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Guidance on Practice for In Service Inspection and Testing of Piping Systems

GP 32-42

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 32-42. This Guidance on Practice (GP) is based on parts of heritage documents from the merged BP companies as follows:

British Petroleum

RP 32-4 Inspection & Testing of In Service Civil and Mechanical Plant -
Technical Guidance – Section B7 & B7A Piping.

BPOUS RPs

RP 20-4-2 In-Plant Inspection of Existing Piping Systems.

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1. Scope

- a. This GP provides guidance for in service inspection and testing of piping systems designed to ASME B31.3 or equivalent national piping codes.
- b. This GP defines requirements for the inspection and assessment of piping systems during operations phase to ensure continuing integrity.
- c. Outside the scope of this GP are control valves, overpressure protection devices, rotating equipment, pipelines, and instrumentation.

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

GP 32-30	Guidance on Practice for In Service Inspection and Testing of Equipment - Management Principles.
GP 32-40	Guidance on Practice for In Service Inspection and Testing of Equipment - Common Requirements.
RD 42-123	Piping Joints Handbook (Controlled document is UKCS-TI-032).

American Society of Mechanical Engineers (ASME)

ASME B31.3	Process Piping.
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American Petroleum Institute (API)

API 570	Piping Inspection Code.
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3. Terms and definitions

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

Condition Monitoring Location (CML)

Designated location on piping systems for performing periodic inspection to monitor the presence and rate of damage.

CMLs have been historically designated thickness measurement locations (TMLs). CML is now used to recognise that non thinning mechanism location may also be required.

Corrosion Under Insulation/Fireproofing (CUI/CUF)

Caused by ingress of water or condensation, resulting in wetting of surface of unprotected steel causing aqueous corrosion of carbon and low alloy steels and stress corrosion cracking of some corrosion resistant alloys.



Dead leg

Component of piping system that normally does not experience any flow and remains filled with fluid from line.

Defect

Defect is an imperfection or anomaly that fails to meet acceptance criteria in design code.

Hold point

Defined stage in a repair or other procedure beyond which further work is not allowed until required inspection is performed.

Injection point

Location where relatively small quantities of fluid (secondary stream) are injected into process streams (primary flow) to control chemistry or other process variable.

Mixing point

Locations where two or more different process streams meet.

Piping circuit

- a. Section of piping made from same material and has all points exposed to environment of similar corrosivity.
- b. Process plant is composed of a number of such piping circuits that are the basis for organisation of inspection activity.

Piping circuits are also commonly known as loops or systems.

Positive materials identification (PMI)

Confirms that identity of material complies with specification.

PMI techniques are normally used to confirm the chemical composition of the material. Additional specification requirements such as heat treatment condition, hardness and microstructure (e.g. ferrite content) require other techniques.

Small bore piping

DN 50 (NPS 2) or smaller piping.

Soil/air interface

- a. Zone where buried piping emerges from ground and is particularly vulnerable to corrosion.
- b. Corrosion is caused by presence of both moisture and oxygen.
- c. Zone is typically considered to extend from 300 mm (12 in) below to 150 mm (6 in) above ground.

4. Symbols and abbreviations

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

CUI/CUF Corrosion Under Insulation/Fireproofing

MOC Management of change

MT Magnetic particle testing



NDE	Non destructive examination.
PT	Liquid penetrant testing
RBI	Risk based inspection.
RT	Radiographic testing
SCC	Stress corrosion cracking.
UT	Ultrasonic testing
WFMT	Wet fluorescent magnetic particle testing.

5. General

5.1. Piping integrity

Piping integrity is critical to safely operating any process equipment and is achieved through the combined efforts of many functions within the organisation over the lifecycle of the piping system, including:

- *Engineering design.*
- *Fabrication, construction, and commissioning.*
- *Operation.*
- *Maintenance.*
- *Inspection.*

5.2. Applicable codes and standards

- This GP covers inspection of piping systems designed to ASME B31.3 or equivalent national piping codes in upstream and downstream operations.
- Defined activities shall comply with applicable national codes and standards related to piping inspection.
- This GP shall be read and interpreted in conjunction with GP 32-30 and GP 32-40.

6. Piping systems inspection procedures

6.1. Site Technical Practices

- This GP shall be adopted, modified or supplemented by Sites into a Site Technical Practice (STP).
- The STP shall be approved by the Site Engineering Authority and form the basis for the development of piping system specific inspection plans and procedures.

6.2. Inspection plans and procedures

- Site piping system inspection plans and procedures shall be approved by Site Inspection Authority.
- Normative references, bibliography, and requirements of this GP shall be used to develop inspection plans and procedures.
- Sites shall have written piping inspection plans and procedures that comply with 6.3 through 6.15.



6.3. Qualified personnel

- a. Inspection personnel shall be qualified based on knowledge and experience in accordance with local requirements.
- b. Inspection personnel shall have access to qualified process/operations, mechanical, materials, maintenance, NDE, and corrosion engineering expertise.

6.4. Regulatory requirements

Inspectors should be familiar with regulatory requirements, but shall ensure compliance with Site inspection plans and procedures. It is the responsibility of the Site Inspection Authority to ensure that Site inspection plans and procedures comply with regulatory requirements.

6.5. Piping register

There shall be an up to date piping register giving details of piping, sizes, and services. See 7.2

6.6. Piping criticality assessment

There shall be a procedure for systematically identifying piping system criticality ratings and inspection plans.

6.7. Damage mechanisms and operating boundaries

Potential damage mechanisms in each area of unit shall be identified and operating boundaries shall be established.

6.8. Special emphasis inspection programs

Inspection procedures shall be generated for the following, as appropriate:

- a. Verification of materials by positive materials identification (PMI).
- b. CUI and CUF.
- c. Injection and mixing points.
- d. Piping supports.
- e. Dead legs.
- f. Small bore piping, including vents, drains, and auxiliary piping.
- g. Threaded piping connections.
- h. Soil/air interfaces.
- i. Buried piping.
- j. Special materials and corrosion issues.
- k. Piping expansion bellows.
- l. Orifice plates.
- m. Piping in intermittent or cyclic service.
- n. Flanges in hydrofluoric (HF) acid service.
- o. Instrument tubing.

6.9. Inspection techniques and locations

- a. Inspection and NDE techniques shall be selected based on anticipated or expected damage.
- b. There shall be procedure for assigning CMLs for monitoring damage, including use of isometric drawings or other means to indicate position of inspection points.



- c. Damage mechanisms other than general thinning by corrosion and erosion shall be considered (e.g., pitting, cracking, metallurgical deterioration).

6.10. Inspection due dates

Inspection due dates shall be established based on recommended inspection intervals.

6.11. Operating boundary violations

- a. There shall be a procedure to immediately notify Inspection Authority of any operation outside recognised operating boundaries that may affect integrity of pressure boundary.
- b. MOC procedure shall be in place for prior approval of any change to established operating boundaries that may affect integrity of pressure boundary.

6.12. Data management and analysis

- a. There shall be a data management system, preferably computerised, to track piping thickness measurements and calculate corrosion rates, remaining life and retirement dates, and next inspection due dates.
- b. Data management shall include management of the inspection data for other deterioration mechanisms as well as capturing visual inspection text/photos and other relevant documentation.
- c. Practices shall be in place for ensuring data quality and resolution of inconsistent data.
- d. Practices shall be in place to identify and generate actions or recommendations based on the data analysis.

6.13. Documentation and communication

There shall be defined process to document inspection findings and communicate results.

6.14. Recommendation tracking

A process shall be implemented to register and report the status of recommendations (open or complete).

6.15. Temporary repairs, clamps, wraps, and enclosures

- a. Register of temporary repairs and clamps fitted to piping shall be maintained. The register shall include the planned removal date.
- b. Strategy shall be in place for periodic inspection and permanent repairs.
- c. The design of all clamps (temporary and permanent) shall be approved by the relevant Site Technical Authority.

Some types of clamp may be considered permanent by the relevant Site Technical Authority via the MOC process (e.g. fully welded sleeves, resin injected designs). Periodic inspection of these clamps should still be performed as part of the piping system inspection plan.

7. Inspection strategy

7.1. General

An inspection strategy shall be established that complies with 7.2 through 7.8.

Factors that make piping inspection difficult and which need to be addressed in the strategy include:

