shall be in accordance with *PIP ELSMT01*.

4.11.2 Drive motors shall have a 1.15 service factor.

4.11.3 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.

4.11.4 Vertical motors shall have a rain shield.

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

4.11.6 Foot-mounted motors shall have stainless steel shims with a minimum thickness of 3 mm (0.125 inch) and a maximum combined thickness of 6 mm (0.250 inch) to support the motor feet. The shim pack shall contain no more than five shim pieces.

4.11.7 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).

4.11.8 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.

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

4.12 **Auxiliary Piping**

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

4.12.2 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.

4.13 **Inspection and Testing**

4.13.1 Requirements for inspections and testing shall be in accordance with purchaser’s *PIP RESM003-T* Inspection and Testing Requirements Sheet. The inspection and test plan shall be included in the bid request and shall be mutually agreed to by the Owner and vendor.

At least 6 weeks before the first scheduled test, the Manufacturer shall submit to the Purchaser, for his review and comment, detailed procedures for all running
tests, including acceptance criteria for all monitored parameters. Monitored parameters shall include but not be limited to:

1. Bearing temperatures
2. Oil temperatures
3. Vibration limits

4.13.2 Mixers shall be tested in air or water at the Manufacturer’s factory. Mixing shall occur freely without excessive noise or vibration. Lateral run-out, T.I.R., shall not exceed 0.05-mm (0.002-inch) at the seal during the run test.

4.13.3 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.

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

4.13.5 If specified on purchaser’s PIP RESM003-T Inspection and Testing Requirements Sheet, the purchaser shall be notified a minimum of 10 working days before any scheduled shop tests and before the equipment is to be ready for final inspection.

4.13.6 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.

4.14 Preparation for Shipment

4.14.1 Preservation

Equipment shall be suitably prepared in accordance with API 686 for the type of shipment specified.

1. After tests and inspection, the internal parts including bearings and shafts and all machined surfaces (including reduction gear if supplied) shall be flushed and coated with a suitable rust preventative, as required to protect equipment during shipment and outdoor storage.

2. The preparation shall make the equipment suitable for 6 months of outdoor storage from the time of shipment, with no disassembly required before operation.

4.14.2 Cleaning and Painting

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

4.14.2.2 Unless otherwise specified, stainless steel surfaces shall not be painted unless covered by insulation

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

4.14.3 Packing and Tagging

4.14.3.1 The mixer or agitator shall be braced, and small piping shall be secured to prevent damage during shipment.
4.14.3.2 Flanged openings shall be sealed with gaskets and metal covers.

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

4.14.3.4 Mounting flanges shall be protected with sheet steel covers and a rubber gasket with a minimum thickness of 3 mm (0.125 inch) and secured with a minimum of four bolts. Additionally, wooden covers with a minimum thickness of 20 mm (0.75 inch) may be placed over the steel covers.

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

4.14.3.6 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.

4.14.3.7 The equipment shall be identified with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags.

4.14.3.8 Each separate item, crate, bag, etc., shall be identified with corrosion resistant tags stating purchaser’s order and requisition numbers and with all special markings specified by the purchase order.

4.14.3.9 The vendor shall provide the Owner with the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before start-up. Crating shall be clearly marked with instructions/indication for proper uncrating. Crating shall be suitable for reuse after initial on-site inspection.

4.14.3.10 Mixers with mechanical seals shall be shipped with the seals installed, cleaned, lubricated, and ready for initial service. Seal tabs shall be installed and identified by means of corrosion-resistant tags attached with stainless steel wire.

4.14.3.11 Bearing assemblies shall be fully protected from the entry of moisture and dirt. If vapor-phase inhibitor crystals in bags are installed in large cavities to absorb moisture, the bags shall be attached in an accessible area for ease of removal. Where applicable, bags shall be installed in wire cages attached to flanged covers, and bag locations shall be indicated by corrosion-resistant tags attached with stainless steel wire.

4.14.3.12 Threaded openings shall be provided with steel caps or round-head steel plugs in accordance with ASME B16.11. The caps or plugs shall be of material equal to or better than that of the housing. In no case shall nonmetallic (such as plastic) caps or plugs be used.

4.14.3.13 Openings that have been beveled for welding shall be provided with closures designed to prevent entrance of foreign materials and damage to the bevel.

4.14.3.14 Lifting points and lifting lugs shall be clearly identified.
4.14.3.15 Rotors shall be blocked if necessary. Blocked rotors shall be identified by means of corrosion-resistant tags attached with stainless steel wire.

4.14.4 Optional Shop Assembly

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

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

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

4.15 Documentation

Documentation shall be provided in accordance with purchaser’s PIP RESM003-R, Documentation Requirements Sheet.
**TANK MIXERS AND AGITATORS (US CUSTOMARY UNITS)**

<table>
<thead>
<tr>
<th>ISSUED FOR:</th>
<th>PROPOSAL</th>
<th>PURCHASE</th>
<th>AS BUILT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACILITY NAME/LOCATION:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>ITEM NAME:</td>
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<td></td>
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</tr>
<tr>
<td>ITEM TAG NO.:</td>
<td></td>
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<tr>
<td>SERVICE:</td>
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<td>PURCHASER ORDER NO.:</td>
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<td>SUPPLIER/LOCATION:</td>
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<tr>
<td>SUPPLIER ORDER NO.:</td>
<td></td>
<td></td>
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<tr>
<td>DATA PROVIDED BY:</td>
<td>● PURCHASER</td>
<td>● SUPPLIER</td>
<td>● SUPPLIER IF NOT BY PURCHASER</td>
</tr>
</tbody>
</table>

### GENERAL

- MIXER MANUFACTURER: ______________
- MODEL NO.: ______________
- SERIAL NO.: ______________
- QTY.: ______________
- DRIVER ITEM NO.: ______________
- DRIVER TYPE: ______________
- DRIVER PROVIDED BY: ______________

### PERFORMANCE

- OPERATING SPEED: __________ RPM
- MAX SHAFT POWER: __________ HP
- CALCULATED PRIMARY PUMPING CAPACITY: __________ GPM
- NORMAL SHAFT POWER: __________ HP
- ROTATION: CW, CCW
- IMPELLER DIAMETER: __________ IN

### SITE DATA

- LOCATION: □ INDOOR □ HEATED □ UNHEATED □ OUTDOOR
- IF OUTDOORS, IS MIXER/AGITATOR SHADED: YES □ NO □
- IF NO. BTU/hr. SOLAR FLUX: __________
- ALTITUDE: __________ FT
- ELECTRICAL CLASSIFICATION: CLASS/ZONE: __________
- GROUP: __________
- DIVISION: __________
- TEMP. CLASS: __________
- AMBIENT TEMPERATURE RANGE: __________ °F MAX. __________ °F MIN.
- RANGE OF RELATIVE HUMIDITY: SUMMER: __________ WINTER: __________
- WINTERIZATION REQUIRED □ TROPICALIZATION REQUIRED □
- DUST □ FUMES □ TYPE OF FUMES: __________
- OTHER: __________

### SPECIAL EQUIPMENT REQUIREMENTS:

- __________

### OTHER:

- __________

### COMMENTS:

- __________

---

**REV NO.** | **DATE** | **ISSUE STATUS** | **BY** | **CHECKED** | **APPROVED**
---|---|---|---|---|---

## Tank Mixer Process Definition

### Fluid Properties, Composition, and Conditions

<table>
<thead>
<tr>
<th>Feed</th>
<th>Component</th>
<th>Rate (GPM)</th>
<th>Temp (°F)</th>
<th>Density (LB/FT³)</th>
<th>Viscosity (CP)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Toxicity:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Operating Temperature (°F):**
  - Normal: __________
  - Minimum: __________
  - Maximum: __________
- **Foaming Tendency:**
  - None
  - Moderate
  - Excessive
- **Viscous Property:**
  - Diluent
  - Newt
  - Pseudoelastic
- **Max. Viscosity (CP):**
  - Startup: __________
  - Intermediate Blend: __________
  - Final Blend: __________
  - Upset: __________
- **Toxicity:**
  - Normal
  - Moderate
  - Difficult
- **Viscosity Property:**
  - __________

### Operation (Continuous Retention Time)

- **Mixing During:**
  - Filling
  - Drawoff
  - Emptying
- **Primary Bulk Fluid Velocity (FT/Sec):**
  - Required: __________
  - Quoted: __________
- **Average Shear Rate (1/SEC):**
  - Required: __________
  - Quoted: __________
  - Maximum: __________
- **Recipe (Volume/Sequence Mix Time):**
- **Nature of Solids:**
  - __________
- **Heat Transfer Fluid:**
  - __________
- **Conductivity:**
  - __________
- **Duty:**
  - __________
- **External Jackets:**
  - __________
- **Internal Coil Tube Baffles:**
  - __________

### Process Requirements (Complete All That Apply)

- **Bleeding of Miscible Liquids**
- **Solids Suspension:**
  - __________
- **Particle Size:**
  - __________ micron
- **Weight % Solids:**
  - __________
- **Dissolution:**
  - __________
- **Nature of Solids:**
  - Soluble
  - Insoluble
  - ABRASIVE
  - Sticky
  - Crystalline
  - Fluffy
- **Settling Velocity:**
  - __________ FPM
- **Resuspend After Settling:**
  - __________
- **All Solids in Motion:**
  - __________
- **Dispersion (Non-Miscible):**
  - __________
- **Reduce Agglomerates to:**
  - __________ microns max
- **Crystallization:**
  - __________
- **Impeller to Scrape Surface:**
  - __________
- **Crystals:**
  - Friable
  - Settle Out
  - Depressed on Surface
- **Polymerizing:**
  - __________
- **Solids Formation:**

### Dissolving

- **Solubility:**
  - Easy
  - Moderate
  - Difficult
- **Dissolving Solids May Agglomerate:**

### Heat Transfer

- **Service:**
  - __________
- **Specific Heat:**
  - __________ BTU/LB
- **Heat Transfer Fluid:**
  - __________ BTU/LB
- **Duty:**
  - __________ BTU/HR
- **Gas Source:**
  - __________
- **Gas Flow:**
  - __________
- **Chemical Reaction:**
  - __________
- **Extraction:**
  - __________
**CONSTRUCTION FEATURES**

- **IMPELLER:**
  - Manufacturer Code: 
  - Quantity: 
  - Type: ____________
  - Pitched
  - Multiple Pitch
  - No. Blades: ____________
  - Recommended Clearance from Obstruction: ____________ in
  - Projected Blade Area: ____________ in²
  - Thickness: ____________ in
  - Attachment: ____________ WELDED
  - ____________ BOLTED
  - Hub: ____________ FABRICATED
  - ____________ CAST
  - ____________ KEY-DRIVEN
  - Balance Quality ISO Grade: 

- **SHAFT:**
  - Hollow
  - Solid
  - Stepped
  - Flanged
  - ____________ Extended Key Seats
  - ____________ Stabilizers
  - Shaft Dia.: ____________ in
  - Critical Speed: ____________ rpm
  - Shaft Runout Tolerance: ____________ in
  - At Face of Seal Housing: 
  - Maximum Shaft Deflection at Seal Housing: ____________ in
  - Direction of Rotation from Drive End: 

- **GEARBOX:**
  - Manufacturer: ____________
  - Model Number: ____________
  - Type: ____________ PARALLEL SHAFT
  - ____________ RIGHT ANGLE
  - Rated Power: ____________ HP
  - Efficiency: ____________ %
  - AGMA S.F: ____________
  - AGMA Quality: ____________
  - Speed Reducer Service Factor: 
  - Input Speed: ____________ rpm
  - Output Speed: ____________ rpm

- **BEARINGS:**
  - HIGH SPEED
  - LOW SPEED

- **LUBRICATION TYPE**
  - ____________ AFEMA L-10 LIFE
  - Plugged Connection for Installation of Temperature Indicator
  - Oil Piping to Be Carbon Steel Upstream of Filter and Stainless Steel Downstream

**DRIVER**

- **MOTOR:**
  - Manufacturer: ____________
  - Model: ____________
  - Type: ____________
  - RPM: ____________
  - HP: ____________
  - Foot Mount
  - Flange Mount
  - Volts: ____________
  - Phase: ____________
  - Hz: ____________
  - Service Factor: 
  - ____________ HORIZONTAL
  - ____________ VERTICAL
  - ____________ Variable Frequency Drive
  - Bearings: Type: 
  - LUBRICATION:

- **BELT DRIVE:**
  - Manufacturer: ____________
  - Model: ____________
  - Type: ____________
  - Size: ____________
  - Rated Power: ____________ HP
  - RPM: ____________
  - S.F: ____________
  - Sheave Diameters: 
  - Max. Allowable Operating Speed: ____________ rpm
  - Max. Allowable Torque: ____________ ft.lbs.
**TANK DETAILS FOR TOP-MOUNTED MIXER**

- **TANK ITEM NUMBER:**
- **SIZE:** DIA.: FT HEIGHT: FT
  (IF CYLINDRICAL, IF RECTANGULAR, SEE NEXT LINE)
  LENGTH: FT
- **TYPE:**
  API 620  API 650  OTHER:
- **INTERNALS:**
- **CAPACITY:**
- **REC. BAFFLE NO./ORIENTATION:**
- **BAFFLES:** WIDTH: IN HEIGHT: IN WALL CLEAR: IN
- **MOUNTING FLANGE SIZE:**
- **PROJECTED BLADE AREA:** IN²
- **IMPELLER:**
  - MANUFACTURER CODE:
  - TYPE:
    - FLAT
    - PROPELLER
    - AEROFOIL
  - QUANTITY:
  - NO. BLADES:
  - PITCH:
  - HUB:
    - FABRICATED
    - CAST
    - KEY-DRIVEN
  - ATTACHMENT:
    - WELDED
    - BOLTED
  - POSITIVE LOCK REQUIRED
- **LOADS:**
  - TORQUE
  - STATIC MOMENT
  - DYNAMIC MOMENT
  - WEIGHT
    - FT-LB
    - FT-LB
    - FT-LB
    - LB
- **DIRECTION OF FLUID MOVEMENT:**
  - UP
  - DOWN
- **WORKING VOLUME (GAL.)**
  - MIN.
  - MEAN
  - MAX.

<table>
<thead>
<tr>
<th>ID</th>
<th>DESCRIPTION</th>
<th>INCHES</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NORMAL LIQUID LEVEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>MAXIMUM LIQUID LEVEL</td>
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</tr>
<tr>
<td>C</td>
<td>IMPELLER DIAMETER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>IMPELLER DEPTH</td>
<td></td>
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</tr>
<tr>
<td>E</td>
<td>MINIMUM LIQUID LEVEL</td>
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<td></td>
</tr>
<tr>
<td>F</td>
<td>TANK I.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>REQUIRED INSTALLATION/REMOVAL SPACE</td>
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</tr>
</tbody>
</table>
### TANK DETAILS FOR SIDE-MOUNTED MIXER

<table>
<thead>
<tr>
<th>ITEM NUMBER</th>
<th>SIZE OPENING FOR IMPELLER INSTALLATION: _____ IN</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE: DIA.: _____ FT HEIGHT: _____ FT</td>
<td>TRUION SUPPORT REQUIRED</td>
</tr>
<tr>
<td>(IF CYLINDRICAL, IF RECTANGULAR, SEE NEXT LINE)</td>
<td></td>
</tr>
<tr>
<td>LENGTH: FT HEIGHT: _____ FT WIDTH: _____ FT</td>
<td>TOP TYPE:</td>
</tr>
<tr>
<td>TYPE: API 620 API 650 OTHER:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>INTERNALS:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>CAPACITY:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>REC. BAFFLE NO./ORIENTATION:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>BAFFLES: WIDTH: _____ IN HEIGHT: _____ IN</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>WALL CLEAR: _____ IN</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>MOUNTING FLANGE SIZE: _____ IN FACING:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>IMPELLER:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>MANUFACTURER CODE:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>QUANTITY:</td>
<td>FLAT OTHER:</td>
</tr>
<tr>
<td>AEROFOIL</td>
<td>PROJECTED BLADE AREA: _____ IN²</td>
</tr>
<tr>
<td>TYPE: FLAT PITCHED MULTIPLE PITCH</td>
<td>THICKNESS: _____ IN</td>
</tr>
<tr>
<td>NO. BLADES: PITCH:</td>
<td>ATTACHMENT: WELDED BOLTED</td>
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<tr>
<td>RECOMMENDED CLEARANCE FROM OBSTRUCTION: _____ IN</td>
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### LOADS:

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<tr>
<th>TORQUE FT-LB</th>
<th>STATIC MOMENT FT-LB</th>
<th>DYNAMIC MOMENT FT-LB</th>
<th>WEIGHT LB</th>
</tr>
</thead>
</table>

### IMPPELLER:

| HUB: FABRICATED CAST KEY-DRIVEN OTHER: |

### TANK MIXERS AND AGITATORS (US CUSTOMARY UNITS)

### ASSOC. PIP RESM003 DATA SHEET RESM003-D

#### ID DESCRIPTION INCHES REMARKS

<table>
<thead>
<tr>
<th>A</th>
<th>NORMAL LIQUID LEVEL</th>
</tr>
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<tbody>
<tr>
<td>B</td>
<td>MAXIMUM LIQUID LEVEL</td>
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<tr>
<td>C</td>
<td>IMPELLER DIAMETER</td>
</tr>
<tr>
<td>D</td>
<td>IMPELLER DEPTH</td>
</tr>
<tr>
<td>E</td>
<td>IMMERION LENGTH</td>
</tr>
<tr>
<td>F</td>
<td>FREE SPACE REQUIRED FOR REMOVAL OF MIXER FROM THE TANK</td>
</tr>
<tr>
<td>G</td>
<td>CUT OUT SWITCH ELEVATION</td>
</tr>
</tbody>
</table>
IMPELLER: (INFORMATION IS FOR BLADES STARTING WITH THE BOTTOM IMPELLER AND SEQUENTIALLY INCREASING TO THE NEXT IMPELLER HIGHER ON THE SHAFT)

MANUFACTURER CODE: QUANTITY: 

- TYPE: 
  - FLAT
  - PITCHED
  - MULTIPLE PITCH
  - OTHER:

NO. BLADES: PITCH: 

RECOMMENDED CLEARANCE FROM OBSTRUCTION:

PROJECTED BLADE AREA: IN² PUMPING DIRECTION: UP DOWN

THICKNESS:

ATTACHMENT: 
  - WELDED
  - BOLTED
  - POSITIVE LOCK REQUIRED

SPACING:

HUB: 
  - FABRICATED
  - CAST
  - KEY-DRIVEN

OTHER:

MANUFACTURER CODE: QUANTITY: 

- TYPE: 
  - FLAT
  - PITCHED
  - MULTIPLE PITCH
  - OTHER:

NO. BLADES: PITCH: 

RECOMMENDED CLEARANCE FROM OBSTRUCTION:

PROJECTED BLADE AREA: IN² PUMPING DIRECTION: UP DOWN

THICKNESS:

ATTACHMENT: 
  - WELDED
  - BOLTED
  - POSITIVE LOCK REQUIRED

SPACING:

HUB: 
  - FABRICATED
  - CAST
  - KEY-DRIVEN

OTHER:

MANUFACTURER CODE: QUANTITY: 

- TYPE: 
  - FLAT
  - PITCHED
  - MULTIPLE PITCH
  - OTHER:

NO. BLADES: PITCH: 

RECOMMENDED CLEARANCE FROM OBSTRUCTION:

PROJECTED BLADE AREA: IN² PUMPING DIRECTION: UP DOWN

THICKNESS:

ATTACHMENT: 
  - WELDED
  - BOLTED
  - POSITIVE LOCK REQUIRED

SPACING:

HUB: 
  - FABRICATED
  - CAST
  - KEY-DRIVEN

OTHER:

MANUFACTURER CODE: QUANTITY: 

- TYPE: 
  - FLAT
  - PITCHED
  - MULTIPLE PITCH
  - OTHER:

NO. BLADES: PITCH: 

RECOMMENDED CLEARANCE FROM OBSTRUCTION:

PROJECTED BLADE AREA: IN² PUMPING DIRECTION: UP DOWN

THICKNESS:

ATTACHMENT: 
  - WELDED
  - BOLTED
  - POSITIVE LOCK REQUIRED

SPACING:

HUB: 
  - FABRICATED
  - CAST
  - KEY-DRIVEN

OTHER:

NO. DATE REVISION DESCRIPTION BY APVD.
### VESSEL DETAILS FOR BOTTOM-MOUNTED AGITATOR

#### VESSEL ITEM NUMBER:

- **TOP HEAD TYPE:**  
  - ASME DISHED
  - FLAT
  - OTHER: 
  - 2:1 ELLIPTICAL
  - CONE

- **BOTTOM HEAD TYPE:**  
  - ASME DISHED
  - FLAT
  - OTHER: 
  - 2:1 ELLIPTICAL
  - CONE

#### SIZE:
- **DIA.:** FT
- **HEIGHT:** FT

#### LENGTH:
- **FT:**
- **HEIGHT:** FT
- **WIDTH:** FT

#### TYPE:
- **API 620**
- **ASME SECT. VIII**
- **OTHER:**

#### INTERNALS:

- **BAFFLES:**
  - NO: 
  - SPACING: IN
  - DEGREES: 
  - WIDTH: IN
  - HEIGHT: IN
  - WALL CLEAR: IN

- **CAPACITY:** GAL
- **WALL CLEAR:** IN

#### MOUNTING FLANGE SIZE:

- **FACING:**

#### RATING:

- **STEADY BEARING:** YES NO

#### SIZE OPENING FOR IMPELLER INSTALLATION:

- **IN:**

#### DIRECTION OF FLUID MOVEMENT:

- **UP**
- **DOWN**

#### WORKING VOLUME (GAL.)

- **MIN.**
- **MEAN**
- **MAX.**

#### LOADS:

<table>
<thead>
<tr>
<th>TORQUE</th>
<th>STATIC MOMENT</th>
<th>DYNAMIC MOMENT</th>
<th>WEIGHT</th>
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<tr>
<td>FT-LB</td>
<td>FT-LB</td>
<td>FT-LB</td>
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#### STEADY BEAR

- **YES**
- **NO**

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<td>G</td>
<td>REQUIRED INSTALLATION/REMOVAL SPACE</td>
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</tbody>
</table>
### Mixer and Agitator Data Sheet

**Facility Name/Location:**

**Item Name:**

**Item Tag No.:**

**Service:**

**Unit:**

**P&ID No.:**

**Supplied by:**

**Supplier/Location:**

**Job No.:**

**Supplier Order No.:**

**Data Provided By:**

**Purchaser**

**Supplier**

**Supplier If Not By Purchaser**

### General

- **Mixer Manufacturer:**
- **Model No.:**
- **Serial No.:**
- **QTY.:**
- **Driver Item No.:**
- **Driver Type:**
- **Driver Provided By:**

### Performance

- **Operating Speed:** RPM
- **Max Shaft Power:** kW
- **Calculated Primary Pumping Capacity:** CMH
- **Normal Shaft Power:** kW
- **Rotation:** CW CCW
- **Impeller Diameter:** CM

### Site Data

- **Location:** Indoor Heated Unheated Outdoor
- **If Outdoors, Is Mixer/Agitator Shaded:** Yes No
- **IF No, W/HR. Solar Flux:**
- **Altitude:** M
- **Electrical Classification:** Class/Zone: Group: Division: Temp. Class:
- **Ambient Temperature Range:** °C Max. °C Min.
- **Range of Relative Humidity:** Summer: Winter:
- **Winterization Required**
- **Tropicalization Required**
- **Dust**
- **Fumes**
- **Type of Fumes:**

### Special Equipment Requirements:

**Other:**

**Comments:**

---

**Rev No.** | **Date** | **Issue Status** | **By** | **Checked** | **Approved**
---|---|---|---|---|---

---

**Note:**

This data sheet is used for tank mixers and agitators with specific performance and site data requirements. It includes details such as operating speeds, power ratings, rotation types, and environmental conditions to ensure proper selection and installation of the equipment.
## TANK MIXER PROCESS DEFINITION

### FLUID PROPERTIES, COMPOSITION, AND CONDITIONS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>OPERATING TEMPERATURE (°C):</th>
<th>FOAMING TENDENCY:</th>
<th>VISCOSITY PROPERTY:</th>
<th>VISCOUS PROPERTY:</th>
<th>MAX. VISCOSITY (CP):</th>
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<tbody>
<tr>
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<td>MINIMUM:</td>
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<td>MAXIMUM:</td>
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</table>

### MIXING DURING:

- PRIMARY BULK FLUID VELOCITY (FT/SEC):
  - REQUIRED:  
  - QUOTED:  

- AVERAGE SHEAR RATE (1/SEC):
  - REQUIRED:  
  - QUOTED:  
  - MAXIMUM:  

- RECIPE (VOLUME/SEQUENCE MIX TIME):  

### OPERATION (CONTINUOUS RETENTION TIME)

- MIN. LEVEL:  

- BATCH:
  - BLEND TIME: MIN

- TURNOVERS PER HOUR:  

- SIZE:
  - NORMAL:  
  - MAX.:  

- CONTINUOUS  

### PROCESS REQUIREMENTS (COMPLETE ALL THAT APPLY)

- BLENDING OF MISCEBLE LIQUIDS

- SOLIDS SUSPENSION:

- PARTICLE SIZE:  

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<thead>
<tr>
<th>NATURE OF SOLIDS:</th>
<th>SETTLING VELOCITY:</th>
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<tr>
<td>SOLUBLE</td>
<td>MPS</td>
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<tr>
<td>INSOLUBLE</td>
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<td>ABRASIVE</td>
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<td>STICKY</td>
<td></td>
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<tr>
<td>CRYSTALLINE</td>
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<tr>
<td>FLUFFY</td>
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</tbody>
</table>

- REQUIRED RESULTS:

- UNIFORM SUSPENSION

- ALL SOLIDS IN MOTION

- RESISTS WETTING

- REQUIRED RESULTS:

- REDUCE AGGLOMERATES TO:  

- CRYSTALLIZATION

- IMPELLER TO SCRAPE SURFACE(S)

- CRYSTALS:

- SETTLE OUT

- DEPOSIT ON SURFACE

- POLYMERIZING

- SOLIDS FORMATION

- DISDILLING:

- SOLUBILITY:

- DIFFICULT

- DISDILLING SOLIDS MAY AGGLOMERATE

- HEAT TRANSFER:

- SERVICE:

- HEAT COOL MAINTAIN TEMP.

- HEAT TRANSFER FLUID:

- SPECIFIC HEAT:  

- W/HR/M²°C

- CONDUCTIVITY:  

- W/HR/M²°C

- DUTY:  

- EXTERNAL JACkETS  

- INTERNAL COIL  

- TUBE BAFFLES  

- OTHER:

- GAS DISPERSION:

- SUPERFICIAL GAS VELOCITY:  

- M/SEC

- GASED/UNGASED VOLUME RATIO:  

- REQUIRED RESULTS:

- COARSE RADIAL DISPERSION

- FINE BUBBLES

- UNGASED POWER INPUT:  

- kW

- TWO SPEED MOTOR

- INTERLOCK DRIVER TO GAS FLOW

- GAS SOURCE:

- SPARGER RING  

- INJECTION TUBE

- FROM EVOLUTION

- CHEMICAL REACTION:

- REACTION RATE:

- RAPID

- MODERATE

- SLOW

- EXTRACTION:

- LIQUID-LIQUID

- LEACHING

- WASHING

- PRECIPITATIVE EXTRACTION
## CONSTRUCTION FEATURES

### IMPELLER:
- (Mixers only, Agitator impellers on a separate sheet)
- Manufacturer code: [ ]
- **TYPE:**
  - [ ] Flat
  - [ ] Pitched
  - [ ] Multiple Pitch
- No. of blades:
- Recommended clearance from obstruction:
- Projected blade area: \( M^2 \)
- Thickness:
- Attachment:
  - [ ] Welded
  - [ ] Bolted
  - [ ] Positive lock required
- Hub:
  - [ ] Fabricated
  - [ ] Cast
  - [ ] Key-driven

### SHAFT:
- [ ] Hollow
- [ ] Solid
- [ ] Stepped
- [ ] Flanged
- [ ] Extended key seats
- [ ] Stabilizers
- Shaft dia.: \( \text{CM} \)
- Critical speed: \( \text{RPM} \)
- Shaft runout tolerance:
  - At face of seal housing:
  - Maximum shaft deflection at seal housing: \( \text{MM} \)
- Direction of rotation from drive end:

### GEARBOX:
- Manufacturer:
- Model number:
- **TYPE:**
  - [ ] Parallel shaft
  - [ ] Right angle
- Rated power: \( \text{kW} \)
- Efficiency: \( \% \)
- AGMA S.F.:
- AGMA Quality:
- Speed reducer service factor:
- Input speed: \( \text{RPM} \)
- Output speed: \( \text{RPM} \)

### SHAFT SEALS:
- [ ] Required
- [ ] Not required
- Rated pressure: \( \text{kPA} \)
- Rated temp.: \( \text{°C} \)
- [ ] Packing manufacturer/type:
- Size/No. rings:
- Mechanical seal type:
- Manufacturer:
- Manufacturer code:
- Positive seal shutoff for maintenance:
- Seal reservoir size:
  - Cooling water:
  - Flow:
    - \( M^3/HR \)
    - \( M^3/HR \)
  - Cooling jacket:
- Seal flush:
  - Fluid:
  - Dead ended
  - Forcured circulation
  - Pressurized
  - \( \text{kPA} \)
  - Source:

### MATERIALS OF CONSTRUCTION:
- IMPELLER:
- Hubs:
- Shaft:
- [ ] Critical speed: \( \text{RPM} \)
- MOUNTING FLANGE:
- Blades:
- Mechanical seal parts:
- Gasket:
- Noise requirement:
  - Max. allow. noise level:
  - \( \text{DBA at 3 FT} \)
- Painting:
  - Manufacturer std.
  - Spec. number:
  - Color:

### OIL PIPING:
- To be carbon steel upsteam of filter and stainless steel downstream

## DRIVER

### MOTOR:
- Manufacturer:
- Model:
- RPM:
- Frame:
- \( \text{kW} \):
  - Foot mount
  - Flange mount
- Volts:
- Phase:
- Hz:
- Service factor:
  - Horizontal
  - Vertical
  - Variable frequency drive
- Bearings:
- Type:
- Lubrication:

### BELT DRIVE:
- Manufacturer:
- Model:
- **TYPE:**
  - \( \text{kPA} \)
  - RPM:
  - S.F.:
- Sheave diameters:

---

**ASSOC. PIP RESM003**
**DATA SHEET**
**RESM003-DM**
**TANK MIXERS AND AGITATORS (METRIC)**
**PAGE 3 OF 8**
**SEPTEMBER 2018**
TANK DETAILS FOR TOP-MOUNTED MIXER

- **TANK ITEM NUMBER:**
- **SIZE:** DIA.: M HEIGHT: M
  - LENGTH: M HEIGHT: M WIDTH: M
- **TYPE:** API 620 API 650 OTHER:
- **INTERIALS:**
- **CAPACITY:** M³
- **RECI. BUNNEL NO./ORIENTATION:**
- **BAFFLES:** WIDTH: CM HEIGHT: M WALL CLEAR: CM
- **MOUNTING FLANGE SIZE:** BANDING:
- **IMPELLER:**
  - MANUFACTURER CODE:
  - TYPE: FLAT PROPELLER AEROFOIL
  - QUANTITY:
  - ATTACHMENT: WELDED BOLTED
  - HUB: FABRICATED CAST KEY-DRIVEN
  - PROJECTED BLADE AREA: M²
  - THICKNESS: MM
- **LOADS:**
  - TORQUE N-M
  - STATIC MOMENT N-M
  - DYNAMIC MOMENT N-M
  - WEIGHT KG
- **DIRECTION OF FLUID MOVEMENT:** UP DOWN
- **WORKING VOLUME (M³)**
  - MIN.
  - MEAN
  - MAX.

<table>
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<tr>
<th>ID</th>
<th>DESCRIPTION</th>
<th>CM</th>
<th>REMARKS</th>
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<td>TANK I.D.</td>
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<td>REQUIRED INSTALLATION/REMOVAL SPACE</td>
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</tbody>
</table>
TANK DETAILS FOR SIDE-MOUNTED MIXER

- **ITEM NUMBER:**
- **SIZE OPENING FOR IMPELLER INSTALLATION:** __________ CM
- **TRUNION SUPPORT REQUIRED**
- **TOP TYPE:**
  - FLAT
  - OTHER: __________
- **BOTTOM TYPE:**
  - FLAT
  - OTHER: __________
- **CAPACITY:** __________ M³
- **INTERNAL WALL CLEAR:** __________ CM
- **MOUNTING FLANGE SIZE:** __________ FACING: __________
- **IMPELLER:**
  - MANUFACTURER CODE: __________
  - TYPE:
    - FLAT
    - PROPELLER
    - AEROFOIL
  - NO. BLADES: __________
  - PITCH: __________ CM
  - ATTACHMENT: WELDED
  - HUB: FABRICATED
    - OTHER: __________
  - PROJECTED BLADE AREA: __________ M²
  - THICKNESS: __________ MM
- **LOADS:**
  - TORQUE: __________ N-M
  - STATIC MOMENT: __________ N-M
  - DYNAMIC MOMENT: __________ N-M
  - WEIGHT: __________ kg

- **MIXER TANKS FOR SIDE-MOUNTED MIXER**

<table>
<thead>
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<td>IMMERSION LENGTH</td>
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<td>FREE SPACE REQUIRED FOR REMOVAL OF MIXER FROM THE TANK.</td>
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<td>CUT OUT SWITCH ELEVATION</td>
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VESSEL DETAILS FOR TOP-MOUNTED AGITATOR

- VESSEL ITEM NUMBER: 
- SIZE: DIA.: ___ M HEIGHT: ___ M
  (IF CYLINDRICAL, IF RECTANGULAR, SEE NEXT LINE)
  LENGTH: ___ M HEIGHT: ___ M WIDTH: ___ M
- TYPE: API 620 ASME SECT. VIII OTHER: ___
- INTERNALS: ___
- BAFFLES: NO. ___ SPACING: ___ DEG.
  WIDTH: ___ CM HEIGHT: ___ M
  WALL CLEAR: ___ CM
- CAPACITY: ___ M$^3$
- MOUNTING FLANGE SIZE: ___ FACING: ___
- RATING: ___
- SIZE OPENING FOR IMPELLER INSTALLATION: ___ CM

LOADS:
- TORQUE N-M
- STATIC MOMENT N-M
- DYNAMIC MOMENT N-M
- WEIGHT ___ KG

DIRECTION OF FLUID MOVEMENT:
- UP
- DOWN

WORKING VOLUME (M$^3$)
- MIN. ___
- MEAN ___
- MAX ___

ID DESCRIPTION CM REMARKS
A NORMAL LIQUID LEVEL ___
B MAXIMUM LIQUID LEVEL ___
C IMPELLER DIAMETER ___
D IMPELLER DEPTH ___
E VESSEL REFERENCE DEPTH ___
F VESSEL I.D. ___
G REQUIRED INSTALLATION /REMOVAL SPACE ___
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<td>B</td>
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<td>G</td>
<td>REQUIRED INSTALLATION/REMOVAL SPACE</td>
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FACILITY NAME/LOCATION: __________________________

ITEM NAME: __________________________ PURCHASER/LOCATION: __________________________

ITEM TAG NO.: __________________________ JOB NO.: __________________________

SERVICE: __________________________ PURCHASER ORDER NO.: __________________________

UNIT: __________________________ SUPPLIER/LOCATION: __________________________

P&ID NO.: __________________________ SUPPLIER ORDER/SERIAL NOS.: __________________________

NOTES

1. SUBMITTAL OF DOCUMENTATION IS A CONDITION OF INVOICE PAYMENT. REFER TO CONTRACT OR PURCHASE ORDER.

2. PURCHASER REVIEW OF DOCUMENTATION SHALL NOT RELIEVE SUPPLIER OF RESPONSIBILITY.

INSTRUCTIONS

1. COMPLETE AND RETURN THIS FORM WITH QUOTATION.

2. SUBMIT "WITH QUOTE" DOCUMENTATION WITH QUOTATION.

3. SUPPLIER SHALL SUBMIT DOCUMENTATION IN COMPLIANCE WITH DOCUMENTATION REQUIREMENTS SHEET(S) AS REGARDS TIMING, QUANTITY, AND FORM OF DOCUMENTATION.

4. DOCUMENTATION SHALL BE IDENTIFIED BY PROJECT, PURCHASE ORDER OR CONTRACT NUMBER, AND ITEM NUMBER.

5. ALL DRAWINGS AND DOCUMENTS SHALL BE BLACK ON WHITE WITH CLEAR IMAGE AND BE SUITABLE FOR REPRODUCTION. DRAWINGS AND DOCUMENTS SHALL SHOW INFORMATION FOR THIS PROJECT ONLY. PURCHASER, AT ITS SOLE DISCRETION, MAY ACCEPT PREPRINTED STANDARD DATA IF APPLICABLE INFORMATION IS CLEARLY INDICATED AND NON-APPLICABLE INFORMATION IS CROSS-HATCHED OUT.

6. "AS BUILT" DOCUMENTS AND DATA BOOKS SHALL BE SUBMITTED AT TIME OF EQUIPMENT COMPLETION.

7. IF HARD COPY DATA BOOKS ARE REQUIRED, DATA SHALL BE PROVIDED ON THREE-HOLE PAPER AND BOUND IN HARD COVERS. UNLESS CLARITY IS ADVERSELY AFFECTED, DRAWINGS SHALL BE REDUCED TO SCALE ON ISO A3 (11-INCH BY 17-INCH) PAPER. WHERE THE CLARITY OF REDUCED DRAWINGS IS ADVERSELY AFFECTED, LARGE DRAWINGS SHALL BE FOLDED AND PLACED IN HEAVY-DUTY THREE-SIDED PLASTIC COVERS AND INSERTED IN THE BINDERS.

8. IDENTIFY SUPPLIER REPRESENTATIVE RESPONSIBLE FOR DOCUMENTATION:

   NAME: __________________________

   TITLE: __________________________

   PHONE: __________________________

DEFINITIONS

1. APPROVAL: SUBMITTED FOR PURCHASER REVIEW AND COMMENT.

2. CERTIFIED: CERTIFIED CORRECT BY PURCHASER/SUPPLIER AND INCORPORATES COMMENTS BY PURCHASER FROM APPROVAL COPY.

3. AS BUILT: INCORPORATES MODIFICATIONS MADE DURING FABRICATION.

REMARKS
### ASSOC. PIP: RESM003

#### DOCUMENTATION REQUIREMENTS SHEET

**MIXERS AND AGITATORS**

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<table>
<thead>
<tr>
<th>DOCUMENT TYPE LEGEND</th>
<th>TIME LEGEND</th>
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<tr>
<td>X = ORIGINAL</td>
<td>A = ___ WEEKS AFTER CONTRACT AWARD</td>
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<td>P = PRINT</td>
<td>B = ___ WEEKS BEFORE WORK STARTS</td>
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<td>R = REPRODUCIBLE</td>
<td>C = ___ WEEKS AFTER WORK COMPLETE</td>
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<tr>
<td>S = SHUTDOWN</td>
<td>D = WEEKLY</td>
</tr>
<tr>
<td>E = ELECTRONIC MEDIA (DISK, TAPE, ETC.)</td>
<td>E = SHIPMENT</td>
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#### DOCUMENTATION

<table>
<thead>
<tr>
<th>WITH APPROVAL CERTIFIED AS DATA BOOK COPIES</th>
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<td>QUOTE</td>
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1. **PROPOSAL DOCUMENTS**

2. **OUTLINE DRAWINGS**

3. **GEAR REDUCER DRAWINGS**

4. **SHAFT SEALING SYSTEM DRAWINGS**

5. **AUXILIARY PIPING SYSTEM DRAWINGS**

6. **FLANGE FORCES/MOMENTS**

7. **BILL OF MATERIALS**

8. **DRIVE MOTOR DATA SHEET**

9. **AS-BUILT DATA SHEETS AND DRAWINGS**

10. **OPERATING & MAINTENANCE INSTRUCTIONS**

11. **PARTS LIST**

12. **CERTIFIED DATA FROM SHOP TESTS**

13. **MATERIAL CERTIFICATIONS**

14. **ROTOR-DYNAMIC ANALYSIS**

#### REQUIREMENTS FOR DOCUMENTATION

**A. PROPOSAL DOCUMENTS**

1. COMPLETED PIP RESM003-D OR RESM003-DM DATA SHEET

2. COMMENTS ON PURCHASER-FURNISHED PROCESS PERFORMANCE DATA, INCLUDING EFFICIENCY, PERFORMANCE, BAFFLE SIZE, AND BAFFLE PLACEMENT

3. COMMENTS ON THE PURCHASER-FURNISHED INSTALLATION DETAILS REGARDING MIXER OR AGITATOR MOUNTING AND ACCESSIBILITY FOR MAINTENANCE

4. EXPECTED SOUND PRESSURE LEVELS IN DB FOR EACH OCTAVE BAND. AGITATOR NOISE LEVEL SHALL NOT BE GREATER THAN THE LEVEL SPECIFIED ON THE PURCHASER'S PIP RESM003-D OR RESM003-DM DATA SHEET.

5. REQUIREMENTS FOR EXTERNAL COOLING OR FORCED LUBRICATION FOR THE GEAR REDUCER, SHAFT SEAL, OR STEADY BEARING. INCLUDE COOLING WATER REQUIREMENTS.

6. MINIMUM MANHOLE OPENING REQUIRED FOR ASSEMBLY AND MAINTENANCE OF INTERNAL COMPONENTS

7. IF THE USE OF STEADY BEARINGS IS APPROVED BY THE PURCHASER, DETAILS OF THE BEARING DESIGN SHALL BE PROVIDED FOR EVALUATION.

8. PRELIMINARY (OR TYPICAL) OUTLINE DRAWINGS SHOWING THE FOLLOWING:

   A. PRINCIPAL DIMENSIONS

   B. WEIGHTS OF PRINCIPAL COMPONENTS

   C. CLEARANCES REQUIRED FOR INSTALLATION AND MAINTENANCE

   D. MOUNTING FLANGE DIMENSIONS

   E. DRIVE MOTOR SUPPORT

   F. MIXER OR AGITATOR BLADE-TO-HUB CONNECTION DETAILS

   G. SEAL RESERVOIR MOUNTING LOCATION

   H. DIRECTION OF ROTATION WHEN LOOKING AT THE TOP OF THE MIXER OR AGITATOR

9. TYPICAL CROSS-SECTIONAL DRAWING OF THE GEAR REDUCER SHOWING DETAILS OF CONSTRUCTION

10. CROSS-SECTIONAL DRAWING OF THE SHAFT SEAL, WITH DETAILS AND SPECIFICATIONS OF ALL SEALING SYSTEM COMPONENTS

11. CROSS-SECTIONAL DRAWING OF THE STEADY BEARING (IF REQUIRED)
12. SPARE PARTS LIST WITH UNIT PRICING FOR SPARE PARTS. SPARE PARTS LIST SHALL INCLUDE PARTS REQUIRED FOR 3 YEARS OF NORMAL OPERATION AND CRITICAL START-UP SPARES.

13. SPECIAL TOOLS OR FIXTURES REQUIRED IF ANY

14. MIXER OR AGITATOR PERFORMANCE (I.E., MIXING) CALCULATIONS AND CURVES

15. THE RESULTS OF A DYNAMIC ANALYSIS OF THE MIXER OR AGITATOR SHAFT ASSEMBLY FOR BOTH DRY AND WET CONDITIONS. THIS ANALYSIS SHALL VERIFY THAT ANY LATERAL OR TORSIONAL RESONANCES ARE SEPARATED FROM THE OPERATING SPEED RANGE BY AT LEAST 20% OF THE NORMAL OPERATING SPEED. THESE RESONANCES SHALL NOT BE WITHIN 10% OF ANY MIXER OR AGITATOR VANE PASS FREQUENCIES (INCLUDING BAFFLE EFFECTS) OR ELECTRICAL EXCITATION FREQUENCIES, SUCH AS THOSE CAUSED BY VARIABLE FREQUENCY DRIVES.

16. TYPICAL SCHEMATICS FOR SEAL FLUSH AND LUBRICATION SYSTEMS IF SPECIFIED

17. DETAILED PROCEDURE FOR REPLACEMENT OF MECHANICAL SEALS

18. DETAILED PROCEDURE FOR BENCH TESTING MECHANICAL SEALS IF SPECIFIED

19. DRAWINGS SHOWING THE FORCES AND MOMENTS APPLIED BY THE MIXER OR AGITATOR ASSEMBLY TO THE VESSEL OR TANK MOUNTING FLANGE

B. CERTIFIED DOCUMENTS

1. OUTLINE DRAWINGS - DRAWING(S) SHOWING THE FOLLOWING INFORMATION FOR THE COMPLETE ASSEMBLED MIXER OR AGITATOR:
   A. PRINCIPAL DIMENSIONS
   B. DIRECTION OF MIXER OR AGITATOR ROTATION
   C. SIZE AND LOCATION OF CONNECTIONS TO THE MIXER OR AGITATOR
   D. SIZE AND LOCATION OF MOUNTING FLANGES
   E. TOTAL WEIGHT AND INDIVIDUAL WEIGHTS OF PRINCIPAL MAINTENANCE ITEMS

2. SPEED REDUCER DRAWINGS - CROSS-SECTIONAL DRAWINGS OF THE PURCHASED GEAR REDUCER SHOWING DETAILS OF CONSTRUCTION

3. SHAFT SEALING SYSTEM DRAWINGS - CROSS-SECTIONAL DRAWINGS OF THE SHAFT SEAL, WITH DETAILS AND SPECIFICATIONS OF ALL COMPONENTS

4. STEADY BEARING DRAWINGS - CROSS-SECTIONAL DRAWINGS OF THE STEADY BEARING SHOWING DETAILS OF CONSTRUCTION

5. AUXILIARY PIPING SYSTEM DRAWINGS - DRAWINGS OF AUXILIARY PIPING SYSTEMS AND EQUIPMENT

6. FLANGE FORCES/MOMENTS - DRAWINGS SHOWING THE FORCES AND MOMENTS APPLIED BY THE MIXER OR AGITATOR ASSEMBLY TO THE VESSEL OR TANK MOUNTING FLANGE

7. BILL OF MATERIALS

8. DRIVE MOTOR DATA SHEET

C. FINAL DOCUMENTS

THE FOLLOWING DOCUMENTS SHALL BE PROVIDED AFTER FINAL INSPECTION:

1. AS-BUILT DATA SHEETS AND FINAL DRAWINGS - AS-BUILT COPIES OF THE DATA SHEETS AND DRAWINGS PREVIOUSLY PROVIDED

2. OPERATION AND MAINTENANCE INSTRUCTIONS - OPERATING AND MAINTENANCE INSTRUCTIONS FOR THE EQUIPMENT AND AUXILIARY PIPING SYSTEMS PROVIDED, INCLUDING LUBRICATION REQUIREMENTS, AND A DETAILED PROCEDURE FOR MECHANICAL SEAL REPLACEMENT IF SPECIFIED

3. PARTS LIST - PARTS LIST WITH FACTORY CROSS REFERENCE NUMBER FOR EQUIPMENT AND AUXILIARY PIPING SYSTEM PROVIDED

4. CERTIFIED DATA FROM SHOP TESTS - CERTIFIED DATA FROM THE SHOP TESTS THAT WERE PERFORMED. DATA SHALL BE PROVIDED FOR PURCHASER’S REVIEW AND ACCEPTANCE BEFORE SHIPMENT OF THE MIXER OR AGITATOR.

5. MATERIAL CERTIFICATIONS
### Inspection and Testing Requirements

#### ASSOC. PIP: RESM003

**MIXERS AND AGITATORS**

**PAGE 1 OF 2**

**SEPTEMBER 2018**

**FACILITY NAME/LOCATION:**

**ITEM NAME:**

**PURCHASER/LOCATION:**

**ITEM TAG NO.:**

**JOB NO:**

**SERVICE:**

**PURCHASER ORDER NO.:**

**UNIT:**

**SUPPLIER/LOCATION:**

**P&ID NO.:**

**SUPPLIER ORDER/ SERIAL NOS.:**

---

1. **PURCHASER** DENOTES PURCHASER OR DESIGNATED REPRESENTATIVE.
2. **PURCHASER** RESERVES THE RIGHT TO WITNESS ALL ASPECTS OF MANUFACTURING, TO REVIEW AND REJECT MANUFACTURING EQUIPMENT, TESTING EQUIPMENT, TEST PROCEDURES, AND TEST RESULTS; AND TO REJECT PRODUCT NOT MEETING SPECIFICATION.
3. IF AN INSPECTION OR TEST IS SPECIFIED, THE PURCHASER SHALL BE GIVEN WRITTEN NOTICE ___ 5 ___ DAYS BEFORE INSPECTION OR TEST.
4. **PURCHASER** MAY PERFORM ADDITIONAL TESTING, INSPECTION, OR BOTH.
5. **THE SUBMISSION OF INSPECTION AND TESTING RESULTS IS A CONDITION OF ACCEPTANCE AND PAYMENT.**

#### Inspection or Test

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1. **ASSEMBLY COMPLETE BEFORE SHIPMENT**
2. **MECHANICAL TEST**
3. **MECHANICAL SEALS BENCH TEST**
4. **NOISE LEVEL TEST**
5. **FINAL INSPECTION BEFORE SHIPMENT**
6. **PART LOAD TEST**
7. **FULL LOAD TEST**
8. **AGITATOR/MIXER ELEMENT DESIGN VALIDATION**

---

**Requirements for Inspections and Tests**

A. **MECHANICAL TEST**

   THE MOTOR, GEAR DRIVE, AND MECHANICAL SEAL ASSEMBLY SHALL BE TESTED MECHANICALLY AT THE SUPPLIER’S FACILITY AS FOLLOWS:

   1. THE MOTOR, GEAR DRIVE, AND SEAL ASSEMBLY SHALL BE OPERATED AT FULL SPEED AND AT PARTIAL OR NO-LOAD CONDITIONS FOR 1 HOUR AFTER BEARING TEMPERATURES HAVE STABILIZED, OR FOR A MUTUALLY AGREED UPON PERIOD.
   2. DUAL SEAL SYSTEMS SHALL BE OPERATED AT NORMAL OPERATING PRESSURE.
   3. BEARING TEMPERATURES AND HOUSING VIBRATION SHALL BE MEASURED AND RECORDED JUST BEFORE THE END OF THE TEST.
   4. BEARING TEMPERATURES SHALL NOT BE GREATER THAN 150°F (65°C). VIBRATION AS MEASURED AT THE TOP OF THE GEAR DRIVE SHALL NOT BE GREATER THAN 5 MM/SEC (0.2 INCH/SEC).
   5. SHAFT RUNOUTS AT THE INPUT SHAFT AND MECHANICAL SEAL AREA SHALL BE MEASURED AND RECORDED ON THE TEST DATA SHEETS AFTER THE MECHANICAL TEST.

---

**NO.** | **DATE** | **REVISION** | **BY** | **APPROVED**
B. NOISE LEVEL TEST

The noise level of the mixer or agitator during the mechanical test shall be measured and recorded as follows:

1. Noise level shall be measured in the horizontal plane at a distance of 1 m (3 ft) from the drive motor or gear reducer surface.
2. A survey of the operating mixer or agitator shall be made to determine the location with the highest noise level. Noise level at this location shall be recorded.
3. Overall noise level shall be measured and recorded using the “A” weight filter.
4. Frequency analysis of the noise shall be performed using an octave band filter with center frequencies from 31.5 to 8 kHz. Noise levels for each of the octave filter bands shall be recorded.
5. Noise level measurements shall be taken with the sound level meter operating in the slow response mode, and a visual average of the meter fluctuation shall be recorded.
6. The meter shall also be observed when operating in fast response mode with the “A” weight filter. If the meter deflection on fast response is greater than 5 dB, the maximum and minimum meter values shall be recorded for each measurement.