

<b>KLM Technology Group</b>  Project Engineering Standard	  <a href="http://www.klmtechgroup.com">www.klmtechgroup.com</a>	Page : 1 of 40
		Rev: 01
		Feb 2011
KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	<b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b>  <b>(PROJECT STANDARDS AND SPECIFICATIONS)</b>	

KLM Technology Group has developed; 1) Kolmetz Handbook of Process Equipment Design (Process Engineering Equipment Design Guidelines), 2) Equipment Design Software, 3) Project Engineering Standards and Specifications, and 4) Unit Operations Manuals. Each has many hours of engineering development.

KLM is providing the introduction to this Project Engineering Standard and Specification for free on the internet. Please go to our website to order the complete document.

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## TABLE OF CONTENT

<b>SCOPE</b>	<b>2</b>
<b>REFERENCES</b>	<b>2</b>
<b>DEFINITIONS AND TERMINOLOGY</b>	<b>2</b>
<b>SYMBOLS AND ABBREVIATIONS</b>	<b>3</b>
<b>UNITS</b>	<b>3</b>
<b>GENERAL REQUIREMENTS</b>	<b>3</b>
<b>PREPARATION PRIOR TO INITIAL START-UP</b>	<b>4</b>
Operational Check-Out	<b>5</b>
Hydrostatic Testing	<b>6</b>
Final Inspection of Vessels	<b>11</b>
Flushing of Lines	<b>12</b>
Instruments	<b>15</b>
Acid Cleaning of Compressor Lines	<b>16</b>
Breaking-In Pumps	<b>16</b>
Breaking-In Compressors	<b>19</b>
Dry-Out and Boil-Out	<b>20</b>

<b>KLM Technology Group</b>  Project Engineering Standard	  <a href="http://www.klmtechgroup.com">www.klmtechgroup.com</a>	Page : 2 of 40
		Rev: 01
		Feb 2011
KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	<b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b>  <b>(PROJECT STANDARDS AND SPECIFICATIONS)</b>	

<b>Catalyst Loading</b>	<b>23</b>
<b>Tightness Test</b>	<b>24</b>
<b>NORMAL START-UP PROCEDURES</b>	<b>25</b>
<b>General</b>	<b>25</b>
<b>Prestart-Up Check List</b>	<b>26</b>
<b>Make Area Safe</b>	<b>27</b>
<b>Utilities Commissioning</b>	<b>27</b>
<b>Air Purging and Gas Blanketing of Non-Catalytic Sections</b>	<b>27</b>
<b>Catalytic Units Reactor Section Air Purging and Gas Blanketing</b>	<b>29</b>
<b>Heat Exchanger Activation</b>	<b>29</b>
<b>Vacuum Test</b>	<b>29</b>
<b>Establish Flow in the Unit</b>	<b>30</b>
<b>Inhibitor/Chemical Injections</b>	<b>30</b>
<b>Adjust Operation to Obtain Quality</b>	<b>30</b>
<b>APPENDIX A</b>	<b>31</b>
<b>APPENDIX B</b>	<b>34</b>
<b>APPENDIX C</b>	<b>38</b>

<p style="text-align: center;"><b>KLM Technology Group</b></p> <p>Project Engineering Standard</p>	<p><b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b></p> <p><b>(PROJECT STANDARDS AND SPECIFICATIONS)</b></p>	Page 3 of 40
		Rev: 01
		Feb 2011

## SCOPE

This Project Standards and Specification covers minimum process requirements for plant start-up sequences and general commissioning procedures for Units or facilities.

Although, the start-up sequences and commissioning procedures differ to some extent from process to process, the basic philosophy and general aspects shall conform to the concepts of this Standard.

However, considering the general commissioning and all activities to be performed prior to initial start-up as outlined in this Standard, feed introduction to the Unit shall be according to the stepwise start-up procedure provided by the Contractor in the Unit Operating Manual.

## REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. API (AMERICAN PETROLEUM INSTITUTE)
  - API Std. 650, "Welded Steel Tanks for Oil Storage", English Edition Latest Edition
2. ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)
  - ASME Code, Section VIII

<b>KLM Technology Group</b>  Project Engineering Standard	<b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b>  <b>(PROJECT STANDARDS AND SPECIFICATIONS)</b>	Page 4 of 40
		Rev: 01
		Feb 2011

## DEFINITIONS AND TERMINOLOGY

**Contractor** - The persons, firm or company whose tender has been accepted by the "Employer", and includes the Contractor's personnel representative, successors and permitted assignees.

**Licensor or Licensor** - A company duly organized and existing under the laws of the said company's country and as referred to in the preamble to the contract.

**Project** - The equipment, machinery and materials to be procured by the "Contractor" and/or "company" and the works and/or all activities to be performed and rendered by the "Contractor" in accordance with the terms and conditions of the contract documents.

**Unit or Units** - One or all process, offsite and/or utility Units and facilities as applicable to form a complete operable refinery/ and or plant.

## SYMBOLS AND ABBREVIATIONS

<u>SYMBOL/ABBREVIATION</u>	<u>DESCRIPTION</u>
<b>DN</b>	Diameter Nominal, in (mm).
<b>LPG</b>	Liquefied Petroleum Gas
<b>OGP</b>	Oil, Gas and Petrochemical.
<b>ppm (by mass)</b>	Parts per million, in (mg/kg).
<b>PSV</b>	Pressure Safety/Relief Valves.
<b>SSU</b>	Saybolt Universal Seconds.

## UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

<p style="text-align: center;"><b>KLM Technology Group</b></p> <p>Project Engineering Standard</p>	<p><b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b></p> <p><b>(PROJECT STANDARDS AND SPECIFICATIONS)</b></p>	Page 5 of 40
		Rev: 01
		Feb 2011

## GENERAL REQUIREMENTS

1. Commissioning shall start from the point at which steps are taken to bring the Unit/facility up to operating pressure and temperature and to cut in the feed. It shall be complete when the Unit/facility is operating at design capacity and producing products to specification.
2. For a project involving a number of process Units and offsite facilities, it shall be agreed between the Contractor and Company in the earliest stages of a project the sequence of the commissioning of the Units. It shall be necessary to commission utilities and some of the Units in advance of others, because of their interdependence from a process point of view.
3. The responsibilities of the Contractor and Company during commissioning stage should be clarified for the provision of labor, operators, specialists and service engineers, and also for the correction of faulty equipment, etc.
4. The general requirements outlined in this Standard for testing of equipment/lines shall be followed. The detail procedures for testing of equipment and lines and other pre-commissioning steps are not included in this Standard and shall be prepared in accordance with the Company's Engineering Standards by the Contractor and submitted to the Company for approval. However, on completion of testing, vessels, equipment and piping should be vented and drained, and where necessary cleaned and dried to the satisfaction of the Company.

Spades, blanks and other equipment installed for testing shall be removed on completion of testing. Wherever a flange joint is broken after testing, e.g., on heat exchangers, pipework, fired heaters and at machinery, then the joint rings or gaskets must be renewed.

Particular attention must be given to heat exchangers employing solid metal or filled gaskets, and great care should be taken to ensure that all gaskets renewed after testing of heat exchangers and are correctly fitted before tightening flanges.

Where required, valves are to be repacked with the appropriate grade of material.

Any temporary bolting which has been used shall be replaced and any temporary fittings which may have been installed to limit travel, e.g., in expansion joints and pipe hangers, shall be removed.

<p style="text-align: center;"><b>KLM Technology Group</b></p> <p>Project Engineering Standard</p>	<p><b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b></p> <p><b>(PROJECT STANDARDS AND SPECIFICATIONS)</b></p>	Page 6 of 40
		Rev: 01
		Feb 2011

5. Prior to commissioning, each item of equipment should have its name, flowsheet number and identification number painted and/or stamped on it according to the Company's Specifications.

### **PREPARATION PRIOR TO INITIAL START-UP**

The procedures described in this Section shall be carried out at the completion of construction and before initial operation of the Unit. Appropriate phases should be repeated after any major repair, alteration, or replacement during subsequent shutdowns. The phases of preparation for initial start-up shall be according to the following steps:

- Operational checkout list.
- Hydrostatic testing.
- Final inspection of vessels.
- Flushing of lines.
- Instruments.
- Acid cleaning of compressor lines.
- Breaking in pumps.
- Breaking in compressors.
- Dry-out and boil-out.
- Catalyst loading.
- Tightness test.

<p style="text-align: center;"><b>KLM Technology Group</b></p> <p>Project Engineering Standard</p>	<p><b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b></p> <p><b>(PROJECT STANDARDS AND SPECIFICATIONS)</b></p>	Page 7 of 40
		Rev: 01
		Feb 2011

### **Operational Check-Out**

1. Check line by line against flowsheet and locate all items.
2. Identify the location of instruments.
3. Indicate the location of all critical valves including valves at critical vent and drain locations.
4. Check control valves, valves, and globe valves to see that they are installed properly with respect to flow through their respective lines. Special attention must be given to check valves regarding their direction of flow.
5. Review all piping and instrument connections for steam tracing.
6. Check that the following facilities have been installed so that the plant can be commissioned and put on stream:
  - Start-up bypass lines.
  - Purge connections.
  - Steam-out connections.
  - Drains.
  - Temporary jumpovers.
  - Blinds.
  - Check valves.
  - Filters and Strainers.
  - Bleeders.
  - Etc.
7. Check pumps and compressors for start-up.
8. Check sewer system for operability.
9. Check blowdown systems.
10. Check heater for burner installation, refractories, stack damper controls, burner refractories, etc.

<p style="text-align: center;"><b>KLM Technology Group</b></p> <p>Project Engineering Standard</p>	<p><b>START-UP SEQUENCE AND GENERAL COMMISSIONING PROCEDURES</b></p> <p><b>(PROJECT STANDARDS AND SPECIFICATIONS)</b></p>	Page 8 of 40
		Rev: 01
		Feb 2011

## Hydrostatic Testing

1. Hydrostatic pressure testing of the Unit shall be performed to prove strength of the materials and weld integrity after completion of the construction. The tests shall be made on new or repaired equipment and piping. The initial testing is ordinarily done by the Contractor in the course of erection.
2. Detail procedure for testing the equipment and lines shall be prepared by the Contractor and submitted to the Company for approval.
3. Fresh water containing a corrosion inhibitor which meets the Company's approval shall be used for hydrostatic test purpose unless otherwise specified in this Standard. In systems where residual moisture can not be tolerated, e.g., in SO<sub>2</sub>, acid, ammonia and LPG service, and where certain catalysts are used, oil is the preferred test medium. If the water has to be used, the system should afterwards be dried out with hot air. Special attention should be given to the points where water may be trapped, such as in valve bodies or low points.
4. If for any reason it is not practical to carry out a hydraulic test, a pneumatic or partially pneumatic test may be substituted subject to prior agreement with the Company. Full details, including proposed safety precautions, will be required. The following are usually excluded from hydrostatic testing, and are usually tested with compressed air and soap suds:
  - a. Instrument air lines (test with dry air only, if possible).
  - b. Air lines to air-operated valves (test with dry air only).
  - c. Very large (usually over DN 600 or 24 inches) gas or steam overhead lines.
  - d. Pressure parts of instruments in gas or vapor service.
5. When austenitic or austenitic acid clad or lined equipment and piping are tested, the test fluid chloride ion content shall meet the following conditions:
  - a. If the piping and equipment metal temperature never exceeds 50°C during commissioning, operation or nonoperation, water containing up to 30 ppm (by mass) chlorides ion shall be used. The chlorides ion content might be increased up to 150 ppm (by mass) if the equipment or piping can be thoroughly washed out using water containing less than 30 ppm (by mass) chlorides ion as soon as testing is complete if allowed by the Company. In