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Guidance on Industry Standard for Agitators

GIS 34-403

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 34-403. This Guidance on Industry Standard (GIS) is based on parts of the heritage document from the merged BP companies as follows:

BP

PTA RE-MXR-GEN-S Rotating Equipment—Bottom and Top Mixer—Specification.

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1. Scope

- a. This GIS provides guidance on industry standard for the design, materials, fabrication, inspection, testing, documentation, and preparation for shipment of agitators.
- b. This GIS applies to bottom and top entering agitators to be installed in pressure vessels and atmospheric tanks.
- c. This GIS does not apply to fractional kW and portable agitators. Eductors, vessels using baffle plates, and spray nozzles are not included as agitators in GIS 34-403.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP

GIS 12-201	Guidance on Industry Standard for IEC Low Voltage Induction Motors.
GIS 12-202	Guidance on Industry Standard for NEMA Low Voltage Induction Motors.
GIS 12-203	Guidance on Industry Standard for IEC High Voltage Induction Motors.
GIS 12-204	Guidance on Industry Standard for NEMA High Voltage Induction Motors.
GIS 14-011	Guidance on Industry Standard for Noise Control.
GIS 34-503	Guidance on Industry Standard for API 671 Special Purpose Couplings.

American Society Mechanical Engineers (ASME)

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form).
ASME B16.5	Pipe Flanges and Flanged Fittings.
ASME B16.47	Large Diameter Steel Flanges, NPS 26 through NPS 60 (use in lieu of API 605).
ASME BPVC, Sec VIII	Boiler and Pressure Vessel Code, Section VIII – Pressure Vessels.

3. Symbols and abbreviations

For the purpose of this GIS, the following symbols and abbreviations apply:

BEM	Bottom entering mixers.
FEA	Finite element analysis.
ODS	Operating deflection shape.
SPL	Sound pressure level.
TIR	Total indicated runout.
L/D	Length/Diameter



4. Terms and definitions

For the purposes of this GIS, the following terms and definitions apply:

Agitator

An agitator is a shaft on which one or more impellers are mounted. Mixing is achieved by rotation.

5. General

5.1. Proven record of performance

- a. Agitators shall be unit of size and design with successful record of proven service at operating conditions similar to those specified.

With respect to the operating conditions to be specified reference should be made to the design requirements stated in the "mixers and agitators" section of GP 34-00.

- b. If no similar unit is available, an alternate may be proposed. Alternate proposals shall include detailed explanation of how offering differs from field proven equipment.
- c. Installation list shall be submitted.

5.2. Conflicting requirements

- a. In case of conflicts, order of precedence shall be:
 1. Local codes and standards.
 2. Purchase order/requisition/contract.
 3. Project data sheet/drawings.
 4. This GIS.
 5. Referenced BP documents.
- b. Conflicting requirements shall be referred to BP in writing. Confirming documentation (if needed for clarification) will be issued by BP.

5.3. Scope of responsibility

- a. This document shall not be a substitute for complete engineering by Vendor.
- b. This document shall not relieve Vendor of responsibility for proper process and mechanical design for specified application.

5.4. Alternate designs

Alternate designs may be offered, provided all deviations are clearly indicated.

5.5. Cost saving recommendations

Design values (pressure and temperature) that incur extra cost, added complexity, or create adverse design issues for mechanical seal or steady bearing bushing compared with designing for maximum operating conditions shall be brought to attention of BP.



6. Design

6.1. Coordination

6.1.1. Auxiliary systems

- a. Vendor shall be responsible for engineering coordination of equipment and auxiliary systems.
- b. Vendor shall coordinate location of vessel internal piping with vessel manufacturer and BP. Changes from data sheet that Vendor deems necessary to prevent vibration or excess unbalanced forces shall be presented to BP in writing. Satisfactory solution shall be jointly developed by Vendor and BP.

Particular attention should be given to location of process air inlet nozzles to ensure these are staggered to avoid harmonic vibrations during agitator operation.

6.1.2. Agitator mounting

- a. Agitator Vendor shall be responsible for coordinating with vessel manufacturer regarding requirements for mounting agitator and ensuring that requirements are properly understood by vessel fabricator, including:
 1. Agitator mounting flange.
 2. Vessel flange.
 3. Vessel to steady bearing support (if required).
 4. Flange finish.
 5. Angularity tolerances on flanges.
 6. Gasket type.
 7. Flush and drain requirements.
 8. Internal clips.
 9. Location of drain nozzles to satisfy operation requirement on bottom entry agitators.
- b. This coordination shall be with BP participation to ensure design mutually complies with satisfactory agitator performance and BP operation and maintenance requirements.

6.1.3. Baffles

Complete design information for any required baffles, including location, size, hydraulic loads, and clearance from vessel shell, shall be provided by Vendor.

6.2. Criteria

6.2.1. Service life

Equipment (including auxiliaries) shall be designed for at least 2 years of continuous operation and minimum service life of 20 years for operating conditions shown in data sheets. Components that are likely to limit the period of continuous operation shall be identified.

Periodic maintenance and servicing is required.

6.2.2. Operating conditions

Equipment shall be suitable for operation under location, environmental, and process conditions specified on data sheet.



6.2.3. Maintainability

- a. Equipment shall be designed to permit rapid, safe, and economical maintenance.
- b. Major parts, such as housing covers, seals, and bearing housings, shall be designed (shouldered or doweled) and manufactured to ensure accurate alignment on reassembly.
- c. Arrangement of auxiliary systems, piping, and instrumentation shall provide adequate clearance areas and safe access for operation and maintenance.
- d. Bottom entering mixers (BEM) shall be designed for easiest access. Design shall be subject to BP review and approval.
- e. Vendor bid shall include preliminary layout with recommended vessel support openings and lifting lugs attached to vessel.

6.2.4. Electrical

Electrical components and electrical installations shall be suitable for area classification specified.

6.2.5. Noise reduction

- a. Sound pressure level (SPL) shall comply with GIS 14-011.
- b. Proposals shall include completed noise data sheets indicating expected sound levels for agitator, gearbox, and driver.

6.3. Analyses**6.3.1. Design analyses**

Vendor shall coordinate with vessel manufacturer for engineering activities needed to perform design analyses to give assurance that the agitator will perform as required.

Further advice on the checking of the design of the mixing process can be found in GP 34-00 under the section for mixers and agitators.

6.3.2. Shaft critical speed

- a. Critical speed analysis shall be performed for all specified cases.
- b. Report shall be given to BP for review.
- c. Report shall comply with requirements in Clause 6.4.1.1.b.
- d. Input data and design drawings shall be included in report.

6.3.3. Force Analysis

- a. Finite element analysis (FEA) shall be performed in accordance with Clauses 12.2.o and 12.2.p.

Flexing of machinery/vessel interface, and in particular vessel head and supports, is a major concern. This should be a major area of focus for finite element study.

- b. Force analysis shall be basis for:
 1. Stress analysis of all parts.
 2. Operating deflection shape (ODS) of entire agitator assembly including predicted or measured (based on experience) deflections.
 3. ODS of intermediate steady bearing support structure.
 4. ODS of bottom steady bearing support structures.
 5. Fatigue life of all parts.

