PIP VESEH001
Electric Immersion Process Heater Specification
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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# PIP VESEH001
## Electric Immersion Process Heater Specification

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1. **Scope**

This Practice provides minimum technical requirements for the process and mechanical design, materials, fabrication, inspection, and testing of electric immersion process heaters and associated controls, including thyristor control panels. This Practice applies to electric immersion process heaters which are inserted and flange mounted on tanks and vessels, installed in dedicated pressure vessels, and installed in pipe.

2. **References**

Applicable parts of the following Practices, industry codes, and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 **Process Industry Practices (PIP)**

- PIP ELSPS01 – *Electrical Requirements for Packaged Equipment*
- PIP PCSPS001 – *Packaged Equipment Instrumentation Specification*
- PIP CTSE1000 – *Application of External Coating*
- PIP VECV1001 – *Design Criteria and Purchasing Requirements for Vessels*
- PIP VESV1002 – *Design and Fabrication Specification for Vessels*
- PIP VEDV1003 – *Documentation Requirements for Vessels*
- PIP PCSCP001 – *Control Panel Specification*

2.2 **Industry Codes and Standards**

For the following reference document, if *Code*, Table U-3 {1.1} lists an edition or addenda different than the edition listed in the reference, the edition listed in *Code*, Table U-3 {1.1} shall be used.

- American Society of Mechanical Engineers (ASME)
  - *ASME Boiler and Pressure Vessel Code* (Code)
    - Section II, Part A – Ferrous Material Specifications
    - Section II, Part D – Properties
    - Section V – Nondestructive Examination
    - Section VIII – Pressure Vessels, Divisions 1 and 2
    - Section IX – Welding and Brazing Qualifications
- Tubular Exchanger Manufacturers Association (TEMA)
  - *Standards of the Tubular Exchanger Manufacturers Association*

3. **Definitions**

*Code*: The *ASME Boiler and Pressure Vessel Code*, Section VIII, Division 1 {or 2} and its referenced Sections (e.g., Section II, Section V, and Section IX) and any *Code* Cases permitted by the User. References to Division 2 are shown in braces { }. 
construction: An all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification (i.e., Code stamp and Manufacturer’s Data Report), {Manufacturer’s Design Report}, and pressure relief.

Manufacturer: The party entering into a contract with the Purchaser to design and construct an electric process heater in accordance with the requirements in this Practice and the contract documents. In accordance with the Code definition, the Manufacturer is the party that possesses a valid Certificate of Authorization to manufacture pressure vessels with the ASME Mark.

National Board: The National Board of Boiler and Pressure Vessel Inspectors, an organization comprised of chief inspectors of various governmental jurisdictions in the United States and Canada.

Owner: The party who owns the facility wherein the electric process heater will be used. The Owner is typically also the User.

Purchaser: The party who awards the contract to Manufacturer. Purchaser may also be the Owner, User, or Owner’s or User’s Designated Agent (e.g., engineering contractor).

Purchaser’s Inspector: The person or company authorized by Purchaser, Owner, and/or User to inspect pressure vessels to the requirements of this Practice and other Purchaser contract requirements.

User: The party who establishes construction criteria in accordance with the Code philosophy and service hazards. User is the operator of the facility wherein the electric process heater will be installed.

vessel: The pressure boundary components of the electric process heater, including the shell, heads, plates, and nozzles.

4. Requirements

4.1 General

4.1.1 Electric immersion process heaters shall be configured and specified in accordance with the requirements of this Practice, the Code, other standards as referenced in this Practice, local requirements, and the other contract documents furnished by the Owner.

4.1.2 The Maximum Allowable Working Pressure (MAWP) for the electric immersion process heater shall be calculated by the Supplier and specified on the drawing and the nameplate.

4.1.3 The method of attachment of the elements to the heater element support plate shall be in accordance with one of the following methods as specified on the Purchaser’s Data Sheet:

a. Screwed (typically for non-hazardous low pressure service only)

b. Compression fittings

c. Welded (from the process side of the heater element support plate)

4.1.4 Clearance shall be provided for removing flange stud bolts from the heater element support plate.
4.2 Design

4.2.1 Process Design

4.2.1.1 The orientation and control of the electric immersion process heater shall be as specified on the Purchaser’s Data Sheet.

4.2.1.2 The Manufacturer shall be responsible for the thermal design.

4.2.1.3 Relevant sections of the Purchaser’s Data Sheet shall be completed, providing all necessary process, mechanical, and electrical data for the heater.

4.2.2 Heater Element Support Plate

4.2.2.1 Element support plates shall be in accordance with Code Mandatory Appendix 41 regardless of mounting location (i.e., tank, vessel, or pipe).

Comment: ANSI blind flanges drilled for element insertion do not always meet Code Mandatory Appendix 41 requirements, and are therefore not acceptable unless calculations that confirm compliance are submitted to the Owner for approval.

4.2.2.2 Heater element support plate bolt hole pattern shall be in accordance with the dimensional requirements of ASME B16.5 or ASME B16.47 flanges.

4.2.2.3 Heater element support plate flange bolt holes shall straddle the horizontal and vertical centerlines.

4.2.2.4 Unless otherwise approved by Purchaser, heater element support plate flange faces shall be raised face design.

4.2.2.5 Lifting lugs shall be provided on the heater element support plate for lifting the bundle, including the terminal box and any other attachments. Bundles shall be sufficiently stiff for removal and lifting.

4.2.3 Element Bundle

4.2.3.1 Element bundle design shall be in accordance with the TEMA standards in regards to pitch, spans, impingement protection, and baffle design.

4.2.3.2 Flow-induced tube vibration shall be considered.

4.2.3.3 The method of vibration analysis shall be approved by User.

4.2.3.4 The element sheath thickness used for design shall be provided to the Purchaser.

4.2.4 Heater Shell (Pressure Chamber)

4.2.4.1 When the heater is installed in a dedicated pressure vessel, the heater shell shall be in accordance with PIP VECV1001, PIP VESV1002, and PIP VEDV1003.

4.2.4.2 Shell supports shall be designed to withstand a longitudinal force equal to 150% of the bundle weight applied at the electric process heater heating elements bundle centerline.
4.2.5 **Control Panel**

4.2.5.1 Heaters shall be contactor controlled or thyristor controlled as specified on the Purchaser’s Data Sheets.

*Comment:* Thyristor control panels are typically used for applications requiring tight control of the process (i.e., fuel gas superheater).

4.2.5.2 Design of the control panel shall be in accordance with *PIP PCSCP001*.

4.2.6 **Electrical Design**

The electrical design shall be in accordance with *PIP ELSPS01*.

4.2.7 **Instrumentation & Controls**

The instrument & controls design shall be in accordance with *PIP PCSPS001*.

4.3 **Materials**

4.3.1 Unless otherwise specified on the Purchaser’s Data Sheet, sheath material shall be Incoloy 800 or equal high grade Nickel/Chromium/Iron alloy.

4.3.2 Unless otherwise specified on the Purchaser’s Data Sheet, if baffles or element supports are included, the supports shall be of the same material as the sheath material.

4.3.3 If compression fittings are used to connect heating elements to the heater element support plate, the material shall be a high grade Nickel/Chromium/Iron Alloy suitable for the design temperature of the element sheath. Alternatives can be used with approval from the Owner.

4.3.4 Heating elements shall be connected through the back of the terminal box using Type 316 SS bushings or compression fittings. Nylon or plastic bushings shall not be permitted.

4.3.5 Unless otherwise specified by the Purchaser, all carbon steel forgings used for electric immersion heater element support plates shall be in accordance with *ASME SA-350* Grade LF2 Class 1 or equal.

4.3.6 Unless otherwise specified by the Purchaser, all stainless steel forgings used for electric immersion heater element support plates shall be in accordance with *ASME SA-182* Grade F316/316L.

4.4 **Inspection and Testing**

4.4.1 **Pressure and Testing**

4.4.1.1 Inspection and testing of bundle heater element support plate flanges shall be in accordance with *PIP VESV1002* and Purchaser’s Data Sheet.

4.4.1.2 Electric process heaters provided with shell or pressure chamber shall be hydrostatically tested as an assembled unit.

4.4.1.3 Electric process heaters which are inserted and flange mounted on a tank or vessel shall be hydraulically tested in a dummy shell bolted to the electric process heater flange.
4.4.1.4 The Manufacturer’s hydrostatic test procedure shall permit unhindered observation of the entire face of the heater element support plate.

### 4.4.2 Electrical Inspection and Testing

Inspection and testing of electrical equipment, including but not limited to heater bundle elements, terminal boxes, and control panels, shall be in accordance with PIP ELSPS01 and PIP PCSCP001.

### 4.5 Painting

The painting and coating of external surfaces shall be in accordance with PIP CTSE1000 using the coating systems as specified on the Purchaser’s Data Sheets.

### 4.6 Nameplate and Stamping

4.6.1 A nameplate shall be permanently attached to the electric process heater.

4.6.2 Nameplate shall include the following as a minimum:
   - a. Tag number (provided by Owner)
   - b. Manufacturer model and serial number
   - c. Vendor information (e.g., name)
   - d. Bundle weight
   - e. Corrosion allowance
   - f. MAWP (i.e., hot and corroded)
   - g. Voltage, current, wattage, heat flux, heat rate, etc. as required to completely define the heater

### 4.7 Documentation

#### 4.7.1 Data Sheets

The Data Sheet furnished by the Purchaser shall be completed by the Manufacturer with the Manufacturer’s information and provided.

#### 4.7.2 Calculations

Mechanical design calculations shall be submitted by the Supplier in accordance with the Code.

#### 4.7.3 Drawings

4.7.3.1 An outline drawing for the electric process heater shall be provided and shall contain the information shown in the appropriate completed Data Sheet. The outline drawing shall include the following information as a minimum:
   - a. Design code, design pressure and temperature, corrosion allowance, test pressure, MAWP (i.e., hot and corroded)
   - b. Material for each part including impact test requirements
   - c. Gasket type and material
   - d. Dimension, orientation, and location of element supports
e. Overall dimensions and bundle removal clearance
f. Weight data and location of center of gravity
g. Non-Destructive Examination/Testing (NDE/NDT) and Post Weld Heat Treatment (PWHT) requirements
h. Associated parts number or model number of individual components as applicable

4.7.3.2 Detailed fabrication drawings, fully describing the electric process heater, shall include the following information as a minimum:

a. Full cross-sectional views with all dimensions and material thickness data for each part
b. Electrical tube bundle details including the following:
   (1) Element layout
   (2) Heater element support plate and element hole details
   (3) Sheathing, baffles, tie rods, and spacer details
   (4) Support plate locations
c. Weld map showing weld joints including applicable welding procedure number
d. Complete bill of materials including material specifications