MIXER MIXING INFORMATION

SLUDGE WASTE (STORAGE) MIXING SYSTEM SPECIFICATIONS

1. GENERAL

a. Each anaerobic digestion mixing tank mixer assembly shall consist of a heavy-duty speed reducer, with a flexible coupling connecting the electric motor to the speed reducer, with coupling, base plate, agitator shaft, and mixing impeller(s).

b. Equipment shall be a current model of a reputable manufacturer specializing in such products, having had previous experience in such manufacture.

c. All Equipment shall be new.

d. The specification includes the mixer only. Not included are installation, anchorage, wiring, starters, tools, grout, panels, mounting brackets, pipe, fittings, anti-swirl baffles, limit rings, grating, mounting beams, maintenance lubricants, sealants, electrical controls, any electrical apparatus, or special coatings unless expressly stated (other than the manufacturers standard) or field painting, or related materials.

2. REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

a. American National Standards Institute – ANSI
b. American Gear Manufacturers Association – AGMA
c. American Society for Testing & Materials – ASTM
d. American Welding Society - AWS
e. National Electric Code – NEC
f. Test Procedures for Poly-phase Induction Motors – IEEE 112
g. Gray Iron Castings – ASTM A 48
h. Ductile Iron Castings – ASTM A 536

3. CONTRACTOR SUBMITTALS: Shop Drawings

a. Manufacturers name and model.
b. General Arrangements, dimensions and mounting details.
c. Drive and motor data in accordance with *Electric Motor Specification*
d. Number, weight and size of items to be shipping
e. *Outline & Installation Drawing*: Dimensioned drawings to include actual mixer weight, shaft diameter and length, tank dimensions, OAH - overall height (measured from the mixers mounting base to tank bottom, coupling size and location, anchor bolt pattern, material list and AGMA service factor based upon motor nameplate horsepower.

4. OPERATION and MAINTENANCE MANUALS:

a. Routine maintenance instructions and specifications.
b. List of recommended spare parts and parts list.
c. Manufactures standard chemically resistant protective coating system.
d. Procedures for field erection.
e. 3 Copies or 1 electronic disc of the complete Operation & Maintenance Manual.

5. INSTALATION, START-UP and OPERATING INSTRUCTIONS and ASSISTANCE:

a. Prior to start-up, the contractor is to submit to manufacture electronic images of each mixer submitted by the contractor to include:
   i. Still images of the mixer mounting both above and below the mounting base, the coupling installation, the impeller hub/ear installation, and impeller orientation or configuration.
   ii. A video of the mixer running in a dry tank indicating proper rotation and mixer run out and/or unusual vibration prior to start-up.
b. Tests shall include recording motor parameters under load and no-load conditions. Test shall be free of overall, jamming and/or excessive vibrations.

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6. **FACTORY TESTS:** Each mixer shall be functionally tested for the following: Gearbox spin test, motor operation, sound test, vibration evaluation, paint inspect, motor no-load current, visual lube leakages, name plate inspection, ratio verification, parts tolerance, agitator shaft and impeller dimensions.

7. **MATERIALS:** Materials shall be suitable for the intended application. Materials shall be high-grade, standard commercial quality, free from defects.

   a. Stainless steel shafts shall be of Type 316 or 316L {Low Carbon} if welded.

   b. All wetted parts hardware shall be Type 316 stainless steel.

   c. Oil seals shall be of high quality and shall be oil or grease lubricated.

8. APPURTENANCES:

   a. Nameplates: Each mixer shall be equipped with corrosion resistant nameplate indicating the Manufactures Name, the direction of rotation indicated by an arrow, instructions referring to the Operation and Maintenance Manual for proper operation, Mixer Model Designation, Serial Number, Gear Ratio, and Mixer Output Speed.

9. **COUPLING, GUARDS & PERIPHERAL SUPPORTS:** On right angle gear box drives, the connection between the heavy duty reducer and the prime motor shaft shall be made with a flexible coupling, which is torsionally resistant to reduce the effect of shock and vibration and to minimize the effects of parallel, angular and axial misalignment. All coupling guards shall conform to OSHA standards. A separate or peripheral support of the gearbox integral motor scoop shall not be allowed to accommodate either the overhung motor weight or its unintended unsupported harmonic frequencies unless that scoop is flush with mixer and/or its pedestal base.

10. ANCHORAGE: The contractor shall provide stainless steel anchor bolts, nuts, washers from based upon the certified dimension prints supplied by the mixer manufacturer.

11. **MANUFACTURERS, OR EQUAL:** The mixer(s) shall be manufactured by ACUMIX, Inc., Harrisburg, PA USA or engineer approved or equal.

12. SLUDGE WASTE (STORAGE) MIXER ASSEMBLY:
The magnesium hydroxide storage mixer gear reducer must be designed and manufactured by the mixer manufacturer. The manufacturer shall supply and shall be responsible for the complete system, which includes speed reducers, pedestals, drives, shafts, blades, oil seals and bearings as well as the interface with all other equipment specified herein. Parts shall be designed and proportioned for ample strength, stability and stiffness for the intended purpose. Each mixer or drive assembly shall be designed for 24 hours per day continuous service and shall be suitable for out-of-doors service and shall be of weatherproof construction. The mixer assemblies shall be furnished for a suitable mixer support system per the following tank dimensions and shall meet the following requirements:

Tank Dimensions (L x W x Side Water Depth), inch φ< > x < > x < >

Overall Height (Bottom to Mixer Mounting), inch < >

Number of Mixers per Tank or Basin < >

Design Temperature, ^{o}C < >

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Wetted Parts Material	316L {Low Carbon} Stainless Steel
Wetted Parts Material (Hardware)	316 Stainless Steel
Maximum Impeller Speed RPM	< >
Maximum Motor Nameplate, Horsepower	< >
Minimum Impeller Diameter, inch	< >

a. MIXER COUPLINGS: The lower mixer or agitator shaft shall be connected to the upper, or drive output shaft, by means of a flanged coupling. The coupling face shall have a rabbeted male and female high tolerance piloted connection for accurate concentricity and shall not require match marks for alignment. The coupling shall be designed to minimize shaft run-out, and shall be located above the mixers mounting base. Split couplings shall not be allowed.

b. MOTOR COUPLINGS: A torsionally resistant flexible coupling will be used to connect the electric motor to the speed reducer. This coupling shall reduce the effects of shock and vibrations and to minimize the effects of parallel, angular and axial misalignment. All coupling guards shall conform to OSHA standards.

c. GEARING/GEARBOX The mixer gear drive must be built and rated in accordance with the current AGMA standard 6010-E88 standard. The AGMA calculated drive horsepower rating shall be indicated on the outline and installation drawing. The gearbox drive housing shall be constructed of either a low weight cast high strength aluminum or close-grained cast iron or fabricated steel where each shall be heat-treated for dimensional stability (for machining). Each shall be provided with a lifting appurtenance or lifting lugs. Each gearbox assembly shall be provided with an integral or separate base plate for mounting to a suitable support structure. Gearing shall be either “spiral bevel/helical” or “all-helical”, to insure a maximum of 2% efficiency loss per gear set. It shall not be necessary to remove the motor to perform routine maintenance of the gearbox assembly. No gear ratio shall exceed a 7 to 1 gear reduction per the strict accepted standards of AGMA, which prevents applying excessive wear and tear that by common sense affects the durability or life of the pinion gear. Gearing shall be of AGMA quality nine (9) or better, per AGMA standard 390.03a and ANSI/AGMA 2000-A88. The drives minimum AGMA service factor, based upon motor nameplate horsepower, will be 1.90 or better. Mixer supplier shall submit gear-rating calculations with approval drawings. All components of each gear drive shall be designed, manufactured and assembled in full compliance with all applicable AGMA requirements. The output shaft shall be integrally supported by two anti-friction bearings. The mixer gear drive and output shaft shall be suitable for the loads imposed by the mixing application. The thermal rating of the gear reducer must exceed the design mechanical rating. No external cooling devices are allowed. Plastic, low-grade commercial steel, powder metal, cast steel, and planetary gearing shall not be acceptable. Inefficient soft worm friction-gearing arrangements, which transform lost efficiencies into heat generation, will not be acceptable. Gear-motors or commercial gearbox assemblies adapting an unsupported overhung pinion gear to reduce the speed will not be allowed. The high-speed pinion gear shall not be located overhung on the high-speed shaft and shall be located and supported between two independent bearings.

d. NOISE: The full load operating noise level of the mixer drives shall not exceed 85 dBA at 1 meter from any part of the drive assembly.

e. BEARINGS: All gearbox bearings shall be grease or oil lubricated of antifriction type, ball or roller bearings capable of accommodating the combined effects of both radial and thrust loads. All bearings (high speed, intermediate and low speed bearings) within the gearbox shall have a minimum AFBMA statistical L-10 life of 100,000 hours (11.41 years) when

operating at full motor nameplate horsepower at design speed. Mixer supplier shall submit bearing life calculations with approval drawings.

f. LUBRICATION: All gearing lubrication shall be accomplished by immersing in oil or by use of an efficient oil splash mechanism. Oil pumps will not be allowed. All gearing must be lubricated by a common oil bath. A single oil drain shall be provided at the low point of the reducer to allow drainage leaving a maximum residual of no more than ¼" of oil in the housing. The gearbox shall be provided with a dipstick or provisions for external oil level observations by sight (glass). To dissipate internal pressure generated by normal gearbox operation the gearbox is to be equipped with either a breather vent or an Enviroseal. Each gearbox must have an effective dry well chamber. Anti-Friction bearings shall be either oil or grease lubricated. Output shaft bearings may be grease lubricated combined with a high quality lip seal to retain the grease. All oil fill and drains shall be located so as to be easily accessible. The gearbox design shall not be restricted into having to use only higher-cost synthetic grades of oil universally due to applying excessive gear ratios. Synthetic oils are to be reserved for special operating conditions (temperatures).

g. AGITATOR SHAFT DESIGN: All shafts shall be designed such that the maximum bending moment stress shall not exceed 9,000 psi under normal operating loads. The mixer or agitator shaft shall be overhung – where the use of underwater steady bearings is not permitted. The agitator shaft straightness, flanged coupling square-ness, and output shaft accuracy must be such that the maximum total indicated run out at the lower end of the shaft does not exceed 1/8" for every 10 foot of overhang, as measured by turning by hand.

h. IMPELLERS: Each mixer assembly shall consist of impeller(s) mounted on a vertical agitator shaft and shall include a heavy-duty speed reducer with bearings, couplings, seals, electric motor and mounting flange. The impeller(s) shall consist of pitch blade or curved blade turbines or non-fouling designs. The minimum impeller diameter(s) and maximum operating speed(s) will be as specified. The impeller shall be constructed of ***wetted parts material***, where the impeller blades are to be bolted onto the impeller hub assembly. The impeller hub(s) shall be welded onto the agitator shaft assembly and shall be located as recommended by the mixer manufacturer. The maximum bending moment stress in any impeller component shall not exceed 12,000 psi under maximum operating loads. The shaft-impeller system design shall be such that its operating speed shall not exceed 70% of its first lateral frequency, otherwise know as the mixers critical speed. The use of a stabilizing device shall be applied to the lower impeller. Calculations supporting all shaft and impeller design criteria (stresses and critical speed) shall be supplied with approval drawings.

i. MOTORS: The electric motor driver shall be commercially available squire cage induction standard NEMA C-Face or T-Frame, rated for continuous duty in a humid corrosive environment with full chemical duty or wash-down duty features suitable for an outdoor environment. The insulation shall be tropicalized class F with a 1.15 service factor and shall be rated 230/460 volt, 3 phase, and 60 hertz. All motors shall be designed with applicable IEEE, NEMA, and ANSI standards and in full compliance with the "Federal Energy Policy Act of 1999". Motors shall be NEMA design B, Totally Enclosed Fan Cooled or Non Ventilated, 208-230/460 volt, 3 phase, 60 Hertz. The motors are rated for a 40 degree Centigrade ambient with Class B temperature rise. The motor shall be self-supporting on the mixer base where no auxiliary motor supports shall be required.

j. CORROSSION PREVENTION: All non-stainless steel surfaces shall be painted with the manufacturers standard chemically resistant paint finish suitable for the intended service. All external surfaces that can be exposed to corrosion shall be applied over all external surfaces covered with paper treated with vapor phase inhibitor covered with water repellant tape. All other surfaces shall be painted using the mixer manufactures standard chemically resistant paint.

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k. ANTI-SWIRL: Contractors installation must include provisions for the mixer manufacturers anti-swirl baffle (vertical plates) recommendation including number required, location, width, length and off-wall distance when necessary.

l. SUBMERGED BEARINGS: No underwater bearings shall be permitted.

m. STRUCTURAL STRENGTH AND STABILITY: Structural members and connections shall be designed to withstand, within normal working stresses and deflections, loads imposed on them by rotation of the assembly at maximum design speeds submerged and dry, as well as loads which may be superimposed during or subsequent to erection while the basins are empty.

MIXER OPTIONS: (Cost Adder Options)

1. Motor shall be high efficiency inverter duty
2. Provide the impeller hub with a key/keyway or setscrew construction so that it can be removed from the agitator shaft assembly.
3. Provide an extended keyway to provide 12" of vertical upward adjustment in 3" increments from its original recommended position.
4. A separate (optional) NEMA 4 variable frequency inverter with keypad speed and on/off controls in its cover shall be supplied for each mixer assembly. The mixer shall be capable of achieving a full range of speed operation (equivalent output RPM's) using inverter inputs from 6 to 60 hertz. The inverter shall also be equipped with remote/local operations feature.
5. Optional instruction assistance of 1 day during start-up by the manufacturer personnel for each type of equipment provided to instruct plant personnel in the operation and maintenance of the equipment. Notice of optional start-up shall be 1 week prior to scheduled date.
6. PEDESTAL: The pedestal shall locate the mixers coupling assembly above the mixers mounting base to facilitate installation and future maintenance. The pedestal shall elevate the gear reducer to facilitate maintenance such as oil changes and periodic grease lubrication. The pedestal shall be provided with a securely fastened removable cover assembly to completely enclose and prevent access to the rotating coupling assembly with the following caution statement, "CAUTION! TURN POWER OFF BEFORE REMOVING COVER". The caution statement shall be stenciled through openings that cannot be obscured by future coatings and coverings. This mixer assembly shall be self-supporting on the mixers pedestal base where no auxiliary motor supports shall be required.

