

Parameters for Mixing Equipment Specifications

The following recommendations for specifying mixing equipment are offered in the interest of assuring the owners and operators the full benefits of the expertise and competition of the mixing equipment manufacturers.

There are usually several solutions for a given application. All may work, but one is the optimum for efficiency in achieving desired results consistent with an appropriate balance of capital and operating costs. The specifications should contain a complete description of the process and other pertinent data and a definition of desired results with the mechanical details limited to those, which are exclusively necessary to assure quality and performance. Thus, each mixer manufacturer is free to apply the best of his technology and designs which enhance the owner's opportunity for the optimum solution. *Therefore we recommend that the customer performs the following steps.*

1. **Classify the Process:** In addition to general data required for almost any mixing operation, other data are required for specific processes. The various classifications are listed below and discussed in the accompanying article:

- a. Blending of Miscible Liquids
- b. Solids Suspension
- c. Dispersion
- d. Dissolving
- e. Heat transfer
- f. Crystallization
- g. Chemical reaction
- h. Extraction
- i. Gas Dispersion

2. **Define the Objective:** State explicitly what the mixer must accomplish for satisfactory results.

3. **Describe the Materials to be Mixed:** Give the relative percentages by weight and the specific gravity and viscosity of each material. State whether the liquids are miscible and describe solids or gasses if any. Give the characteristics of the final mixture, including specific gravity, viscosity and temperature..

4. **Outline the Mixing Cycle:** State whether it is a batch or a continuous operation. If batch, give the following data:

- Batch size.
- Time allowed for mixing.
- Sequence of adding materials.
- Progressive changes in production characteristics
- Whether mixer will operate during filling or draining

If continuous, give the following data:

- Gallons per minute flow rate
- Required retention time

5. Give Vessel Data:

- Type and dimensions
- Shape and depth of top and bottom
- Mixer supports and dimensions

- Baffle details
- Largest opening to pass impeller
- Available headroom
- Whether a steady bearing is permissible
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6. **Specify type of mixer:** State the type mixer required or preferred (e.g., top entering, side entering, clamp-on portable, fixed mount portable, V-belt or gear drive, etc.).

7. **Specify sealing data:** If a shaft seal is required, state the preferred type and material and give data as to pressure, vacuum and temperature. In case of aside entering application, state whether the seal is to be serviced while the vessel is under pressure.

8. **Specify Materials of Construction of Wetted Parts:**

9. **Specify Motor Data:** State the motor type and enclosure and the electrical requirements.

10. **Advise Previous Experience:** If the mixing operation has been performed in the past, details as to the process, the equipment and the results are valuable assistance for determining the optimum solution. *Although information is sufficient for any qualified mixer manufacturer to recommend his best solution to the problem, the customer may wish to add the following mechanical details for assurance of quality and performance.*

11. **The Drive Assembly:** State preference for right angle or vertical arrangement. State preference for flange or foot mounted (flexibly coupled) motor. Do not specify the make of coupling unless exclusively necessary. Specify guards in accordance with OSHA standards.

12. **The Gear Reducer:** The gear reducer should be specifically designed for mixer service with the output shaft and bearings of sufficient size to carry the weight of the impeller shaft and impellers, and to withstand all torsional, bending and thrust loads so that significant deflections are not transmitted to the gears and other

bearings. The thermal rating should not be less than the rated motor horsepower, and the mechanical horsepower rating should provide the service factor suggested by the following table as a minimum:

AGMA CLASSIFICATION

Service	Uniform Load	Medium Shock	Heavy Shock
Normal (10 hour/day) Severe (24 hour/day)	1.00 1.25	1.25 1.50	1.50 1.75

13. **Reducer Bearings:** All reducer bearings should be of the anti-friction type and oil or grease lubricated. No bearings should be located below the drive base. B-10 bearing life specifications should be related to the service life expected of the gears, as the purpose is to provide reasonable assurance of a given term of service before a major overhaul is required. An excessive B-10 specification usually forces the selection of an unnecessarily costly reducer.

14. **Lubrication:** Bearings positioned outside the reducer oil supply must be grease lubricated. Other bearings should be lubricated by a constant flow of oil through splash lubrication, an oil slinger or pump. Recommended lubricants should be in accordance with AGMA standards and available from local sources.

15. **Impeller Shafts:** Impeller shafts must be able to withstand the torsional and bending moments inherent in the application, and to operate at or below 60% of the natural frequency of the system, unless equipped with an adequate stabilizing device to allow a maximum of 80%. Keyways designed to permit adjustment of the impeller may be specified, but they should be staggered around the shaft to avoid relieving the stress on one side and causing the shaft to bow.

16. **Impellers:** Require only that impellers be removable and that they be attached to the shaft by positive means of the manufacturer's design.

Design Features, which Cleveland Eastern Mixer will recommend:

1. **Specify Horsepower Output RPM or Impeller Design:** The sizing of a mixer is a delicate balance of horsepower, output rpm and impeller diameter and configuration. This is a major area for the mixer manufacturer to contribute. For example, more efficient mixing often can be achieved with lower horsepower, at a slower speed, with a larger impeller than the reverse. The comparative initial cost depends on each manufacturer's standard line of gear reducers.

The operating cost comparison is obvious.

2. **Specify the Type of Reducer Gears:** Differences in gear types can be incorporated in mixer applications whereby they are reduced to a common denominator in the efficiency of mixing through the overall sizing of the equipment. Restricting the specification to a particular type restricts competition to the detriment of the customer. We provide an unbiased analysis.

3. **Specify Shaft Bearing Arrangements:** Gear reducers used by qualified mixer manufactures provide protection from torsional and bending loads imposed by the impeller system. To specify one manufacturer's method effectively reduces

competition by causing other manufacturers to add unnecessary cost or to refrain from bidding.

4. **Specify Non-Proprietary Features:** Specifying proprietary features such as the method of determining oil levels, the location of oil drains, the device for lubrication, the exact distance from the lower bearing to the liquid level, the location of seldom changed change gears, the type of impeller keys, etc.; tends to describe the features of one manufacturer's equipment to the exclusion of others. This can be harmful in terms of the optimum solution as well as the cost of the equipment.

It is our sincere belief that these recommendations assure the customer the benefits of head-on competition and a sound basis for evaluation of bids. Thus he has a greater opportunity to realize the optimum solution for his mixing process.