## The System Approach to Lean Manufacturing

Manufacturing and Trade

The System

Lean Thinking and Lean Production

Questions

References

#### **Measurements and Numbers**

History

Standards

**Dimensions** 

Units

**Dimensional Analysis** 

**Units for Mechanical Systems** 

**Conversions and Dimensional Analysis** 

**Problems** 

References

## **General Calculations**

**Basic Principles** 

Conservation of Mass

**Problems** 

## **Properties of Fluids**

Physical Properties of Flow

Surface Tension and Capillary Action

**Hydrostatics** 

Basic Concept of Fluid Motion

Types of Flow

Conservation of Energy in Liquids

**Problems** 

## **Pumps**

Introduction

**General Principles** 

**Pump Efficiency** 

Centrifugal Pumps

Suction Systems and Sump Design

**Positive Displacement Pumps** 

Pipelines in the Industry

**Pipeline Construction** 

**Problems** 

## Thermodynamics

Energy of a System Characteristics of a System Gases and Vapors Problems

## **Electrical Systems**

**Electricity Generation** 

**Definitions** 

**Energy Conversion** 

**Electric Motors** 

Motor Management

**Power Transmission** 

Control Equipment for Electrical Apparatus

Illumination of the Processing Facility

## **Heating Systems for Processing Plants**

**Heat Transfer** 

**Conductive Heat Transfer** 

Composite Cylinder

Convective Heat Transfer

Heat Transfer by Radiation

**Steam Heating** 

Heat Pressure Diagram for Water

Steam Tables

**Boiling Point of Water** 

**Hot Water Systems** 

**Piping** 

**Problems** 

#### **Steam Generation**

**Boilers** 

Fire Tube Boilers

**Water Tube Boilers** 

**Boiler Efficiency** 

**Boiler Selection Criteria** 

**Boiler Fittings and Accessories** 

**Steam Purity** 

## **Refrigeration and Freezing**

Overview

**Natural Refrigeration** 

Solid CO2

Mechanical Refrigeration

Thermodynamics of Vapor Compression

**Secondary Refrigeration** 

Management

**Storage Rooms** 

## **Water and Waste Systems**

Water Quality

Potable Water

Substances in Water

**Treatment of Water Supplies** 

Treatment of Boiler Feedwater

**Wastewater Treatment** 

**Treatment Facilities** 

Waste Disposal

## **Materials Handling**

Importance of Materials Handling

**Increasing Materials Handling Efficiency** 

Materials Handling Equipment

Plant Layout for Materials Handling

Efficient Use of Materials Handling Equipment

## **Manufacturing Plant Design**

**Building Design** 

**Legal Aspects** 

Expansion

Plant Location

Planning the Building on the Site

The Structure

**Facilities Layout** 

Summary

#### **Environmental Issues**

Costs and Benefits of Environmental Compliance

**Mandated Environmental Costs** 

Corporate Social Responsibility

Legislative Issues

**Environmental Compliance of Operations** 

ISO 140Series Environmental Management Standards

Corporate Responsibility
Application of the Principles
References

# Safety

Workplace Safety
Causes of Accidents
Safety
Accident Prevention
General Plant Safety
Fire Protection
Noise Control
Occupational Safety and Health Administration