

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

TECHNICAL SPECIFICATION

LABORATORY DESIGN

PTS 34.17.10.31

JANUARY 2011



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This revision of PTS **34.17.10.31–Laboratories Design (January 2011, Revision 1)** has been updated *either* to incorporate PETRONAS Lessons Learnt, Best Practice *and/or* 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 **34.17.10.31–Laboratories (December 1996)** will be removed from PTS binder / e-repository from herein onwards.

The custodian of this PTS is:

Name: Awang B Botok

Tel. No: 603-27836370

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

Document Approval

	Name	Designation	Date	Signature
Prepared	Nur Fazliana Bt A Rahman	Executive (Analytical), Process Engineering, Engineering, GTS	7/2/11	
Reviewed	Awang B Botok	Principal Chemist Process Engineering, Engineering, GTS	7/2/11	
Approved	Zainab Bt Kayat	Custodian, Process Engineering, Engineering, GTS	7/2/2011	
Verified	Shahrul Izan Bakti B A Aziz	Senior Manager, Process Engineering, Engineering, GTS	8/2/2011	
Verified	Pau Kiew Huai	General Manager, Engineering, GTS	11/2/2011	
Endorsed	Pau Kiew Huai	Senior General Manager, GTS	11/2/2011	

Revision History

Rev No.	Reviewed by	Approved by	Date
1	Awang B Botok	Zainab Bt Kayat	JANUARY 2011

PTS REVIEW TEAM

1. Awang B Botok	GTS (Analytical)
2. Nur Fazliana Bt Abdul Rahman	GTS (Analytical)
3. Suhaimi B Tajuddin	GTS (Analytical)
4. Zulkifli B A Rahman	GTS (Analytical)
5. Hemadevi a/p Balasubramaniam	GTS (Analytical)
6. M Zaki B Ismail	GTS (Analytical)
7. Nik Pa B Nik Leh	GTS (Electrical)
8. Asrul Hazimin B Mohamad	GTS (Mechanical)
9. Fazrun B Zaini	GTS (Civil)
10. Siti Zubaidah Bt A Wahab	GTS (Civil)
11. Ir. Mohd Nazri B Mustafa	GTS (Civil)
12. Aishah Bt Hussin	GTS (Civil)
13. M Khalil B Hashim	GTS (Civil)
14. Muhammad B Ramli	GTS (Civil)
15. Jamil B Jamaludin	GTS (Civil)
16. Rosly B Hj Mat Nor	PPMSB (PESD)
17. Sh. Norliza Bt Sy Salim	PGB (TFDD)
18. M Hizam Shah B Rusmi	PGB (POD)
19. Noor Azwa Bt Zulkarnain	PGB (CUF)
20. Safian B Shafiee	MLNG (PLM)
21. Ting Kang Lung	MLNG (PLM)
22. Tan Kain Kwa	MLNG (PLM)
23. Jazmie B Osman	PCSB (DD)
24. Sarina Bt Zainul Abideen	PCSB (DD)



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' 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.

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1.0 INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for the design of laboratories.

This PTS is a revision of the PTS with the same number dated *December 1996*.

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 Group and to Contractors nominated by them.

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

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. 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 which 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 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 the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4 ABBREVIATIONS

ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BS	British Standards
CFR	Cooperative Fuel Research
DSEAR	Dangerous Substances and Explosive Atmospheres Regulation
EN	European Standards
HRC	High Rupture Capacity
HVAC	Heating, Ventilating and Air Conditioning
IEC	International Electrotechnical Commission
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
NFPA	National Fire Protection Association
PMMA	Poly Methyl Metha Acrylate
PTS	PETRONAS Technical Standards

PVC Poly Vinyl Chloride
RAL Reichsausschuß für Lieferbedingungen
USECHH Use and Standard of Exposure of Chemical Hazardous to Health

1.5 SUMMARY OF CHANGES

The previous edition of this PTS was dated December 1996. Summary of changes made to the last edition is given below:

Section	Changes
Page 1	Change the PTS title from "Laboratories" to "Laboratory Design".
Page 2	Insert the word "either" and "or" in Para 1.
1.4	Insert the "Abbreviations" section.
1.5	Insert the "Summary of Changes" section.
2.0	Delete Para 1 of last PTS edition.
	In Para 2 of last PTS edition, add "In general", "PTS 34.17.00.32" and "This shall be away". Delete "sometimes called a general site laboratory", "at least 200 m" away" and "which". Change "which is" to "shall be" and plant laboratory definition from "part of the control building" to "a laboratory located in major hazard area".
	Relocate Para 6 of last PTS edition to Para 3 of new PTS edition
	In Para 7 of last PTS edition, change "research" to "non-processing site". Relocate the Para to Para 4 of new PTS edition.
	In Para 4 of last PTS edition, add "Refer PTS 33.64.10.10". Relocate the Para to Para 5 of new PTS edition.
	In Para 5 of last PTS edition, add "limits level". Change "50 dBA maximum" to "in accordance with PTS 31.10.00.31". Relocate the Para to Para 6 of new PTS edition.
	In Para 8 of last PTS edition, add requirements of HVAC; "ASHRAE Publication 4514" and "PTS 34.17.00.32". Change "ASHRAE Handbook" to "ASHRAE Application Handbook" related to laboratory and Engine Test Facilities. Delete "Product Directory". Relocate the Para to Para 7 of new PTS edition.
	In Para 9 of last PTS edition, add "For laboratories that are continuously occupied by people", "for human comfort" and "Laboratory instruments that operate outside these ranges shall be placed in a separate room". Change "temperatures in laboratories" to "indoor temperatures". Relocate the Para to Para 11 of new PTS edition.
	In Para 10 of last PTS edition, delete "in a control building". Change "see" to "refer". Relocate the Para to Para 8 of new PTS edition.
	Insert requirements of risk assessment (Para 9 and 10 of new PTS edition).
	Insert common list of equipments in Para 12 of new PTS edition
3.0	In Para 1 of last PTS edition, add "main". Change "IEC 79-14" to "PTS 34.17.00.32".
	In Para 2 of last PTS edition, change "showing laboratory rooms" to "consist of the following but not limited to testing area or room", "offices" to "offices area (work partition, pantry, wash/locker room and toilets)", "chemical and glass store" to "chemical storage area", "bottle wash room" to "glassware storage/wash room area", "CFR engine room" to "CFR engine room (if applicable)", "air conditioning" to "HVAC (with humidity control) and electrical room", "gas cylinder area" to "gas cylinder storage area", "instrument/maintenance workshop" to "maintenance room". Delete "machine room" and cleaners' cupboard". Add "safety devices (fume hood, fire extinguisher, eyewash and shower).
	Insert requirements of lean laboratory concept in Para 3 of new PTS edition.
	In Para 3 of last PTS edition, change "CFR engine room" to "CFR engine". Add "see section" and "in a dedicated room". Change "such" to "so" and "are kept outside the laboratory rooms" to "will not affect other testing area". Delete

	second statement
	<i>Insert requirements of entrance of pressurized and liquefied hydrocarbon samples (Para 4).</i>
	<i>In Para 4 of last PTS edition, change "gas supply bottles" to "pressurized gas cylinders". Add "laboratory" and "see section".</i>
	<i>In Para 5 of last PTS edition, delete "to minimize, "bulk" and "toxic or flammable". Change "should" to "shall" and "poured" to "handled". Add "classified as Zone 1 and".</i>
4.1	<i>In Para 1 of last PTS edition, change "in" to "for" and "minutes" to "one hour". Insert fire resistance requirements. Change the Para to Para 3 of new PTS edition.</i>
	<i>In Para 2 of last PTS edition, add "annular". Change the Para to Para 5 of new PTS edition.</i>
	<i>In Para 3 of last PTS edition, change "collect" to "trap". Change the Para to Para 6 of new PTS edition.</i>
	<i>In Para 4 of last PTS edition, change "acid-proof and alkyd-proof" to "chemical resistant". Change the Para to Para 7 of new PTS edition.</i>
	<i>Change Para 5 of last PTS edition to Para 9 of new PTS edition.</i>
	<i>Insert requirements of formal risk assessments and hazardous area classifications, chemical resistance materials and explosion proof (Para 1, 2 and 8 of new PTS edition respectively).</i>
4.2	<i>In Para 1 of last PTS edition, change "should" to "shall". Add "at least".</i>
	<i>In Para 2 of last PTS edition, delete "is possible".</i>
	<i>In Para 3 of last PTS edition, delete "outside door". Insert main entrance door requirements.</i>
	<i>Insert requirements of distance of travel from within the testing area to the nearest final exit (Para 4 of new PTS edition).</i>
4.3	<i>In Para 1 of last PTS edition, change "See" to "Refer".</i>
4.4	<i>In Para 1 of last PTS edition, change "such" to "so".</i>
5.1	<i>Insert general piping requirements (PTS documents) to Para 1 of new PTS edition</i>
	<i>In Para 1 of last PTS edition, add "see section". Change the Para to Para 2 of new PTS edition.</i>
	<i>In Para 2 of last PTS edition, delete "and". Change the Para to Para 3 of new PTS edition.</i>
	<i>In Para 3 of last PTS edition, change "provided" to "installed" and "which" to "and". Change the Para to Para 3 of new PTS edition.</i>
	<i>In Para 4 of last PTS edition, add "around". Change the Para to Para 5 of new PTS edition.</i>
	<i>In Para 5 of last PTS edition, change "motorized emergency valves actuated" to "emergency actuator valves which can be activated" and "and" to "or". Add "Actuator valve shall fail in a safe position (fail-closed)". Change the Para to Para 6 of new PTS edition.</i>
	<i>In Para 6 of last PTS edition, change "provided" to "installed", "easy reach" to "accessibility", "a" to "an individual" and "isolating" to "isolation". Delete "individual benches". Change the Para to Para 7 of new PTS edition.</i>
	<i>In Para 8 of last PTS edition, change "air, water and soil" to "environment (air, water and soil)". Change the Para to Para 9 of new PTS edition.</i>
	<i>In Para 9 of last PTS edition, add "materials". Change the Para to Para 10 of new PTS edition.</i>
	<i>Insert requirements of piping painting and insulation (Para 11 of new PTS edition).</i>
5.2	<i>Change "the following materials shall be used (Note 1) to "Piping materials shall be in accordance with Table 1". Insert table title "Table 1 Piping materials".</i>
	<i>Add compressed air requirements in Table 1 (second column of Piping material section- Seamless steel pipe, threaded, galvanized internally and externally)</i>
5.3.1	<i>Insert requirements of hot water piping and insulation to Para 11 of last PTS edition.</i>

5.3.2	<i>In Para 3 of last PTS edition, add "As an option, installation of" and "to produce demineralized". Change "use inside a laboratory" to "laboratory use".</i>
5.3.3	<i>In Para 1 of last PTS edition, delete "plant". Add "or from plant utility system". Change "ga" to "gauge".</i>
	<i>In Para 2 of last PTS edition, add "Compressed air having the same quality as instrument air (refer PTS 31.37.00.11) will be suitable for most common laboratory applications". Change "ga" to "gauge".</i>
	<i>In Para 3 of last PTS edition, add "laboratory" and "or higher". Change "see" to "refer".</i>
5.3.5	<i>In Para 1 of last PTS edition, add "with its venting point located outside the building" and "Steam trap shall also be located outside the building. As an option, sometimes it is safer and more economical to discharge the condensate to the drain without putting it back to the system".</i>
	<i>In Para 2 of last PTS edition, change "in order to be reused" to "to reuse".</i>
5.3.6	<i>In Para 1 of last PTS edition, change "taken to the" to "located" and "along" to "with" at first statement. Delete "with" at second statement.</i>
	<i>In Para 2 of last PTS edition, change "Drain for flammable liquids shall be closed by a spring-loaded valve" to "A spring-loaded valve shall be installed to close drains for flammable liquids".</i>
5.3.7	<i>In Para 1 of last PTS edition, add "and filter".</i>
5.3.8	<i>Add "Compressed gases:" to the section title.</i>
	<i>In Para 1 of last PTS edition, change second statement to "General requirements are described below".</i>
	<i>In Para 2 of last PTS edition, delete "shall be supplied from" and "by a sloped canopy which shall collapse immediately in the event of an explosion". Change "installed" to "shall be kept and secured in a special rack" and "of air can be maintained" to "can be achieved".</i>
	<i>In Para 3 of last PTS edition, delete first statement. In second statement, add "Gas", delete "containing oxidising gases" and change "from those containing reducing gases" to "based on their compatibility".</i>
	<i>In Para 4 of last PTS edition, change "enclosed" to "protected".</i>
	<i>In Para 5 of last PTS edition, add "located outside the building and", "check valves" and "accessories". Change "provided" to "installed". Delete "all".</i>
	<i>Change "Standard pressure at offtake points in bar (ga)*" to "The standard pressure at offtake points shall be in accordance with Table 2". Insert table title "Table 2 Offtake gas pressures". Insert row title in the table.</i>
	<i>In Para 6 of last PTS edition, change "each case" to "specific application".</i>
	<i>In Para 7 of last PTS edition, delete "Nyla".</i>
	<i>In Para 8 of last PTS edition, delete "of a type".</i>
	<i>In Para 10 of last PTS edition, add "safety devices such as".</i>
	<i>In Para 12 of last PTS edition, rearrange "so". Delete "external".</i>
	<i>In Para 13 of last PTS edition, change "apparatus" to "equipment".</i>
	<i>Insert requirements of non-flammable gas cylinders (Para 14 of new PTS edition).</i>
5.3.9	<i>In Para 1 of last PTS edition, change "at 1.5 times the design pressure for 24 hours" to "in compliance to ASME B31.3 requirements".</i>
	<i>Delete Para 2 of last PTS edition.</i>
5.4	<i>In Para 1 of last PTS edition, change "used:" to "in accordance with Table 3". Insert table title "Table 3 Colour codes for piping".</i>
	<i>Insert Para 2 of last PTS edition into Table 3-note section.</i>
	<i>In Para 5 of last PTS edition, insert requirements of colour coding of taps and valves".</i>
6.1	<i>In Para 2 of last PTS edition, change "IEC 79-14" to "IEC 60079-14".</i>
	<i>In Para 3 of last PTS edition, change "bottle" to "glassware". Add "as a minimum in accordance with IEC 60079-10".</i>
6.3	<i>In last PTS edition, add "preferably in metal conduit or duct" to first statement.</i>
6.4	<i>In Para 1 of last PTS edition, add "Only one socket outlet for one equipment shall be allowed".</i>

6.7	<i>In Para 1 of last PTS edition, add "Signs giving directions for escape should be visible at all times".</i>
7.1	<i>Insert requirements of laboratory furniture and fittings (Para 1 of new PTS edition)</i>
	<i>In Para 1 of last PTS edition, change "shall" to "should". Change the Para to Para 2 of new PTS edition.</i>
	<i>In Para 2 of last PTS edition, change "shall" to "should". Combined Para 2 and Para 3 of last PTS edition into one para (Para 2 of new PTS edition). In Para 3 of last PTS edition, change "shall" to "should".</i>
	<i>In Para 4 of last PTS edition, change "Trespa-Volkern, a" to "high density". Delete "(e.g. Toplab)" in the same statement. Change the Para to Para 5 of new PTS edition.</i>
	<i>Change Para 5 of last PTS edition to Para 6 of new PTS edition.</i>
	<i>In Para 6 of last PTS edition, delete "Hardwood". Add "made from hardwood". Change the Para to Para 7 of new PTS edition.</i>
	<i>Change Para 7 of last PTS edition to Para 8 of new PTS edition.</i>
	<i>Change Para 8 of last PTS edition to Para 9 of new PTS edition.</i>
7.2	<i>In Para 1 of last PTS edition, change "carrying" to "The rectangular steel tubes should be able to carry".</i>
	<i>In Para 4 of last PTS edition, change "executed" to "designed", "and" to "or" and "Their sides shall be properly finished on the outside since they may be permanently visible" to "The visible side of under bench units shall be finished with the material decided by Principal".</i>
	<i>In Para 5 of last PTS edition, change "180" to "90".</i>
	<i>In Para 6 of last PTS edition, add "see section".</i>
	<i>In Para 8 of last PTS edition, delete "special" and "selected, preferably in two halves".</i>
7.3	<i>Insert requirements of fume cupboard (Para 1 and Para 2 of new PTS edition).</i>
	<i>In Para 1 of last PTS edition, change "Perspex" to "PMMA or Polycarbonate". Change the Para to Para 3 of new PTS edition.</i>
	<i>Change Para 2 of last PTS edition to Para 4 of new PTS edition.</i>
	<i>Change Para 3 of last PTS edition to Para 5 of new PTS edition.</i>
	<i>Insert exhaust ducting requirements (Para 6 of new PTS edition).</i>
	<i>In Para 4 of last PTS edition, change "window" to "sash". Delete "The entrance air velocity shall be 0.30-0.60 m/s". Add requirements of Containment Factor for fume cupboards and a minimum face velocity. Change the Para to Para 7 of new PTS edition.</i>
	<i>In Para 5 of last PTS edition, change "air conditioning" to "ventilation". Add "to maintain the negative pressure in the laboratory room in relation to other parts of the building. Fire detection and alarm system shall not be interlocked to automatically shut down exhaust fans" to second statement. Change the Para to Para 8 of new PTS edition.</i>
	<i>In Para 6 of last PTS edition, change "window" to "sash opening". Change the Para to Para 9 of new PTS edition.</i>
	<i>In Para 7 of last PTS edition, add "above the roof at a location, height and velocity sufficient to prevent re-entry of chemicals and to prevent exposures to personnel. Exhaust stacks should extend at least 3 m above the highest point on the roof or more after dispersion studies". Change the Para to Para 10 of new PTS edition.</i>
	<i>Change Para 8 of last PTS edition to Para 11 of new PTS edition.</i>
	<i>In Para 9 of last PTS edition, change "Each cupboard shall have its own exhaust ducting and shall be provided with its own acid-resistant non-sparking fan" to "The fume cupboard shall be provided with an acid-resistant, non-sparking fan connected to exhaust ducting" at first statement. For second statement, add "and accessible for maintenance". For third statement, delete "away". Change the Para to Para 12 of new PTS edition.</i>
	<i>In Para 10 of last PTS edition, delete "passing people or opening of doors will not disturb the". Add "is not disturbed and should be away from access door".</i>

	<i>Change the Para to Para 13 of new PTS edition.</i>
	<i>In Para 11 of last PTS edition, delete "as far as possible". Change the Para to Para 14 of new PTS edition.</i>
	<i>Change Para 12 and Para 13 of last PTS edition to Para 15 and Para 16 of new PTS edition respectively.</i>
	<i>In Para 14 of last PTS edition, change "adequate for a" to "classified as". Change the Para to Para 17 of new PTS edition.</i>
	<i>In Para 15 of last PTS edition, add "fume". Change the Para to Para 18 of new PTS edition.</i>
	<i>Insert requirements of exhaust group and ducting (Para 19 and 20 of new PTS).</i>
7.4	<i>In Para 1 of last PTS edition, add "section".</i>
	<i>In Para 1 of last PTS edition, change the statement to "The sample tables shall be firmly fixed to the wall or floor".</i>
	<i>In Para 3 of last PTS edition, add "section".</i>
	<i>In Para 4 of last PTS edition, change "kg/m" to "kg/m²".</i>
7.5	<i>In Para 1 of last PTS edition, change "refinery" to "plant" and "tank" to "area".</i>
	<i>In Para 2 of last PTS edition, add "and an exhaust hood shall be mounted above the entire unit".</i>
	<i>In Para 4 of last PTS edition, delete the statement.</i>
	<i>In Para 5 of last PTS edition, change "if whether and where" to "requirement and location for" and "shall" to "to".</i>
	<i>In Para 6 of last PTS edition, delete the statement.</i>
	<i>Insert requirements of vent gases (Para 6 and 7 of new PTS edition).</i>
	<i>In Para 7 of last PTS edition, add "Exhaust height shall comply with statutory requirement".</i>
8.0	<i>In Para 1 of last PTS edition, delete "combustion fuel reference". Add "engine". Change "ASTM Volume 05.04" to "ASTM D 613, ASTM D 909, ASTM D 2699, ASTM D 2700 and/or ASTM D 2885, as applicable".</i>
	<i>In Para 3 of last PTS edition, change "in" to "for".</i>
	<i>In Para 6 of last PTS edition, add "room".</i>
	<i>In Para 7 of last PTS edition, delete the statement.</i>
	<i>In Para 8 of last PTS edition, add "engine".</i>
	<i>In Para 9 of last PTS edition, change "Ventilation shall rely on natural ventilation" to "Mechanical exhaust ventilation shall be provided".</i>
9.0	<i>Insert new section "Pressurised and liquefied gas samples area".</i>
10.0	<i>Insert new section "Sample (other than sample specified in section 9.0)/reagent reception and storage".</i>
11.0	<i>Relocate section 9.0 of last PTS edition to section 11.0 of new PTS edition.</i>
11.1	<i>Delete "and". Add additional standard reference of NFPA 45 and "shall apply if specified by the Principal or required by local regulations".</i>
11.2	<i>Delete Para 2 of last PTS edition.</i>
	<i>Insert requirements of fire, smoke and gas detector (Para 2 and Para 3 of new PTS edition).</i>
11.3	<i>Add "for CFR engine room" to section title.</i>
	<i>In Para 1 of last PTS edition, delete "CFR" at first statement.</i>
	<i>Insert requirements of flammable gas, heat detector and extinguishing system (Para 2 of new PTS edition).</i>
11.4	<i>Delete Para 1 and Para 2 of last PTS edition.</i>
	<i>Insert requirements of fire extinguisher installation (Para 2 of new PTS edition).</i>
	<i>In Para 3 of last PTS edition, change "25 mm reeled water hoses fed from the potable water system" to "In addition, hose reels with diameter specified by Principal connected to the potable water system" and "of the building such that all work spaces will be within reach of the nozzle" to "so that storage rooms, offices and laboratory areas will be well accessible to the hose reel nozzles."</i>
12.0	<i>Update all standard references.</i>
	<i>Relocate and reword the Notes statements or disclaimer.</i>
13.0	<i>Insert Attachment 1: Typical Analytical Equipment and Apparatus</i>

2.0 GENERAL

In general, there are two types of laboratories in an oil refinery, chemical plant or gas plant. Refer PTS 34.17.00.32.

- A main laboratory *shall be* a separate building and shall be located *in non-major hazard area*. This shall be away from any plant containing hydrocarbons or hazardous chemicals, and should be located in the administration area.
- A plant laboratory *is a laboratory located in major hazard area*.

The main laboratory building shall be designed in accordance with PTS 34.17.00.32.

The plant laboratory shall comply with PTS 34.17.10.30 and PTS 34.17.00.32.

For *non-processing site* laboratories, the requirements for a main laboratory shall apply.

The illumination level in laboratory shall be at least 400 lux. Refer PTS 33.64.10.10

Ambient noise *limits level* within the laboratory shall be in accordance with PTS 31.10.00.31.

Heating, ventilating and air conditioning of a main laboratory shall be in accordance with the principles specified in the *ASHRAE Publication 4514 and ASHRAE Application Handbook related to laboratory and Engine Test Facilities*. HVAC for office area in laboratory building, refer PTS 34.17.00.32.

For heating, ventilating and air conditioning of a plant laboratory refer PTS 31.76.10.10.

Formal risk assessments and hazardous area classifications shall be carried out to enable the selection of appropriate engineering control equipment to be used in laboratory areas. This is of particular importance for areas where large volumes of hazardous materials are handled. Samples stores, sample receiving area and the pressurised/liquefied hydrocarbon gas samples testing area (e.g. LPG/LNG) should be classified as Zone 1 (that part of a hazardous area in which a flammable atmosphere is likely to occur in normal operation). Refer IEC 60079-10 and DSEAR 2002 for zones classification.

Requirements arising from any health, safety and environment risk assessment studies relevant for the laboratory shall be incorporated in the design.

For laboratories that are continuously occupied by people, indoor temperatures shall be maintained between 20 °C and 26 °C and a relative humidity of between 30 % and 70 % for human comfort. Laboratory instruments that operate outside these ranges shall be placed in a separate room.

Testing equipments in a laboratory is depending on category of the laboratory (oil refinery, chemical plant, gas plant or non-processing site laboratories), types of product and services. Refer Attachment 1 for typical laboratory or analytical equipment and apparatus by category.

3.0 LOCATION AND LAYOUT

The *main* laboratory building and any adjacent area reserved for extension shall be located in an area as defined in PTS 34.17.00.32.

General design drawings shall be prepared by the Principal and typical laboratory design, *consists of the following:*

- *Testing area or room*
- *Office area*
- *Chemical storage room*
- *Gas cylinder storage area*
- *Glassware storage room*
- *Washing area/room*
- *Sample receiving area*
- *CFR engine room for refinery (if applicable)*
- *HVAC (with humidity control) and electrical room*
- *Maintenance room*
- *Schedule waste storage area*

The Principal shall consider lean laboratory concept in designing laboratory layout. Lean laboratory is a management and organization process that focus on testing products and materials to deliver results in most efficient way in terms of cost or speed or both (less effort, less resources and less time) by utilizing an open laboratory plan (enhance staff utilisation, communications, supervision, share equipment), proficient workstations (suitable number and equipment size, location and workstation function) automated/robotic equipment (eliminate waste within design, optimise workflow and relationship/adjacencies within the laboratory) and levelling same amount of daily work.

The CFR engine room, (see section 8.0), shall be located *in a dedicated room* so that noise and vibrations *will not affect other testing area.*

For laboratory handling pressurised and liquefied hydrocarbon gas samples should be designed so that sample cylinders enter via an entrance directly into the dedicated gas handling laboratory and not via other laboratory areas/corridors.

Pressurised gas cylinders shall be located outside the laboratory building (see section 5.3.8).

In order to minimize the risk of fire flash-over and the extent of explosion damage, retained samples, solvents, chemicals and fuels *shall* be stored in a separate building at least 15 m from the laboratory. This store shall be *classified* as Zone 1 and adequately ventilated near the ceiling and the floor to prevent accumulation of vapours. Ventilation and spillage containment facilities shall be provided where chemicals, solvents or fuels are *handled*.

4.0 ARCHITECTURAL DESIGN

4.1 WALLS, CEILINGS AND FLOORS

Layout and minimum area of a laboratory unit shall be determined by formal risk assessments and hazardous area classifications. NFPA 45 shall apply if specified by local regulations.

Chemical resisting finishes shall be provided to an area that expose to chemical spillage such as liquid/solid chemical store and other areas, as approved by Principal. Details of the proposed chemical resisting material that shall include methodology of installation or application shall be submitted, prior to Principals' approval.

All *internal* walls, ceilings and floors of rooms where flammable products are stored or used shall have a fire resistance of at least one hour. Doors for these walls shall be self-closing and shall have a fire resistance of at least one hour. For the fire resistance requirements of other building elements, refer PTS 34.17.00.32.

Adequate space in the ceiling shall be provided to accommodate utilities piping, cable services, drainage, ventilation ducts and laboratory equipment, including space for future services.

If *annular* spaces above ceilings are unavoidable (pitched roofs), these spaces shall be ventilated to prevent an accumulation of gases.

If there is a flat concrete roof, the acoustic and fireproof ceiling panels may be glued to the underside of the concrete ceiling. The underside shall be flat to prevent dead corners where light gases could *trap*.

If a perforated ceiling is required for an evenly distributed supply of air from the air-conditioning system then the ceiling panels shall be *chemical resistant* finished.

Rooms that are identified will be exposed to an explosion, shall be designed to Principal approval. Requirement for explosion proof design shall follow PTS 34.17.10.30. Ceiling material, lightings, other fixtures and fittings that are installed inside the room shall be made of an explosion proof material.

In sample storage areas, ventilation shall be such that gases lighter than air cannot accumulate near the ceiling (i.e., extraction shall take place at the highest point of the room) and gases heavier than air cannot accumulate on the floor (i.e., extraction shall take place at the lowest point of the room). See also the ventilation arrangement in a typical analyser house, Standard Drawing S 17.001

4.2 DOORS

Each laboratory room containing flammable or explosive products shall have at least two doors located as far as possible from each other and *shall* have *at least* one door opening directly to the outside of the building.

Access to the laboratory shall be such that easy transport of samples through a separate entrance. Equipment doors shall be sized so that the largest piece of anticipated equipment can enter the building and the room in which it will be installed.

If attached to control building, the emergency exit door in the plant laboratory in a pressurized control building shall be protected against opening from the outside and shall be self-closing, to prevent loss of over-pressure in the control building. The main entrance door to the plant laboratory shall open outwards.

The distance of travel from within the testing area to the nearest final exit or exit serving a storey should be no more than 15 m.

4.3 WINDOWS

All internal doors and all internal windows in laboratory rooms shall have transparent Georgian wired glazing with a maximum pane size of 0.25 m² and 1 m², respectively. Refer also PTS 34.17.00.32.

The number of outer windows shall be limited for safety and insulation reasons. These windows shall have a maximum pane size of 1 m² in main laboratories and 0.25 m² in plant laboratories. See also PTS 34.17.00.32 and PTS 34.17.10.30.

The sills of all windows shall be at least 250 mm above the laboratory benches.

The laboratory windows shall be protected from direct sunlight. This can best be achieved by locating the laboratory in such a way that direct sunlight cannot reach the windows. If this is not possible, a solar-reflecting film shall be affixed to the glass panes or sun blinds shall be installed.

4.4 LOCATION OF BENCHES

Benches and tables shall be located so that from any point in the laboratory the emergency exits can be reached in two different directions. Therefore, only wall-type benches and island-type benches shall be installed, not finger-type benches.

There shall be at least 1 500 mm free space between benches and tables, and there shall be at least 800 mm free space between a bench or table and a wall. The central corridor in a laboratory room shall be at least 2 000 mm wide.

5.0 PIPING

5.1 GENERAL

Refer PTS 31.38.01.11 and PTS 31.38.01.12.

Except for drain pipes and piping in benches and fume cupboards, all piping for the systems listed in (see section 5.2) shall be surface-mounted along the walls and ceiling, or shall be mounted in service ducts along the wall or along the centre of island-type benches.

The service ducts above the benches should follow the same route as the electrical service ducts. There shall be one duct for gases and water; a separate duct for electricity and telephone cabling.

All incoming supply piping shall be *installed* with emergency valves *and* shall be located in an easily accessible main valve pit outside the building.

All incoming gas supply piping shall be provided with block valves at an operable height of *around* 1.60 m. These valves shall be located outside every laboratory hall or room *for complete isolation* in case of an emergency.

For each floor, *emergency actuator valves which can be activated* simultaneously by central push buttons shall be installed in all piping carrying flammable, toxic or oxygen-suppressing gases. *Actuator valve shall fail in a safe position (fail-closed).*

In the laboratory room the main supply piping to fume cupboards and benches shall be *installed* with valves within *accessibility*. Each branch to a bench shall have an *individual* valve for *isolation*.

All fittings in piping systems of benches, fume cupboards, etc. shall be chrome-plated or plastic-coated.

Piping shall be provided for the safe venting and draining of samples. Disposal systems for these samples shall meet the local regulations for *environment (air, water and soil)*.

All piping and ancillaries *materials* shall be suitable for the fluids with which they will come into contact.

All painting and insulation to piping shall comply with PTS 30.48.00.31 and PTS 30.46.00.31.

5.2 MATERIALS

Piping materials shall be in accordance with Table 1.

Table 1 Piping materials

SERVICE	PIPING MATERIAL ¹⁾					
	Seamless copper tubing with soldered fittings	Seamless steel pipe, threaded, galvanized internally and externally	Seamless steel pipe, threaded and insulated ²⁾	Stainless steel pipe with welded fittings	ABS ³⁾	Polyethylene
Hydrogen	X			X		
Helium	X			X		
Argon	X			X		
Oxygen	X			X		
Nitrogen	X			X		
Carbon dioxide	X			X		
Acetylene				X		
Nitrous oxide	X			X		
Propane	X			X		
Butane	X			X		
Natural gas	X			X		
Hot water	X					
Cold water	X					
Distilled or demineralized water					X	X
Compressed air	X	X				
Steam			X			
Vacuum	X (branch)		X (mains)			
Drain piping in fume cupboards and benches						X
Disposal drain for hydrocarbons				X		
Steam Condensate		X				
¹⁾ The use of other materials is subject to the approval of the Principal. ²⁾ Seamless steel pipe shall pass through walls in a pipe sleeve to prevent corrosion in these areas. ³⁾ ABS is acrylonitrile butadiene styrene.						