

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

TECHNICAL SPECIFICATION

HYDROSTATIC PRESSURE TESTING OF NEW PIPELINES

PTS 31.40.40.38

FEBRUARY 2008



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Subject: DESIGN AND ENGINEERING PRACTICE

PTS No.: PTS 31.40.40.38

PTS Title: HYDROSTATIC PRESSURE TESTING OF NEW PIPELINES

Issue: December 2004

Please be informed that the referred PTS has been revised.

The relevant content as per the stated above shall be removed from PTS binder and replaced by **PTS 31.40.40.38 (Revision 1 – February 2008)** herein onwards.

Verification :	Endorsement :
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Position: General Manager, Engineering - PGTS	Position: Senior General Manager, PGTS
Date: 21 March 08	Date: 25.03.08

PREFACE

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They are based on the experience acquired during the involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPUs in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use PTS they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the PTS. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

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PTS No:	PTS 31.40.40.38		
Publication Title:	Hydrostatic Pressure Testing of New Pipelines	Revision (Date):	Revision 1 (February 2008)
		Reviewed:	Rosman Arifin 
		Approved:	Hashim Zainal Abidin 
		Base PTS Version:	Release 13

1. INTRODUCTION

This PTS shall make reference to PTS 31.40.40.38; Hydrostatic Pressure Testing of New Pipelines (December 2004). In addition to this, the custodian of this PTS has assessed/reviewed/evaluated the stated PTS and offered the following exceptions/amendments. This PTS also includes PETRONAS Lessons Learnt and PETRONAS Best Practice for the subject matter as stated above.

PTS 31.40.40.38 shall be the main reference for Hydrostatic Testing of New Pipeline. In future, the PTS 20.117 Cleaning, Pigging and Hydrostatic Testing of Offshore Pipeline (August 1989) will become obsolete whilst its best practices will be incorporated into the PTS 31.40.40.38.

2. EXCEPTIONS/AMMENDMENTS

2.1. Page 4, (1.1), add sentence to 7th paragraph:

"Additional requirements related to hydrostatic pressure testing are also specified under PTS 20.117. Any conflicting statement between these two PTS, Contractor shall refer to Principal."

2.2. Page 8, (2.2), add new paragraph after k):

"In addition to test procedure, Hydrostatic test readiness checklist shall be prepared and submitted to the Principal for verification. The checklist shall be supported by relevant QA/QC inspection documents for all completed activities such as welding, NDT, weld repair, backfilling, joint coating, holiday inspection, cleaning, gauging, etc."

2.3. Page 8, (f), add the following sentence:

"as well as test certificates to warrant their functionality and safety."

2.4. Page 11, Onshore Pipelines, 2nd paragraph, add the following sentence:

"If necessary, dedicated personnel should be stationed at testing site during the hydrostatic testing activities for above ground facilities or at any exposed/unburied pipeline sections if the sites are located within/closed proximity to public or working area."

2.5. Page 13, (4), Offshore Pipelines, delete the following sentence:

"Where flanges are installed in a test section"

New sentence shall read as follows:

A dye should be added to the linefill water for leak detection during the hydrostatic pressure test. Fluorescein and Rhodamine B, or equivalents, dosed into the line-fill water at a concentration of 40 mg/kg (active constituent mass) are recommended.

2.6. Page 15, (5), add new paragraph after 1st paragraph

"Sufficient notice of at least 2 weeks shall be given to allow Principal to carry out inspections onto the proposed equipment especially for major equipment such as filling/pressurizing pumps, air compressor, temperature/pressure recorder, flow meter, dead weight tester, etc prior to its mobilization to site"

2.7. Page 15, (5), Table 5.1, 1st row, Filling and Pressurizing Pumps, add the following sentence:

"The filling pumps shall be capable of filling the pipeline at the volume rate required. The pressurize pump shall be capable of pressurizing 25% above the maximum test pressure."

2.8. Page 15, (5), Table 5.1, 19th row Test Head, add the following sentence:

"Test head shall be equipped as a minimum with fitting on the top where a pressure relief valve and a gauge can be connected. On the pressurizing side, it shall have a nipple for connection of pressurizing piping and a thermowell insert for installation of a thermowell meter (Figure 1). Test head shall be marked with identification number".

2.9. Page 18, (6.1), 4th Para, insert the following after 1st sentence under this paragraph:

"Flanges used on the temporary launcher or receiver shall be of standard manufactured type with proper ratings and certificates."

2.10. Page 19, (6.3), add new paragraph after 1st paragraph:

"A caliper/geometric pig run, if required, should consist of three pigs: one brush pig (not applicable for pipeline with internal coating), one batching/displacement pig and one Caliper pig. The results of this Caliper pig run shall be analyzed and made available to the Principal as soon as possible after that particular run has been completed. Any signs of damage or irregularities such as dents, buckles, flat spots, construction debris, etc, shall be analyzed and the results shall be issued by the Contractor in the form of a proper report to the Principal."

3. PETRONAS LESSON LEARNT

- 3.1 The filling pumps shall be capable of filling the pipeline at the volume rate required. The pressurize pump shall be capable of pressurizing 25% above the maximum test pressure. This is to ensure the pump is able to perform the test as required. Under capacity pump will take longer period to pressurize the line. This is also specified in PTS 20.117.
- 3.2 Flanges used on the temporary launcher or receiver shall be of standard manufactured type with proper ratings and certificates. This is to ensure safety of personnel during testing.

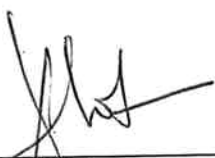
4. PETRONAS BEST PRACTICE

- 4.1 Dedicated personnel should be stationed at testing site during the hydrostatic testing activities for above ground facilities or at any exposed/unburied pipeline sections if the sites are located within/closed proximity to public or working area. This is and extra safety precautions to ensure no unauthorized trespassers enter the testing area.
- 4.2 Dye should be added to the line fill water for leak detection during the hydrostatic pressure test regardless whether flanges are installed or not.
- 4.3 Hydrostatic test readiness checklist shall be prepared and submitted to the Principal for verification. This is to ensure all installations are completed and compliance with QA/QC requirements prior to hydrostatic pressure test.
- 4.4 Sufficient notice of at least 2 weeks shall be given to allow Principal to carry out inspections onto the proposed equipment especially for major equipment such as filling/pressurizing pumps, air compressor, temperature/pressure recorder, flow meter, dead weight tester, etc prior to its mobilization to site. This shall be accompanied with details of the test equipment, including layouts, size and performance as well as test certificates. This is to minimize possibility of facing equipment breakdown or not functioning to specifications after delivery to site.

- 4.5 Test head shall be equipped as a minimum with fitting on the top where a pressure relief valve and a gauge can be connected. On the pressurizing side, it shall have a nipple for connection of pressurizing piping and a thermowell insert for installation of a thermowell meter. Test head shall be marked with identification number. Best practice as specified in PTS 20.117.

5. REFERENCE

- 5.1. PTS 20.117 Cleaning, Pigging and Hydrostatic Testing of Offshore Pipeline (August 1989)
- 5.2. PTS 30.40.40.38 Hydrostatic Pressure Testing of New Pipelines (December 2004)


Ir Abdul Razak Hassan
Head Plant Engineering
Date: 12/03/08

- END -

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE (CORE)

TECHNICAL SPECIFICATION

HYDROSTATIC PRESSURE TESTING OF NEW PIPELINES

PTS 31.40.40.38
DECEMBER 2004



PREFACE

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1. INTRODUCTION

1.1 SCOPE

This PTS gives minimum requirements for hydrostatic pressure testing of new onshore and offshore pipelines after construction, to prove their strength and leak tightness. The test medium is water.

The various stages of planning and carrying out hydrostatic pressure testing operations are specified in this PTS, including cleaning, gauging, filling, strength testing, leak testing and depressurising. It describes the selection and preparation of a test section, the safety and environmental precautions, the test medium and test equipment requirements, the specific parts of a pressure test and the documentation of the work. It also includes the necessary dewatering activities for the rectification of any defects detected during the hydrostatic pressure test, but excludes final dewatering. It also covers the post-testing period (up to 2 years) where the pipeline may be left full of treated test water. If corrosion protection methods other than leaving the pipeline full of treated test water during the post-testing period are necessary, they are classified as pre-commissioning and do not form part of this PTS.

It is assumed that the minimum test pressure is not less than 24.5 bar (ga) and the maximum test pressure is not above 550 bar (ga). It is also assumed that the hydrostatic pressure test is carried out at ambient temperature.

This PTS is restricted to rigid metallic pipelines constructed from carbon steel, clad steel and stainless steel linepipe material. It does not address flexible pipelines or cement-lined pipelines, nor pipelines constructed from other materials such as GRP or RTP.

This PTS is not intended to cover hydrostatic pressure testing of pipelines which have been in service, although many of the same principles would apply.

The special provisions for pipelines constructed from the various types of stainless steel and clad steel linepipe materials are covered in [\(Appendix A\)](#).

This PTS is intended for use in the pressure testing of new pipelines.

This PTS is a revision of the PTS of the same title and number dated June 1993; a summary of the main changes is given in [1.7](#). This PTS is consistent with PTS 31.40.00.10, ASME B31.4 and ASME B31.8. It is expected that an updated revision of this PTS will be issued after the next revision of PTS 31.40.00.10 has been made based on ISO 13623.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS or managed by a Group company.

This PTS is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and, where applicable, supply/marketing installations.

When PTS are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this PTS which is considered to be necessary in order to comply with national and/or local regulations. Based on the potential impact on design, construction and maintenance costs, the Principal may decide to consult with the Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Assembly	An arrangement of pipes/components such as a crossing, pig trap, block valve station or riser.
Block valve	A valve for interrupting the flow or to shut in a section of a pipeline. A block valve is normally either fully opened or fully closed.
Golden weld	A weld which is not subject to a hydrostatic pressure test and as such must pass additional non-destructive inspection.
Hydrostatic pressure test	That part of the hydrostatic pressure testing operations during which the test section is pressurised. The hydrostatic pressure test includes a strength test and a leaktightness test.
Line-fill water	Water, chemically treated if required, used as medium to fill and pressurise the test section.
Pre-test	A hydrostatic pressure test carried out on part or all of an Assembly prior to final installation.
Scope of work	The part of the construction contract which includes the scope of work relating to the pressure testing of pipelines.
Test engineer	The specialist engineer appointed and specifically named by the Contractor to be in full charge of all pressure testing operations to be performed.
Test equipment	All temporary fittings, piping, test heads, pumps, pigs, materials, equipment and consumables used for the pressure testing operations.
Test point	The primary point of pressure measurement of a test section. This is normally at the point of pressurisation.
Test pressure	The pressure at which the pipeline is tested for strength.
Test procedure	The Contractor's procedure covering preparation, testing, rectifying and post-testing activities.
Test section	A section of the pipeline or the entire pipeline which is subject to a hydrostatic pressure test.

1.4 ABBREVIATIONS

GRP	Glass Reinforced Plastic
MAOP	Maximum Allowable Operating Pressure
MIC	Microbial Induced Corrosion
RTP	Reinforced Thermo Plastic
SMYS	Specified Minimum Yield Strength
THPS	TetrakisHydroxymethylPhosphonium Sulphate
TP	Test Pressure

1.5 ACTION ITEMS

An (S) in the margin is shown when the Principal is required to make a decision or to give the particular specification value of a parameter.

NOTE: A summary check-list of these items for the scope of work is given in (11). If the Principal's decision is only required under certain circumstances, this is not shown by a margin marker.

An (A) in the margin is shown when the Contractor is required to obtain the Principal's approval for a particular action or procedure.

NOTE: Most, if not all, of these approvals are normally part of the test procedure which has to be approved by the Principal prior to the commencement of the hydrostatic testing operations. Requirements for the test procedure and the supervising personnel are given in (2.2). A summary listing of required additional approvals is given in (13). It is assumed that the Contractor's quality systems and procedural details will have been screened prior to contract award and that the referenced approvals merely need finalising and/or formalising.

1.6 CROSS - REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced in this PTS are listed in (14).

1.7 SUMMARY OF CHANGES SINCE PREVIOUS REVISION

The previous edition of this PTS was dated June 1993. Other than editorial changes, the major change from the previous edition is to Section 4, which has been updated to reflect the latest HSE requirements.

2. GENERAL REQUIREMENTS

2.1 BASIC REQUIREMENTS

- (S) The minimum test pressure at any point of the test section shall be equal to the test pressure specified in ASME B31.4 (ref. 437.4.1) or ASME B31.8 (ref. Table 841.322 (f) and A847.2), as applicable or to the pressure creating a hoop stress of 90% SMYS of the linepipe material, calculated in accordance with 8.2, whichever is higher, unless otherwise specified by the Principal.

During the hydrostatic pressure test the equivalent stress shall not exceed 100% SMYS of the linepipe material based on minimum wall thickness. The combined stress shall be calculated in accordance with ASME B31.4 (ref. 419.6.4) or ASME B31.8 (ref. A842.223).

- (S) The margin between the hoop stress of 90% SMYS and the equivalent stress of 100% SMYS allows for elevation differences in the test section and/or longitudinal stresses, e.g. due to bending. However, the elevation differences in each test section shall be limited to a value corresponding to 5% of SMYS of the linepipe material or to 50 m, whichever is the lower, or as specified in the scope of work.

NOTE 1: Especially in hilly terrain, this could lead to a large number of test sections. In such cases, it should be considered whether a possible reduction in MAOP would lead to a more cost effective solution.

NOTE 2: The hydrostatic test pressures for deepwater gas pipelines, where the design takes into account external hydrostatic pressure, shall be determined on an individual basis.

The test medium shall be water.

All measurements and calculations shall be in SI units. The unit of pressure is the bar, where 1 bar
= 10^5 N/m^2
= 10^5 Pa

2.2 SEQUENCE, PERSONNEL AND PROCEDURES

The sequence of pressure testing operations of pipelines should be as follows:

Selection of test sections, see (2.3)

- Assemblies
- Pre-test sections

Preparation of the test section, see (6)

- cleaning
- gauging
- filling

Preparation of the hydrostatic test, see (7)

- temperature stabilisation
- pressurising
- air content check

Hydrostatic test, see (8)

- strength test
- leaktightness test
- testing of "special" test sections

Post-testing activities, see (9)

- depressurising
- documentation

Rectification activities, if required, see (10)

- leak locating during test
- dewatering for rectification
- rectification of defects

The hydrostatic pressure testing operations shall be carried out by an experienced test engineer who shall have no other duties during the hydrostatic testing operations. The test engineer shall be in full charge of all activities related to the hydrostatic testing operations. There shall be a sufficient number of qualified supervising assistants provided so that at least one shall be available on site at

all times during each pressure testing operation. The test engineer should be mobilised sufficiently early to familiarise himself with the specific job in hand.

- (S) The test engineer shall prepare a procedure for all pressure testing operations, including a statement of the responsibilities of his subordinates. The test procedure shall be submitted to the Principal for approval not less than 28 days prior to commencement of testing or as specified in the scope of work. No part of the hydrostatic pressure testing operations shall commence until the approval is given in writing.
- (A)

The test procedure shall include, but not be limited to:

- a) List of nominated personnel who are to supervise the pressure testing operations with their qualifications, tasks, responsibilities and authorities.
- b) Detailed schedule giving proposed dates of the main activities, tests and mobilisation dates of the nominated personnel.
- c) Details of the selected test sections, including assemblies and pre-test sections in accordance with (2.3).
- d) Identification of potential safety and environmental hazards, including the necessary measures and emergency plans, in accordance with (3).
- e) Details of the line-fill water, including the source, treatment method, discharge/disposal and permits in accordance with (4).
- f) Details of the test equipment, including layouts and size and/or performance in accordance with (5).
- g) Details of the test section preparation, including cleaning, gauging and filling in accordance with (6).
- h) Details of the hydrostatic pressure test preparation, including temperature stabilisation period, in accordance with (7).
- i) Details of the hydrostatic pressure tests, including pre-test, strength test and leaktightness test in accordance with (8).
- j) Details of the post-testing activities, including depressurising and documentation in accordance with (9).
- k) Details of rectification activities, including proposal for locating leaks, dewatering and leak rectification in accordance with (10).

NOTE: A check-list of the details required in the test procedure is given in (12).

2.3 TEST SECTIONS

The Contractor shall select the test sections in accordance with the following requirements.

Test sections should be as long as practicable and shall be piggable, either by temporary test heads or pig launcher and receiver. If an above-ground or above-water section length exceeds 3% of the total test section length, separate hydrostatic pressure tests for the above-ground/above-water and the buried/submerged sections shall be carried out, to allow for the influence of temperature fluctuation.

Above-water or above-ground test sections shall be tested in accordance with (8.4).

The difference in elevation of each test section should not exceed the limits given in (2.1).

ONSHORE PIPELINES

Where the pipeline traverses hilly terrain, the elevation profile shall be plotted to assist in checking that the test pressures at the low and high points fall within the specified limits.

The Contractor shall determine the first test section to be tested and the subsequent test sections' sequence, taking account of the availability of water and environmental constraints relating to use and disposal of water.

OFFSHORE PIPELINES

The elevation difference between the sea-level/water surface and the test head on the platforms shall be measured to check that the test pressure at the water surface and high point falls within the specified limits. If the pipeline goes to shore the profile of the onshore section should be plotted as specified for onshore pipelines. Pipelines should be pre-tested prior to burying or trenching.

If the pipeline consists of several sections with different wall thicknesses and/or steel grades, the hoop stress level should be considered in selecting test sections. The various sections may have to be tested separately; see (2.1).

- (S) Assemblies should be tested separately at specific test pressures to demonstrate the strength and leaktightness of pipes and welded assemblies used for special installations such as rail crossings, river crossings, major road crossings, risers and block valves. The method of construction, components installed in a test section, test pressure level and risk/consequences in the event of a test section failure should be considered in specifying separate assembly testing. Under certain circumstances it may be necessary to test assemblies prior to installation, i.e. strings for directional drilling, pipes for a bored rail or major road crossing installed without casing, or risers. The assembly testing and/or pre-testing should be specified in the scope of work and verified in the test procedure.
- (S) To avoid possible damage to valve internals caused by debris, the Principal may decide to install block valves after successful completion of the hydrostatic pressure testing. This will depend on the cleanliness of the test section, presence of internal coating, test sequence and allowable test pressure difference. The timing of block valve installation shall be specified in the scope of work.

The pressure test of each test section should commence as soon as practicable after construction of the test section or assembly has been completed. Testing should be undertaken progressively throughout the construction of the pipeline.

After the various test sections have been tied-in to each other, a hydrostatic leak-tightness test should be carried out on the entire pipeline. The pressure-tested test sections or assemblies shall be tied in by "Golden Welds", see ASME B31.4 (ref.437.1.4 (5) (b)) and ASME B31.8 (ref. 841.31 and A847.6).

3. SAFETY AND ENVIRONMENT

3.1 SAFETY MEASURES

The Contractor shall take all necessary measures to ensure that all persons and property are adequately protected from the consequences of a possible system failure during the testing operations. For the period from the start of pressurisation until the reduction in pressure at the end of the test, the Contractor shall ensure that all access to, or work on or near a pipeline section under test is properly authorised taking into account the hazards associated with pressure testing operations.

The Contractor shall confirm to the Principal in writing that he has instructed all employees engaged on testing work, or any work associated with testing, or any work in the immediate area (e.g. on platform) of the possible consequences of a pipeline or test fitting failure under pressure test conditions. Contractor shall comply with any permit-to-work system applicable at any location influenced by the hydrotest activities.

- (A) Sites for test equipment shall be set up in a safe location away from public places, roads, inhabited areas/living quarters etc. The test work sites shall be closed off to unauthorised personnel. The arrangement of the test equipment and the location of the test work sites shall be approved by the Principal.

The sites shall be provided with a radio or other means of verbal communication to provide contact between all locations associated with the test work sites.

Warning notices reading 'KEEP AWAY - PIPELINE UNDER TEST' shall be placed at appropriate locations such as blanked ends of the test sections, areas where pre-tests or assembly testing are carried out and test equipment sites. Notices shall be in both English and the local/working language.

The Contractor shall prepare an emergency plan which shall describe actions to be taken in case the test section or test equipment leaks or bursts. The emergency plan should include, but not be limited to, the following:

- How to deal with washouts and other damage
- Telephone numbers of standby crews
- Telephone numbers of police, medical and other emergency services that may need to be summoned
- Telephone number of Principal's local operations base/control room which may have to be contacted
- List of equipment and machines available or needed
- List of personnel
- Location of medical and first aid facilities.

- (A) The Contractor shall obtain the Principal's approval in writing of the emergency plan before commencing pressurisation.

Any leaking flanges should be tightened only after the pressure in the test section is reduced to a safe level which shall not exceed 70 bar (ga) or MAOP, whichever is the lower. Before any other work is permitted on the test section under pressure or associated connections, the pressure shall be reduced to a level not greater than static head plus 1 bar. It may be possible to isolate the leaking part by use of a double-block-and-bleed installation.

ONSHORE PIPELINES

The boundaries of the test equipment sites shall be defined by marker tapes or a fence.

When testing takes place, patrols shall be provided to watch special points of hazard, in particular road, railway and water-crossings, block valve stations, above-ground installations and points of public access.

When deemed necessary, protective walls, constructed of sand bags or other methods approved by the Principal shall be placed in agreed locations. Particular attention shall be paid to blanked or capped ends of pipe, unrestrained above-ground pipework and any adjacent operational pipework.

Testing shall not commence until the Principal has received from the Contractor confirmation that the following precautions have been taken:

- a) that notification has been given, in writing, to persons present in the vicinity of the pipeline (e.g. farmers, other construction contractors etc.) that testing is to be carried out.
- b) that the local police and other authorities that may need to be informed have been notified in writing that testing is to take place.

Should there be an extension of the duration of testing, this shall be notified by the Contractor to the persons detailed in a) and b) above.

OFFSHORE PIPELINES

The main hazard lies in the topside facilities, onshore locations and site assembly testing.

Barriers and warning notices shall be erected forbidding entry to personnel other than the test team. The co-operation of platform or site managers shall be sought in preventing unauthorised entry to these areas. Where applicable, a permit-to-work shall be obtained. Announcements via the public address system, if installed, should be made.

If the pipeline goes to shore, the onshore locations should be supervised in accordance with the requirements of onshore pipelines.

Flanges to be tightened by divers should have more stringent controls than above-water flanges but work is permitted at a pressure level where the outflow from the leak has ceased. The diving superintendent shall be given full details required for diver safety.

3.2 ENVIRONMENTAL MEASURES

All chemicals, including corrosion control products and leak detection dyes, should be handled as if toxic. Before purchase of these, the Contractor shall obtain from the chemicals' Supplier a material safety data sheet and written recommendations for storing and disposal. The Contractor shall be responsible for ensuring that the information contained within the documents is complete. The Contractor shall ensure that any Suppliers' proposed protective measures are followed, and that the information is available, known and understood by the personnel carrying out the work.

The Contractor shall be responsible for carrying out any Chemical Hazard Assessment and Risk Assessment required by local authorities before using the proposed chemicals.

The chemicals shall be stored in the original packing and properly marked. The chemicals shall be handled and stored in accordance with the HSE requirements stated in the Supplier's data sheet.

Protective clothing, gloves and goggles shall be worn when handling chemicals. A safety shower and eye-bath shall be available at appropriate locations.

The seasonal/environmental status of the source of line-fill water and the dilution and dispersion of the line-fill water after its use shall be taken into account when specifying the locations, methods, rates and timing. The Contractor shall ensure that the disposal recommendations of the Supplier are implemented and that all current environmental regulations applicable to the pipeline system are met.

The test sites shall be left in a clean condition and free of debris. The waste, chemicals, dyes, etc. shall be disposed of by the Contractor in accordance with the Principal's waste disposal requirements.

ONSHORE PIPELINES

The Contractor shall have the written consent of the owner/local authorities of any source or property before any water is taken from or discharged into that source or property.

Water, whether contaminated with chemicals or not, shall not be returned to any watercourse or lake without full permission of the appropriate local authorities.

If line-fill water contains millscale and/or rust, this should be removed before the water is discharged.

Line-fill water containing biocides shall not be discharged into watercourses or sewer systems or onto open ground.

The Contractor shall at all times ensure that the noise level does not exceed 85 dB in areas accessible to the general public.

OFFSHORE PIPELINES

The Contractor shall have the written consent of the appropriate local authorities before any substances other than uncontaminated fresh water or sea-water are discharged into the sea. If line-fill water contains millscale and/or rust, consent shall be obtained before it is discharged.

The Contractor shall ensure that the owner of any installation and/or any other person within 1 km of the point of line-fill discharge is not affected by the discharge. The Contractor shall obtain agreement from these persons prior to the discharge.

- (A) Any water desalination equipment within 1 km of the discharge point should not be used during the discharge period or for 24 hours thereafter unless approved by the Principal's safety officer.

4. LINE-FILL WATER

Water for testing and flushing shall be clean and free from any suspended or dissolved substances which could be harmful to the pipe material or internal coating (where applied) or which could form deposits within the pipeline, or which may be unacceptable at the disposal location. Only clean fresh water taken from a river, aquifer or a potable water system or clean sea-water taken from the open sea should be used. Brackish water from estuaries or harbours should be avoided as a source of line-fill water wherever possible.

The Contractor shall be responsible for obtaining all necessary permits from the owner/local authority concerning the supply and the disposal of line-fill water.

The water used for pressure testing should be selected from a location that will minimise the temperature stabilisation period (7.2). The water shall be filtered through 50-µm filters, except for water injection lines for which the water shall be filtered through 2-µm filters before entering the test section. The arrangement of filters at the test work sites should enable back-flushing without disconnecting the pipe work.

ONSHORE PIPELINES

There is no requirement to inject dyes.

OFFSHORE PIPELINES

Where flanges are installed in a test section, a dye should be added to the line-fill water for leak detection during the hydrostatic pressure test. Fluorescein and Rhodamine B, or equivalent, dosed into the line-fill water at a concentration of 40 mg/kg (active constituent mass) are recommended.

Depending on the quality of water, the duration of contact of line-fill water with the interior of the test section, the pre-commissioning requirements and the future use of the pipeline, treatment packages containing an oxygen scavenger and biocide may be added to the line-fill water. The Contractor shall demonstrate the environmental acceptability of any proposed treatment package e.g. toxicological, Biochemical Oxygen Demand, Chemical Oxygen Demand etc. after filtering/separation and/or neutralisation. Environmentally acceptable line-fill treatment packages should be used.

The Contractor shall obtain samples from all water sources proposed as line-fill water for analysis by a testing laboratory approved by the Principal. The analysis shall show:

- sulphate concentration
- fatty acids concentrations, if the total dissolved organic carbon is above 15 mg/kg.
- ammonium concentration.

To minimise biological fouling and/or bacterial corrosion to an acceptable level in the filled pipeline, the above concentrations shall not exceed the following limits:

- | | |
|-----------------------------|----------|
| - sulphate concentration | 42 mg/kg |
| - fatty acids concentration | 14 mg/kg |
| - ammonium concentration | 3 mg/kg |

Sea-water analyses are not required. If water from aquifers is used, the analysis shall show all components and their concentrations. The Contractor shall provide all details of water treatment necessary to bring the water to the quality as specified above.

Oxygen corrosion generated by the dissolved oxygen in the line-fill water is acceptable in carbon steel pipelines used for oil and gas service.

- (S) If the above limits for biological fouling cannot be met and/or oxygen corrosion must be kept to a minimum as specified in the scope of work (e.g. for water injection lines), then the Contractor shall treat the line-fill water. The table below gives approved chemical treatment and concentrations for fresh water or sea-water to be used as line-fill water for carbon steel pipelines. All concentrations are related to the active constituents.

WATER	FRESH WATER				SEA-WATER		
BIOLOGICAL ACTIVITY	Within specified limits		Outside specified limits		Always outside specified limits		
ARE CORROSION PRODUCTS ACCEPTABLE?	YES	NO	YES	NO	YES	YES	NO
DURATION OF CONTACT	< 24 months	< 24 months			< 1 month	> 1 month and <24 months	< 24 months
BIOCIDE (to prevent MIC)	None	None			Gluteraldehyde, THPS (or similar) 500 mg/kg		
OXYGEN SCAVENGER	None						Ammonium bisulphite 100 mg/kg or sodium bisulphite 100 mg/kg
pH-TREATMENT (to prevent MIC)	None	Sodium hydroxide/ sodium bicarbonate buffer pH 9.8 to 10.2			None		

- NOTES:
1. Overdosing of bisulphite can lead to possible sulphide corrosion problems. Precautions should be taken to prevent oxidation of bisulphite in its concentrated form, as this is important for pH control.
 2. When a sodium hydroxide/sodium bicarbonate buffer is to be used it should be demonstrated to the Principal before use that no precipitation in the line-fill water will occur.
 3. Sodium hydroxide/sodium bicarbonate buffer also achieves the required microbial control.
 4. Monitoring of residual scavenger should be performed.
 5. Samples should be taken from each tank at the end of the filling in order to check that no contamination has taken place.
 6. Duration of contact with fill water should be limited to 24 months. Longer duration may be allowed if extra testing of the line-fill water is carried out.
 7. Specialist advice should be obtained e.g. from production chemist on quantity (ppmw) of sodium hydroxide/sodium bicarbonate buffer to be added as this will depend on product mixture used, water used and other conditions.
 8. The oxygen scavenger treatment should achieve a dissolved oxygen content of 10 ppb or lower.

Individual chemicals and dye shall be injected by separate injection pumps and an injection manifold unless otherwise agreed by Principal. The injection points at the manifold shall be positioned at least 1 m apart. If both oxygen scavenger and biocide are required, the oxygen scavenger shall be injected upstream of the biocide and given sufficient time to react with the oxygen in the water before the biocide is injected. Concentrated chemicals shall not be mixed. The injection should be upstream of the filling pumps so as to allow thorough mixing before entry to the test section.

Where the line-fill water is to be transferred from one test section to another, the quality of the water shall be checked and the water shall be chemically retreated as necessary before it is transferred. The water shall be refiltered through 50-µm filters to reduce the entrainment of debris from one test section to another.

Line filling should not take place if the ambient temperature is below 2 °C unless a suitable antifreeze has been added to the line-fill water. It should be noted that the bulk modulus and volumetric expansion coefficient of a water/antifreeze mixture are different from those of water alone, depending on the antifreeze concentration. If a hydrostatic pressure test is to be carried out in freezing conditions, the Contractor shall provide the required data for the pressure/temperature variation calculation as specified for the leaktightness test, see (8.3). The test equipment required and the disposal of the antifreeze/water mixture shall be part of the test procedure.

The Contractor shall detail in the test procedure the source(s) and quality of water, the procedure for the withdrawal of water from the source and the details of the water treatment proposed and dosing rates necessary to bring the water to the required quality for both filling and hydrostatic testing use. The disposal of the line-fill water after its use, including the timing, location, rates of discharge, treatment methods if required and filtration, shall also be detailed in the test procedure.

5. TEST EQUIPMENT

The Contractor shall define the number, size and/or performance of each component required for the work, including the spare parts and stand-by units, and shall supply all the test equipment necessary to fulfil the requirements of this PTS.

A schematic equipment layout of a typical test section is shown in (Figure 1). The test equipment should include, but not be limited to, that shown in (Table 5.1).

The number and types of pigs to be used, and the material, length and if applicable the configuration of the shoes, brushes, oversize and hardness shall be defined by the Contractor.

TABLE 5.1 Test equipment

(S)	Filling and pressurising pumps	complete with stroke counter or flow meter suitable for the required duty.
	Filters	2 µm or 50 µm, as specified in the scope of work, compatible with flow rate of filling pumps. Filters with 50 µm and above should be suitable for back-flushing.
	Break tanks and piping	to keep the pumps constantly on load.
	Valves	to allow exchange or replacement of instruments and equipment during the hydrostatic pressure test.
	Chemical injection pumps	for continuous injection of water treatment packages and dye, including the injection manifold and block valves. The injection pumps shall have an accuracy within 5% of the specified injection rate.
	Air-conditioned or heated test cabin unit	complete with the necessary gauges, recorders, deadweight tester, barometer, etc. for installation at the end of the test section so that the test engineer can accurately assess the progress of the hydrostatic test and record the pressure and water volume conditions throughout the tests. As an alternative to the deadweight tester and pressure recorder, the use of a pressure transducer in combination with a computerised logging system is acceptable.
	Filling/Pressurising flowmeter and temperature probe	measuring and recording continuously the flow and temperature of the line-fill water with the specified accuracy in (Table 5.2).
	Pipe wall temperature recorder	measuring and recording equipment in accordance with the specified accuracy in (Table 5.2).
	Pressure recorder	measuring and recording continuously the pressure at the test head with the specified accuracy in (Table 5.2).
	Ambient air temperature recorder	measuring and recording equipment with the specified accuracy in (Table 5.2).
	Soil temperature probes and recorder	measuring and recording equipment with the specified accuracy in (Table 5.2).
	Subsea temperature probes and recorder	measuring and recording equipment with the specified accuracy in (Table 5.2).
	Pressure relief valve	fitted to the pressurising pump, capable of handling the full capacity of the pump, and set at 3% above the specified test pressure to assure that the test section is not overpressurised.
	Pressure let-down valve	to release the pressure in a controlled manner on completion of the hydrostatic tests.
	Tank	for calibrating the high-pressure pump and flow meter.
	Temporary pig launchers and receivers	for cleaning, gauging, filling and dewatering operations. The receiver should be fitted with a throttling valve.
	Pigs	various pigs for cleaning, gauging, filling and dewatering operations.
	Pig tracking equipment	for locating the pigs in the test section, usually only used when the test section length is greater than 5 km.
	Test head	to separate the test section for pressure testing.

Air compressors	if compressed air is to be used to drive pumps or pigs. The air to drive pigs shall be oil-free and air coolers shall be included if the discharge temperature is outside the limits specified for the test section.
Communication equipment	for communication between the various locations of the test section.
Spare parts and stand-by facilities	to replace any defective test equipment during the hydrostatic pressure test.

Any test equipment pressurised during the test operations shall be designed for a working pressure not less than the test pressure. These components shall have material certificates and the equipment itself shall have data sheets from the Manufacturer. The test equipment connected to the test section shall have hydrostatic test certificates and shall have been tested to a pressure at least 1.25 times the test pressure of the test section. The test equipment shall be internally clean and fit for purpose.

The test heads and temporary pig traps shall be designed, fabricated, installed and tested according to the same code as the pipeline. However, the allowable "code breaks" between ASME B31.4/ASME B31.8 and other codes may be used, specifically where prefabricated items are used. The test procedure shall take account of any proposed code breaks. Test heads and temporary pig traps shall be numbered and a certificate shall be kept by the Contractor for each one. This certificate shall show the results of non-destructive tests on each fabrication weld, the pressure at which it was initially tested, the number of times it has been used and the test pressure attained on each test. Entries in the record shall be signed by the test engineer. Test heads that do not have a complete certificate and record of use from the new condition shall not be used.

Wall thickness transitions between test heads and the pipeline resulting from unequal wall thickness or unequal yield strength, or both, shall meet acceptable welding configuration requirements in accordance with ASME B31.4 and ASME B31.8. The maximum wall thickness for design pressure of a test head shall not be greater than 1.5 times the nominal wall thickness of the matching pipe.

Prior to each re-use, the welded test head shall be cut back to remove all weld metal and the heat-affected zone. To achieve this at least 12 mm of pipe should be removed. The full circumference of the new weld end shall be tested ultrasonically for laminations over a width of 25 mm from the bevelled end in accordance with PTS 31.40.20.35 or PTS 31.40.20.37 as appropriate. All temporary connections fitted to enable the hydrostatic test to be performed shall be adequate to handle the test pressures involved and should be of rigid construction.

- (A) Flexible hose shall be of the armoured type and shall only be used if it is manufactured to standards applicable for permanent hydraulic installations. Such hose shall only be used in short lengths as required for the pressurising line to the test head and for instrumentation. Hoses shall be anchored at maximum of 5 metre intervals to prevent "whip" in the event of failure and shall be protected against external damage. The method of anchoring shall be approved by the Principal. Hoses shall not pass through doorways. Where hoses pass over walkways they should be protected from any passing personnel or equipment. Only one system of hose connectors from one Supplier shall be used to ensure that the various types are not mixed up. Prior to each re-use, all hoses and connectors shall be visually inspected for damage. Flexible pressurising or monitoring hoses should not be allowed inside the test cabin.

The test equipment shall be adequately protected against lightning and accumulation of static electricity e.g. by earthing.

- (S) Electrical installations shall comply with PTS 33.64.10.10 The rules governing the use of electrical equipment in hazardous areas shall be complied with. The applicable zone classifications shall be as advised by Principal .

If diesel engines are to be used in hazardous areas, they shall be suitably protected. No such engines should be used in, or within 15 metres of, a zone 1 area. Their use in zone 2 areas should be avoided wherever possible. If the use of diesel engines within 15 metres of a zone 1 or 2 area or within a zone 2 area is unavoidable the following is required:

- Surface temperature limitation to 250 °C or to the specified temperature class.
- Exhaust flame trap and spark arrestor.
- Non-electric starting system.

- An inlet air shut-down control system to operate in response to high temperature, overspeed and gas detection.
- Cooling fan blades should be non-metallic and all fan belts antistatic fire-resistant type.
- Any ancillary electrical equipment shall comply with PTS 33.64.10.10

Test instruments shall be in accordance with the requirements of (Table 5.2) below:

TABLE 5.2 Accuracy of test instruments

Instrument	Reading division	Range	Accuracy
Deadweight tester (NOTE 1)	0.05 bar	0 to 1.5 x TP	$\pm 0.05\%$ (NOTE 2)
Pressure data logger	0.05 bar	0 to 1.5 x TP	$\pm 0.05\%$ (NOTE 2)
Pressure gauge	1, 2 or 5 bar	0 to 1.5 x TP	$\pm 0.6\%$ (NOTE 3)
Pressure recorder (24 hours)	2 or 5 bar	0 to 1.5 x TP	$\pm 1\%$ (NOTE 3)
Barometer	1 mbar	-	± 0.8 mbar
Ambient air temperature recorder (24 hours)	0.5 °C	0 to 80 °C	$\pm 1\%$ (NOTE 3)
Temperature probes and recorder (digital)	0.1 °C	0 to 50 °C	± 0.1 °C (NOTE 4)
Filling-flowmeter (turbine)	m ³ /h	-	$\pm 1\%$ (NOTE 3)
Pressurising flowmeter	strokes/litres	-	1% volume per stroke

- NOTES:
1. For vessel-mounted operations, especially at high pressure, a data-logger should be used.
 2. Percentage of measured value.
 3. Percentage of the full range.
 4. When a short pipeline with small diameter is tested, an accuracy of $\pm 0.01^\circ\text{C}$ should be considered.

- Pressure gauges shall be checked for accuracy on site, in the presence of the Principal, before the commencement of the hydrostatic pressure test of any test section. This shall be carried out by comparison with the deadweight tester.
- The accuracy of the pressurising flow meter shall be checked by the Contractor, in the presence of the Principal, using a calibrated tank.
- Other instruments shall have calibration certificates from a recognised certifying authority or a Principal-approved third party. Where instruments are connected with electrical cables to the test section or are in contact with the test medium, the instrument's calibration shall include the cabling. The certificates shall not be older than 6 months at the start of testing. The original certificates shall be shown to the Principal and copies included in the hydrostatic pressure test report (9.2). If, during the testing period, the certificates become older than 12 months, or if the Contractor or Principal has doubts about the calibration of any instrument to be used for the test, the Contractor shall have the instruments in question recalibrated in the presence of the Principal, or a Principal-approved third party.

6. CLEANING, GAUGING AND LINE FILLING

6.1 GENERAL

Prior to pressure testing, the Contractor shall clean and gauge sections of the pipeline between suitable tie-in points, such as block valve stations or crossings (river, railway, road), to ensure the removal of construction debris and loose scale and to check that the section is free of deformations and/or obstructions.

The Contractor shall calculate the required pressure and volume to drive the pigs as specified. The elevation difference and back-pressure of the outlet at the receiving end shall be taken into account.

Block valves should not be installed before the cleaning operations have been completed, see (2.3).

- (A) Temporary pig launchers and receivers shall be approved by the Principal prior to use and shall be welded to the test section or flanged if a permanent flange is available. If compressed air is to be used as the driving medium, the air should be oil-free and the inlet line of the driving medium should be fitted with a pressure relief valve set at 7 bar (ga).

NOTE: In sections with a diameter less than 10" a higher pigging pressure may be required. Therefore, water should be used as the driving medium for smaller pipelines.

When the driving medium is water, its source and the filtration method shall be as specified for line-fill water, see (4).

In pipelines longer than 5 km, single pigs or the last pig of a pig train should be fitted with a pig location device.

ONSHORE PIPELINES

In onshore pipelines, an electromagnetic pig location device should be used.

OFFSHORE PIPELINES

In offshore pipelines, a pinger-type pig location device should be used.

If water is to be used to drive pigs, a batch of water corresponding to a minimum of 4% of the section volume or 150 linear metres of the line section, whichever is the greater, shall be introduced ahead of the first cleaning pig to wash foreign materials away. Pigs used in a pig train shall be separated by the same volume of water as specified ahead of the first pig.

During the running of all pigs, the Contractor shall record the pressure at the inlet and outlet of the test section.

The Contractor shall inform the Principal before any pigging operation is carried out. All pigging operations shall be documented in a pig register.

The pig register should include the following:

- pig run number
- pig type
- launching and receiving time
- downstream pressure
- arrival condition of the pig
- amount and kind of material received with the pig.

- (A) If a pig becomes stuck in the pipeline and the driving medium is air, the Contractor shall not employ a differential pressure greater than 7 bar to dislodge the pig. If the driving medium is water and a differential pressure up to 50% of MAOP is insufficient to dislodge the pig, the pig shall be located and removed from the pipeline by cutting the pipe or by other methods to be approved by the Principal.

6.2 CLEANING

ONSHORE PIPELINES

The length of the cleaning sections to be cleaned and gauged should be between 10 and 20 km depending on suitable tie-in points.

OFFSHORE PIPELINES

Prior to using water for the cleaning operations, the Contractor shall ensure that all pipeline spans of the cleaning section have been inspected either by divers or by a remote controlled vehicle or side scan sonar survey to ensure the pipeline's unsupported spans do not exceed the allowable span value for the hydrostatic pressure test conditions, see (8.2).

When lay-down heads are to be used, a combined cleaning/gauging and filling operation may be required. As a minimum, 3 pigs should be used. The last pig should be the gauging pig as specified in (6.3).

The first pig driven through the cleaning section should be of a bi-directional type. The position of the pig should be monitored by means of a pig tracking device with a minimum battery life span of 72 hours. A series of wire brush cleaning pigs in combination with a bi-directional pig should follow until the required cleanliness of the cleaning section has been established. The by-pass of the cleaning pigs should be kept open in order to transport the loose debris out of the cleaning section. To remove ferrous debris, including broken bristles from brush pigs from the cleaning section, a magnetic cleaning pig should be used after the brush cleaning has been completed.

In order to assist the speed control of the cleaning pig and the jet stream of the pig bypass, a constant back-pressure should be maintained by suitable adjustment of a throttling valve [e.g. set at 3 bar (ga) depending on the driving medium] installed at the receiving test head. The speed of the cleaning pigs should not be less than 0.5 m/s and not more than 2.5 m/s.

If the pipeline has been internally coated, cleaning pigs without wire brushes shall be used.

The amount of material received at the end of each pig run should be assessed on a volume and mass basis. The material received should show a reducing trend, in both volume and particle size. Pigging should continue until the volume of the received material is less than 5 litres and further pigging will not result in a significant reduction in the material received.

The absence of rust in the discharge is a further indicator of the test section cleanliness. If all rust is removed, all other loosely adhered material on the metal is considered removed. The time to inspect the outflow for rust colouring is just before and just after pig arrival.

All debris received with the pig shall be disposed off in accordance with the Principal's waste management requirements.

6.3 GAUGING

After cleaning and back-filling the trench, the complete test section shall be gauged by means of either a gauge plate pig or an instrumented caliper pig.

A bi-directional pig with 2 sets of separate guiding and sealing discs shall be fitted with one or two aluminium gauging plates to be located as follows:

If two gauging plates are fitted, one shall be fitted in front of the first set of discs and the second shall be in front of the last set of discs. If only one gauging plate is fitted it shall be at the rear location. The gauging plates should be made as follows:

- 3 mm thick for pipeline diameters up to DN 100
- 6 mm thick for pipeline diameters from DN 100 to DN 300
- 12 mm thick for pipeline diameters above DN 300.

The gauging plates should have 8 radial incisions at 45 degree intervals.

The radial incisions should extend from the outside diameter of the gauging plate to the outside circumference of the locating plate of the pig.

The gauging plate diameter shall be determined from the formula:

$$d = ID - 0.01D - 2b \quad \text{or} \quad d = 0.95 \times ID, \text{ whichever is smaller,}$$

where:	d	=	gauging plate diameter	mm
	D	=	nominal outside diameter	mm
	ID	=	minimum internal diameter	mm
			taking due account of any	
			thick wall pipe section and	
			internal diameter of fittings	
			and valves	
	b	=	clearance of 5	mm

The gauging pig speed and back-pressure control should be as specified in (6.2) for cleaning pigs.

- (A) Gauging plate measurement, introduction of the gauging pig into the test section, and removal from the test section shall be carried out in the presence of the Principal. A photographic record shall be taken of the condition of each gauging plate after use.

If the test section to be filled with line-fill water is a combination of two or more cleaning and/or gauging sections, the second filling pig shall be a gauging pig which shall be inspected by the Principal upon removal of the test head.

The gauging plates shall be examined for any signs of damage or irregularities such as dents and buckles. In case of damage, the gauging pig shall be re-run with new gauging plates of the same diameter. If the defect cannot be located by the gauging operation, the Contractor shall run a geometric inspection pig to locate the defect.

Any damage noted by the second gauging pig or by the geometric inspection pig shall be located and repaired by the Contractor in accordance with (10.3). The Contractor shall not proceed with the testing procedure before a re-run gauging plate has been accepted by the Principal.

6.4 LINE FILLING

The test section shall be filled with line-fill water meeting the requirements specified in (4).

If block valves are installed, the test engineer shall ensure prior to filling that all block valves are correctly positioned in the fully open position. Provision shall be made to equalise the pressure between the valve body cavity and the line.

Before filling the test section the test engineer shall ensure that piping and facilities for the disposal of treated water are installed and functional.

All necessary measures shall be taken by the Contractor to remove air from the line during filling. This includes back-pressure control, a steady controlled filling rate, use of a break tank, and use of at least two bi-directional pigs with water in front and in-between. Where practicable, the test sections shall be filled from the lower end. The Contractor shall ensure that the pump suction will not draw in air with the water and that the pigs are in good working order and correctly fitted in the test section. Venting shall be carried out repeatedly at points in the test section where air might accumulate, e.g. at ancillary piping.

The filling shall be performed at a controlled rate. The filling pig speed should be approximately 0.6 m/s and should not exceed 1.8 m/s. The pressure in front of the pig shall be carefully monitored and controlled at not less than 2 bar (ga). Depending on the elevation profile of the test section and the pigging pressure, it may be necessary to increase the pressure at the receiver test head in order to control the pig speed.

In order to assist in controlling the line filling and water treating, the following measurements and records shall be recorded:

- inlet flowrate of line-fill water
- inlet pressure of line-fill water
- inlet temperature of line-fill water
- pressure at the receiver head
- chemical injection rates (if carried out)
- dye injection rate (if carried out).

In the event of chemical injection pump failure the filling pump shall be stopped.

No filling shall take place if the air temperature is 2 °C and falling or in freezing conditions unless antifreeze precautions are taken in accordance with (4).

7. PRE-TEST REQUIREMENTS

7.1 REQUIREMENTS PRIOR TO PRESSURISING

A pre-test check shall be performed, detailing the status and location of each item to be inspected before pressurising is commenced.

The checklist should include checks to confirm that:

- The test section has been isolated from all other pipeline sections.
- All temporary piping, test heads, and other equipment connected to the test section have been tested to a pressure of at least 1.25 times the test pressure.
- The test section has been filled completely and air has been vented off.
- The block valves, if they are installed, have been returned to the half-open position so that there is no differential pressure across the seats/seals.
- All instruments and gauges to be used during pressurising and testing have been calibrated and valid test certificates have been approved by the Principal.
- All warning notices, marker tapes, protective barriers and other safety equipment have been positioned and the appropriate authorities have been informed.
- All relevant personnel at the affected stations have been informed of the commencement and duration of the hydrostatic pressure test.
- The communication channels have been tested and established and back-up equipment is available.
- The personnel engaged in the testing work have been briefed on the emergency plans.
- The person operating the pressurising equipment has been instructed by the test engineer regarding the limiting pressure which shall apply to the test section.

ONSHORE PIPELINES

The test section should be completely buried, up to the test heads, to the specified depth before testing commences. The trench should also be reinstated to the maximum extent possible prior to commencement of the test. Test heads and above-ground sections should be sheltered and thermally insulated in order to minimise the effects of ambient temperature variations.

Pipe and soil temperature should be measured and recorded at each end of the test section and at approximately every 5 km throughout the length of the pipeline, depending on the ground water contact with the test section. A minimum of 3 temperature measurements should be carried out, one at each end plus one in the middle. The points of measurement at each end of the test section should be such that there is at least 100 m of pipeline buried to the specified depth between that point and the test section end.

OFFSHORE PIPELINES

Buried test sections should have the specified depth of cover before testing commences. The sea-water temperature should be measured next to the pipeline on the seabed and, if the volume of the riser exceeds 10% of the test section volume, additionally half-way down the riser. The test section temperature should be measured at each end of the test section by means of thermocouple type instruments. For the pipe temperature measurements, they should be firmly installed into the line-fill water at points where temporary fittings have been used. The location of temperature measurement on the seabed and the number of locations should be specified on site after the pipeline has been laid.