

## Pump Standards

There are many pump standards used in the pump industry today. These standards may be national, international, industry specific, company specific or project specific. This paper attempts to cover the more commonly used pump specifications within Australia. Undoubtedly, there are other pump specifications being utilised and the writer would be pleased to hear about them.

Other associated standards such as those defining test standards are also available however we have not attempted to cover these in this paper.

This paper is broken up into the following sections:

- **Definitions:** This area details the organisations that either prepare or certify pump specifications.
- **The various standards are covered by application as follows:**
  - Fire
  - Oil and Gas
  - Process
  - General Purpose

There are many national specifications e.g. Japanese, British, Australian etc, however the vast majority are based on ISO standards or reference other standards such as API. Project specific specifications would generally reference other standards.

The following should be noted

1. Many pumps available on the market today do not comply with any documented standard. This does not mean that these pumps are not of excellent quality or fit for purpose.
2. If the intention of a buyer is to define compliance with a specific standard, ensure that it is relevant to the application. For example, specifying API compliance for a building services application does not make any sense.
3. Any pump specifier should take care that defining compliance with a particular specification does not disqualify other suitable pumps. For example, specifying ANSI B73.1 may disqualify offers of very suitable pumps complying with ISO 5199.
4. There have been a number of instances where compliance with more than one pump specification is detailed. This may appear to be a safe process however this often causes confusion for a pump supplier as there may be contradictions between the two standards.

## DEFINITIONS

### Standards Australia – AS

Standards Australia is the nation's peak non-government Standards organisation. It is charged by the Commonwealth Government to meet Australia's need for contemporary, internationally aligned Standards and related services.

It leads and promotes a respected and unbiased Standards development process ensuring all competing interests are heard, their points of view considered and consensus reached.

### **International Organisation for Standardisation - ISO**

The International Organisation for Standardisation, widely known as ISO, is an international-standard setting body composed of representatives from various national standards organisations. Founded on 23 February 1947, the organisation promulgates worldwide proprietary industrial and commercial standards. It has its headquarters in Geneva, Switzerland. While ISO defines itself as a non-governmental organisation, its ability to set standards that often become law, either through treaties or national standards, makes it more powerful than most non-governmental organisations. In practice, ISO acts as a consortium with strong links to governments.

ISO classifies pumps as Class I, II and III with Class I having the most stringent requirements. The selection of class is determined by the application and the intention is that it is agreed between purchaser and supplier. It is impossible to standardise the class of technical requirements, however, the criteria for class determination may include;

- reliability
- required operating life
- operating conditions
- environmental conditions
- local ambient conditions

It is possible that pumps built in accordance with Classes I, II and III may work beside one another in the same plant.

### **American Petroleum Institute - API**

The American Petroleum Institute, commonly referred to as API, is the main U.S trade association for the oil and natural gas industry, representing about 400 corporations involved in production, refinement, distribution, and many other aspects of the petroleum industry. The association's chief functions on behalf of the industry include advocacy and negotiation with governmental, legal, and regulatory agencies; research into economic, toxicological, and environmental effects; establishment and certification of industry standards; and education outreach. API both funds and conducts research related to many aspects of the petroleum industry.

### **American National Standards Institute- ANSI**

The American National Standards Institute or ANSI is a private non-profit organisation that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organisation also coordinates U.S. standards with international standards so that American products can be used worldwide. For example, standards make sure that people who own cameras can find the film they need for that camera anywhere around the globe. ANSI accredits standards that are developed by representatives of standards developing organisations, government agencies, consumer groups, companies, and others. These standards ensure that the characteristics and performance of products are consistent, that people use the same definitions and terms, and that products are tested the same way. ANSI also accredits organisations that carry out product or personnel certification in accordance with requirements defined in international standards.

### **Hydraulics Institute- HI**

The Hydraulic Institute is a non-profit industry (trade) association established in 1917. HI and its members are dedicated to excellence in the engineering, manufacture, and application of pumping equipment.

The Institute plays a leading role in the development of pump standards in North America and worldwide. HI standards are developed within guidelines established by the American National Standards Institute (ANSI). HI members work through a number of technical committees to develop draft standards. The Institute involves pump users and other interested parties to reach consensus on published standards. HI standards are developed to define pump products, installation, operation, performance, testing, and pump life and quality.

### **National Fire Protection Association - NFPA**

The National Fire Protection Association (NFPA) is a U.S. organisation (albeit with some international members) charged with creating and maintaining minimum standards and requirements for fire prevention and suppression activities, training, and equipment, as well as other life-safety codes and standards. This includes everything from building codes to the personal protective equipment utilised by firefighters while extinguishing a blaze.

## **FM Global**

FM Global is a U.S.-based insurance company, with offices worldwide, that specialises in loss prevention services primarily to large corporations throughout the world in the *Highly Protected Risk* (HPR) property insurance market sector. "FM Global" is the communicative name of the company, whereas the legal name is "Factory Mutual Insurance Company". The company employs a non-traditional business model whereby risk and premiums are determined by engineering analysis as opposed to historically based actuarial calculations. This business approach is centered on the belief that property losses can be prevented or mitigated. FM Global engineering personnel regularly visit insured locations to evaluate hazards and recommend improvements to their property or work practices to reduce physical and financial risks if a loss occurs.

FM Approvals certifies industrial and commercial products and services for companies worldwide. When a product or service meets the standards of FM Approvals, it is issued the "FM APPROVED" mark to signify it will perform as expected and support property loss prevention.

## **Deutsches Institut für Normung (DIN)**

DIN, headquartered in Berlin, is the German national organisation for standardisation and is that country's ISO member body. There are currently around thirty thousand DIN Standards covering nearly every field of technology. One of the earliest, and probably the most well-known, is DIN 476 — the standard that introduced the A-series paper sizes in 1922 — adopted in 1975 as International Standard ISO 216.

It was founded in 1917 as the Normenausschuss der deutschen Industrie (NADI, "Standardisation Committee of German Industry"). In 1926, the NADI was renamed Deutscher Normenausschuss (DNA, "German Standardisation Committee"), to reflect the fact that the organisation now dealt with standardisation issues in many fields; viz., not just for industrial products. Since 1975, the DNA is known as 'DIN' and is recognised by the German government as the official national-standards body, representing German interests at the international and European levels.

# **STANDARDS AND CERTIFICATIONS**

## **FIRE**

### **AS2941 Fixed fire protection installations - Pumpset systems**

This Standard specifies requirements for pumpset systems for use with fixed fire protection installations such as sprinkler, hydrant, water spray, and hose reel systems. It covers water supplies and specific requirements for pumps, drivers, fire pump controllers, and auxiliary equipment. Requirements for installation and acceptance testing for electrical and compression-ignition drivers are also included.

### **AS2419-2005 Fire hydrant installations**

This Standard sets out requirements for the design, installation, and commissioning of fire hydrant systems to protect properties. It applies to fire hydrant systems installed to protect buildings, structures, storage yards, marinas and associated moored vessels, wharves, and plant. This Standard also applies to street fire hydrants used in lieu of on-site fire hydrants or to supplement the coverage afforded by street fire hydrants. This standard has relevance as fire pump packages regularly include piping and valving.

### **AS2118 Fire Sprinkler Systems**

AS2118.1-06 (Sprinkler) and AS2118.6-95 (Combined Sprinkler/Hydrants) define the general requirements for automatic sprinkler systems. This has relevance as fire pump packages regularly include piping and valving.

### **NFPA20 Standard for the Installation of Stationary Fire Pumps for Fire Protection.**

This standard deals with the selection and installation of pumps supplying liquid for private fire protection. The scope of this document shall include liquid supplies; suction, discharge, and auxiliary equipment; power supplies, including power supply arrangements; electric drive and control; diesel engine drive and control; steam turbine drive and control; and acceptance tests and operation.

## **FM Certification**

*FM Approvals not only evaluates sprinklers and sprinkler system components for compliance with existing standards, but also work closely with manufacturers to evaluate new products and develop appropriate standards. FM provides certification for fire pump sets to be utilized in sprinkler systems. It approves both fire pump package components e.g. pump, driver, panel and also the package assembler.*

## OIL AND GAS

### **API 610 Centrifugal Pumps for General Refinery Service**

This International Standard specifies requirements for single and multistage centrifugal pumps, including pumps running in reverse as hydraulic power recovery turbines, for use in petroleum, petrochemical and gas industry process services. This Standard is applicable to overhung pumps, between-bearings pumps and vertically-suspended pumps. This Standard is not applicable to seal-less pumps.

### **API 685 Seal-less Centrifugal Pumps**

This standard covers the minimum requirements for seal-less centrifugal pumps for use in petroleum, heavy duty chemical and gas industry services. Single stage pumps of two classifications, magnetic drive pumps (MDP) and canned motor pumps (CMP), are covered by this standard.

### **API 674 Positive Displacement Pumps - Reciprocating**

This standard covers the minimum requirements for reciprocating positive displacement pumps for use in service in the petroleum, chemical, and gas industries. Both direct-acting and power-frame types are included.

### **API 675 Positive Displacement Pumps - Controlled Volume**

This standard covers the minimum requirements for controlled volume positive displacement pumps for use in service in the petroleum, chemical, and gas industries. Both packed-plunger and diaphragm types are included. Diaphragm pumps that use direct mechanical actuation are excluded.

### **API 676 Positive Displacement Pumps - Rotary**

This standard covers the minimum requirements for rotary positive displacement process pumps and pump units for use in the petroleum, petrochemical, and gas industry services.

### **ISO 13709 Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries**

This International Standard specifies requirements for centrifugal pumps, including pumps running in reverse as hydraulic power recovery turbines, for use in petroleum, petrochemical and gas industry process services. This International Standard is applicable to overhung pumps, between-bearings pumps and vertically suspended pumps. It is not applicable to seal/less pumps.

## PROCESS

### **ISO 9905:1994 Technical specifications for centrifugal pumps -- Class I**

The technical requirements refer only to the pump unit. Includes design features concerned with installation, maintenance and safety of such pumps, including baseplate, coupling and auxiliary piping. The selection of the class to be used is made in accordance with the technical requirements for the application for which the pump is intended. The class chosen is to be agreed between purchaser and manufacturer/supplier.

### **ISO 5199:2002 Technical Specifications for Centrifugal Pumps - Class II**

This International Standard specifies the requirements for Class II centrifugal pumps of single-stage, multistage, horizontal or vertical construction, with any drive and any installation for general application. Pumps used in the chemical process industries (e.g. those conforming to ISO 2858) are typical of those covered by this International Standard.

This International Standard includes design features concerned with installation, maintenance and safety for these pumps including baseplate, couplings and auxiliary piping, but it does not specify any requirements for the driver other than those related to its rated power output.

### **ISO 9908:1993 Technical specifications for centrifugal pumps -- Class III**

Covers class III requirements for centrifugal pumps of single stage, multistage, horizontal or vertical construction (coupled or close-coupled) with any drive and any installation for general application. Includes design features concerned with installation, maintenance and safety of such pumps including baseplate, coupling and auxiliary piping but excluding the driver, if it is not an integral part of the pump.

### **ISO 14847:1999 Rotary positive displacement pumps -- Technical requirements**

This standard specifies the technical requirements, other than safety and testing, for rotary positive displacement pumps and rotary positive displacement pump units. This standard does not apply to rotary positive displacement pumps for fluid power applications.

### **ISO 15783:2002 Seal-less centrifugal pumps - Class II – Specification**

This International Standard specifies the requirements for seal-less centrifugal pumps that are driven with permanent magnet coupling (magnet drive pumps) or with canned motor, and which are mainly used in chemical processes, water treatment and petrochemical industries.

Pumps will normally conform to recognised standard specifications (e.g. ISO 5199, explosion protection, electromagnetic compatibility), except where special requirements are specified herein. This International Standard includes design features concerned with installation, maintenance and operational safety of the pumps, and defines those items to be agreed upon between the purchaser and manufacturer/supplier.

### **ISO 16330:2003 Reciprocating positive displacement pumps and pump units -- Technical requirements**

This International Standard specifies the technical requirements, other than safety and testing, for reciprocating positive displacement pumps and pump units. It applies to pumps which utilise reciprocating motion derived from crankshafts and camshafts and also direct-acting fluid driven pumps. It does not apply to reciprocating positive displacement pumps, nor pumping water, where the whole pump is lubricated with the liquid being pumped.

### **ANSI/ASME B73.1 Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process**

This standard covers centrifugal pumps of horizontal, end suction single stage, centre-line discharge design. This Standard includes dimensional interchangeability requirements and certain design features to facilitate installation and maintenance. It is the intent of this Standard that pumps of the same standard dimension designation from all sources of supply shall be interchangeable with respect to mounting dimensions, size and location of suction and discharge nozzles, input shafts, baseplates, and foundation bolt holes.

### **ANSI/ASME B73.2 Specifications for Vertical In-Line Centrifugal Pumps for Chemical Process**

This Standard covers motor-driven centrifugal pumps of vertical shaft, single stage design with suction and discharge nozzles in line. It includes dimensional interchangeability requirements and certain design features to facilitate installation and maintenance. It is the intent of this Standard that pumps of the same standard dimension designation, from all sources of supply, shall be interchangeable with respect to mounting dimensions and size and location of suction and discharge.

### **ASME B73.3 Specification for Seal-less Horizontal End Suction Metallic Centrifugal Pumps for Chemical Process**

This Standard covers seal-less centrifugal pumps of horizontal end suction single stage and centre-line discharge design. This Standard includes dimensional interchangeability requirements and certain design features to facilitate installation and maintenance. It is the intent of this Standard that pumps of the same standard dimensional designation from all sources of supply shall be interchangeable with respect to mounting dimensions, size, and location of suction and discharge nozzles, input shafts, baseplates, and foundation bolt holes

### **ASME B73.5M Specification for Thermoplastic and Thermoset Polymer Material Horizontal End Suction Centrifugal Pumps for Chemical Process (not often used in Australia)**

This Standard covers centrifugal pumps of horizontal, end suction single stage, centreline discharge design, which components are made of thermoplastic and thermo-set polymer materials either reinforced or non-reinforced. It includes dimensional interchangeability requirements and certain design features to facilitate installation and maintenance. It is the intent of this Standard that pumps of the same standard dimension designation from all sources of supply shall be interchangeable with respect to mounting dimensions, size, and location of suction and discharge nozzles, input shafts, baseplates, and foundation bolt holes. This Standard does not include lined or non polymer components.

### **ANSI/HI 3.1-3.5 Rotary Pumps (not often used in Australia)**

This standard applies to industrial rotary positive displacement pumps. It includes: types and nomenclature; definitions; design and application, operation and maintenance. The updated standard also includes:

- Capability tables in both metric and US customary units providing comparisons of rate of flow, pressure, viscosity, solids and abrasive handling, reversible rotation, and power range for 11 different types of rotary pumps;
- A consolidated range chart providing a comparison of pressure and rate of flow in both metric and US customary units for 11 different rotary pump types;
- Detailed explanation of each rotary pump type including basic operation, design features, typical applications, and driver requirements;

- New and updated cross-sectional illustrations of popular rotary pump designs;
- Revised and expanded list of definitions;
- Listing of viscosities of common fluids;
- Plot of efficiency vs. rate of flow for different pump types;
- A completely new section on multiphase pumps for oil and gas applications.

#### **ANSI/HI 4.1-4.6 Seal-less Rotary (not often used in Australia)**

This standard applies to industrial rotary positive displacement pumps. It includes: types and nomenclature, definitions; design and application; installation, operation and maintenance; and test. It does not include standards on magnetic drives for seal-less pumps.

#### **ANSI/HI 5.1-5.6 Seal-less Centrifugal Pump Standards (not often used in Australia)**

This standard is for seal/less centrifugal pumps that are driven by canned motors or magnetic couplings. It includes types and nomenclature; definitions; design and application; installation, operation/maintenance and testing. The testing section includes:

- Hermetic Integrity Test
- Mechanical Integrity Test
- Winding Integrity Test

#### **ANSI/HI 6.1-6.5 Reciprocating Power Pump Standard (not often used in Australia)**

This Standard applies to industrial/commercial reciprocating power pumps. It includes:

- Types and Nomenclature
- Definitions
- Design and Application
  - Basic Speeds
  - Pump Torque Characteristics
  - Calculating Volumetric Efficiency
- Installation
  - Protection of Pump Against Seepage or Flood
  - Drive Alignment after Piping Installation
- Operation and Maintenance

#### **ANSI/HI 7.1-7.5 Controlled Volume Metering Pumps (not often used in Australia)**

This Standard applies to Controlled-Volume Metering Pumps, which are reciprocating power pumps used to accurately displace a predetermined volume of liquid within a specified time. It contains sections on:

- General Description
- Types and Nomenclature
- Definitions
- Application and sizing
  - Typical performance curves
  - Materials of construction
  - Control methods
- Installation
  - Storage recommendations
- Operation and trouble solving

#### **ANSI/HI 10.1-10.5 Air Operated Pumps (to our knowledge the only standard available for this type of pump and to date not seen in Australia)**

This standard is for air-operated pumps and includes those positive displacement reciprocating pumps used for general fluid transfer, which are driven by means of a compressed gas (usually air) from an outside source. The pump may be designed with a single diaphragm or double diaphragms connected to a reciprocating shaft in which one side of the diaphragm is in contact with the liquid being pumped and the other side is in contact with the compressed gas. The standard includes the following sections:

- Types, configurations, and nomenclature
- Definitions
- Design and Application
- Installation, Operation, and Maintenance

#### **ANSI/HI 12.1-12.6 Centrifugal Slurry Pumps (not often used in Australia)**

This standard for centrifugal slurry pumps for nomenclature, definitions, applications and operation addresses a long-standing challenge in the wastewater pump industry for development and acceptance of a test standard written specifically for slurry pumps. The scope of this standard includes:

- Slurry pump types
- Types of slurries

- Slurry limitations
- Slurry solids effect on pumps
- Pumping of froth, pump wear, and application

The standard provides requirements for wet-end and bearing housing shaft seals, establishes allowable nozzle loads, and provides a data sheet that can be used by purchasers and vendors to exchange information.

## GENERAL PURPOSE

### **ISO 2858:1975 End-suction centrifugal pumps (rating 16 bar) -- Designation, Nominal duty point and Dimensions**

The standard covers the ISO requirements for general purpose pumps primarily for use with water. The pump designation consists of three numbers detailing suction and discharge connection sizes and nominal impeller diameter in mm e.g. 125 x 100-250. The table covers flange sizes from 50 mm up to and including 200 mm. This is primarily a dimensional standard.

### **DIN 24255 End-suction centrifugal pumps (normal rating 10 bar although some may claim 16 bar)**

This specification details single stage, end suction overhung impeller centrifugal pumps for general purpose applications design to be used primarily with water up to a maximum of 120 C. This is primarily a dimensional standard. The majority of DIN 24255 pumps supplied in Australia are manufactured in China.