

PETRONAS TECHNICAL STANDARDS

HEALTH, SAFETY AND ENVIRONMENT

STANDARD

EXCAVATION

PTS 60.2116

NOVEMBER 2010



© 2010 PETROLIAM NASIONAL BERHAD (PETRONAS)

All rights reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise) without the permission of the copyright owner.

PTS Circular 2010



PTS No:	60.2116
PTS Title:	Excavation

This new PTS 60.2116 - Excavation (November 2010, Revision 0) has been developed to provide the minimum requirement for all excavation activities conducted at PETRONAS and JV's (with operational controls) facilities and installations. This is to ensure that all excavation work carried out within the OPU/JVs does not cause harm to persons carrying out the excavation work or working within the excavation and does not cause damage to buried services, pipelines, properties or the environment.

This PTS also includes PETRONAS Lessons Learnt and PETRONAS Best Practice for the subject matter **Excavation**.

The custodian of this PTS is: Manager - HSE MS, Standards & Regulations, GHSED

Please direct any questions regarding this PTS to the above-mentioned.

Document Approval

	Name	Designation	Date	Signature
Prepared	Morris Kho Kee Wee	Custodian, Safety Management Operations, Group HSE Division	15/02/11	
Technical Approved	Morris Kho Kee Wee	Custodian, Safety Management Operations, Group HSE Division	10/02/11	
Verified	Maureen Song Chai Kee	General Manager, Group HSE Strategy and Performance, Group HSE Division	11/2/11	
Approved	Mohd Tarmizi Bin Munir	Head, Group HSE Division	11/2/11	

Revision History

Date	Version	Description of Updates	Author
Nov '10	Original		GHSED

PREFACE

PETRONAS Technical Standards (PTS) publications reflect the views, at the time of publication, of PETRONAS OPU/Divisions.

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' OPU 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, it is expected of 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 owner.

The right to use PTS rests with three categories of users:

- 1) PETRONAS and its affiliates.
- 2) Other parties who are authorised to use PTS subject to appropriate contractual arrangements.
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) and 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, PETRONAS disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any PTS, combination of PTS or any part thereof. The benefit of this disclaimer shall inure in all respects to PETRONAS and/or any company affiliated to PETRONAS that may issue PTS or require the use of PTS.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, PTS shall not, without the prior written consent of PETRONAS, be disclosed by users to any company or person whomsoever and the PTS shall be used exclusively for the purpose they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of PETRONAS.

The copyright of PTS vests in PETRONAS. Users shall arrange for PTS to be held in safe custody and PETRONAS may at any time require information satisfactory to PETRONAS in order to ascertain how users implement this requirement.

TABLE OF CONTENTS

1.0 INTRODUCTION	7
2.0 PURPOSE	7
3.0 SCOPE	7
4.0 DEFINITION	7
5.0 RESPONSIBILITIES	9
6.0 EXCAVATION REQUIREMENTS	11
6.1 SHALLOW EXCAVATIONS	11
6.2 UNSUPPORTED EXCAVATIONS	11
6.3 DEEP EXCAVATIONS	12
6.4 DEEP FOUNDATIONS	12
6.5 MECHANICAL DIGGING	12
6.6 HEADINGS & TUNNELS	12
6.7 PREPARATION & PERMIT REQUIREMENTS	13
6.8 SUPPORT SYSTEM DESIGN & REQUIREMENTS	13
6.9 WRITTEN EXCAVATION PLAN	14
6.9.1 General Considerations	14
6.9.2 Preparation	15
6.9.3 Work Planning	15
6.10 UNDERGROUND SERVICES AVOIDANCE TOOLS	15
6.10.1 Prior to Start Work	15
6.10.2 Other Scanning Machine	16
6.11 PILOT TRENCHING	16
6.11.1 Requirements for Pilot Trenches	16
6.11.2 Pilot Trenching - Method B	17
6.12 DISPOSAL OF SOIL & BACKFILLING	18
6.12.1 Disposal of Soil	18
6.12.2 Backfilling	18
6.13 GAS TESTING	19

6.14	VENTILATION.....	19
6.15	LIGHTING.....	19
6.16	WATER REMOVAL.....	20
6.16.1	Rain Water & Surface Water	20
6.16.2	Ground Water	20
6.17	ACCESS & BARRIERS	21
6.17.1	Access	21
6.17.2	Gangways & Bridges.....	21
6.17.3	Barriers	22
6.18	CHECKLIST	22
7.0	EXCAVATION PROCEDURE.....	23
7.1	PREPARATION.....	23
7.2	DURING EXCAVATION	24
7.3	COMPLETION OF EXCAVATION	24
8.0	PRECAUTIONS	24
8.1	GENERAL PRECAUTIONS.....	24
	FAILURE MODES.....	26
8.1.1	Soft Clay	26
8.1.2	Stiff Clay	26
8.1.3	Rock	26
8.2	SUPPORT SYSTEMS	26
8.2.1	Supports Design & Specified On-site.....	26
8.2.2	Supports Design by Specialist Engineers	27
8.3	ACCESS.....	27
8.4	BARRIERS	27
8.5	MEANS OF ESCAPE	27
8.6	DISCOVERY OF SUSPICIOUS OBJECTS	27
9.0	COMPETENCY & TRAINING	28
9.1	TRAINING CONTENTS.....	28
9.2	EXPERIENCE.....	28

10.0 AUDIT & REVIEW	28
11.0 REFERENCES	29
APPENDIX 1 – GROUND CONDITION AND SLOPES	30
APPENDIX 2 - CHECKLIST FOR EXCAVATION PLAN	32
APPENDIX 3 - CHECKLIST PRIOR TO START OF WORK	33
APPENDIX 4 - CHECKLIST WHILST WORK IS IN PROGRESS	34
APPENDIX 5 – SUPPORT AND SHORING OF EXCAVATION	36

1.0 INTRODUCTION

This standard provides the minimum requirement for all excavation activities conducted at PETRONAS and JV's (with operational controls) facilities and installations. It shall be used in conjunction with local guidelines, regulations and statutory requirements

2.0 PURPOSE

The purpose of this procedure is to ensure that all excavation work carried out within the OPU/JVs does not cause harm to persons carrying out the excavation work or working within the excavation and does not cause damage to buried services, pipelines, properties or the environment

3.0 SCOPE

This procedure covers the minimum requirements necessary for safely carrying out excavation work for:

- Brownfield projects within the OPU/JVs.
- Greenfield projects adjacent to existing Brownfield area in OPU/JVs.
- Greenfield projects which are less than 250 meters away from existing Brownfield or occupied areas (residential or industrial).

More stringent requirements may be implemented or may have to be adopted due to local, state or national legislation or experience gained in specific areas of excavation.

Except for established gardens, all excavations or penetration of the ground over 150 mm in depth require a Permit to Work and Excavation Certificate. For excavation below 1.5 meters from ground level, it is categorized as confined space. Thus requirements under PTS 60.2105 Entry to Confined Space shall apply. If excavation is carried out in classified hazardous location requirements under PTS 60.2123 ignition source control shall apply.

This procedure shall also apply to all piling work and borehole drilling to be carried out in all OPU/JV

4.0 DEFINITION

Contractor: The party that carries out all or part of the design, engineering, procurement, installation, and commissioning or management of a project or operation of a facility. Owner may sometimes undertake all or part of the duties of the Contractor.

Owner: The party that initiates the project and ultimately pays for its design and construction. The owner will generally specify the technical requirements. The owner may also include an agent or consultant, authorized to act for the owner.

Batter: The inclination of a slope expressed as vertical units/ horizontal units

Benching: Excavation of a sloping ground in horizontal steps

Excavation: The removal, boring or penetration of soil, sand, clay, or the breaking of concrete, asphalt, or rock to a depth of greater than 150 mm, by manual, mechanical or other means.

Excavation Plan: A document in the format prescribed by this guideline signed by a competent person specifying controls and precautions for the excavation. The plan is also signed by the Approving Authority of the work indicating agreement with the controls. It does not replace a Permit to Work.

Fill: Material removed from the ground whether soil, sand, rock, vegetation, stones, or such like material.

Maximum Allowable Slope: The Angle to the horizontal at which the material in the cut face is stable and does not fall away. The Greatest Angle Above The Horizontal Plane At Which A Material Will Lie Without Sliding. For faces above the water table, the slope is not to exceed 1 Vertical: 1 Horizontal, and for saturated soils the slope is not to exceed 1V:1.5H

Pegging Out: A means of marking out the area to be excavated with the use of wooden or metal pegs hammered into the ground or by the use of paint or other visual means.

Borehole: A narrow shaft drilled in the ground, either vertically or horizontally.

Shoring System: A structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides or roof of an excavation and which is designed to prevent cave-ins.

Sheeting: The sections of a shoring system that retain the earth in position and in turn are supported by other members of the shoring structure.

Wales: The shoring structure that supports the sheeting.

Shallow Excavation: An excavation which lowers the existing ground level to a depth of less than 1.5 meters.

Unsupported Excavation: An excavation where the sides of the work are battered (i.e. sloped or raked) away from the bottom of the excavation to ground level, without support.

Deep Excavation: Any excavation which lowers the existing ground level to a depth of 1.5 metres or more.

Supported Excavation: An excavation where the sides of the work are supported by timber, steel, concrete or other materials.

Hand Digging: Excavation using spades and other hand tools, but does not include use of spikes, pickaxes and the like, unless specifically permitted in writing.

Mechanical Digging: The use of excavators, breakers, or any similar power assisted tools.

Total Working Area: The area which is used to get the work done, i.e. the location of the trenching, the planned area where spoil is stockpiled and the area where heavy equipment travels.

Dewatering: The removal of water from the water table by means of a mechanical pumping unit in order to minimize water in the excavation / soil.

5.0 RESPONSIBILITIES

1. Senior Management
The Senior Management shall:
 - establish a site procedure on excavation in line with the requirements of this PTS and local regulatory requirements
 - ensure adequate resources including manpower and equipment for excavation activities are made available
 - ensure availability of Emergency Response Plan in the event of an emergency
 - ensure availability of site inspection / audit plan to check compliance to procedure and standards
 - conduct review based on the incident reports, inspection, audit findings and new regulatory requirements
2. HSE Department
The HSE Department shall:
 - coordinate training and promote awareness on excavation procedure to all staff and contractors
 - coordinate excavation audit on a regular basis and ensure close-out of audit findings
 - coordinate incident investigation and disseminate the lessons learned
 - Engineering Department / Project Management Team (PMT)
 - The Engineering Department / Project Management Team (PMT) shall:
 - Enforce the requirement of excavation procedures throughout the duration of the contracts
 - Audit the excavation activities as per audit plan and ensure close-out of audit findings
 - Enhance the excavation procedures based on audit & investigation findings
3. Contractor Management
Contractor management shall:
 - Ensure adequate resources including manpower and equipment for excavation activities are made available.
 - Ensure their workers comply with the excavation procedure.
 - Communicate the requirements on excavation procedure to their workers including emergency response.
 - Ensure availability of Emergency Response Plan for emergency during excavation.
4. Specialist Engineer
Specialist engineer shall:
 - Ensure an excavation which needs side support i.e. timber, steel, concrete or other materials are properly designed and constructed.
5. Excavation Supervisor
Excavation supervisor shall ensure that:
 - No excavation is allowed to be carried out in an area without the prior knowledge and approval of the Asset Owner
 - A written plan is prepared and submitted for asset owner approval for all excavations which exceed 1.5 meters in depth.
 - All worksite supervisors are properly trained in the relevant permit to work and safety requirements for each proposed excavation. All possible steps have been taken to identify all underground services in the vicinity of the intended excavation and precautions taken to prevent damage to them
 - a system of review and control is established to ensure that the safety requirements of excavation activities are reviewed on a regular basis
6. Worksite Supervisor
Worksite supervisor shall:
 - A permit to work, supported by an excavation certificate, has been obtained before

work commences and that permit conditions are observed.

- All personnel wear the correct personal protective equipment at all times whilst undertaking the work.
- All persons are properly supervised at all times whilst the work is taking place.
- The excavation is adequately protected against possible collapse.
- The excavation is properly protected, having proper regard to location, depth and public accessibility.
- The safety aspects of the excavation work are properly addressed, and that any written excavation plan is properly followed.

7. Worker

Worker shall:

- Ensure that all excavation work is carried out safely based on the written work instructions and PTW requirements.
- Ensure that all safety precautions are adhered at all times at work site.
- Comply with rules and regulations related to safe excavation.

6.0 EXCAVATION REQUIREMENTS

6.1 SHALLOW EXCAVATIONS

Unless unusual conditions are encountered, e.g. loose sand or the like, a shallow trench may usually be excavated without being battered or supported (see Figure 1)

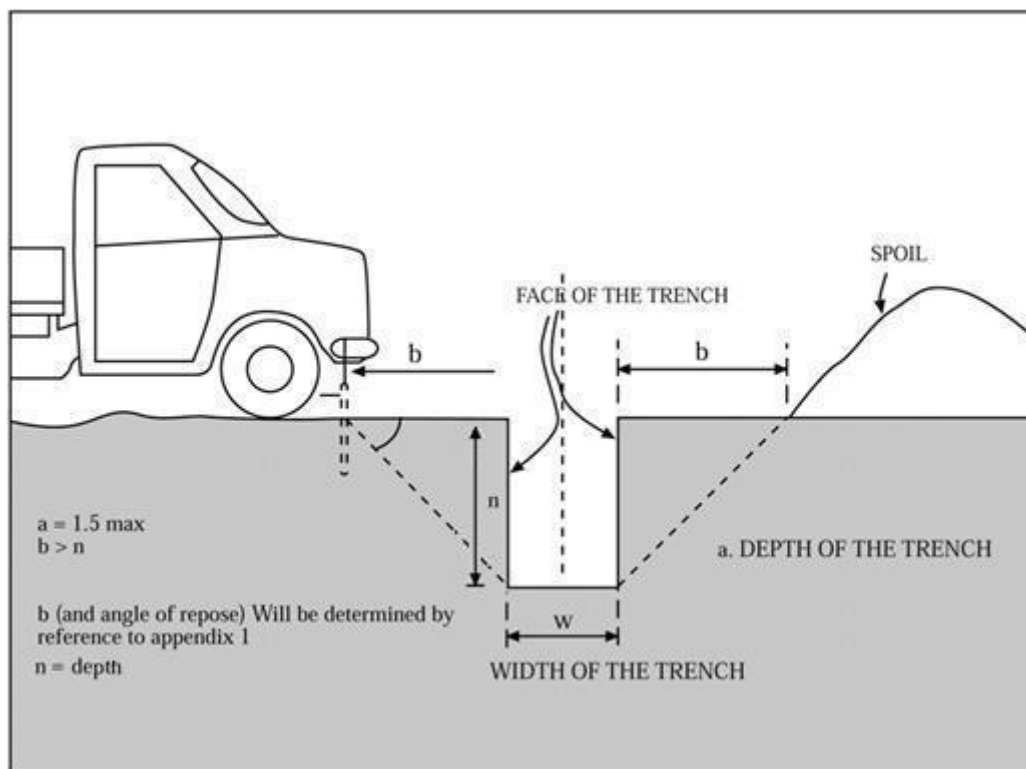


Figure 1 - Shallow Excavations: Trench Depth of 1.5m Maximum

The maximum angle of batter permitted, in optimum conditions for any unsupported excavation, shall be 45 degrees from the horizontal

6.2 UNSUPPORTED EXCAVATIONS

Unsupported excavations shall only be allowed if:

- The excavation depth does not exceed 1.5 meters,
- The characteristics of the ground are known and
- The behavior of the soil can be accurately predicted.

Appendix 1 gives a set of guidelines for the estimation of ground conditions and relevant slope angles.

Dewatering is necessary if the water table is less than 0.5m from the bottom of the intended maximum dept of the excavation (i.e more than 1.7m depth). A dewatering plan is to be submitted to the relevant Site Supervisor for approval in these cases.