

PETRONAS TECHNICAL STANDARDS

SEPARATOR MODELLING TECHNIQUES

PTS 20.22.10.39

OCTOBER 2011



© 2011 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 2011-1



PTS No:	20.22.10.39
PTS Title:	Separator Modeling Techniques

This revision of PTS **20.22.10.39 - Separator Modeling Techniques (October 2011, Revision 1)** has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates in the document are highlighted in *italic* font.

The previous version of this PTS **20.22.10.39 (February 2009)** will be removed from PTS binder / e-repository from herein onwards.

The custodian of this PTS is:
Name: Hasnor Hassaruddin Hashim
Tel. No: 03-27836476

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

Document Approval

	Name	Designation	Date	Signature
Prepared	Zalina Harun	Process Optimization Engineer	17 Oct 2011	
Reviewed	Hasnor Hassaruddin Hashim/ Fadzrul Izwan Ali	Principal Engineer/ Staff Engineer	19 Oct 2011	
Approved	Shahrul Azman Zainal Abidin	Custodian Engineer	21 Oct 2011	
Verified	Shahrul Izan Bakti B A Aziz	Senior Manager, Process Engineering, GTS	31/10/2011	
Verified	Saifol Mualim B Ahmad Yahaya	General Manager, Engineering, GTS	31/10/11	
Endorsed	Pau Kiew Huai	Senior General Manager, GTS	1.11.11	

Revision History

Rev. No	Reviewed by	Approved by	Date
0	Shahrul Azman Zainal Abidin/ Hasnor Hassaruddin Hashim	Shahrul Azman Zainal Abidin	Feb 2009
1	Hasnor Hassaruddin Hashim/ Fadzrul Izwan Ali	Shahrul Azman Zainal Abidin	Oct 2011

PREFACE

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

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. INTRODUCTION	5
1.1 SCOPE	6
1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	6
1.3 DEFINITIONS	6
1.4 CROSS REFERENCES	7
1.5 SYMBOLS AND ABBREVIATIONS	7
1.6 CHANGES FROM PREVIOUS EDITION	7
2. EXCEPTIONS/AMMENDMENTS	7
3. SEPARATOR IN MODELLING	8
4. TYPES OF SEPARATOR	8
4.1 TWO PHASE SEPARATOR	8
4.2 THREE PHASE SEPARATOR	9
5. MODELLING SEPARATORS	12
5.1 FLASHING METHODS	12
5.2 ENTRAINMENT IN SEPARATORS IN ICON (STEADY STATE MODELING)	16
6. SEPARATOR IN DYNAMICS	18
6.1 TRANSITIONING SEPARATOR IN STEADY STATE TO DYNAMICS	18
7. PETRONAS BEST PRACTICES	26
8. REFERENCES	26

LIST OF FIGURES

Figure 4.1.1: Schematic Diagram of 2 Phase Horizontal Separator	8
Figure 4.1.2: Schematic Diagram of 2 Phase Vertical Separator/Scrubber	8
Figure 4.2.1: Schematic Diagram of 3 Phase Horizontal Separator	9
Figure 4.2.2: Schematic Diagram of 3 Phase Vertical Separator.....	9
Figure 4.2.3: Schematic Diagram of MultiFeed Separator..	7
Figure 4.2.4: 2-Phase MultiFeed Separator Face Plate.....	7
Figure 4.2.5: 3-Phase MultiFeed Separator Face Plate.....	8
Figure 5.1.2.1: Schematic Diagram for Bubble Point Calculation	14
Figure 5.1.2.2: Schematic Diagram for Dew Point Calculation.....	15
Figure 5.2.1: Entrainment Functionality Tab: No Entrainment.....	16
Figure 5.2.2: Entrainment Functionality Tab: Feed Based	16
Figure 5.2.3: Entrainment Functionality Tab: Feed Based	17
Figure 6.1.1: Transitioning Separator in Steady State to Dynamics	18
Figure 6.1.2: Specifying Separator Sizing in Dynamics.....	19
Figure 6.1.3: Separator in Steady State: Fixed Volume	20
Figure 6.1.4: Separator in Steady State: Level at 50%	21
Figure 6.1.5: Configuring a Separator in Dynamics	22
Figure 6.1.6: Identifying DOF for a Separator	22
Figure 6.1.7: Adding a Liquid Product Valve and Level Controller.....	24
Figure 6.1.8: Adding a Pressure Controller	24
Figure 6.1.9: Adding a Feed Flow Controller	25

1. INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for the preparation of Steady-state simulation model for separators. The party responsible for the process design and process optimization work prepares these simulation models.

The requirements and recommendations in this PTS are independent of the tools with which the simulation models are produced. However, it is advised that iCON (PETRONAS Process Simulation Software) is used to generate the steady-state model to aid models accessibility. If other process simulation software is used, it shall be endorsed by GTS Process Optimization Group and a copy of the software shall be made available to PETRONAS.

For separator selection and design rules, please refer to PTS 31.22.05.11 for Gas/Liquid Separator and PTS 31.22.05.12 for Liquid/Liquid and Gas/Liquid/Liquid Separator.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorized by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS or managed by a Group company, and to Contractors nominated by them.

This PTS is intended for use in oil refineries, gas plants, chemical plants, exploration and production facilities and where applicable, supply/marketing installations. When PTSs 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 to 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. The Principal may then negotiate with the authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

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

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

The **Principal** is the party that 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 authorized to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4 CROSS REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced by this PTS are listed in Section 7.

1.5 SYMBOLS AND ABBREVIATIONS

C	Degree Celsius
T	Temperature
P	Pressure
kPa	kilo pascal
kg/hr	kilogram per hour
kgmole/hr	kilogram mole per hour
SCMD	Standard cubic meter per day

1.6 CHANGES FROM PREVIOUS EDITION

The previous edition of this PTS was February 2009. Other than editorial editions, the following are the main changes since that edition:

Old Section	New Section	Change
5.2		Deleted Back Flashed Calculation section due to several inconsistency in the results –pending new robust approach
	4	Added new section on Multifeed Separator
	5.2	Added new Section 5.2: Entrainment in Separator (Steady State Modeling)
	6	Added new Section 6: Separator in Dynamics

2. EXCEPTIONS/AMMENDMENTS

Nil

3. SEPARATOR IN MODELLING

Separation of oil and gas are the most critical of the field processing operation although it is still the most common.

Separations are divided into 2 types which are scrubbers and separators. Scrubbers are designed to handle relatively small quantities of liquid (gas scrubbing) and separators are used as the primary liquid separations since it can handle larger liquid capacity.

The function of a separator is to provide removal of free gas from oil and/or water at a specific temperature and pressure. There are also separators that are used to separate two immiscible liquid phases using the density difference principle.

For modeling, there are several types of separators can be configured as described in section 4.

4. TYPES OF SEPARATOR

4.1 TWO PHASE SEPARATOR

A vessel that separates the mix phase fluids into gas and total liquid. A two-phase separator can be horizontal, vertical or spherical. In the simulation software, only horizontal and vertical vessels are available for modeling. It can be multiple feeds, with the liquid (oil, emulsion) leaves the vessel at the bottom and the gas leaves the vessel at the top.

A two phase separator also consists of liquid-liquid separators. The function of this separator are to separate two immiscible liquid phases.

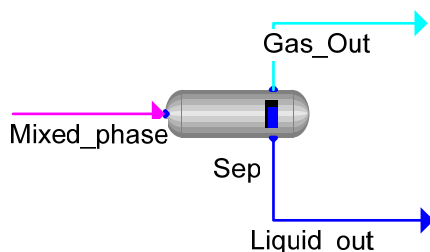


Figure 4.1.1: Schematic Diagram of 2 Phase Horizontal Separator

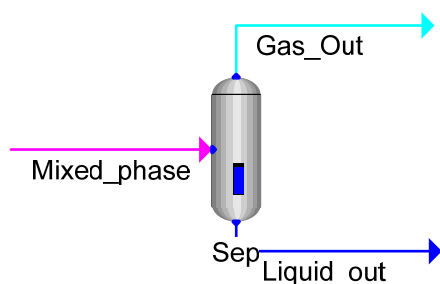


Figure 4.1.2: Schematic Diagram of 2 Phase Vertical Separator/Scrubber