

	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date:01/15/2024
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	1 Page of 44
	Document Title: Technical Specification for Agitator	02	00	



Technical Specification for Agitator

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	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client
	Document Title: Technical Specification for Agitator	02
		00
		Date:01/15/2024
		2 Page of 44

Tabulation of Revised Page

Sheet	Revisions							Sheet	Revisions						
	00	01	02	03	04	05			00	01	02	03	04	05	
1	X	X	X					41	X						
2	X	X	X					42	X						
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5	X							45							
6	X							46							
7	X							47							
8	X	X						48							
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10	X							50							
11	X							51							
12	X							52							
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16	X							56							
17	X							57							
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20	X							60							
21	X							61							
22	X	X						62							
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25	X							65							
26	X							66							
27	X							67							
28	X							68							
29	X							69							
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32	X							72							
33	X							73							
34	X							74							
35	X							75							
36	X							76							
37	X							77							
38	X							78							
39	X							79							
40	X							80							

	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date:01/15/2024
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	3 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

TABLE OF CONTENTS

1. GENERAL.....	4
1.1 Introduction	4
1.2 Scope.....	4
1.3 Regulations.....	5
1.4 Reference Codes and Standards	5
1.5 Occupational Health and Safety	8
1.6 Quality Management and Records	8
1.7 Measurement units	9
1.8 Language.....	9
2. Design Data	9
2.1 Working time	9
2.2 Site condition	10
3. BASIC DESIGN	10
3.1 General	10
3.2 Pressure Casings.....	13
3.3 Pressure Casing Connections.....	14
3.4 Rotating Elements.....	15
3.5 Seals & Lubrication	17
3.6 Dynamics	19
3.7 Bearings and Bearing Housing	20
3.8 Materials	22
3.9 Name Plates and Rotation Arrows	27
4. ACCESSORIES	28
4.1 Drivers.....	28
4.2 Couplings and Guards	32
4.3 Shut-Off Devices.....	33
4.4 Special Tools	33
4.5 Instrumentation	34
4.6 Mounting Support.....	34
5. Maintenance	34
6. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT.....	35
6.1 Inspection.....	35
6.2 Testing	38
6.3 Preparation for Shipment	40
7. Surface Preparation.....	42
8. GUARANTEE AND WARRANTY.....	42

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	4 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

1. GENERAL

1.1 Introduction

The plant is “Designed” to accommodate the “Maximum” conditions.

1.2 Scope

This specification defines the minimum requirements for the design, manufacture, inspection and testing of Agitators in Copper-Moly concentrate plant project. If some item of this specification is not applicable, VENDOR shall specify, a list of any specific exclusion to this specification, otherwise any claims for extras arising out of non-compliance with this specification will not be considered. Compliance by the manufacturer with the provisions of this specification does not relieve him of the responsibility of furnishing Agitators and relevant accessories of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

In addition to requirements of this criteria, work shall be done in accordance with recognized and accepted theories, methods, codes, standards and good engineering practice. It should be noted that all Engineering (Detail Design), Procurement and Construction activities must be done by Contractor, based on Project Design Criteria, Specifications and engineering documents approved by Employer.

No deviations or exceptions from this specification shall be permitted without written approval of the Contractor. All activities must be done based on contract documents by contractor and should be submitted to Employer for review and approval. Contractor should be assured about using last revision of all documents.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	5 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

Supplier shall follow requirements of this specification together with all its due referred approved documents (such as P&ID, data sheets, material requisition, welding procedure specification, surface preparation and painting specification, etc.) as well as latest available edition of all specified international codes and standards which most of them are mentioned in following section.

1.3 Regulations

The work shall be done in accordance with the national and local laws and regulations. For subjects not covered by regulations or specifications, the design and construction shall be based on good engineering and working practice and shall be subject to approval by EMPLOYER in written.

The contractor shall inform the EMPLOYER in case of any deviation from the requirements of this specification which is considered necessary, in order to comply with national/local regulations.

1.4 Reference Codes and Standards

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	6 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

AGMA (AMERICAN GEAR MANUFACTURERS ASSOCIATION)

420 "Enclosed Speed Reducers and Increases
Using Spur, Helical, Herringbone and Spiral
Bevel Gears"

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)

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	7 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

- 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

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 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	8 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

Indications on Ferrous Casting"

E 142 "Method for Controlling Quality of Radiographic Testing"

Denversala hand book

1.5 Occupational Health and Safety

The Contractor shall adopt safe systems of work which minimize the risk to health and safety. All persons working on the site shall be competent to carry out their tasks and duties safely and in a manner that will not endanger their own health nor the health of others. Persons, when first employed on the site, shall be subject to appropriate pre-employment occupational health checks, instructed on the hazards inherent in the site, precautions to be taken, the form of construction, and emergency procedures and fire safety. Such instructions shall be given whenever there is a material change in the working arrangements. The Contractor shall maintain a record of all persons instructed and each person shall be required to sign such record confirming that instruction has been received. No person shall be permitted on site without being inducted as set out above. The Contractor shall prepare a written statement of Safe Systems of Working which shall be issued to all persons at site.

1.6 Quality Management and Records

- The project shall be administered using an accredited Quality Management System conforming.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	9 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

- References to the agreement of materials, workmanship, methods, etc. throughout this Specification shall be interpreted as requiring the agreement of the Employer.
- The Contractor shall maintain all records necessary under this Specification, including quality records as appropriate.
- Copies of all site records shall be available to the Employer.
- The Contractor shall supply the Engineer with all information necessary for the Health and Safety File including as-built drawings and records, maintenance schedules, operation and maintenance manuals, within the time specified in the contract, after substantial completion of the Works. Information shall be provided in the agreed format.

1.7 Measurement units

SI units shall be applied to the measuring units.

1.8 Language

All drawing design information, Documentation, Operation, and Maintenance Instructions and correspondence shall be in English.

2. Design Data

2.1 Working time

The working time is as follow:

Description	Value
Calendar days per year	365
Production days per year	320
Number of shifts per day	3

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	10 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

Working hours per shift	8
Utilization factor	0.85

2.2 Site condition

For Site Condition Refer to Document no. 12002-D-PR-DOC-303-GNL-001.

3. BASIC DESIGN

3.1 General

3.1.1 Agitators 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.

3.1.2 The vendor shall assume responsibility for the engineering coordination of the equipment and all auxiliary systems.

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

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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	11 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

Equipment	Sound Pressure Limit in dB Reference Equivalent (RE) 20 µPa
Agitator	87 dB (A)
Agitator + 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 Agitator and 85 dB(A) for the Agitator + driver.

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

3.1.4 Agitators 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.

3.1.5 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.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	12 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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

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

3.1.8 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.

3.1.9 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 project requirements.

3.1.10 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.

3.1.11 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.

3.1.12 Spare parts for the Agitator and all furnished auxiliaries shall meet all the criteria of this Standard.

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 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	13 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

3.1.13 Agitators shall be suitable for outdoor installation for the climatic condition specified in the data sheet.

3.2 Pressure Casings

3.2.1 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.

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

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

3.2.4 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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	14 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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.

3.2.5 The following design criteria shall be observed for agitators 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 agitator shaft shall be outside the pressure vessel.

c) Component parts shall be provided with means to ensure accuracy of realignment during reassembly.

3.3 Pressure Casing Connections

3.3.1 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.

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

3.3.3 For nonflammable and nontoxic liquids, auxiliary connections

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	15 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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.

3.3.4 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.

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

3.3.6 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.

3.4 Rotating Elements

3.4.1 Impellers shall be secured to the agitator shaft and shall be retained against circumferential movement. The securing device shall be threaded to tighten by liquid drag on the impeller during normal operation and a positive mechanical locking method such as (Corrosion resistance) set screw, tongue-type washer shall be used.

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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	16 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

3.4.3 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 thick.

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.

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

3.4.5 Unless otherwise approved, impeller shall be single piece constructed and balanced statically and dynamically to minimize vibration.

3.4.6 Propeller type impeller shall be true helical pitch with forward rake.

3.4.7 Propellers or paddles in agitators shall be installed in appropriate position within the tank or vessel.

If the propellers or paddles are too close to liquid level, the agitator will create a vortex that will entrain air and prevent adequate blending or mixing. If the propellers are set too low, compress vortexing may occur. When this

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	17 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

happens, the agitator will create stagnant zone in the area under the rotating assembly. As a result, some of the product will settle in this zone and proper mixing cannot occur. Setting the agitator too close to a corner or the side of the mixing vessel also can create a stagnant zone that will prevent proper blending or mixing of the product.

3.5 Seals & Lubrication

3.5.1 General

3.5.1.1 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.

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

3.5.1.3 Mechanical seals shall be furnished unless otherwise specified.

3.5.2 Mechanical shaft seals

3.5.2.1 Unless otherwise specified, Single hydraulically balanced mechanical seal designs shall be used for sealing pressures above 517 kPa (5.17 bar).

3.5.2.2 The design and materials of the mechanical seal component

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	18 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

parts shall be suitable for the specified service condition.

3.5.2.3 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. When specified, seal leakage detector is required to give early warning of seal failure.

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

3.5.2.5 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.

3.5.3 Stuffing boxes for packing

3.5.3.1 Stuffing boxes shall be integral with the cover.

3.5.3.2 Stuffing boxes shall be provided with seal cages and connections for the introduction

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	19 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

of a cooling medium or lubricant directly into the packing.

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

3.5.3.4 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.

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

3.5.3.6 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.

3.5.3.7 Drains shall be provided to remove stuffing box leakage.

3.6 Dynamics

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

3.6.2 The torsional resonances of the complete train shall be at least 10 percent above or 10 percent below any possible excitation frequency

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	20 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

within the specified operating speed ranges.

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

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

Where:

$U_{\max}$ = Residual unbalance in gram – millimeter

W = Journal static weight load in kilograms

N = Maximum continuous speed in revolutions per minute

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

3.7 Bearings and Bearing Housing

3.7.1 Bearings

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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	21 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

3.7.1.2 Antifriction bearings shall provide a minimum **L₁₀** rating life of 40,000 hours in continuous operation at rated load.

Note:

L₁₀ 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.

3.7.1.3 When standard antifriction bearings fail to meet an **L₁₀** rating life, hydrodynamic bearings shall be required.

3.7.1.4 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.

3.7.1.5 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.

3.7.1.6 Sleeve bearings shall be renewable insert type.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	22 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

3.7.1.7 Bearings whenever applicable shall be designed in accordance with AFBMA standards and Denversala hand book.

3.7.2 Bearing housings

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

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

3.7.2.3 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.

3.8 Materials

3.8.1 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.

3.8.2 Classification of agitator materials shall be in accordance with Items "a" through "f" below:

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT		 SCICO.
 Shargan Consultant Engineer Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project		
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev	Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor
	Document Title: Technical Specification for Agitator	02	00
23 Page of 44			

- 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
AGITATORS OPERATING AT A MAX. PRESSURE OF 1035 kPa OR LESS AND WITH BOLT METAL DESIGN TEMPERATURE	A 307	A 307, GRADE B

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	24 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

OF 177°C OR LESS. TEMP. HIGHER THAN 177°C OR PRESSURE EXCEEDING 1035 kPa (10.35 BAR) TEMP. BELOW -29°C	A 193, B 16 A 320, L7	A 194, GRADE 2H 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 EQUAL TO FEP (TEFLON) COMPRESSED ASBESTOS SPIRAL WOUND	-40 TO + 90
	-62 TO + 200
	TO 400
	ABOVE 400 TO 540

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

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 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	25 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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

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

3.8.4 Shaft and mixing element materials will be specified. Shaft shall be engineering hard chrome plated in seal, bearing and shut-off areas.

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

3.8.6 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.

3.8.7 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.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	26 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

3.8.8 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.

3.8.9 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.

3.8.10 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, shot blasting, chemical cleaning, or any other standard method. Mold-parting fins and remains of gates and risers shall be chipped, filed, or ground flush.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	27 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

3.8.11 Weld able 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.

3.8.12 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.

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

3.8.14 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.

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

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

3.9 Name Plates and Rotation Arrows

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 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	28 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

3.9.1 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.

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

- a) Serial number (shall also be plainly stamped on the casing);
- b) Agitator 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.

4. ACCESSORIES

4.1 Drivers

4.1.1 The type of driver will be specified by purchaser. The driver shall be sized to meet the maximum specified operating conditions,

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	29 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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.

4.1.2 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.

4.1.3 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.

4.1.4 Driver power rating shall be calculated per the following:

Minimum driver power rating ☐ Normal Power _____

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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	30 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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 agitator is guaranteed.

4.1.5 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.

4.1.6 Antifriction bearings in drive systems designed for radial or axial loads transmitted from

the Agitator shall meet the following requirements:

a) Bearings shall be selected to give a minimum **L₁₀** rating lift (see AFBMA Standard 9) of 25,000 hours in continuous operation at pump rated conditions.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	31 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

b) Bearings shall be selected to give a minimum **L₁₀** rating life of 16,000 hours when carrying the maximum loads (radial or axial or both) imposed with internal agitator 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.

4.1.7 Motor drivers shall meet the project requirements.

4.1.8 Service factors for gearing shall be 1.7 as per AGMA Standards using a "Uniform" load classification.

4.1.9 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) Belt type: joined (multiple V-belt).

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	32 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

c) V-belts shall be of heavy duty or premium quality with oil resistant, static conducting characteristics.

4.1.10 Proposals to use variable speed transmissions shall be submitted to purchaser for approval. Electric motor drivers shall be in accordance with "Technical Specification for MV & LV Motors".

4.2 Couplings and Guards

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

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

4.2.3 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.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	33 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

4.2.4 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 resistant material. Guards shall be non-sparking with internal surface coated with fire resistant resin.

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

4.3 Shut-Off Devices

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

4.3.2 To ensure 100% effectiveness, a means shall be provided for testing of the "Shut-off Device" after it has been applied, and prior to any bearings and or mechanical seal removal.

4.3.3 Any material such as, flexible "O" rings or gaskets which deform, wear or perish with time, shall not be used in the shut-off mechanism.

4.4 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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	34 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

marked "special tools for (item number)". Each tool shall be stamped or tagged to indicate its intended use.

4.5 Instrumentation

If any instrumentation is specified by the purchaser it shall conform to Instrument Design Criteria attached to the relating inquiry documents.

4.6 Mounting Support

4.6.1 Side entry agitator unit over 700 kg shall be fitted with support slings to impose minimum force load to the mounting support.

The standard support slings shall incorporate variable load slings to accommodate tank shell movement during filling and emptying.

5. Maintenance

The Agitator will be designed in order to minimize maintenance and make unavoidable maintenance safe, quick and easy.

In order to minimize the frequency of maintenance, the temporary table of inspection and maintenance of Agitator components, contained in the offer documentation, must be drawn up in terms of previous engineering experience and subsequent improvements.

Every component must be easy to handle and equipped with hooks to allow them to be properly balanced when lifted.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	35 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

Components which need frequent maintenance must be easily accessible and they must not need special tools.

6. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

6.1 Inspection

6.1.1 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.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	36 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

6.1.2 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.

6.1.3 When radiographic, ultrasonic, magnetic, particle, or liquid penetrant inspection of welds or materials is required or specified, the criteria in 7.1.3.1 through 7.1.3.4 shall apply unless other criteria are specified by the purchaser.

6.1.3.1 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.

6.1.3.2 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,

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	37 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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.

6.1.3.3 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
------	--------	---------------------------

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		Date: 09/27/2023
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	38 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

I	LINEAR DISCONTINUITIES	1
II	SHRINKAGE	2
III	INCLUSIONS	2
IV	CHILLS AND CHAPLETS	1
V	POROSITY	1
VI	WELDS	1

6.1.3.4 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.

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

6.2 Testing

6.2.1 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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer: Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	39 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

all monitored parameters.

6.2.2 The agitator 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 agitator 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.

6.2.3 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.

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	40 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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

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

6.3 Preparation for Shipment

6.3.1 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.

6.3.2 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.

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

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

 NICICO NATIONAL IRANIAN COPPER INDUSTRIES CO.	NATIONAL IRANIAN COPPER INDUSTRIES CLIENT			 SCICO.
 Shargan Consultant Engineer mobina Mobina Engineering Co.	Sarcheshmeh Phase III Copper-Moly Concentrator Project			
Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	41 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

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

6.3.5 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.

6.3.6 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.

6.3.7 Lifting points and lifting lugs shall be clearly identified.

6.3.8 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.

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

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Contract No: 2001218	Document Number: 12002-D-ME-SPC-303-GNL-027	Rev		
Class: FA	Library Code: 303-E03-2401-00-ME-SPC-027-02	Client	Vendor	42 Page of 44
	Document Title: Technical Specification for Agitator	02	00	

6.3.10 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.

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

7. Surface Preparation

Painting system should be carried out in accordance with manufacturer's standard.

Supplier should submit detailed rust prevention and painting procedure and application list for the equipment package, to approve by employer.

Supplier should propose procedures to prevent rusting of warehouse stored equipment, during long term storage installation, and during long term suspension of operation.

Least painting requirement should be as project Specification For Paint. 12002-D-PI-SPC-303-GNL-004.

8. GUARANTEE AND WARRANTY

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	Document Title: Technical Specification for Agitator	02	00	

- The **VENDOR** shall guarantee the Package for the duty, emissions, noise levels and utility consumption as specified on Equipment Data Sheets, and for safe and reliable operation.
- The **VENDOR** shall guarantee the suitability of the materials of construction for the duties required, even if the **CONSULTANT** has specified the type and grade of material to be used.
- The **VENDOR** shall guarantee all equipment and components against design fault, defective or improper materials, poor workmanship and failure during normal usage.
- The Guarantee period is according to main contract.