HI 50.7-2010

Hydraulic Institute Standard for

# Electronic Data Exchange for Pumping Equipment

Hydraulic Institute

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# Electronic Data Exchange for Pumping Equipment

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## **Foreword** (Not part of Standard)

### Purpose and aims of the Hydraulic Institute

The purpose and aims of the Institute are to promote the continued growth and well-being of pump users and manufacturers and further the interests of the public in such matters as are involved in manufacturing, engineering, distribution, safety, transportation and other problems of the industry, and to this end, among other things:

a) To develop and publish standards for pumps;

b) To collect and disseminate information of value to its members and to the public;

c) To appear for its members before governmental departments and agencies and other bodies in regard to matters affecting the industry;

d) To increase the amount and to improve the quality of pump service to the public;

e) To support educational and research activities;

f) To promote the business interests of its members but not to engage in business of the kind ordinarily carried on for profit or to perform particular services for its members or individual persons as distinguished from activities to improve the business conditions and lawful interests of all of its members.

### Purpose of Standards

1) Hydraulic Institute Standards are adopted in the public interest and are designed to help eliminate misunderstandings between the manufacturer, the purchaser and/or the user and to assist the purchaser in selecting and obtaining the proper product for a particular need.

2) Use of Hydraulic Institute Standards is completely voluntary. Existence of Hydraulic Institute Standards does not in any respect preclude a member from manufacturing or selling products not conforming to the Standards.

### Definition of a Standard of the Hydraulic Institute

Quoting from Article XV, Standards, of the By-Laws of the Institute, Section B:

"An Institute Standard defines the product, material, process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, quality, rating, testing and service for which designed."

### Comments from users

Comments from users of this standard will be appreciated, to help the Hydraulic Institute prepare even more useful future editions. Questions arising from the content of this standard may be directed to the Technical Director of the Hydraulic Institute. The inquiry will then be directed to the appropriate technical committee for provision of a suitable answer.

If a dispute arises regarding contents of an Institute Standard or an answer provided by the Institute to a question such as indicated above, the point in question shall be sent in writing to the Technical Director of the Hydraulic Institute, who shall initiate the appeals process.

Moreover, no person shall have the right or authority to issue an interpretation of a Hydraulic Institute Standard in the name of the Hydraulic Institute. Requests for interpretations should be addressed to the Technical Director of the Hydraulic Institute.

### Revisions

The Standards of the Hydraulic Institute are subject to constant review, and revisions are undertaken whenever it is found necessary because of new developments and progress in the art. If no revisions are made for five years, the standards are reaffirmed using the internal Hydraulic Institute balloting procedures and a peer review.

## Disclaimer notice

The Electronic Data Exchange (EDE) Committee prepared this standard. Neither the Hydraulic Institute, its EDE committees, nor any person acting on behalf of the Hydraulic Institute: a) makes any warranty, expressed or implied, with respect to the use of any information, apparatus, method, or process disclosed in this standard or guarantees that such may not infringe privately owned rights; b) assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this standard. The Hydraulic Institute is in no way responsible for any consequences to an owner, operator, user, or anyone else resulting from reference to the content of this standard, its application, or use.

This standard does not contain a complete statement of all requirements, analyses, and procedures necessary to ensure safe or appropriate selection, installation, testing, inspection, and operation of any pump or associated products. Each application, service, and selection is unique with process requirements that shall be determined by the owner, operator, or his designated representative.

## Units of measurement

Metric units of measurement are used, and corresponding US customary units appear in brackets. Charts, graphs, and sample calculations are also shown in both metric and US customary units. Since values given in metric units are not exact equivalents to values given in US customary units, it is important that the selected units of measure to be applied be stated in reference to this standard. If no such statement is provided, metric units shall govern.

## Committee list

This standard was produced by a working committee that met many times to facilitate its development. At the time the standard was approved, the committee had the following members:

*Chair* – Dr. Trygve Dahl, Intelliquip, LLC
*Vice-chair* – Michael Mueller, Flowserve Pump Division

| **Committee Members** | **Company** |
|---|---|
| Kenneth Burkhardt | DuPont |
| David McKinstry | IMO Pump/Colfax Corp. |
| John Owen (Alternate) | IMO Pump/Colfax Corp. |
| Mark Palmer | National Institute of Standards Technology |
| Robert Rollings (Alternate) | DuPont |
| Fred Walker | Weir Floway, Inc. |

| **Other Contributors:** | |
|---|---|
| Henri Azibert | A.W. Chesterton Company |
| James Bonifas | Emerson Motors/US Motors |
| Scott Frees | Intelliquip, LLC |
| Ralph Gabriel | John Crane, Inc. |
| Ray Hardee | Engineered Software, Inc. |
| Denairic Hardersen | Aurora Pump |
| Gary Leander | Weir Minerals North America |
| Roy Lightle | Engineered Software, Inc. |
| Michael Meyers | Sundyne |
| Zeki Oral | Grundfos Pumps USA |
| Costas Papadakis | ITT |
| Wendy Peppel | Weir Floway, Inc. |
| Timothy Rahill | Siemens Industry, Inc. |
| David Tress | Intelliquip, LLC |
| Trey Walters | Applied Flow Technology |
| Randolph West | BigMachines, Inc. |
| Jeffrey Williams | Patterson Pump Company |

Additional thanks to Mary Turton, Alar Engineering, Inc.; Karen Anderson, Hydraulic Institute; American Petroleum Institute (API); American Society of Mechanical Engineers (ASME); and support from FIATECH and the National Institute of Standards and Technology (NIST).

## 50.7 Electronic data exchange for pumping equipment

### 50.7.1 Introduction

This document explains the electronic data exchange (EDE) initiative of the Hydraulic Institute promoting a common standard for the digital exchange of technical data for pumping equipment. This document also provides guidance for implementing these requirements in software applications and for the successful deployment of electronic data exchange within an enterprise and between various stakeholders in the design, purchase, manufacture, installation, operation, and maintenance of pumping equipment. This standard was developed in collaboration with the FIATECH/AEX project and is endorsed by, and referenced within, API 610, 11th ed.; ISO 13709, 2nd ed.; Process Industry Practices (PIP) standards; and the ANSI/ASME B73 standards. This HI-EDE standard is intended for use by business leaders, engineers, and information technologists at organizations involved in processing technical data for all types of pumping equipment.

#### 50.7.1.1 Purpose of standard

The purpose of this standard is to define a common industry standard for the electronic exchange of technical data commonly used to describe pumping equipment. All software applications or systems that adhere to this standard are able to exchange technical data reliably and efficiently with all other systems that comply with this standard.

#### 50.7.1.2 Scope of standard

The scope of this standard includes the following:

- Data exchanged in procurement, bidding, and quoting transactions for various types of pumping equipment including, but not limited to, rotodynamic (centrifugal) pumps
- An electronic data dictionary with a supporting set of data elements and their definitions
- Data elements grouped into various compliance levels
- Data exchange standards utilizing the XML (see Section 50.7.1.3.2) schemas developed by FIATECH/AEX
- Standard units of measure and conversion for HI-EDE transactions

#### 50.7.1.3 Background

In the pump industry, technical information is shared throughout the supply chain, i.e., among purchasers, suppliers, engineering contractors, procurement, operations, and maintenance, playing a crucial role in the life cycle of pumping equipment and pumping systems. Using, storing, and managing this technical information contributes to the overall design, procurement, and maintenance costs of the equipment. This information is often created, reviewed, used, and updated with numerous software applications by the stakeholders over the life cycle of the pump and the pumping system.

Electronic data exchange (EDE) is the process of sending and receiving technical and commercial information using digital file transfer methodologies. This data exchange is accomplished using neutral XML files. The XML files created using this standard will allow users and suppliers to work in their existing computer environments. An interface will convert the data to a neutral XML file, which can be easily stored and exchanged using conventional electronic means. The recipient of the XML file can quickly upload it into their own internal software using an interface. EDE is advantageous over conventional paper-based or manual methods because the data are reliably transferred between purchasers and suppliers without time-consuming and error-prone manual transcription of data.

##### 50.7.1.3.1 Industry use of data sheets

The inability to electronically and reliably exchange information between software applications is a major source of inefficiencies and delays in capital facility and procurement projects. The industry generally uses various layouts of equipment data sheets to collect, organize, and exchange the technical information about the functional and physical requirements for mechanical equipment. These data sheets range from company-specific formats to industry standard layouts. In addition to the variation in data sheet layouts, there are inconsistencies in the vocabulary and nomenclature used for describing engineered equipment.

Users, contractors, equipment manufacturers, and suppliers must accommodate the different layouts of the equipment data sheets and must expend significant amounts of time and labor to decipher the inconsistencies in filling out the equipment data sheets and manage the transcription of technical information among organizations and the different software applications. The purpose of this electronic data exchange standard is to provide a means to transfer technical data for pumping equipment in a defined, standardized manner.

### 50.7.1.3.2 An enabling technology – XML

XML (eXtensible Markup Language), which emerged in the late 1990s, provides an enabling technology offering the potential to promote widespread, cost-effective electronic data exchange among software systems. XML is a fundamental Internet technology standard that is broadly recognized and supported. Information, training, tools, and skilled personnel are readily available to build XML support into existing and new software systems.

XML is a user-definable text file format that provides the capability to store highly structured digital information in a standardized, software neutral text file. XML will work on virtually any computer hardware and operating system platform and with any software program. As a result, XML can be used both for software neutral data exchange today, and for long-term data archival and reuse. Like the Hyper-Text Markup Language (HTML) used on most Internet Web sites, XML is derived from the ISO 8879 Standard Generalized Markup Language (SGML). The World Wide Web Consortium (W3C) defined XML as a recommended Internet standard in 1998.

HTML, XML, and SGML are all text-based, computer-interpretable "tag" languages where information is enclosed inside markup tags. HTML tells you how the information is displayed in a browser or on a printed page. A simple example of HTML using pump data follows:

```
<p>Centrifugal pump
<br>Model P280
<br>ABC Pumps
```

In contrast, XML provides an added dimension by describing data in terms of referenceable data elements. Where HTML describes "how" data is displayed, XML describes "what it means" and essentially offers a database structure in a flat file format. An example of XML is shown below:

```
<pump>
    <type>Centrifugal</type>
    <model>Model P280</model>
    <supplier>ABC Pumps</supplier>
</pump>
```

In order for XML to be an effective technology for electronic data exchange, industry users need to agree on common XML tags, tag structures, and definitions – an electronic vocabulary. In May 2001, W3C defined a related standard, called *XML Schema* (www.w3.org/XML/Schema/html), which provides the ability to define tag structures that support rich data types such as real numbers, integers, Booleans, dates, etc., and object-oriented complex data structures. This is the fundamental technology used in this standard to exchange data between various software applications or systems.

### 50.7.1.3.3 Industry partnerships

To promote a common electronic vocabulary suitable for use in the pump industry, a set of industry standards is required that addresses both the XML structures as well as the pump domain knowledge. Development of an effective electronic data exchange standard requires broad support both outside and within the pump industry.

 

The FIATECH[1] organization started the AEX (Automating Equipment Information Exchange) project to streamline the equipment supply chain, eliminate redundant input of data, and automate information exchange. The initial focus of the AEX project was to understand general work processes, software applications, and technical information that describe engineered equipment. Equipment data sheets, equipment lists, and material properties for nearly 50 different types of mechanical equipment, including pumps, were studied and included in the broad range of applicable equipment types of interest by AEX. Through a cooperative agreement between HI and AEX, the AEX project provided the XML schema architecture that HI could adopt and use toward the development of a "pump-specific" standard for electronic data exchange.

Other standards bodies within the pump industry expressed a desire to develop and support electronic data exchange initiatives for pumping equipment. Through additional cooperative agreements, the HI-EDE standard is also referenced and endorsed in the following standards:

- API 610, 11th ed.: Standard for *Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries*. The American Petroleum Institute (API) and its Subcommittee on Mechanical Equipment.
- ANSI/ASME B73.1: *Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process.*
- ANSI/ASME B73.2: *Specification for Vertical In-Line Centrifugal Pumps for Chemical Process.*
- ISO 13709, 2nd ed.: Standard for *Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries.*
- *Practices*, published by Process Industry Practices (PIP), the consortium of process industry owners and engineering construction contractors who serve the industry and related equipment and software suppliers.

Further, the AEX project has established other cooperative working relationships with industry groups with similar interests, including American Society for Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) and Design Institute for Physical Properties (DIPPR). The AEX project is also participating in the Accelerating Deployment of ISO 15926 (ADI) project.

### 50.7.1.4 Overview of the HI-EDE standard

#### 50.7.1.4.1 Overview

This HI-EDE standard explains the overall purpose of the electronic data exchange initiative of the Hydraulic Institute and the work with industry groups such as the FIATECH Automating Equipment Information Exchange (AEX) project. The requirements for software implementations to be compliant with this HI-EDE standard are outlined in the section describing the HI data transaction, and formalized in the section on implementation guidelines. Further guidance for implementing these requirements in software applications and for the successful deployment of this standard within an enterprise and across various stakeholders in the design, purchase, manufacture, installation, operation, and maintenance of pumps and pumping systems is also described.

#### 50.7.1.4.2 Intended audience for the standard

This standard addresses three categories of users:

- **Business leaders/managers.** These users are seeking new and improved means of driving cost reductions and process efficiencies within their organizations. These users in the corporate, sales, marketing, engineering, oper-

[1] FIATECH is a nonprofit industry consortium with the mission of providing leadership in identifying and accelerating the development, demonstration, and deployment of fully integrated and automated technologies to deliver the highest business value throughout the life cycle of all types of capital facilities projects. FIATECH's vision is a future state where capital facilities projects are executed in highly automated and seamlessly integrated environments across all phases and processes of the capital project life cycle. FIATECH members include owner-operators, engineering companies, equipment suppliers, and software suppliers. More information about this consortium can be found at the FIATECH Web site (www.fiatech.org).

ations, procurement, or information technology functions will be the visionaries and decision makers who review and promote adoption of the standard within their organizations.

- **Pump specifiers and manufacturers.** These users are purchasers, manufacturers, distributors, or specifiers of pumping equipment. They are typically practicing procurement, sales, applications, or product specialists of pumping equipment. These will be the primary users of systems that adopt the standard.

- **Information technology (IT) staff/IT system implementation specialists.** These are the information technology or system/software integration specialists ultimately involved with implementing this standard into existing or emerging software systems. These users will implement the standard and maintain the affected systems during their life cycle.

The following sections are recommended reading or optional reading based on the user's position.

| Section | Title | Business Leaders/ Managers | Pump Specifiers and Manufacturers | IT Staff/ Implementers |
|---|---|---|---|---|
| 50.7.1 | Introduction | ● | ● | ● |
| 50.7.2 | Defining the pump data transaction | ● | ● | ❍ |
| 50.7.3 | The HI pump data transaction set | ● | ● | ● |
| 50.7.4 | Implementation guidelines | ❍ | ❍ | ● |
| 50.7.5 | Getting started with AEX XML | ❍ | ❍ | ● |

● Recommended reading.
❍ Optional reading.

#### 50.7.1.4.3 Normative and informative content

This standard combines both informative and normative content.

The normative portion of this standard is prescriptive in nature and thereby mandatory for compliance to this standard. The normative content in this standard is isolated to Sections 50.7.3.2 to 50.7.3.7, inclusive, and Section 50.7.4.1.

The content found in Sections 50.7.1, 50.7.2, 50.7.3 (except 50.7.3.2 to 50.7.3.7, inclusive), 50.7.4.2, 50.7.5, and 50.7.6 is informative and not mandatory for compliance to this s'tandard. The significant informative content available in this standard offers the user a better understanding of the broad applicability and thorough background that led to the development of the normative portions of the standard.

## 50.7.2 Defining the pump data transaction

### 50.7.2.1 Information flow in the equipment life cycle work process

The equipment life cycle work process requires a flow of information between each of the major work process steps shown in Figure 50.7.2.1a. Software systems have emerged to reduce the time and labor involved in the work processes and to improve the quality of these information flows. As a consequence, these information flows increasingly include electronic documents produced by the software systems used throughout the equipment life cycle (see Figure 50.7.2.1b).

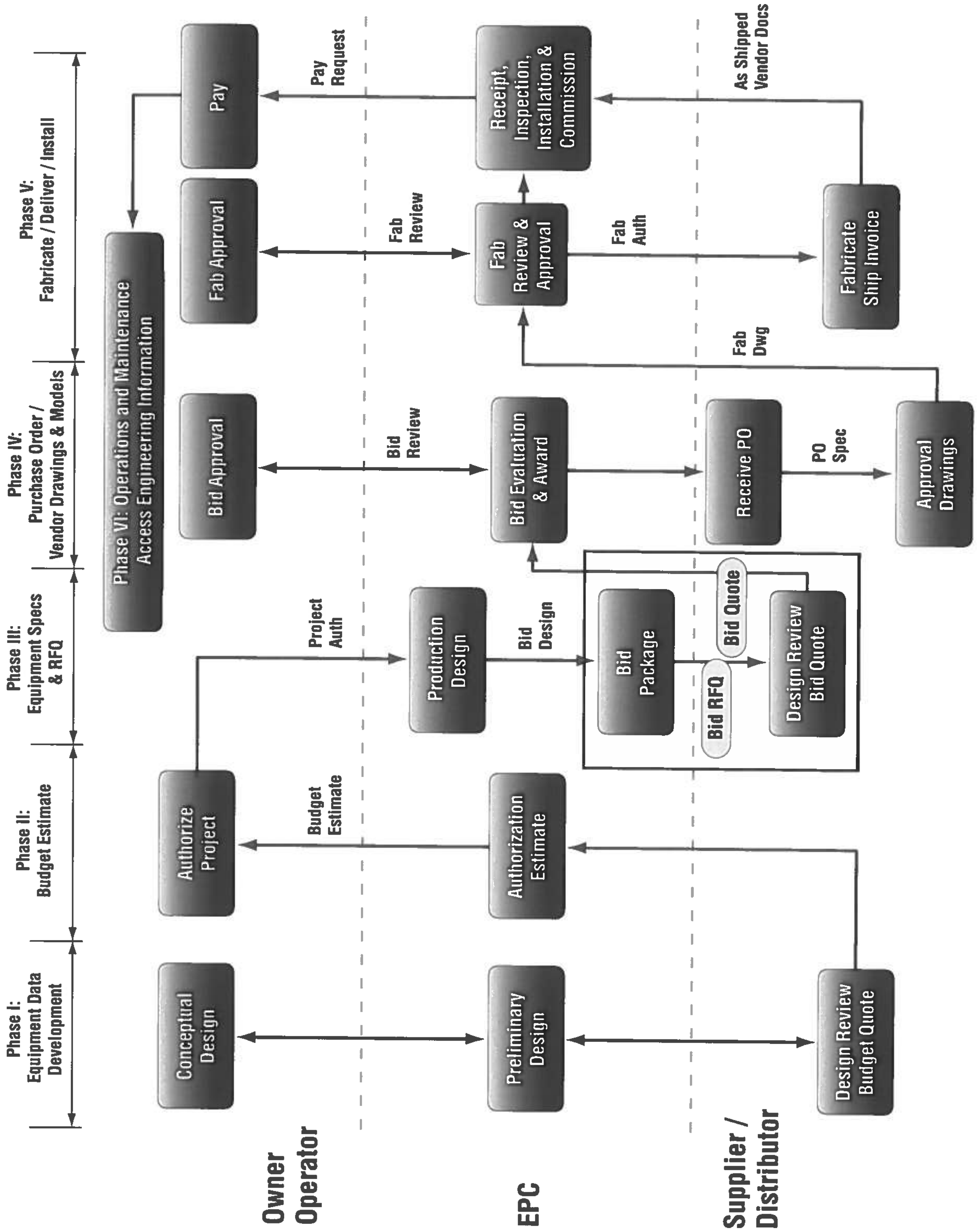


**Figure 50.7.2.1a — Equipment life cycle work process (Courtesy of FIATECH/AEX)**

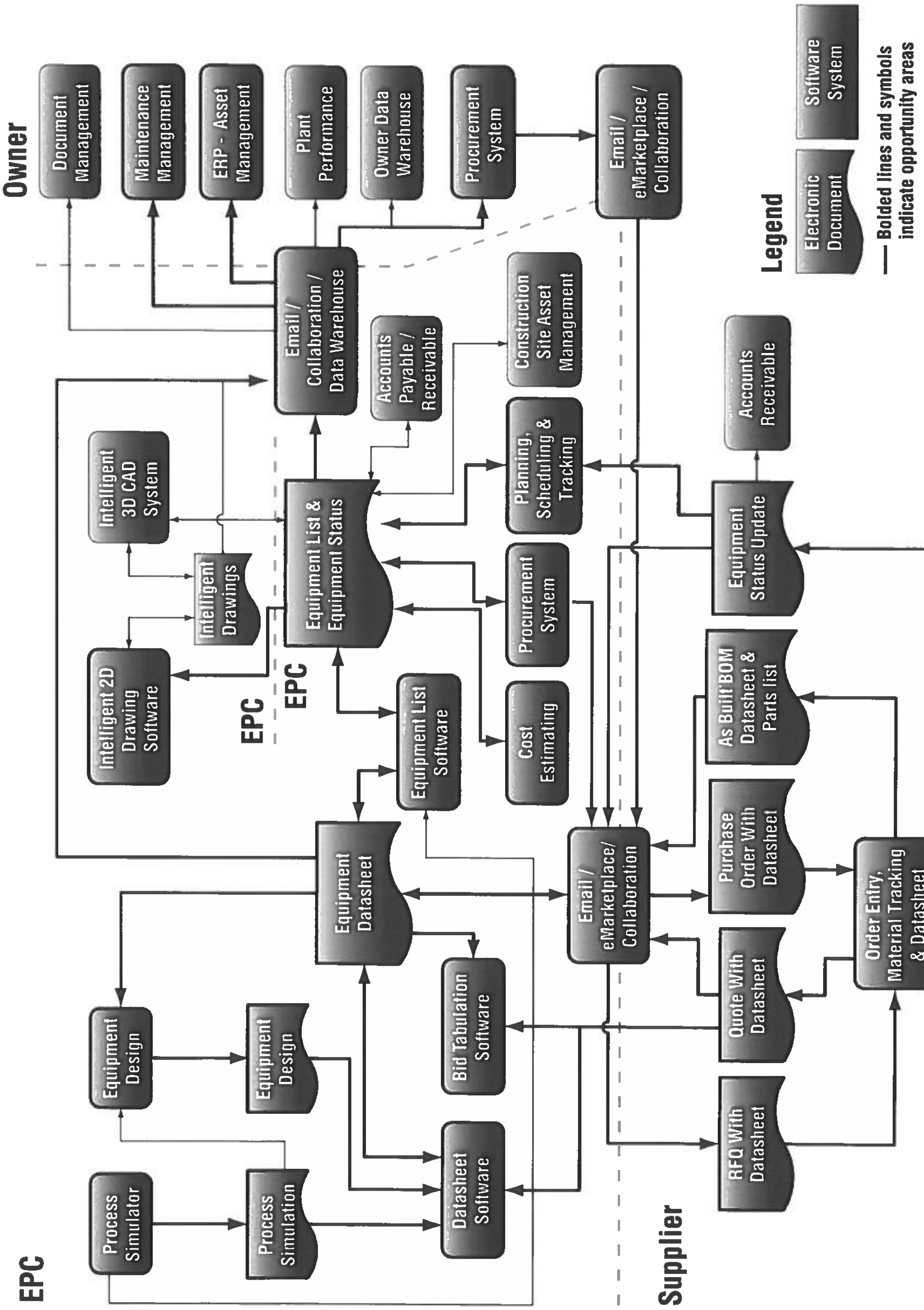


Figure 50.7.2.1b — Software and information flows for equipment life cycle (Courtesy of FIATECH/AEX)

#### 50.7.2.2 Software systems and documents used

The work process and information flows in Figure 50.7.2.1b illustrate the breadth of technical data that is considered part of the overall information flow in the pumping equipment life cycle. The following are representative software systems and document types that could benefit from electronic data exchange.

The software system types included:

- Process simulation
- Equipment design
- Equipment data sheet production
- Equipment and instrument tracking
- Intelligent piping and instrumentation diagram (P&ID) production
- Cost estimating
- Procurement
- Bid tabulation
- Order entry and tracking
- Collaboration
- E-Marketplace
- Planning, scheduling, and tracking
- Enterprise resource planning (ERP) – asset management
- Maintenance management
- Integration
- Data warehouse

The key document types included:

- Process simulation reports
- Equipment design reports
- Equipment data sheet
- Equipment list
- Bill of material
- Intelligent drawing
- Equipment status update

#### 50.7.2.3 Pump technical data

One of the most useful and relevant sources of technical data conveyed in any of the work processes, software systems, or embodied in a key document type is that found in a *pump data sheet*. Virtually all work processes involve the presentation of technical information as a data sheet. In the pump industry, there are data sheet formats published by standards organizations for general use in the industry. A few well-known examples used for rotodynamic (centrifugal) pumps are the data sheets published in:

- API 610, Standard for *Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries*. The American Petroleum Institute and its Subcommittee on Mechanical Equipment.

- ISO 13709, Standard for *Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries*.

- PIP RESP73 data sheet

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

  – ANSI/ASME B73.2: *Specification for Vertical In-Line Centrifugal Pumps for Chemical Process*.

Examples of these data sheets are found in Figures 50.7.2.3a and b, respectively. Many other data sheets in use are actually found to be close derivatives of these two prominent examples.

#### 50.7.2.4 Forming a data exchange dictionary

The pump data sheets described in the previous section are a convenient basis for developing a dictionary of data elements (i.e., "data dictionary") that is used in the software systems and documents outlined in Section 50.7.2.2. A comprehensive data dictionary is readily created by compiling a list of data elements from relevant data sheets used in the pump industry. For example, imagine a process where a data dictionary is created by combining the data elements in both the API 610 and PIP data sheets. Further, imagine that data elements from additional data sheets are referenced and combined into this data dictionary. By introducing these new data sheets, one observes that most, if not all, of the data elements in the new data sheets are already contained in the data dictionary. This is analogous to finding common English words used in everyday speech and writing in a popular dictionary, such as Webster's.

Thus, the essential theme of electronic data exchange (EDE) is:

- There is a bounded set of data elements that is defined and documented for use by the sender and receiver of that information. This is analogous to *Webster's Dictionary*.

- There is a digital format that any software application can read and write in order to communicate the data elements in the data dictionary. This is analogous to following rules of grammar to logically combine individual words into effective communication that is understood and processed.

In this standard, the digital format is based on XML, with all the benefits described in Section 50.7.1.3.2. Secondly, the bounded set of data elements is the technical data dictionary that is found in a pump data sheet as described in Section 50.7.2.2. The digital XML file format and its contents comprise a *neutral data exchange file*. Once this information is captured in a neutral data exchange file (the XML file), then the interfacing software tools can readily display the data in any data sheet view/report desired.

The next sections formally describe the data elements contained within this HI-EDE standard as well as the XML transaction files used to communicate these data between supported software applications and systems.

**Centrifugal pump process data sheet — SI units**

PAGE 1 OF

JOB NO. ITEM NO.(S)
REQ. / SPEC. NO. /
PURCH. ORDER NO. DATE
ENQUIRY NO. BY

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ☒ AS BUILT
FOR UNIT
SITE SERVICE
NOTES: INFORMATION BELOW TO BE COMPLETED: ○ BY PURCHASER ☐ BY MANUFACTURER ☒ BY MANUFACTURER OR PURCHASER

| ○ DATA SHEETS | | | | | | | REVISIONS | | |
|---|---|---|---|---|---|---|---|---|---|
| | ITEM NO. | ATTACHED | ITEM NO. | ATTACHED | ITEM NO. | ATTACHED | NO. | DATE | BY |
| PUMP | | ○ | | ○ | | ○ | 1 | | |
| MOTOR | | ○ | | ○ | | ○ | 2 | | |
| GEAR | | ○ | | ○ | | ○ | 3 | | |
| TURBINE | | ○ | | ○ | | ○ | 4 | | |
| APPLICABLE OVERLAY STANDARD(S): | | | | | | | 5 | | |

○ OPERATING CONDITIONS (5.1.3)

FLOW, NORMAL (m³/h) RATED (m³/h)
OTHER
SUCTION PRESSURE MAX./RATED / (MPa)
DISCHARGE PRESSURE (MPa)
DIFFERENTIAL PRESSURE (MPa)
DIFF. HEAD (m) NPSHA (m)
PROCESS VARIATIONS (5.1.4)
STARTING CONDITIONS (5.1.4)
SERVICE: ○ CONT. ○ INTERMITTENT (STARTS/DAY)
○ PARALLEL OPERATION REQ'D (5.1.13)

○ SITE DATA (5.1.3)

LOCATION: (5.1.30)
○ INDOOR ○ HEATED ○ OUTDOOR ○ UNHEATED
○ ELECTRICAL AREA CLASSIFICATION (5.1.24 / 6.1.4)
CL GR DIV
○ WINTERIZATION REQ'D ○ TROPICALIZATION REQ'D.
SITE DATA (5.1.30)
○ ALTITUDE (m) BAROMETER (MPa)
○ RANGE OF AMBIENT TEMPS: MIN./MAX. / (°C)
○ RELATIVE HUMIDITY: MIN. / MAX. / (%)
UNUSUAL CONDITIONS: (5.1.30) ○ DUST ○ FUMES
○ OTHER

○ DRIVER TYPE

○ INDUCTION MOTOR ○ STEAM TURBINE ○ GEAR
○ OTHER

○ MOTOR DRIVER (6.1.1 / 6.1.4)

☒ MANUFACTURER
☐ (kW) ☐ (r/min)
☐ FRAME ☒ ENCLOSURE
☒ HORIZONTAL ☒ VERTICAL ☒ SERVICE FACTOR
☒ VOLTS/PHASE/HERTZ / /
○ TYPE
○ MINIMUM STARTING VOLTAGE (6.1.5)
☒ INSULATION ○ TEMP. RISE
☒ FULL LOAD AMPS
☒ LOCKED ROTOR AMPS
☒ STARTING METHOD
☒ LUBE
BEARINGS (TYPE/NUMBER):
☐ RADIAL /
☐ THRUST /
☐ VERTICAL THRUST CAPACITY
UP (N) DOWN (N)

○ LIQUID (5.1.3)

LIQUID TYPE OR NAME
○ HAZARDOUS ○ FLAMMABLE ○ (5.1.5)

| | MIN. | NORMAL | MAX. |
|---|---|---|---|
| PUMPING TEMP (°C) | | | |
| VAPOUR PRESS. (MPa) | | | |
| RELATIVE DENSITY (SG): | | | |
| VISCOSITY (mPa·s) | | | |

SPECIFIC HEAT, Cp (kJ/kg·K)
○ CHLORIDE CONCENTRATION (6.5.2.4) (mg/kg)
○ $H_2S$ CONCENTRATION (mol fraction) WET (5.12.1.12c)
CORROSIVE / EROSIVE AGENT (5.12.1.9)

MATERIALS (5.12.1.1)

○ ANNEX H CLASS (5.12.1.1)
○ MIN DESIGN METAL TEMP (5.12.4.1) (°C)
○ REDUCED-HARDNESS MATERIALS REQ'D. (5.12.1.12)
☐ BARREL/CASE IMPELLER
☐ CASE/IMPELLER WEAR RINGS
☐ SHAFT
☐ DIFFUSERS

☒ PERFORMANCE:

PROPOSAL CURVE NO. ☐ r/min
☐ IMPELLER DIA. RATED MAX. MIN. (mm)
☐ IMPELLER TYPE
☐ RATED POWER (kW) EFFICIENCY (%)
☐ MINIMUM CONTINUOUS FLOW:
THERMAL (m³/h) STABLE (m³/h)
☐ PREFERRED OPER. REGION TO (m³/h)
☐ ALLOWABLE OPER. REGION TO (m³/h)
☐ MAX. HEAD @ RATED IMPELLER (m)
☐ MAX. POWER @ RATED IMPELLER (kW)
☐ NPSHR AT RATED FLOW (m) (5.1.10)
☒ MAX. SUCTION SPECIFIC SPEED: (5.1.11)
☒ MAX. SOUND PRESS. LEVEL REQ'D (dBA) (5.1.16)
☒ EST. MAX. SOUND PRESS. LEVEL (dBA) (5.1.16)
☒ EST. MAX. SOUND POWER LEVEL (dBA) (5.1.16)

○ UTILITY CONDITIONS (5.1.3)

| ELECTRICITY | VOLTAGE | PHASE | HERTZ |
|---|---|---|---|
| DRIVERS | | | |
| HEATING | | | |

SYSTEM VOLTAGE DIP ○ 80% ○ OTHER (6.1.5)

| STEAM | MAX. PRESS. | MAX. TEMP. | MIN. PRESS. | MIN. TEMP. |
|---|---|---|---|---|
| DRIVERS | | | | |
| HEATING | | | | |

COOLING WATER: (5.1.19) SOURCE
SUPPLY TEMP. (°C) MAX. RETURN TEMP. (°C)
NORM. PRESS. (MPa) DESIGN PRESS. (MPa)
MIN. RET. PRESS. (MPa) MAX. ALLOW. D.P. (MPa)
CHLORIDE CONCENTRATION: (mg/kg)

**Figure 50.7.2.3a — API 610 10th ed./ISO 13709:2003 data sheet (Reproduced courtesy of the American Petroleum Institute)**

| PIP | ASSOC. PIP RESP73H/V | DATA SHEET | RESP73-D |
|---|---|---|---|
| | ASME CENTRIFUGAL PUMPS (US CUSTOMARY UNITS) | | PAGE 1 OF 3 FEBRUARY 2007 |

ISSUED FOR ☐ PROPOSAL ☐ PURCHASE ☐ AS BUILT
FACILITY NAME/LOCATION
ITEM NAME — PURCHASER/LOCATION
ITEM TAG NO — JOB NO
SERVICE — PURCHASER ORDER NO
UNIT — SUPPLIER/LOCATION
P&ID NO — SUPPLIER ORDER/SERIAL NOS /

DATA PROVIDED BY ● PURCHASER ■ SUPPLIER ◆ SUPPLIER IF NOT BY PURCHASER

● GENERAL

NO PUMPS REQ — ◆ PUMP SIZE — ◆ PUMP MODEL — ◆ PUMP TYPE
NUMBER MOTOR DRIVEN — NUMBER TURBINE DRIVEN — GEARBOX ITEM NUMBER
MOTOR ITEM NUMBER — TURBINE ITEM NUMBER — GEARBOX PROVIDED BY
MOTOR PROVIDED BY — TURBINE PROVIDED BY — GEARBOX MOUNTED BY
MOTOR MOUNTED BY — TURBINE MOUNTED BY

● OPERATING CONDITIONS

| | RATED | MAX | NORMAL | MIN | |
|---|---|---|---|---|---|
| CAPACITY | | | | | GPM |
| SUCTION PRESSURE | | PSIG | | | |
| DISCHARGE PRESSURE | | PSIG | | | |
| DIFFERENTIAL PRESSURE | | PSI | | | |
| DIFFERENTIAL HEAD | | FT @ MINIMUM S G | | | |
| HYDRAULIC POWER | | HP | | | |
| OPERATING TIME | | | | | HR/YR |
| NPSH AVAILABLE | | | | | FT |

SUCTION SPECIFIC SPEED, MAXIMUM
SYSTEM DESIGN
☐ STAND ALONE OPERATION ☐ PARALLEL OPERATION
☐ SERIES OPERATION WITH ITEM NUMBER
SUCTION PRESSURE MIN/MAX / PSIG
SERVICE
☐ CONTINUOUS ☐ INTERMITTENT STARTS/DAY
SYSTEM CONTROL METHOD
☐ SPEED ☐ FLOW ☐ LEVEL ☐ TEMPERATURE
☐ PRESSURE ☐ PIPE FRICTION RESISTANCE ONLY

■ PERFORMANCE

PERFORMANCE CURVE NO — ◆ SPEED RPM
MEASURED AT CAPY: RATED MAX NORMAL MIN
NPSH REQ'D FT
TOTAL DIFFERENTIAL HEAD @ RATED IMPELLER FT
MAX DIFFERENTIAL HEAD @ RATED IMPELLER FT
MINIMUM CONTINUOUS FLOW
THERMAL GPM STABLE GPM
ALLOWABLE OPERATING REGION TO GPM
BEST EFFICIENCY POINT FOR RATED IMPELLER GPM
SUCTION SPECIFIC SPEED
IMPELLER DIA RATED MAX MIN IN
PUMP RATED POWER BHP EFFICIENCY %
MAXIMUM POWER @ RATED IMPELLER BHP

CASE PRESSURE RATING
☐ MAX ALLOWABLE WORKING PRES PSIG @ °F
☐ HYDROSTATIC TEST PRESSURE PSIG

● PUMPED FLUID

PUMPED FLUID

| | RATED | MAX | NORMAL | MIN | |
|---|---|---|---|---|---|
| PUMPING TEMP | | | | | °F |
| AT DESIGNATED TEMP | RATED | MAX | NORMAL | MIN | |
| SPECIFIC GRAVITY | | | | | |
| VAPOR PRESSURE | | | | | PSIA |
| VISCOSITY | | | | | CP |
| SPECIFIC HEAT | | | | | BTU/LB°F |

INITIAL BOILING POINT °F @ PSIA
LIQUID ☐ HAZARDOUS ☐ FLAMMABLE
☐ OTHER
CORROSION / EROSION CAUSED BY
% SOLID — MAX PARTICLE SIZE IN

● SITE CONDITIONS

LOCATION
☐ INDOOR ☐ OUTDOOR
ALTITUDE FT
RANGE OF AMBIENT TEMPS MIN/MAX / °F
ELECTRICAL CLASSIFICATION
CL GR DIV
☐ NON HAZARDOUS

● GENERAL REMARKS

| NO | DATE | REVISION DESCRIPTION | BY | APVD |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**Figure 50.7.2.3b — PIP RESP73 H/V data sheet for ANSI/ASME centrifugal pumps (Reproduced courtesy of Process Industry Practices [PIP])**

## 50.7.3 The HI pump data transaction set

### 50.7.3.1 Overview of the pump data transaction set

The range of relevant data elements that need to be conveyed in a given transaction is dependent on both the *work process* and the *equipment type*. The baseline equipment type in this standard is the rotodynamic (centrifugal) pump. As the standard evolves, additional equipment types such as rotary, rotodynamic (vertical), CVMP, air operated, reciprocating, and slurry pumps will be included. The entire range of pump types found in ANSI/HI 9.1-9.5 *Pumps - General Guidelines for Types, Definitions, Application, Sound Measurement, and Decontamination* can be supported by this standard.

One of the most prevalent work processes involving the exchange of technical information is found in the bid, quotation, and purchasing of pumping equipment. A vast amount of technical data is communicated between trading partners, including purchaser, manufacturer, and subsupplier of pumping equipment and accessories. Data embodied in the pump data sheet described earlier is used prolifically in this work process and also generously used in other software applications and work processes as described in Section 50.7.2.2. The work processes of bid and quotation will be the primary processes addressed in this standard.

A summary of the applicable scope of this standard is found in Table 50.7.3.1 below. The work processes currently supported include bid, quotation, and purchase. Future extensions may be considered. The equipment types currently supported in Appendix A includes rotodynamic (centrifugal) pumps. Future extensions are already under development for rotary pumps, vertically suspended pumps, and slurry pumps (Update 1). All of the pump types shown in ANSI/HI 9.1-9.5 *Pumps — General Guidelines for Types, Definitions, Application, Sound Measurement and Decontamination* are candidates as supported equipment types in this standard. These updates will be available through the Web links outlined in Appendix A with the revision history duly noted on the Web site.

**Table 50.7.3.1 — Supported work processes and equipment types**

| Parameter | Current Standard | Future Extensions |
|---|---|---|
| Work process | Bid<br>Quotation<br>Purchase | To be determined. |
| Equipment type | Rotodynamic (centrifugal) pumps | Update 1:<br>• Rotary pumps<br>• Rotodynamic (vertical) pumps<br>• Slurry pumps<br><br>Update 2:<br>• Product types prioritized from pump types shown in ANSI/HI 9.1-9.5. |

The remainder of this section will be devoted to the *data elements* of the pump data transaction set. These sections include:

- Data field designations
- R/D/S field designations (see Section 50.7.3.4)
- Pump technology designations
- HI data exchange compliance levels

The *format* of the XML schemas and files will be addressed in Section 50.7.4, Implementation guidelines.

Note: In developing the HI-EDE format and content, multiple rotodynamic (centrifugal) pump data sheets from numerous organizations were reviewed. During this process, it was observed that roughly 1000+ data elements were needed to support all of the data elements found in the referenced data sheets. As additional pump types are considered, including vertically suspended pumps, rotary pumps, slurry pumps, etc., the number of data elements continues to expand. The large number of data elements in the total XML schema exceeds the breadth of data supported by any typical software application commonly used in the pump industry. Therefore, it was found that a well-defined set of data in a transaction between data sender and data receiver is necessary, and should be chosen specifically for a given work process. In this way, trading partners are assured that their data will be reliably processed, since the sending and receiving entities both support the same transaction dataset.

### 50.7.3.2 Data elements and attributes (normative)

The data found on a data sheet are categorized as *data elements* and their associated data field names, definitions, units of measure, and data groups. Data are also associated to the applicable work process (*information completed by*). These categorizations are described below.

#### 50.7.3.2.1 Data element (data field)

A *data element* is defined by an individual data field name. Examples include "Rate of Flow," "Suction Pressure," "Discharge Pressure," and "Service." There are different classes of data elements as well, as described in the following:

- Numeric field - contains only numeric data. "Rate of Flow" and "Suction Pressure" are examples of numeric data. Example: Rate of Flow = 100.0 $m^3$/h. Numeric fields are further decomposed into integer or real numbers.

- Character string field - contains alpha or numeric data, typically limited by field length (e.g., 20 characters). Example: General Remarks = "This pump shall conform to paint standard 123 as provided separately."

- Pick list field - offers one or more predefined choices, provided as a "choice list." A choice list is useful when one choice among many choices is selected. For example: Service = Pick List (Continuous or Intermittent).

A data element generally refers to the data field name and its associated attributes. A data field is generally the name of the data field without specific reference to the associated attributes.

#### 50.7.3.2.2 Units of measure – physical quantity

Many numeric fields have an associated unit of measure. In the example above, the "Rate of Flow" data element has a unit of measure of cubic meters per hour ($m^3$/h). This unit of measure is a physical quantity belonging to the group, "flow-volume liquid." By labeling each numeric field with a specific unit of measure, the value is readily interpreted by a digital program and conversions to different units of measure (e.g., gallons per minute [gpm], cubic meters per hour [$m^3$/h], and liters per second [L/s] are all units of measure within the flow-volume liquid group).

Since units of measure are readily converted from one unit to another, the HI-EDE Standard will adopt a single unit of measure for each unit group that will be used in the HI pump data transaction set. These standard units are defined in Appendix A.

#### 50.7.3.2.3 Data element group

The *data element group* observed in these examples is "Operating Conditions." This is used to group similar data fields together. For example: Rate of Flow, Suction Pressure, Discharge Pressure, and Service are all grouped into Operating Conditions.

#### 50.7.3.2.4 Information completed by

Another data categorization is *Information completed by*. Both the PIP and API data sheets designate each data element according to the entity responsible for completing that data element: the *purchaser*, the *manufacturer*, or the *manufacturer or purchaser*. These are useful designations toward defining the role of the purchaser or manufacturer with respect to the completion of the data elements.

The *Information completed by* categorization found in a data sheet will be replaced in the HI-EDE standard with designations called *Work Process Designations* and *R/D/S Field Designations*. These are described in the following two sections.

#### 50.7.3.2.5 Data field definition

*Data field definitions*, in most data sheets, are defined based on convention, past practice, or referenced to definitions within the companion standard. In order to facilitate and promote broad use of a common HI-EDE neutral exchange file, a complete set of definitions for each supported data field in the HI transaction dataset was developed.

Implementers are encouraged to clearly adopt the intent of these definitions in their supporting software systems. These data field definitions are crucial in mapping data fields from the existing software systems to the HI-EDE data field names that correspond to each definition.

### 50.7.3.3 Work process designations (normative)

The HI pump data transaction set is composed of two work process transactions. The first transaction, *RFQ*, is defined as the transmittal of technical requirements from purchaser to supplier to initiate a *Request for Quotation (RFQ)*. This transaction requires the purchaser to convey all critical information needed for the supplier to understand the application, select a pump, and respond with a qualified pump quotation, with complete confidence. The second transaction, *Quote*, is defined as the transmittal of pump performance and configuration data typically contained in a technical quotation. This transmittal shall have sufficient detail to permit the purchaser to assess technical quotations from different suppliers, usually through a bid-tab, in order to make a sound purchase decision.

### 50.7.3.4 R/D/S field designations (normative)

In formalizing the data elements that shall be communicated during the RFQ or Quote process, the process of establishing industry consensus on the absolute minimum number of required fields necessitated extensive deliberations. It was observed that some fields are always needed while other fields are convenient, but not required. Hence, the following definitions were established.

- ***Required*** data are the minimum data that must be transmitted to provide the necessary information to the recipient of the RFQ or the Quote transaction.
- However, there are cases where additional ***desired*** data are useful to enhance the quality of the transaction, by providing that data when they are available.
- Further, there are ***supplementary*** data that are interesting, but considered informative in the transaction.

Fields were thus given the distinction of being a ***Required***, ***Desired***, or ***Supplementary*** field. These are known simply as the **R/D/S** field designations.

#### 50.7.3.4.1 Required data

Required data elements are the minimum data elements needed:

- In the RFQ transaction, allowing the supplier to make a qualified pump selection and budget quotation
  - Example: A purchaser transfers basic fluid and process conditions allowing the supplier to make a pump selection
- In the Quote transaction, allowing the purchaser to make a qualified purchasing decision
  - Example: The minimum information from the supplier to describe the pumping unit being offered and its performance parameters

 

Implementation requirements

- These data *are* required to be transmitted by the initiator to the recipient of the transaction
- Provisions *must* be made in both the sending/receiving systems to process this information
- The recipient has the option of rejecting the transaction if the value of a required field is left blank

#### 50.7.3.4.2 Desired data

Desired data elements are used in conjunction with required data elements:

- In the RFQ, to specify the purchaser's requirements with fields of data that are useful in many suppliers' quotation processing systems
- In the Quote, to describe the supplier's quotation with fields of data that are generally available as output from supplier's quotation processing systems

Implementation requirements:

- These data are not required to be transmitted by the initiator to the recipient of the transaction
- While it is not required to be transmitted, provisions *must* be made in both sending/receiving systems to process this information
- The recipient cannot reject the transaction if the value of a desired field is left blank

#### 50.7.3.4.3 Supplementary data

Supplementary data elements are informative in the RFQ and Quote transactions and have value in some transaction systems.

Implementation requirements:

- These data are not required to be transmitted by the initiator to the recipient of the transaction.
- While it is not required to be transmitted, provisions must be made in both sending/receiving systems to map this data field. The data field is considered informative, but the recipient may/may not actually process (i.e., take action) the field in their system.
- The recipient cannot reject the transaction if the value of a supplementary field is left blank.

#### 50.7.3.4.4 Additional data to support the API 610/ISO 13709 data sheet

The API 610/ISO 13709 data sheet is a well-recognized and standardized data sheet for use in petroleum and petrochemical industry applications. The data contained in this data sheet are extensive and tend to exceed the requirements of many data transactions for applications in water resources, general industry, agriculture, or other applications. These data elements are supported by AEX XML schema definitions in the same fashion that HI data fields are supported by AEX XML schema definitions. Users who adopt this HI standard can readily extend their implementations to include these additional data fields to support the exchange of data found in API 610 data sheets.

Provisions have been made in this standard to designate all fields that are solely used in an API 610 data sheet as an "A" field. Further information about these data elements and the API 610 data sheet format may be found in ISO 13709, 2nd ed., and API 610, 11th ed.

Note that data field definitions are available in this standard for each R/D/S field. The data element definitions for "A" fields are generally defined separately in the supporting API 610 specification.

### 50.7.3.5 HI data exchange compliance levels (normative)

The required, desired, supplementary, and additional field designations now provide a defined subset of data that will be conveyed in a given pump data transaction. These are conveniently described in the following compliance levels:

#### 50.7.3.5.1 R compliance

R compliance indicates that a software application is able to transact the technical information of all fields marked with an "R" data field designation. This ensures that the software application is designed to support and process all "R" data fields.

- RFQ work process: Minimum technical information required by the pump supplier to provide a pump selection and technical scope-of-supply

- Quote work process: Minimum technical information required by the pump purchaser to evaluate the pump performance basic technical scope-of-supply for the pump item

R compliance is normally needed for budgetary quotations.

#### 50.7.3.5.2 R/D compliance

R/D compliance indicates that a software application is able to transact the technical information for all fields marked with an "R" data field designation plus all fields marked with a "D" designation.

- RFQ work process: Typical technical information required by the pump supplier to provide a pump selection and technical scope-of-supply. All required data are needed and some or all of the desired information.

- Quote work process: Typical technical information required by the pump purchaser to evaluate the pump performance and technical scope-of-supply for the pump item. All required data are needed and some or all of the desired information.

R/D compliance is normally needed for quotations involving an upcoming purchase.

#### 50.7.3.5.3 R/D/S compliance

R/D/S compliance indicates that a software application is able to transact the technical information of all fields marked with an "R" data field designation plus all fields marked with a "D" (desired) designation and "S" (supplementary) designation.

- RFQ work process: Typical technical information required by the pump supplier to provide a pump selection and technical scope-of-supply. All required data needed and some or all of the desired, plus supplementary, information.

- Quote work process: Typical technical information required by the pump purchaser to evaluate the pump performance technical scope-of-supply for the pump item. All required data needed and some or all of the desired plus supplementary information.

R/D/S compliance is normally needed for quotations involving an upcoming purchase or to communicate "as-built" construction or order entry requirements.

#### 50.7.3.5.4 R/D/S/A or API 610 compliance

R/D/S/A compliance indicates that a software system is able to transact the technical information of all fields marked with an "R" data field designation plus all fields marked with a "D" (desired) designation, "S" (supplementary) designation, and "A" (additional) designation. Note that there may be some R, D, or S data fields that are not specifically required in an API data sheet.

- RFQ definition: Technical data needed to produce an API 610 data sheet. This includes support for all R/D/S/A fields. Only the "R" fields are required in this transaction.

- Quote definition: Technical data needed to produce an API 610 data sheet. This includes support for all R/D/S/A fields. Only the "R" fields are required in this transaction.

R/D/S/A compliance is normally needed for API 610 applications involving an upcoming purchase or to provide a description of as-built or as-ordered construction.

#### 50.7.3.5.5 Compliance level summary

The relationship between the R, D, and S data fields is described pictorially in Figure 50.7.3.5.5. The entire set of data supported in the HI transaction dataset is the union of the R, plus the D, plus the S, data field designations for a given RFQ or Quote transaction.

The Hydraulic Institute EDE standard has provisions for four levels of compliance: R, R/D, R/D/S, and R/D/S/A. These levels are selected by the purchaser and/or supplier based on the purpose of the data transaction. To support a transaction that is capable of completing an API 610 data sheet, the sending and receiving systems must support R/D/S data fields plus all "A" data fields.

A summary of the data field designations is shown in Table 50.7.3.5.5.

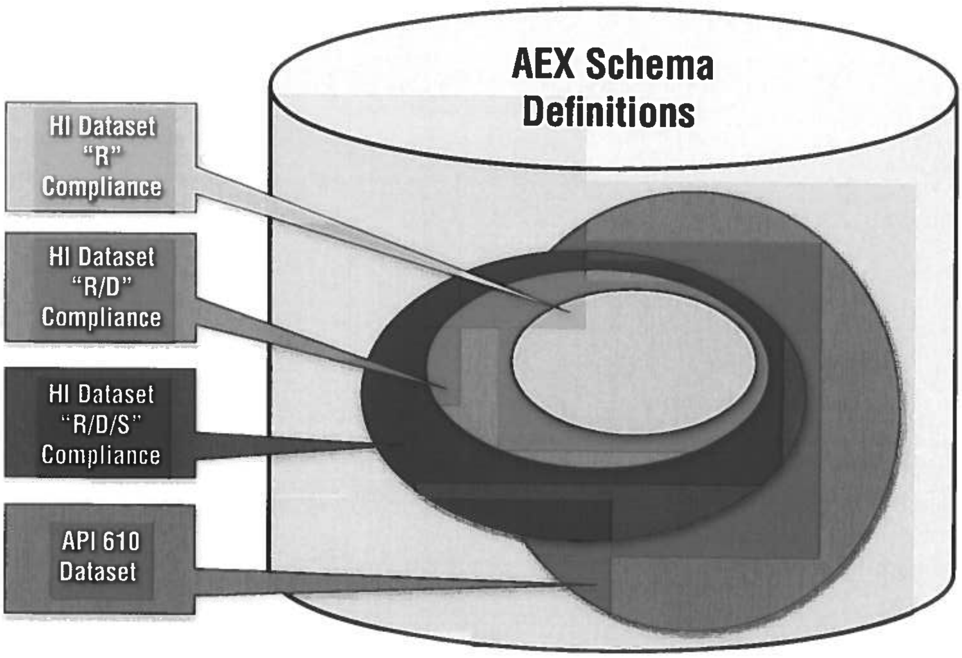


**Figure 50.7.3.5.5 — HI-EDE transaction compliance levels**

**Table 50.7.3.5.5 — Summary of R/D/S/A data field designations**

| | | | Transaction Description | |
|---|---|---|---|---|
| **Compliance Level** | **Designation Letter** | | **Work Process: RFQ** | **Work Process: Quote** |
| Required | R | Process Definition | Minimum technical information required by the pump supplier to provide a pump selection and technical scope-of-supply. | Minimum technical information required by the pump purchaser to evaluate the pump performance basic technical scope-of-supply for the pump item. |
| | | Typical Use | Inquiry for budgetary quotation. | Response to budgetary quotation. |
| Required/ Desired | R/D | Process Definition | Typical technical information required by the pump supplier to provide a pump selection and technical scope-of-supply. All required data are needed and some/all of the desired information. | Typical technical information required by the pump purchaser to evaluate the pump performance and technical scope-of-supply for the pump item. All required data are needed and some/all of the desired information. |
| | | Typical Use | Request for quotation for an upcoming purchase. | Response to quotation for an upcoming purchase. |
| Required/ Desired/ Supplementary | R/D/S | Process Definition | Typical technical information required by the pump supplier to provide a pump selection and technical scope-of-supply. All required data needed and some/all of the desired plus supplementary information. | Typical technical information required by the pump purchaser to evaluate the pump performance technical scope-of-supply for the pump item. All required data needed and some/all of the desired plus supplementary information. |
| | | Typical Use | Request for quotation for an upcoming purchase or as-built construction. | Response to quotation for an upcoming purchase or description of as-ordered or as-built construction. |
| API 610, ISO 13709 | R/D/S/A | Process Definition | Technical data needed to produce a complete API 610 data sheet. These data are in addition to the required plus desired plus supplementary data. | Technical data needed to produce a complete API 610 data sheet. These data are in addition to the required plus desired plus supplementary data. |
| | | Typical Use | Request for quotation for an upcoming purchase or as-built construction for an API 610 application. | Response to quotation for an upcoming purchase or description of as-built construction for an API 610 application. |

### 50.7.3.6 Pump technology designations (normative)

There are numerous pump technologies supported by Hydraulic Institute standards as outlined in ANSI/HI 9.1-9.5 *Pumps — General Guidelines for Types, Definitions, Application, Sound Measurement and Decontamination.*

Most data fields are applicable across many or all pump technologies. An example is the field name "Rated Flow," which is equally relevant to kinetic pumps of the rotodynamic (centrifugal) or regenerative turbine type or positive displacement (PD) pumps of the rotary or reciprocating type. These data fields have corresponding field attributes (definitions, XML structures, etc.) that are shared across pump technologies wherever possible.

There are many cases where certain data fields may or may not be applicable to a particular pump technology. An example is the field name "Differential Head, Rated," which is used for kinetic (rotodynamic) type pumps but is not particularly relevant for positive displacement pumps. PD pumps use "Differential Pressure, Rated" as the relevant data element for specifying relevant "Rating" data.

To accommodate these specific requirements, an *applicable pump technology* designation is assigned to each data field according to its applicability to the reference pump technology. An example showing the applicability to rotodynamic (vertical) and rotary type pumps for a sample set of data fields in the operating conditions heading is shown in Table 50.7.3.6.

### 50.7.3.7 Industry use of the HI data transaction set (normative)

#### 50.7.3.7.1 Recommended use

The HI data transaction set is intended for use in automating the exchange of technical information between the many software systems used by purchasers, suppliers, and engineering design firms. However, there is a practical balance between those data elements that are readily defined and communicated using an XML transaction and information that is of a commercial nature or highly specialized that cannot be efficiently mapped at this phase of the pump dataset life cycle. This standard has adopted the R/D/S/A compliance levels to meet a broad range of industry needs.

Further, this HI-EDE standard is not intended to completely replace normal engineering processes or intelligent interpretation of data during data transactions. This standard is simply intended to streamline the laborious task of transferring data between various software applications and systems.

#### 50.7.3.7.2 Extended use

The HI transaction dataset may also be used in work processes beyond those described in this standard. In these cases, the standard may be used "as-is," with participants acknowledging the compliance level used in their interface. For example, pump performance data can be conveniently exchanged between a pump data sheet application and a system analysis application using an "R" level compliance transaction even though all of the "R" data fields are not relevant in that transaction.

In cases where the transaction dataset needs to be extended to include additional data elements, the AEX schema can be customized to meet these requirements. This is described in Section 50.7.5. In other cases, additional fields can be added to the standard by making recommendations directly at the Web site, http://www.Pumps.org/ede.

#### 50.7.3.7.3 Unsupported use

This EDE XML transaction is not intended to take the place of legal documents such as commercial quotations or purchase orders. However, the content of those documents may indeed be derived from the XML transaction and embedded in a separate, authorized document.

 

**Table 50.7.3.6 — HI transaction dataset - contents**

| | | | Data Item Compliance Designation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Rotodynamic (Centrifugal) | | Rotodynamic (Vertical) | | Rotary | | |
| **HI Data Element** | **HI Data Element Group** | **HI Choice List** | **Bid RFQ** | **Bid Quote** | **Bid RFQ** | **Bid Quote** | **Bid RFQ** | **Bid Quote** | **Definition** |
| Differential Head, Rated | Operating Conditions | | R | R | R | R | – | – | The total discharge head minus the suction head measured relative to any common horizontal datum plane. Total head is the static head plus the vertical distance from the static head measurement instrument to the datum. This is the purchase contract differential head that is used to select the pump. Rated conditions are specified by the purchaser. |
| Differential Pressure, Rated | Operating Conditions | | R | R | R | R | R | R | The algebraic difference in the same pressure units between the discharge and the suction pressure. Rated conditions are specified by the purchaser. Differential pressure is needed to specify positive displacement pumps but not typically used for rotodynamic pumps. |
| Duty Cycle | Operating Conditions | Continuous; Intermittent; Standby; Other; Unspecified | R | R | R | R | S | D | A statement of whether the pump will be operated continuously (more than 4 hours per run) or will be cycled on/off (less than 4 hours per run) within an operating day. A more detailed description of the duty cycle including number of hours of operation per day can be described in the "Operating Conditions Comments." |
| Rate of Flow, Rated | Operating Conditions | | R | R | R | R | R | R | Volumetric quantity of fluid required to be delivered per unit of time, including entrainment and dissolved gas, at rated conditions of speed, differential pressure, specific gravity, and viscosity. This is the purchase contract flow rate used to select the pump. Note that the choice of pump classification and fixed vs. variable speed will affect the relevance of a fixed, rated capacity. Data provided by the purchaser. |

### 50.7.4 Implementation guidelines

#### 50.7.4.1 Introduction (normative)

The AEX project and HI have undertaken the task of compiling a standard data dictionary to define data elements that may be exchanged during a pump specification and procurement work flow. These items are categorized by type of data, information flow transaction, and whether the data is required, supplementary, or desired. Subsets of this standard of data elements are transmitted between parties during a variety of stages in the development and procurement process (bid, quote, etc.). The purpose of this HI-EDE standard is to specify a standard *electronic* format for the exchange of this information.

For the purposes of this document, the "implementer" is a software developer, system developer, or integration developer who has been given the task of adapting an existing software system (equipment and system design, pump selection, quotation, data sheet generation, bid-tab, etc.) such that it is capable of receiving and producing HI-EDE documents (AEX XML schema-compliant XML transaction documents). This chapter outlines the basic requirements needed to meet one of the supported HI-EDE compliance levels. For information about extending the AEX XML schema, please refer to the AEX Implementation Guidelines on the AEX Web site.

The remainder of this section is designed to guide the implementer through the HI-EDE development process. These sections presuppose familiarity with XML, XML schemas, and XPATH technology. For more information on these technologies, and for details specific to the AEX XML schema architecture, consult the links and text in Section 50.7.5 and the AEX XML documentation.

##### 50.7.4.1.1 Step 1: Integrating with the HI data elements

Before considering the AEX XML schema structure, the developer must first develop mapping between data used within their own system and the HI-EDE data outlined in Appendix A.1, HI-EDE data dictionary. Care should be taken to not only map data elements (using the given definitions), but also to consider mapping internal pick lists and options to the HI pick list enumerations for applicable data elements. This process requires collaboration between the implementer and domain experts within the implementer's company.

During this process, several other decisions/considerations should be discussed:

- **R/D/S compliance levels:** During this mapping phase, it is important to decide which levels of HI compliance will be supported by your system. Please consult Section 50.7.3.5 for a description of these compliance levels. In Appendix A.1, HI-EDE data dictionary, each data element's compliance level for each transaction type is documented.

- **Support for API 610/ISO 13709 data sheets:** If you are already familiar with API 610 data sheets, Appendix A.1, HI-EDE data dictionary, can be used to map API 610 data elements to HI's standard. Existing translation between internal data names and API 610 fields can form a bridge to the HI standard and will greatly increase the speed in which the standard can be implemented.

- **Handling of extra data:** There are occasions when a software application contains data that are not specified within the HI-EDE standard set. Typically these "custom" data are not transferred to third parties, so it is not necessary to include these data within an HI-EDE document. If these are data that must be transmitted, however, appropriate use of AEX XML "custom" tags within the XML instance document may need to be employed. Consult the AEX XML documentation for more implementation details. It is important to note that not every party receiving an XML document containing these custom tags may be able to correctly process and/or interpret the data. This issue needs to be dealt with on a case-by-case basis between individual parties such that they can agree on how custom data will be transferred. Finally, each implementer should also consider how their applications will handle incoming XML documents containing data elements not supported in the HI standard (the listing of AEX XML fields is a superset of HI). Care should be taken not to destroy this information while processing if the XML document is to be passed along to another party.

#### 50.7.4.1.2 Step 2: Producing and importing HI-EDE compliant documents

Once a mapping between internal data and HI data elements has been agreed on, the implementer is ready to write software (application code) to store and retrieve HI data elements to and from an AEX XML document. The HI-EDE standard defines the XPATH for each HI data element within an AEX XML document. This mapping is defined by Appendix A.1, HI-EDE data dictionary. XML reading and writing is well supported by all major programming languages. The implementer is responsible for deciding on which approach suits their needs based on their existing application and the decisions made in Step 1 above.

#### 50.7.4.1.3 Step 3: Testing the implementation

Implementers must test their implementation in two ways.

1) Conformance to AEX XML schema

   Implementers must ensure that their software system's AEX XML document export capabilities are compliant with the most recent AEX XML schema and that their system is capable of importing (but not necessarily processing all items within) any valid AEX XML document. To do this, the implementer may use any one of a variety of freely available XML checking programs and application program interfaces (APIs). See www.Pumps.org/ede for recommendations. Two clarifications should be noted:

   - **Non-HI data:** In order to be compliant with the HI standard, the implementer is *only* responsible for importing, processing, and persisting R/D/S/A fields (according to the implementer's stated compliance goal). The implementer must decide how to treat XML documents containing information not defined in the HI-EDE standard. The implementer is responsible for ensuring that their application can process any valid AEX XML document (i.e., shall not "crash" the system) within their stated compliance level. All non-HI data or data beyond their stated compliance level can be safely ignored.

   - **Units of measure:** The HI-EDE standard places additional restrictions on the XML document that limit some of the advanced features of the AEX XML schema. The most important example of this is HI's treatment of units of measure. All data elements within the HI standard have been assigned a standard unit set, as shown in Appendix A.2, Standard units of measure and conversions for HI-EDE transactions using HI 50.7. Although AEX XML includes the ability for units of measure to be specified in a variety of ways within the XML document, HI-EDE implementations are *not* expected to process this information (and should not produce this information in exported XML documents). All data elements are expected to be transmitted in the standard unit set defined in this document.

2) HI-EDE conformance testing

   The second phase of testing ensures that the newly developed application interface meets the desired HI compliance level. This means that if the application's goal is to be "R/D" compliant, it shall be able to produce XML documents that contain all "R" and "D" fields for a particular transaction, and it shall be able to successfully import, process, and "persist" all R/D entries within an AEX XML document sent by another party. In this context, "persist" means that any nonessential data elements included in the XML document that are outside the scope of the compliance level shall be "persisted" or maintained in a subsequent data transaction.

   The AEX XML schema does not include facilities to perform this R/D/S/A "validation" automatically. To allow developers to better evaluate their application, HI provides a Web site (see www.Pumps.org/ede) where developers can upload XML documents produced by their system to be verified to contain all relevant fields (and to conform to any enumerations/bound checking included in Appendix A.1, HI-EDE data dictionary). In addition, the Web site will have available sample XML instance documents that the developer can download and import into their system to test that their application can process a typical HI-EDE document exhibiting R, D, S, or A compliance.

Check the HI-EDE Web site for more information on this service at http://www.Pumps.org/ede.

### 50.7.4.2 Demonstration of real usage scenarios

A number of demonstrations of electronic data exchange of real capital project data for the design and procurement of rotodynamic (centrifugal) pumps have been completed by the AEX project[1] and HI. One such demonstration simulated an owner-operator company and pump suppliers using a multitude of different software applications. For each data transaction, the associated software program required an interface to import and export data from an XML file, as prepared by the software suppliers. All the information exchanged strictly adhered to the HI-EDE R compliance level.

The exchange sequence is summarized in Figure 50.7.4.2, consisting of the following key steps:

1) The owner-operator manually entered basic data into an Excel® data sheet, which included an "add-in" to enable import and export of AEX XML. These data are exported into an XML file and transferred to a system modeling program.

2) This system modeling program was utilized to perform system pipe loss analysis. The resulting data were then imported back into the data sheet to view.

3) These data were then sent as standard AEX XML to a pump supplier's selection and configuration program.

4) The supplier's programs were run, various pumps selected, and the specifications for each exported back into a data sheet application.

5) The various sets of data from these different suppliers were again viewed in the data sheet and were also imported into an equipment procurement company's BidTab analysis program.

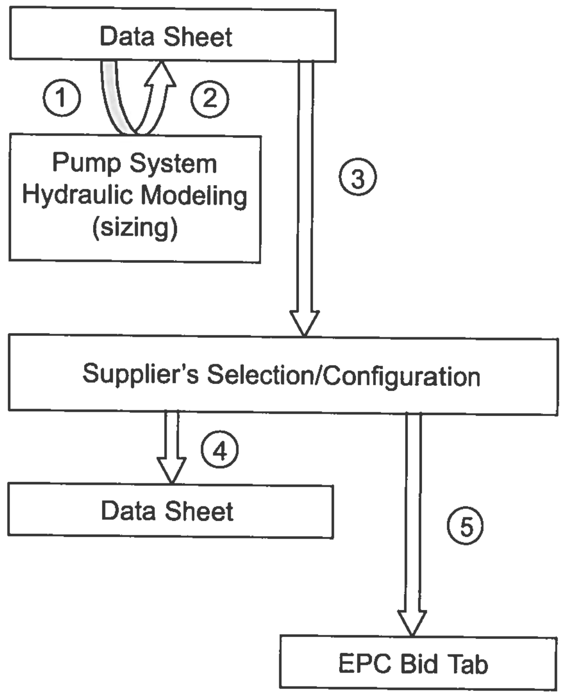


**Figure 50.7.4.2 — Data exchange sequence in the rotodynamic (centrifugal) pump procurement demonstration**

#### 50.7.4.2.1 Key points from AEX XML testing and demonstration

The key points from this demonstration are:

a) The use of XML data exchange between different software programs works.

b) A standard set of XML schemas is essential.

c) All participants in the demonstration realize that full implementation of XML interfaces are advantageous for their organizations.

[1] See www.Pumps.org/ede for link to Powerpoint slides of AEX Pump Pilot, "EDE in the pump industry.pdf," and API demo Powerpoint slides.

d) The use of an XML interface does not require alteration of the normal operation of existing software and does not otherwise detract from existing software.

e) The software user does not need to know details of XML as the interfaces to import and export AEX XML can be provided as additional functionality.

### 50.7.5 Getting started with AEX XML

This section outlines the basics to create an AEX XML interface for a software application.

#### 50.7.5.1 Prerequisites and tools

Before starting to develop application mapping interfaces, developers should have at least a basic working knowledge of XML, XML schema, XPath, and object-oriented information modeling principles, especially the concepts of inheritance, containment, and references. The details provided in this guideline document provide the specific information to understand the use of AEX XML for information on pumps. The World Wide Web Consortium Web site contains the official specifications for XML, XML schema, and XPath. Some of the most frequently required documentation can be found at: http://www.w3.org/TR/xmlschema-0/, http://www.w3.org/TR/xmlschema-1/, and http://www.w3.org/TR/xmlschema-2/ for schema, and http://www.w3.org/TR/xpath for XPath.

#### 50.7.5.2 Where to find AEX XML schemas

The latest versions of the AEX XML schemas are available from the following Web sites:

a) FIATECH AEX: http://fiatech.org/aex.html.

b) cfiXML: http://www.cfixml.org/ (navigate to schema and documentation download pages).

c) SourceForge: http://www.sourceforge.net/ and search on 'cfidev'.
(Note: if you open an account with SourceForge, an open-source software development Web site, then you will be able to access a Bugs & Requests system.)

These links are also available directly from the HI Web site, www.Pumps.org/ede.

#### 50.7.5.3 Schema content

The AEX XML schema architecture has been developed to support any equipment item, engineering document, and material property for any information exchange usage scenario. This HI-EDE standard only addresses the XML structures used for representing information about the pump types supported by this standard.

##### 50.7.5.3.1 Equipment data foundation

AEX schemas are based on a set of foundation files that describe data on the context, project, and documentation associated with an equipment dataset. In addition, data on physical properties and units of measurement are included. The foundation files therefore cover a wide range of information, from an organization's name, URL, and project details, to ambient temperatures at an equipment site.

##### 50.7.5.3.2 Equipment items

Schemas have been produced for key equipment items, with particular emphasis placed on meeting the needs of a design and procurement work flow cycle. The equipment or accessory schema files are divided into groups, as illustrated in Figure 50.7.5.3.2.

 

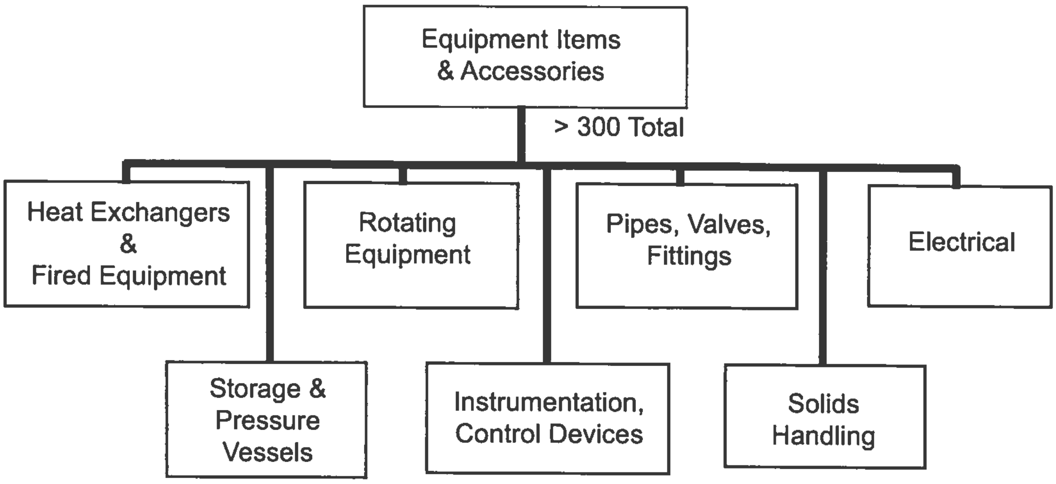


**Figure 50.7.5.3.2 — Equipment item coverage and groups of related schema files**

#### 50.7.5.3.3 Construction materials and properties

The equipment item schemas are supported by a comprehensive set of material properties, which were originally developed in collaboration with the Design Institute for Physical Properties (DIPPR). Description of process materials and associated properties as well as equipment construction materials and properties are included. This also provides for the exchange of property curve and property table data, for example.

Files covering streams and stream conditions complete the set of schemas required to describe conceptually through design and operating performance specifications for an equipment item.

### 50.7.5.4 Schema structural design

There are many ways of representing XML data, each of which have different consequences in terms of reusability, extensibility, ease of processing, and ease of writing XML documents. The design principles are based on extensive research of available resources in the XML schema development community to be in line with best practices.[1] The standards for XML schema provided by W3C[2] for specifying and validating the contents of XML data have been adopted. Hence, AEX XML is constructed using W3C standard XML schema as its basis and developed to handle the technical information requirements of the capital facilities industry.

The AEX cfiXML model is a layered structure shown in Figure 50.7.5.4. This ensures that there is a common consistent foundation, and maximum potential for the reuse of items for efficient schema development. There are four basic layers of the cfiXML architecture, as follows:

a) **Core data type schemas** are built from the W3C XML Schema Standard basic data types to provide a common foundation of features available for all data in AEX XML. Some of the key core sets of data types support change tracking and revision history, provide physical quantities and units of measurement, and describe geometric shapes.

b) **Core object schemas** include reusable base engineering objects that can be used by multiple engineering disciplines and subject domains. These objects consist of a base set of data types and attributes that enable any item extended from an object to be uniquely identified throughout the life cycle of the item. Information on documents (ownership and identification), context (organization, person, or location), the project, site, and material properties are all included in the core object schemas.

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[1] http://www.xfront.com/BestPracticesHomepage.html.

[2] http://www.w3.org/XML/Schema/.

c) **Subject schemas** are extensions of the core object schemas and provide details on specific engineering equipment items and accessories. Examples of the subject domains are shown in Figure 50.7.5.3.2.

d) **Collection-container schemas** are used to combine core and subject-specific engineering objects in various ways to support required data transactions and usage scenarios. These can be considered as data sample exchange "documents" such as data sheets, equipment lists, and catalogues.

### 50.7.5.4.1 Versions and revisions system

The core features of the schema provide support for version management so that records can be kept throughout the life cycle of the equipment item. The design also incorporates a means to record any changes to data elements, i.e., change tracking. While version management is supported in the AEX schema, use of these features is not mandatory for any of the HI compliance levels.

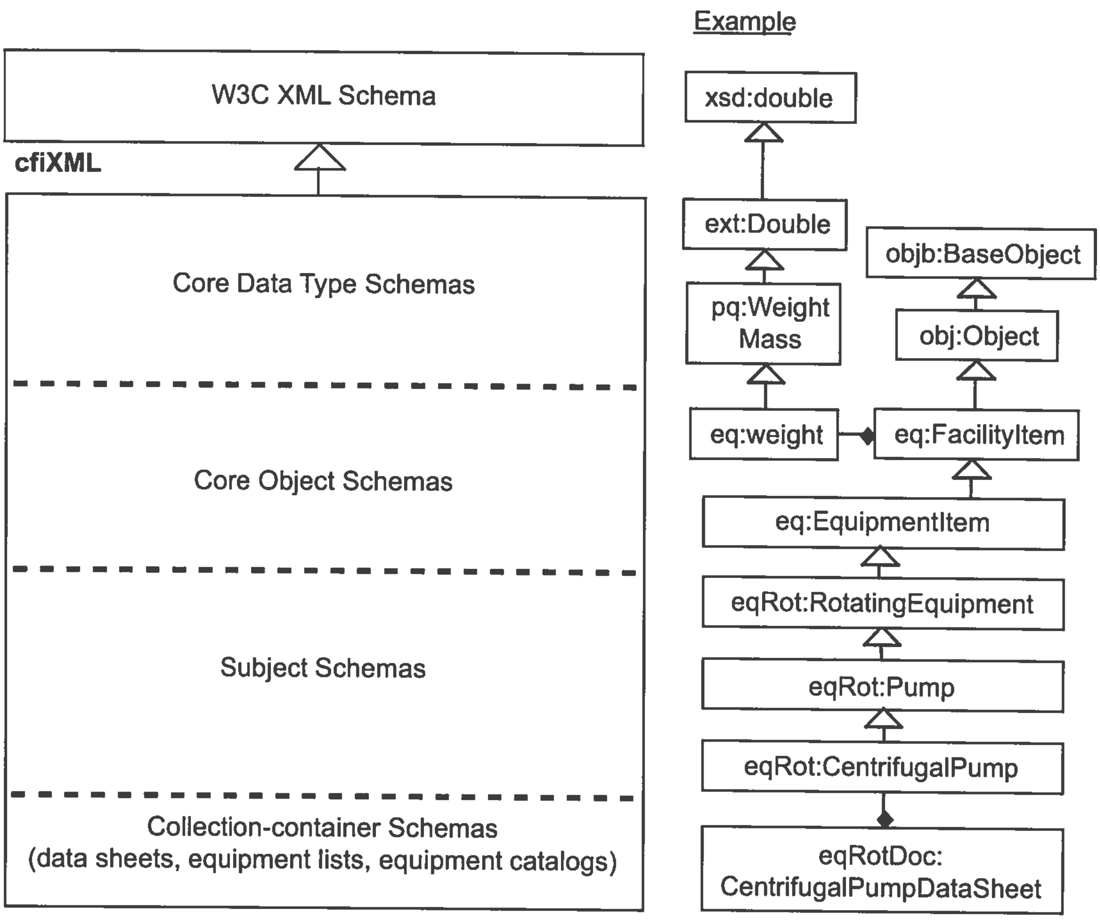


**Figure 50.7.5.4 — Schema model layered structure and reusability of AEX schemas using an example of a rotodynamic (centrifugal) pump data sheet**

 

### 50.7.5.5 Schema file folder organization

The AEX XML schemas are structured to support information across the life cycle of capital facilities and possible extensions from other supply chains in the capital facilities industry. Therefore, the root node of the AEX XML schemas is called "cfiXML." The schemas are organized in the following file folder structure:

**[cfiXML]**

| | |
|---|---|
| **[documentation]** | (All public cfiXML documentation files) |
| **[examples]** | (Example XML instance files) |
| **[schema]** | (All cfiXML Core Data Type, Core Object and Subject schemas) |
| **[custom]** | (Implementer specific customized schemas) |
| **[document]** | (All cfiXML Collection-container Schemas, e.g., data sheets ) |

### 50.7.5.6 Use of namespaces

#### 50.7.5.6.1 W3C schema namespace declaration

AEX XML is based on the schema specification from the World Wide Web Consortium (W3C). Therefore, all AEX XML schemas include the W3C schema namespace declaration:

<xsd:schema xmlns:xsd=http://www.w3.org/2001/XMLSchema>

The namespace abbreviation of "xsd" is used throughout the cfiXML schemas for consistency.

#### 50.7.5.6.2 AEX XML schema namespaces

The AEX XML schema model uses uniquely named XML namespaces to allow multiple reusable core and subject-specific schemas to be used together in a single XML "Collection-container" schema file ("document"). All AEX XML namespaces consist of a string composed of the globally unique identifier URI "owned" by the organization developing the schema and the namespace short identifier.

**Unique Namespace Name = URI + "/" + "short ID"**

For the capital facilities industry XML, all namespaces belong to a common "root" URI, specifically "**http://www.cfixml.org**." To the end of this common root, a short identifier is placed, separated by a forward slash. For example, the "**pq**" (physical quantities) namespace would have a full unique identifier of **http://www.cfixml.org/pq**.

Figure 50.7.5.4 illustrates the capital facility industry namespaces and their relationships to each other. By convention, the short identifier tag (e.g., "pq:") is used in a schema declaration to mean the same thing as "http://www.cfixml.org/pq" so that the XML files are more human readable, yet maintain uniqueness for the XML parsing program. In this document the file name, namespace prefix, and full namespace qualifier will often be treated as synonymous, for convenience and simplicity. Figure 50.7.5.6.2 uses Unified Modeling Language (UML) notation, where the dashed arrow lines indicate a usage dependency of a namespace upon the namespace that is pointed to. For example, the "eq" namespace depends on the "mtrl" namespace to define the construction material of an equipment item. The open arrow lines indicate that complex types in a namespace extend complex types in the namespace that is pointed to. For example, the "ext" extended data types are extension types from the base "xsd" namespace, and the "eq" EquipmentItem complex type extends from the "obj:Obj" complex type.

#### 50.7.5.6.3 Document namespaces

The "Collection-container schemas" (see Figure 50.7.5.4) are used to combine any of the core or subject schemas and so effectively provide the requirements for all data elements to describe a document, such as a data sheet or catalogue. A similar method is used to uniquely name these namespaces, for example: **http://www.cfixml.org/document/eqHxDoc** for the cfiXML schema "document" for heat exchange equipment.

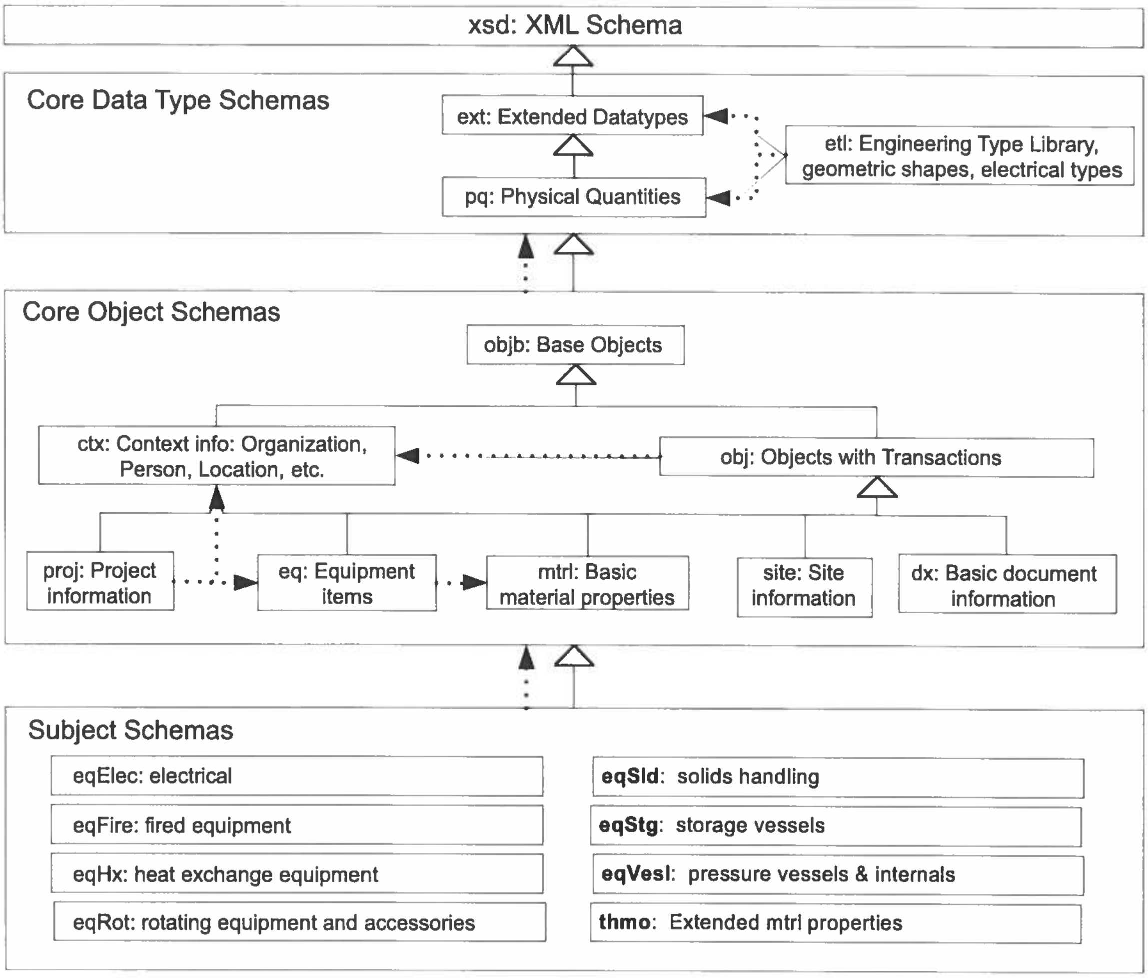


**Figure 50.7.5.6.2 — AEX cfiXML namespace overview**

### 50.7.5.7 XML schema definition (XSD) file names and associated namespaces

The AEX XML schema definition files include the name of the associated namespace identifier. For example, the main schema file that contains the elements in the mtrl (material) namespace is mtrl.xsd.

The layered schema structure and upwards inheritance are applied when a large family of related namespaces exists, as indicated by the use of the same root namespace identifier as a prefix. A suffix is then added to create the specialized associated schema file.

#### 50.7.5.7.1 Example of related namespaces and subject XSD files

"**eq**" (equipment) namespace
- <u>Includes related namespaces of:</u>
- "**eqHx**" (heat exchanger equipment)
  - <u>Includes related schema files of:</u>
  - "**eqHxAc**" (air-cooled heat exchangers)
  - "**eqHxSt**" (shell and tube heat exchangers)
  - "**eqHxBase**" (common heat exchanger elements; developing schema)
- "**eqRot**" (rotating equipment)
  - <u>Includes related schema files of:</u>
  - "**eqRotCpmp**" (centrifugal pumps)

"**eqRotCfan**" (centrifugal fans), etc.
"**eqBase**" (common equipment item elements; developing schema)

This example shows the subject schemas of "eqHx" and "eqRot" as being extended from the core object schema file "eq" (as in Figure 50.7.3.5.5). The schema files within the subject schema namespaces include equipment item specific prefixes, e.g., "Ac" for "air-cooled."

The "-Base" named schema files have two purposes. The first is as a "placeholder" of subject-specific equipment types that have been created as an object of some form, but are not further extended. The second is as a repository for elements that are likely to be (or already are) used in more than one, higher level namespace.

Collection-container schemas, as shown in Figure 50.7.5.4, are found in the cfixml/schema/document folder and take the form of, for example, eqRotDoc.xsd, as this represents a rotating equipment document.

#### 50.7.5.8 XPaths

Simply stated, an XPath describes the way through the AEX XML schema model to a specific data element, and subsequently, also provides a means for locating a data element in an XML instance file. Each element is uniquely identified by its XPath within a particular context. Thus, XPaths for an equipment *data sheet* will differ from those of an equipment *list* because the starting document element in each case is different. However, after the document element step, the XPaths will be identical if describing the same equipment data element.

Example XPaths provide a useful means to become familiar with the schema by following the path through the schema to each element addressed. The full set of XPaths for rotodynamic (centrifugal) pumps is provided in Appendix A.1, HI-EDE data dictionary.

Real example XPaths from cfiXML are available at the Web site, http://www.Pumps.org/ede.

##### 50.7.5.8.1 Deployment requirements and constraints

###### 50.7.5.8.1.1 Complete documents

It must always be possible to send a single file or document of XML that is complete and contains no references to another XML. The XSD must support this fully.

###### 50.7.5.8.1.2 Duplicate XML

An AEX XML document should never contain more than one copy of the detailed XML data of an object. Even if more than one reference to the same object exists within a document, the XML data of that object must only appear at most once within the document. For example, if the same stream object is connected to one side of a heat exchanger as well as appearing in a table of streams within a data sheet document, then one of the stream objects in the data sheet will refer to the other. This target, referred-to stream object will contain all the detailed information on the stream.

###### 50.7.5.8.1.3 XML test files

Example files illustrating the various HI-EDE compliant files for rotodynamic (centrifugal) pumps are available at www.Pumps.org/ede. A library of example files and baseline files for assessing AEX interfaces compliance to the HI standard are also available.

### 50.7.6 Abbreviations and definitions

Following is a list of abbreviations and publications used in this standard.

AEX – **A**utomating **E**quipment Information E**X**change

API – **A**merican **P**etroleum **I**nstitute
ASME – **A**merican **S**ociety of **M**echanical **E**ngineers
cfiXML – **C**apital **F**acilities **I**ndustry **XML**
EDE – **E**lectronic **D**ata **E**xchange
EPC – **E**ngineer/**P**rocure/**C**onstruct
ERP – **E**nterprise **R**esource **P**lanning
FIATECH – **F**ully **I**ntegrated and **A**utomated **Tech**nology
HI – **H**ydraulic **I**nstitute
HTML – **H**yper-**T**ext **M**arkup **L**anguage
ISO – **I**nternational **O**rganization for **S**tandardization
NIST – **N**ational **I**nstitute of **S**tandards and **T**echnology
PIP – **P**rocess **I**ndustry **P**ractices
Quote – Bid quote
RFQ – **R**equest **F**or **Q**uotation
SGML – **S**tandard **G**eneralized **M**arkup **L**anguage
SI – **I**nternational **S**ystem of Units as defined by NIST
UML – **U**nified **M**odeling **L**anguage
VDMA - **V**erband **D**eutscher **M**aschinen und **A**nlagenbau
W3C – **W**orld **W**ide **W**eb **C**onsortium
XML - e**X**tensible **M**arkup **L**anguage
XSLT – **XML** **S**tylesheet **L**anguage **T**ransforms

ISO 15926: An emerging standard titled *Industrial automation systems and integration—Integration of life-cycle data for process plants including oil and gas production facilities.*

ISO 13709: Standard for *Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries.*

API 610, 11th ed.: Standard for *Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries.*

ANSI/ASME B73.1-2001 (R2008): *Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process.*

### 50.7.7 AEX XML schema overview

AEX XML schema is constructed using XML schema as its basis, building extensions onto the W3C standard to handle the technical information requirements of the capital facilities industry. AEX XML provides a cohesive, object-oriented framework to describe capital facilities equipment and material data over the life cycle of a capital facility. The facilities equipment XML schemas consist of many related and interdependent XML namespaces, schema files, and complex type definitions, covering a variety of subject areas. The AEX XML architecture provides a flexible architecture that can be readily used to construct any electronic exchange document that is needed to support any usage scenario involving the exchange of facility equipment data.

There are four basic parts to the capital facilities industry XML architecture, as illustrated in Figure 50.7.5.4.

- *Core data type schemas* for essential extensions to the W3C XML Schema Standard basic data types to support engineering requirements

- *Core engineering object schemas* for reusable base engineering objects that can be used by multiple engineering disciplines and subject domains

- *Subject engineering object schemas* that provide schemas related to specific equipment items

- *Collection-container schemas* that are used to allow core and subject-specific engineering objects to be combined in various ways to support various data transactions and usage scenarios

Figure 50.7.5.6.2 illustrates how these parts relate to each other, to standard XML schema definitions, and to various messaging protocol containers that are currently being developed by various industry groups.

XML documents need to have unique names for XML global elements that have specific meanings. In a small schema, with relatively few elements, it is relatively easy to define and maintain unique tags. In large systems, such as the capital facilities industry XML, where multiple collaborating groups working independently could potentially define thousands of global element definitions, it becomes more difficult to ensure uniqueness across the various parts of the schema. The AEX XML schema uses XML namespaces to allow multiple reusable core and subject-specific schemas to be used together in a single XML "container" document.

In order to ensure interoperable XML documents that use multiple namespaces, the namespaces themselves are required to be named uniquely. It is a common usage convention to use a common globally unique identifier string that is composed of a URL that is "owned" by the organization developing the schema. Just to be clear, this is a unique way to name the namespaces, not the location of the schema files.

For the capital facilities industry XML, all namespaces belong to a common "root" URL, specifically "http://www.cfixml.org." A short identifier is put at the end of this common root separated by a forward slash. For example, the "pq" namespace would have a full unique identifier of "http://www.cfixml.org/pq." By convention, we assign the shorthand prefix tag "pq:" that is typically assigned in a schema declaration to mean the same thing as "http://www.cfixml.org/pq" so that the XML files are much more human readable, yet maintain uniqueness for the XML parsing program. In this document the file name, namespace prefix, and full namespace qualifier will often be treated as synonymous, for convenience and simplicity. Figure 50.7.5.6.2 illustrates the 20 capital facility industry namespaces and their relationships to each other.

The namespaces shown in Figure 50.7.5.6.2 were defined to meet the following general requirements:

- To enable conceptually-related schema elements to reside in the same namespace
- To enable namespaces to be easily imported and reused in other derivative schemas
- To separate domains that are likely to be developed and maintained by separate organizational groups
- To anticipate the need for collection-container XML documents to use only the relevant portions of a potentially very large suite of AEX XML schemas

### 50.7.8 Additional resources

The Internet has made it possible to access a wide range of information on electronic data exchange. The list below contains some sites that may be useful to the reader.

cfiXML
www.cfixml.org

FIATECH (also provides access to the AEX page)
www.fiatech.org

Hydraulic Institute (HI)
www.Pumps.org

World Wide Web Consortium (W3C)
www.w3.org

XML
www.xml.org

# Appendix A

# References to HI-EDE Online Content (Normative)

Appendix A contains normative data that will be updated and revised on a periodic basis. Appendix A is posted at www.Pumps.org/EDE, the "HI-EDE Resource Center." A subscription is required to access the "HI-EDE Subscriber Home" page of the "HI-EDE Resource Center" which has the links to Appendix A.1 and A.2.

Subscribers of the standard are encouraged to refer to these links frequently to determine if updates have been released.

## A.1 HI-EDE data dictionary

See link at www.Pumps.org/EDE.

## A.2 Standard units of measure and conversions for HI-EDE transactions using HI 50.7

See link at www.Pumps.org/EDE.

# Appendix B

# Index

This appendix is included for informative purposes only and is not part of this standard. It is intended to help the user gain a better understanding of the factors referenced in the body of the standard.

Note: an f. indicates a figure, and a t. indicates a table.

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Hydraulic Institute
Creating Pump Standards Since 1917

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Optimizing Pumping Systems: A Guide to Improved Efficiency, Reliability and Profitability

Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems

Variable Speed Pumping: A Guide to Successful Applications

Mechanical Seals for Pumps: Application Guidelines


**ANSI/HI Pump Standards**

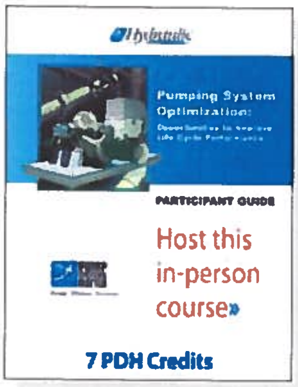
Individual Standards

- Hardcopy
- Downloadable

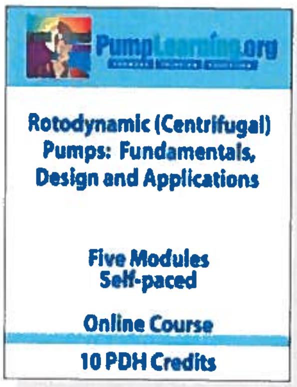
Complete Set — Hardcopy

ANSI/HI Pump Standards on CD — complete set

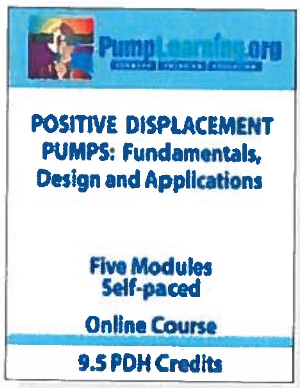
ANSI/HI Pump Standards by Subscription




Pumping System Optimization Course
Benefit from Major Energy Efficiency Improvements and Bottom-line Savings.




Rotodynamic (Centrifugal) Pumps: Fundamentals, Design and Applications Online Course




Positive Displacement Pumps: Fundamentals, Design and Applications Online Course

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