

MATERIAL AND EQUIPMENT STANDARD
FOR
MIXERS

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1. SCOPE

This Standard covers the general requirements governing the design, fabrication and inspection of mixers for use in refinery services, chemical plants, petrochemical plants, gas plants and where applicable in production and new ventures.

Compliance with the provisions of this standard does not relieve the mixer manufacturer of the responsibility of furnishing mixer and accessories of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

No deviations or exceptions from this Standard shall be permitted, without explicit approval of the Company. Intended deviations shall be separately listed by the Vendor, supported by reasons thereof and submitted for the Company’s consideration.

2. REFERENCES

The editions of the following standards, codes and specifications that are in effect at the time of publication of this standard shall, to the extent specified herein, form a part of this standard. The applicability of changes in standards, codes, and specifications that occur after the inquiry shall be mutually agreed upon by the Purchaser and the Vendor.

IPS (IRANIAN PETROLEUM STANDARDS)

M-EL-132	"Induction Motors"
E-SF-900	"Noise and Vibration Control"
M-PM-300	"Special Purpose Gear Units"
E-EL-110	"Electrical Area Classification & Extent"
M-PM-320	"Lubrication, Shaft Sealing and Control Oil Systems for Special Purpose Applications"
M-PM-240	"General Purpose Steam Turbines"
M-PM-250	"Special Purpose Steam Turbines"

AGMA (AMERICAN GEAR MANUFACTURERS ASSOCIATION)

420	"Enclosed Speed Reducers and Increasers Using Spur, Helical, Herringbone and Spiral Bevel Gears"
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ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

Boiler and Pressure Vessel Code:

Section V	"Non-Destructive Examination"
Section VIII	"Rules for Construction of Pressure Vessel" Division 1
Section IX	"Welding and Brazing Qualifications"

ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)

B 1.1	"Unified Inch Screw Threads"
B 1.20.1	"Pipe Threads"
B 16.5	"Pipe Flanges and Flanged Fittings"
B 16.11	"Forged Steel Fittings, Socket-Welding and Threaded"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

A 193	"Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service"
A 194	"Carbon and Alloy Steel Nuts for Bolts for High Temperature and High Pressure Service"
A 307	"Carbon Steel Externally Threaded Standard Fasteners"
A 320	"Alloy Steel Bolting Materials for Low Temperature Service"
A 395	"Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures"
A 216	"Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service"
A 276	"Stainless and Heat Resisting Steel Bars Shapes"
E 94	"Guide for Radiographic Testing"
E 709	"Practice for Magnetic Particle Examination"
E 125	"Reference Photographs for Magnetic Particle Indications on Ferrous Casting"
E 142	"Method for Controlling Quality of Radiographic Testing"

AFBMA (ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION)

NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)

MR-01-75	"Sulfide Stress Corrosion Cracking Resistant Metallic Material for Oil Field Equipment"
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3. UNITS

The International system of Units (SI) shall be used, unless otherwise specified.

4. CONFLICTING REQUIREMENTS

In case of conflict between documents relating to the inquiry or order, the following priority of document shall apply:

- First priority : Purchase order and variations thereto.
- Second priority : Data sheets and drawings.
- Third priority : This specification.

5. BASIC DESIGN

5.1 General

5.1.1 The equipment (including auxiliaries) covered by this standard Shall be designed and constructed for a minimum service life of 20 years.

Mixers ratings shall not exceed the limits of the vendor’s design but shall be well within the manufacturer’s actual experience. Only equipment which has proven its reliability is acceptable.

5.1.2 The vendor shall assume responsibility for the engineering coordination of the equipment and all auxiliary systems included in the scope of order.

5.1.3 Mixers shall be designed to minimize the generation of noise and shall not exceed the noise limits given in the clauses below.

5.1.3.1 All definitions, notations, measuring equipment, measuring procedures, test reporting, calculation methods and calculation procedures shall be in accordance with IPS-E-SF-900.

5.1.3.2 Unless otherwise specified, the following limits shall be met at any measuring location 1 m from the equipment surface:

Sound Pressure	Limit in dB re 20 Pa
Mixer	87 dB (A)
Mixer + Driver	90 dB (A)

If the equipment produces impulsive and/or narrow band noise, the above limits shall be taken 5 dB(A) lower, thus 82 dB(A) for the Mixer and 85 dB(A) for the Mixer + driver.

The above requirements apply in the absence of reverberation and background noise from other sources, and for all operating conditions specified.

5.1.4 Mixers designed for mechanical seals shall be fitted with a close clearance throttle bush outboard of the mechanical seal to restrict leakage rate of vessel or tank media in the event of ultimate seal failure.

5.1.5 The need for cooling should be mutually agreed upon by the purchaser and the vendor. When cooling is required, the type, pressure and temperature of the cooling liquid will be specified by the purchaser. The vendor shall specify the required flow.

5.1.6 Cooling jackets for seal chambers and bearings should have cleanout connections arranged so that the inter passageway can be mechanically cleaned, flushed and drained.

5.1.7 Jacket cooling systems shall be designed to positively prevent the process stream from leaking into the coolant.

5.1.8 Cooling water systems shall be designed for not less than 517 kPa (5.17 bar) working pressure or 793 kPa (7.93 bar) test pressure.

5.1.9 Motors, electrical components, and electrical installations shall be suitable for the area classification (class, group and division) specified by the purchaser on the data sheets and shall meet the requirements of IPS-E-EL-110.

5.1.10 Oil reservoirs and housings that enclose moving lubricated parts (such as bearings, shaft seals and highly polished parts) shall be designed to minimize contamination by moisture, dust and other foreign matter during periods of operation and idleness.

5.1.11 All equipment shall be designed to permit rapid and economical maintenance. Major parts such as casing components and bearing housings shall be designed and manufactured to ensure accurate alignment and reassembly.

5.1.12 Spare parts for the mixer and all furnished auxiliaries shall meet all the criteria of this Standard.

5.1.13 Mixers shall be suitable for outdoor installation for the climatic condition specified in the data sheet.

5.2 Pressure Casings

5.2.1 The stress used in design for any material shall not exceed the values given for that material in section VIII, Division 1, of the ASME Code. For cast materials, the factor specified in the code shall be applied. Pressure casing of forged steel, rolled and welded plate, shall comply with the applicable rules of Section VIII, Division 1 of the ASME Code. Manufacturer’s data report forms and stamping, as specified in the code, are not required.

5.2.2 Pressure containing component including mounting flanges, shall be suitable for the design pressure and temperature of the mixing vessel.

5.2.3 Pressure casing for In-Line Blenders shall have a corrosion allowance equal to the connecting piping, but not less than 3 mm.

5.2.4 Bolting shall be furnished as specified in the following paragraphs:

- a) The details of threading shall conform to ANSI B1.1.
- b) The use of tapped holes in pressure parts shall be minimized. To prevent leakage in pressure section of casings, sufficient metal, in addition to the allowance for corrosion shall be left around and below the bottom of drilled and tapped holes.
- c) Internal bolting shall be of a material fully resistant to corrosive attack by the mixed liquid.
- d) Adequate clearance shall be provided at bolting locations to permit the use of socket or box wrenches.

5.2.5 The following design criteria shall be observed for mixers mounted external to tanks or vessels:

- a) Replacement of bearings, shaft sealing devices, gear unit, and driver shall be possible without dismantling other major parts of the unit, and without emptying or depressurizing the vessel.
- b) Connection of the drive shaft to the mixer shaft shall be outside the pressure vessel.
- c) Component parts shall be provided with means to insure accuracy of realignment during reassembly.

5.3 Pressure Casing Connections

5.3.1 Openings for normal pipe sizes of DN 32, 40, 90, 125, 175 and 225 (1¼, 2½, 3½, 5, 7, and 9 inches) shall not be used.

5.3.2 The minimum size of casing connections should be DN 15(½").

5.3.3 For nonflammable and nontoxic liquids, auxiliary connections to the pressure casing may be threaded. Pipe threads shall be taper threads conforming to ASME B1.20.1. Tapped openings and bosses for pipe threads shall conform to ANSI B16.5.

5.3.4 For flammable or toxic liquids, auxiliary connections to the pressure casing shall be socket welded, butt welded, or integrally flanged. Field connections shall terminate in a flange or a valve.

5.3.5 Connections welded to the casing shall meet the material requirements of the casing, including impact values, rather than the requirements of the connected piping.

5.3.6 Tapped openings not connected to piping shall be plugged with round-head plugs furnished in accordance with the dimensional requirements of ANSI B16.11. These plugs shall meet the material requirements of the casing. Threads shall be lubricated.

5.4 Rotating Elements

5.4.1 Impellers shall be secured to the mixer shaft and shall be retained against circumferential movement. The securing device shall be threaded to tighten by liquid drag on the impeller during normal rotation, and a positive mechanical locking method is required.

5.4.2 Shafts and shaft sleeves shall be furnished at the bearing and seal surfaces.

5.4.3 Shaft sleeves shall be installed as follows:

- a) Sleeves shall be locked to the shaft and sealed at one end and shall not be less than 2.5 mm;
- b) the end of the shaft-sleeve assembly (or nut) shall extend beyond the outer face of the packing gland, so that any leakage between the shaft and the sleeve cannot become confused with leakage through stuffing box packing.

5.4.4 Total shaft deflection under the most severe dynamic condition shall be 51 micrometers maximum at the face of the stuffing box or seal chamber.

5.5 Seals

5.5.1 General

5.5.1.1 External lubrication shall be provided for any shaft seal operating in a gas zone of a vessel, or in the liquid zone of a vessel containing non-lubricating fluids.

5.5.1.2 Lubrication facilities or devices shall be automatic, and supply lubrication requirements for a minimum of one week without refilling.

5.5.1.3 Mechanical seals shall be furnished unless otherwise specified.

5.5.2 Mechanical shaft seals

5.5.2.1 Single hydraulically balanced mechanical seal designs shall be used for sealing pressures above 517 kPa (5.17 bar).

5.5.2.2 The design and materials of the mechanical seal component parts shall be suitable for the specified service condition.

5.5.2.3 A non-sparking throttle bushing shall be provided for single and double seals unless auxiliary packing is specified as the auxiliary containment device. The bushing shall be pressed into the seal plate from the inside against an outside shoulder to prevent blow-out.

5.5.2.4 Seal parts, including non-metallic parts, shall be inert to the fluids being mixed and to any lubricant.

5.5.2.5 Sealing liquid for double mechanical seals will be provided from one of the following sources as specified:

- a) From an external process stream, with piping and instrumentation provided by purchaser.
- b) From an auxiliary, self-contained seal oil system, including reservoir, pumping or other pressurization equipment, instrumentation, and piping, to be provided by purchaser or vendor, as specified.

5.5.3 Stuffing boxes for packing

5.5.3.1 Stuffing boxes shall be integral with the cover.

5.5.3.2 Stuffing boxes shall be provided with seal cages and connections for the introduction of a cooling medium or lubricant directly into the packing.

5.5.3.3 Seal cage shall be the split-type with threaded holes or other means to facilitate removal.

5.5.3.4 Stuffing boxes shall have not less than six rings of packing plus the seal cage. The minimum packing size permitted shall be 6.3 mm square.

5.5.3.5 Space shall be provided for the packing replacement without removing or dismantling any part other than the gland and the seal cage.

5.5.3.6 Glands shall not permit bolts to slip off if the packing becomes loose. Where split glands are used, the halves shall be bolted together. Eye bolts shall not be used for gland fasteners.

5.5.3.7 Drains shall be provided to remove stuffing box leakage.

5.6 Dynamics

5.6.1 First lateral critical speed shall not be less than 140% of the maximum operating speed.

5.6.2 The torsional resonances of the complete train shall be at least 10 percent above or 10 percent below any possible excitation frequency within the specified operating speed ranges.

5.6.3 Major rotating parts such as impellers shall be dynamically balanced to the unbalance limit given in the following equation:

$$U_{\max} = 6350 W/N$$

Where:

U_{\max} = Residual unbalance in gram-milimeter

W = Journal static weight load in kilograms

N = Maximum continuous speed in revolutions per minute

5.6.4 When spare impellers are supplied, they shall be dynamically balanced to the same tolerances and procedures as the main impeller.

5.7 Bearings and Bearing Housing

5.7.1 Bearings

5.7.1.1 Radial and thrust bearings shall be either antifriction or hydrodynamic type.

5.7.1.2 Antifriction bearings shall provide a minimum L_{10} rating life of 25,000 hours in continuous operation at rated load.

Note:

L_{10} rating life is the number of hours at constant speed that 90% of a group of identical bearings will complete or exceed before the first evidence of failure.

5.7.1.3 When standard antifriction bearings fail to meet an L_{10} rating life, hydrodynamic bearings shall be required.

5.7.1.4 Oil-lubricated bearings shall be equipped with constant level oilers and a threaded oil filling connection. Large oil sumps may be fitted with an oil level indicating gage. The recommended oil quantity level shall be marked.

5.7.1.5 Thrust bearings shall be sized for continuous operation under all specified conditions. In addition to the thrust from impeller and any internal gear reactions due to the most extreme allowable conditions, the axial force transmitted through flexible couplings shall be considered a part of the duty of any thrust bearing.

5.7.1.6 Sleeve bearings shall be renewable insert type.

5.7.1.7 Bearings whenever applicable shall be designed in accordance with AFBMA standards.

5.7.2 Bearing housings

5.7.2.1 Bearing housings shall be arranged so that bearings can be replaced without disturbing mixer drives or mountings.

5.7.2.2 Bearing housings for oil lubricated bearings shall be provided with tapped and plug fill and drain openings at least DN 15, NPT in size.

5.7.2.3 Sufficient cooling, including an allowance for fouling, shall be provided to maintain the oil temperature below 71°C for pressurized systems and below 82°C for ring-oiled or splash systems, based on the specified operating conditions and ambient temperature of 43°C.

5.8 Materials

5.8.1 Materials shall be identified in the proposal with their applicable ASTM, AISI, ASME, or SAE numbers, including the material grade.

When no such designation is available, the vendor’s material specification, giving physical properties, chemical composition, and test requirements, shall be included in the proposal.

5.8.2 Classification of mixer materials shall be in accordance with Items "a" through "f" below:

- a) Pressure casings shall be of carbon or alloy steel for flammable or toxic services.
- b) Cast iron construction may be offered for other services.
- c) For operating temperatures below -29°C or when specified for other low ambient temperatures, steels shall have, at the lowest specified temperatures, an impact strength sufficient to qualify under the minimum Charpy V-notch impact energy requirements of Section VIII, Division 1, UG-84, of the ASME Code. For materials and thicknesses not covered by the code, the purchaser will specify the requirements on the data sheets.
- d) Bolting shall be selected per the following:

SERVICE REQUIREMENTS	ASTM STANDARDS	
	Bolts	Nuts
MIXERS OPERATING AT A MAX. PRESSURE OF 1035 kPa OR LESS AND WITH BOLT METAL DESIGN TEMPERATURE OF 177°C OR LESS.	A 307	A 307, GRADE B
TEMP. HIGHER THAN 177°C OR PRESSURE EXCEEDING 1035 kPa (10.35 BAR)	A 193, B 16	A 194, GRADE 2H
TEMP. BELOW -29°C	A 320, L7	A 194, GRADE 4

e) Gasket materials (including O-rings but excluding seal plate gasket) may be used as follows:

GASKET MATERIAL	MIXING TEMPERATURE °C
EQUAL TO BUNA. N	-40 TO + 90
EQUAL TO FEP (TEFLON)	-62 TO + 200
COMPRESSED ASBESTOS	TO 400
SPIRAL WOUND	ABOVE
	400 TO 540

f) Metallic seal parts shall be of the following materials unless otherwise specified:

SEAL PART	MATERIAL
SHAFT SLEEVE	11 TO 13 Cr, OR 18 Cr 8Ni, UNHARDENED
OTHER METAL PARTS	11 TO 13 Cr, OR 18 Cr 8Ni
HARD FACE	EQUAL TO TUNGSTEN CARBIDE

5.8.3 Seal plates and their mounting hardware, including bolts or studs and nuts, shall be 18 Cr 8 Ni stainless steel.

5.8.4 Shaft and mixing element materials will be specified.

5.8.5 Sleeve nuts, if used, shall be made of a material capable of withstanding external corrosion.

5.8.6 When specified for pressure-casing parts, impellers, and shafts, the vendor shall furnish chemical and mechanical data for the heat from which the material is supplied.

5.8.7 The purchaser will specify any corrosive agents present in the motive and process fluids and in the environment, including constituents that may cause stress corrosion cracking.

5.8.8 Materials with a yield strength of more than 6200 bar or a hardness of more than Rockwell C 22 shall not be used for the following components if the components will be exposed to H₂S, including trace quantities:

- a) the pressure casing;
- b) shafting (including wetted shaft nuts);
- c) impellers;
- d) pressure-retaining mechanical seal components (excluding-seal faces);
- e) wetted bolting.

The yield-strength and hardness restrictions above may be modified in accordance with NACE MR-01-75.

5.8.9 To avoid brittle failure during operation, maintenance, transportation, erection, and testing, good design practices shall be followed in the selection of fabrication methods, welding procedures, and materials for vendor-furnished carbon steel piping and appurtenances that may be subject to temperatures below the ductile-brittle transition point.

5.8.10 castings shall be sound and free from porosity, hot tears, shrink holes, blow holes, cracks, scale, blisters, and similar injurious defects. Surfaces of castings shall be cleaned by sand-blasting, shotblasting, chemical cleaning, or any other standard method. Mold-parting fins and remains of gates and risers shall be chipped, filed, or ground flush.

5.8.11 Weldable grades of steel castings may be repaired by welding, using a qualified welding procedure based on the requirements of Section VIII, Division 1, and Section IX of the ASME Code. Unless otherwise specified, weld repairs shall be inspected according to the same quality standard used to inspect the casting.

5.8.12 Iron casting may be repaired by plugging within the limits of the applicable ASTM specification. The holes drilled for plugs shall be examined, using liquid penetrant, to ensure that all defective material has been removed. All repairs that are not covered by ASTM specifications shall be subject to the purchaser's approval.

5.8.13 Any repair procedure shall be subjected to purchaser's approval.

5.8.14 Welding of piping, pressure-containing parts, and wetted parts, as well as any weld repairs to such parts, shall be performed and inspected by operators and procedures qualified in accordance with Section VIII, Division 1, and Section IX of the ASME Code.

5.8.15 The purchaser will specify whether radiographic, magnetic particle, or liquid penetrant inspection of welds is required.

5.8.16 All welds shall be heat treated in accordance with the methods described in Section VIII, Division 1, UW-40, of the ASME Code.

5.9 Name Plates and Rotation Arrows

5.9.1 A name plate of 18 Cr 8 Ni stainless steel, or Monel shall be securely attached with stainless steel pin at an easily accessible point on the equipment.

5.9.2 The name plate shall be stamped with the following data and information:

- a) Serial number (shall also be plainly stamped on the casing);
- b) mixer speed;
- c) driver power rating kW;
- d) size and type of bearing;
- e) equipment identification number.

Name plate data shall be in english language and SI units, unless otherwise is specified.

6. ACCESSORIES

6.1 Drivers

6.1.1 The type of driver will be specified by purchaser. The driver shall be sized to meet the maximum specified operating conditions, including bearing, mechanical seal, external gear, and coupling losses, as applicable, and shall be in accordance with the applicable specifications, as stated in the inquiry and order. The driver shall be suitable for satisfactory operation under the utility and site conditions specified by the purchaser.

6.1.2 Anticipated process variations that may affect the sizing of the driver (such as changes in the pressure, temperature, or properties of the liquid handled, as well as special plant start-up conditions) will be specified by the purchaser.

6.1.3 The starting conditions for the driven equipment will be specified by the purchaser, and the starting method shall be mutually agreed upon by the purchaser and the vendor. The driver’s starting-torque capabilities shall exceed the speed-torque requirements of the driven equipment.

6.1.4 Driver power rating shall be calculated per the following:

$$\text{Minimum driver power rating} = \frac{\text{Normal Power}}{\text{Mechanical Efficiency of Separate Power Transmission}}$$

Where:

1) Normal power

Power required by the driven equipment at normal operating conditions and includes all mechanical losses within the driven equipment, except power transmission losses. Drivers shall be designed to deliver optimum efficiency when developing normal power.

2) Normal operating conditions refer to pressure, density, capacity, viscosity, and other conditions for which the operation of the mechanical mixer is guaranteed.

6.1.5 The motor’s starting-torque requirements shall be met at a reduced voltage specified by the purchaser, and the motor shall accelerate to full speed within a period of time agreed upon by the purchaser and the vendor.

Note:

For most applications, the starting voltage will be 80 percent of the normal voltage, and the time required to accelerate to full speed will be less than 15 seconds.

6.1.6 Antifriction bearings in drive systems designed for radial or axial loads transmitted from the Mixer shall meet the following requirements:

- a)** Bearings shall be selected to give a minimum L_{10} rating life (see AFBMA Standard 9) of 25,000 hours in continuous operation at pump rated conditions.
- b)** Bearings shall be selected to give a minimum L_{10} rating life of 16,000 hours when carrying the maximum loads (radial or axial or both) imposed with internal mixer clearances at twice the design values and when operating at any point between minimum continuous stable flow and rated flow.
- c)** For vertical motors, the thrust bearing shall be in the top end, with axial float of not more than 127 micrometers.
- d)** Single- or double-row bearings shall be of the Conrad type (no filling slots). Except for the angular-contact type, bearings shall have a loose internal clearance fit equivalent to AFBMA Symbol 3, as defined in AFBMA Standard 20.

6.1.7 Motor drivers shall meet the requirements of IPS-M-EL-132.

6.1.8 Steam turbine drivers shall meet the requirements of IPS-M-PM-240 or IPS-M-PM-250.

6.1.9 Gears shall conform to IPS-M-PM-300 whenever applicable.

6.1.10 Service factors for gearing shall be per applicable AGMA Standards using a "Uniform" load classification, if not otherwise specified.

6.1.11 The use of belt transmissions shall be as approved by the Purchaser. Limitations on the use of belt transmissions shall be as follows:

- a)** Maximum driver power rating: 110 kw.
- b)** Drive service factor: 1.5.
- c)** Belt type: joined (multiple V-belt).
- d)** V-belts shall be of heavy duty or premium quality with oil resistant, static conducting characteristics.

6.1.12 Proposals to use variable speed transmissions shall be submitted to purchaser for approval.

6.2 Couplings and Guards

6.2.1 Unless otherwise specified, couplings and guards between drivers and driven equipment shall be supplied by the vendor.

6.2.2 Couplings shall be keyed in place. Cylindrical interference fits shall be "light" to permit removal of the hub in the field without heat.

6.2.3 Couplings shall be forged steel, type.

A spacer-type coupling shall be provided for vertical units using solid shaft drive units equipped with mechanical seals:

- a)** The spacer shall be long enough to permit replacement of the seal assembly without removing the driver.
- b)** The driver half-coupling shall be designed for removal without heat.

6.2.4 Removable-type coupling guards or belt drive guards, as applicable, shall be furnished and mounted. Guards shall be constructed to provide ready access to equipment for maintenance; and shall be fabricated from corrosion-resisting material.

6.2.5 Couplings and coupling-to-shaft junctures shall be rated for at least the maximum driver power, including any motor service factor.

6.2.6 Coupling and coupling mounting shall conform to IPS-M-PM-310 whenever applicable.

6.3 Shut-Off Devices

6.3.1 Metal sealing faces, in any shutoff device, shall be corrosion resistant.

6.3.2 A means shall be provided for testing the effectiveness of the shut-off device after it has been applied, and prior to servicing the Mixer.

6.4 Special Tools

All special maintenance tools necessary to service the shaft sealing devices, and to dismantle and assemble the unit shall be furnished with the equipment. Special tools shall be packaged in separate, rugged boxes and marked "special tools for (item number)". Each tool shall be stamped or tagged to indicate its intended use.

6.5 Instrumentation

If any instrumentation is specified by the purchaser it shall conform to any detailed specifications in the purchaser's inquiry or order or both, when no detailed specification are furnished, instrumentation and installation shall conform to the requirements of API Standard . Unless otherwise specified, controls and instrumentations shall be suitable for outdoor installation.

7. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

7.1 General

7.1.1 After advance notification of the vendor by the purchaser, the purchaser's representative shall have entry to all vendor and subvendor plants where manufacturing, testing, or inspection of the equipment is in progress.

7.1.2 The vendor shall notify subvendors of the purchaser's inspection and testing requirements.

7.1.3 The vendor shall provide advance notice to the purchaser 15 days before conducting any inspection or test that the purchaser has specified to be witnessed or observed.

7.1.4 The purchaser will specify the extent of his participation in the inspection and testing.

7.1.4.1 When shop inspection and testing have been specified by the purchaser, the purchaser and the vendor shall coordinate manufacturing hold points and inspectors' visits.

7.1.5 Equipment for the specified inspection and tests shall be provided by the vendor.

7.1.6 Purchaser's representative shall have the rights to reject any parts that do not comply with the requirements of the purchase order.

7.2 Inspection

7.2.1 The vendor shall keep the following data available for at least 5 years for examination by the purchaser or his representative upon request:

- a) Necessary certification of materials, such as mill test reports.
- b) Purchase specifications for all items on bills of materials.
- c) Test data to verify that the requirements of the specification have been met.
- d) Results of documented tests and inspections.
- e) Final-assembly maintenance and running clearance.

7.2.2 The purchaser will specify the following:

- a) Parts that shall be subjected to surface and subsurface examination.
- b) The type of examination required, such as magnetic particle, liquid penetrant, radiographic, and ultrasonic examinations.

7.2.3 When radiographic, ultrasonic, magnetic, particle, or liquid penetrant inspection of welds or materials is required or specified, the criteria in 7.2.3.1 through 7.2.3.4 shall apply unless other criteria are specified by the purchaser.

7.2.3.1 Radiography

Radiography shall be in accordance with ASTM E 94 and ASTM E 142. The acceptance standard used for welded fabrications shall be Section VIII, Division 1, UW-52, of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7, of the ASME Code.

7.2.3.2 Ultrasonic inspection

Ultrasonic inspection shall be in accordance with Section V, Article 5, of the ASME Code.

The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 12, of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7, of the ASME Code.

7.2.3.3 Magnetic particle inspection

Both wet and dry methods of magnetic particle inspection shall be in accordance with ASTM E 709. The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 6, of the ASME Code. The acceptability of defects in castings shall be based on a comparison with the photographs in ASTM E 125.

For each type of defect, the degree of severity shall not exceed the limits of Table 1.

TABLE 1 - MAXIMUM SEVERITY OF DEFECTS IN CASTINGS

TYPE	DEFECT	MAXIMUM SEVERITY LEVEL
I	LINEAR DISCONTINUITIES	1
II	SHRINKAGE	2
III	INCLUSIONS	2
IV	CHILLS AND CHAPLETS	1
V	POROSITY	1
VI	WELDS	1

7.2.3.4 Liquid penetrant inspection

Liquid penetrant inspection shall be in accordance with Section V, Article 6, of the ASME Code. The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 8, of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7, of the ASME Code.

7.2.4 The purchaser's representative shall have access to the vendor's quality-assurance program for review.

7.3 Testing

7.3.1 When specified, at least 10 weeks before the first scheduled test, the vendor shall submit to the purchaser, for his review and comment, detailed procedures for all running tests, including acceptance criteria for all monitored parameters.

7.3.2 The mixer shall be tested by the vendor, if specified, using its testing tank and facilities. These tests shall consist of the following:

- a) Operation of the assembled mixer under no load.
- b) Running test of shaft seal with the seal under pressure.
- c) Actuation of the shut-off device with the test tank held at maximum operating pressure.

7.3.3 The following certified data shall be given to the inspector if inspection is specified, or to the purchaser if inspection is not specified.

- a) Physical and chemical data (on pressure casing, except if cast iron) is preferred to be actual test data from the melt or heat from which the part is made. However, certification with a particular manufacturer's or national specification may be substituted.
- b) Evidence of specified materials for critical parts shall be provided, such as purchase specifications or bills of material.
- c) Copies of all test data and performance curves.

7.3.4 Test data shall include performance data for all final tests, and mechanical operation during tests (vibration and starting and stopping cycles).

7.3.5 Power requirements shall be given for operation on water, and on fluids of the specified densities.

7.4 Preparation for Shipment

7.4.1 The preparation shall make the equipment suitable for 12 months of outdoor storage from the time of shipment, with no disassembly required before operation except for inspection of bearings and seals.

7.4.2 The vendor shall provide the purchaser with the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before start-up.

7.4.3 The equipment shall be prepared for shipment after all testing and inspection have been completed and the equipment has been approved by the purchaser.

7.4.4 Exterior surfaces, except for machined surfaces, shall be given at least one coat of the manufacturer's standard paint.

Stainless steel parts need not be painted. Painting of unmachined exterior surfaces or marine atmospheres will be specified.

7.4.5 Unless otherwise specified, a rust preventive shall be applied to unpainted exterior machined surfaces and shall be of a type:

- 1) To provide protection during outdoor storage for a period of twelve months exposed to a normal industrial environment.
- 2) To be removable with mineral spirits or any standard solvent.

7.4.6 Mounting flanges and any other flanged connections shall be protected with either: metal, hardboard, or solid wood covers. Threaded openings shall be protected with metal or plastic, plugs or caps.

7.4.7 Lifting points and lifting lugs shall be clearly identified.

7.4.8 The equipment shall be identified with item and serial numbers. No material shall be shipped separately. Miscellaneous parts shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. All such parts shall be suitably boxed, and shipped with the unit.

7.4.9 Exposed shafts and shaft couplings shall be wrapped with waterproof, moldable waxed cloth or vapor-phase-inhibitor paper. The seams shall be sealed with oilproof adhesive tape.

7.4.10 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 must 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.

7.4.11 One copy of the manufacturer's standard installation instructions shall be packed and shipped with the equipment.

8. VENDOR'S DATA

8.1 Proposal

The vendor's proposal shall include the information specified in Items a through k below:

- a) A copy of the Vendor Drawing and Data Requirements form indicating the schedule according to which the vendor agrees to furnish the data requested by the purchaser.
- b) Copies of the purchaser's data sheets with complete vendor's information entered thereon.
- c) Utility requirements such as steam, water, electricity, air, gas, and lube oil, including the quantity of lube oil required at the supply pressure and the nameplate rating and operating power requirements. This information shall be entered on the data sheets.
- d) Preliminary outline and arrangement drawings, schematic diagrams.
- e) Typical cross-sectional drawings and literature to fully describe details of the offerings.
- f) A specific statement that the system and all its components are in strict accordance with this standard. If the system and components are not in strict accordance, the vendor shall include a specific list that details and explains each deviation.
- g) A list of spare parts recommended for start-up and two years of continuous operation with price list. The Vendor proposal shall include proposed method of protection from corrosion during shipment and consequent storage.
- h) An itemized list of the special tools included in the offering. The vendor shall list any metric items included in the offering.
- i) A description of the tests and procedures for materials as required by 7.3.2.

- j) When specified, a list of similar machines installed and operating under analogous conditions.
- k) Any start-up, shutdown, or operating restrictions required to protect the integrity of the equipment.

8.2 Contract Data

8.2.1 The following paragraphs specify information to be furnished by the vendor. The vendor shall complete and forward the Vendor Drawing and Data requested, to the purchaser.

8.2.2 The data shall be identified on transmittal (cover) letters and in title blocks or pages with the following information:

- a) The purchaser/user's corporate name.
- b) The job/project number.
- c) The equipment name and item number.
- d) The purchase order number.
- e) Any other identification specified in the purchase order.
- f) The vendor's identifying shop order number, serial number, or other reference required to identify return correspondence completely.

8.2.3 The following information shall be provided on the drawings (typical drawings are not acceptable):

- a) The purchaser's order number (on every drawing).
- b) The purchaser's equipment item number (on every drawing).
- c) The vendor's shop order and/or serial number (on every drawing).
- d) Lift points for the entire assembly.
- e) Principal dimensions, including those required for the piping design, maintenance clearances, and dismantling clearances.
- f) The direction of rotation.
- g) The size, type, rating, location, and identification of all the purchaser's connections, including vents, drains, lubricating oil, conduits, and instruments. (The vendor's plugged connections shall be identified).
- h) When shaft couplings are furnished, their make, size, and Type and the style of the coupling guards.
- i) Complete bills of materials covering the vendor's entire scope of supply.

8.2.4 When specified, the vendor shall make the following information available to the purchaser:

- a) The vendor's physical and chemical data from mill reports (or certification) of pressure parts, impellers, and shafts.
- b) Certified shop logs of the performance test.
- c) A record of shop test data (which the vendor shall maintain for at least 5 years after the date of shipment). The vendor shall submit certified copies of the test data to the purchaser before shipment.

8.2.5 The vendor shall provide as-built running clearance and, where applicable, thrust- and radial bearing clearances.

8.2.6 The vendor shall furnish an illustrated parts list for all equipment supplied. The list shall include pattern, stock, or production drawing numbers and materials of construction.

The list shall completely identify each part so that the purchaser may determine the interchangeability of the part with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number.

8.2.7 No more than 15 days after the actual shipment date, the vendor shall furnish the required number of instruction manuals for the equipment and any auxiliaries and instruments provided by the vendor. Methods of lifting the assembled machine shall be completely described. The manual shall include legible drawings of the specific equipment included (typical drawings are not acceptable), an illustrated parts list, completed data sheets, and certified performance curves. They shall also include instructions covering installation, final tests and checks, start-up, shutdown, operating limits, and operating and maintenance procedures. The recommended clearances and maximum and minimum design clearances shall be clearly stated. The required amount, specifications, and supply temperature and pressure ranges for lubricating oils shall be stated.

9. GUARANTEE AND WARRANTY

9.1 Mechanical

Unless exception is recorded by the vendor in his proposal, it shall be understood that the vendor agrees to the following guarantees and warranties:

During a period of 12 months after the date of commissioning, the vendor shall, with all possible speed and without cost to the purchaser, replace or repair the goods or any part thereof found to be defective due to faulty material, workmanship or to any act or omission of the vendor. In particular the vendor shall reimburse any transportation and other charges incurred by the purchaser in effecting such replacement or repair at the point of use.

9.2 Performance

The mixer shall be guaranteed for satisfactory performance at all operating conditions specified on the data sheet. Normal power requirement (at normal operating conditions) shall not exceed the predicted power requirement by more than 4%.

APPENDICES

APPENDIX A
MIXER OR AGITATOR SPECIFICATION SHEET

(VENDOR MUST COMPLETE THIS FORM AND RETURN WITH PROPOSAL)

page 1 of 2
 JOB No. _____ DATE _____
 REV. No. _____ DATE _____
 BY _____ CHKD _____
 P. O. No. _____

No. UNITS _____ TAG Nos. _____
 SERVICE _____
 TYPE: PORTABLE _____ SIDE ENTERING _____ TOP ENTERING _____ BTM ENTERING _____

COMPONENT	BATCH ^b		CONTINUOUS ^b						
	QUANTITY		VISCOSITY		SPECIFIC GRAVITY	TEMP.		PRESSURE	
	M ³	BBLs	CP°	m Pa.s		C°	F°	kPa	bar
FINAL MIX									

CLASS OF AGITATION: BLEND^b DISSOLVE^b DISPERESE GAS^b SUSPEND SOLIDS^b HEAT EXCHANGE^b
 EMULSIFY OTHER _____ FOAMING (YES) (NO)

DEGREE OF AGITATION: MILD^b MEDIUM^b VIOLENT^b
 TOO MUCH AGITATION WILL _____
 TOO LITTLE AGITATION WILL _____

IF BATCH, LARGEST OR LEVEL BATCH IS _____ SMALLEST _____

MIXER SHALL BE DESIGNED TO _____ IN _____ HOURS

MIXER (WILL, WILL NOT) BE OPERATED WHILE FILLING OR DRAWING OFF

VESSEL OPEN TOP^b CLOSE TOP^b HORIZ^b VERTICAL^b API TANK^b
 SIZE: _____ m (.D.) _____ : STRAIGHT SIDE OR _____ m. LENGTH _____
 BOTTOM TYPE: FLAT^b FLANGED AND DISHED^b SEMI ELLIPTICAL^b CONE^b
 TOP TYPE: FLAT^b FLANGED AND DISHED^b SEMI ELLIPTICAL^b CONE^b
 MIXER MOUNTING FLANGE: SIZE _____ RATING _____
 LOCATION AGITATOR MOUNTING FLANGE _____
 DESIGN PRESSURE _____ kPa ga _____ bar ga DESIGN TEMPERATURE _____ °C _____ °F
 BAFFLES: No. _____ SIZE _____ mm × _____ mm _____ " × _____ " VERTICAL^b HORIZONTAL^b

(to be continued)

APPENDIX A (continued)

page 2 of 2

JOB No. _____ DATE _____
 REV. No. _____ DATE _____
 BY _____ CHKD _____
 P. O. No. _____

MIXER: MOTOR DRIVE: a.c **b** d.c **b** EXP. PROOF **b** TEPC **b** D.P.**b**
 _____ PHASE _____ CYCLE _____ VOLT

MIXER: TURBINE DRIVE: LIVE STEAM: _____ kPa ga _____ °C _____ bar ga _____ °F
 EXHAUST STEAM: _____ kPa ga _____ °C _____ bar ga _____ °F

SHAFT SEAL: MECHANICAL **b** PACKING **b** TYPE LUBRICATION _____

SIZE OPENING FOR IMPELLER INSTALLATION _____

HEAD ROOM ABOVE VESSEL FOR INSTALLING MIXER _____

MATERIALS OF CONSTRUCTION WETTED PARTS _____

MINIMUM AGMA SERVICE FACTOR FOR GEAR REDUCER _____ MINIMUM BEARING LIFE _____

DATA BY VENDOR

MIXER MODEL No. _____

DRIVE: _____ KW _____ HORSE POWER _____ RPM _____ MFOR.

GEAR: _____ RATIO _____ AGMA RATING _____ OUTPUT RPM _____ MFOR.

SHAFT COUPLING: DESCRIBE _____

MECHANICAL SEAL: DESCRIBE _____

STUFFING BOX: DESCRIBE _____

SHAFT: _____ mm × _____ mm (LENGTH FROM MOUNTING FLANGE) _____ " × _____ " (LENGTH FROM MOUNTING FLANGE)

IMPELLER _____ TYPE _____ mm O.D. _____ " O.D. ___ No. BLADES REMOVABLE FROM SHAFT YES (NO)

ADDITIONAL DATA _____

REMARKS

**APPENDIX B
PIPE COMPONENTS NOMINAL SIZE**

The purpose of this Appendix is to establish an equivalent identity for the piping components nominal sizes in Imperial System and SI System.

Nominal Size		Nominal Size		Nominal Size		Nominal Size	
DN (1)	NPS (2)						
15	½	100	4	500	20	1000	40
20	¾	125	5	600	24	1050	42
25	1	150	6	650	26	1100	44
32	1¼	200	8	700	28	1150	46
40	1½	250	10	750	30	1200	48
50	2	300	12	800	32	1300	52
65	2½	350	14	850	34	1400	56
80	3	400	16	900	36	1500	60
90	3½	450	18	950	38	1800	72

1) Diameter Nominal, mm.

2) Nominal Pipe Size, Inch.

**APPENDIX C
PIPE FLANGE PRESSURE TEMPERATURE RATING**

PN	ANSI RATING CLASS
20	150
50	300
65	400
100	600
150	900
250	1500
420	2500

1) Pressure Nominal, bar.