PIP RESP002
Design of ASME B73.1 and General Purpose Pump Baseplates
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.

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PUBLISHING HISTORY

February 1996  Issued
January 2004  Complete Revision
May 2004  Technical Correction
October 2010  Complete Revision
May 2017  Complete Revision

Not printed with State funds
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Data Forms
RESP002-DM – Data Sheet for Pump Baseplates – SI Units
RESP002-D – Data Sheet for Pump Baseplates – US Customary Units
1. Scope

This Practice provides the minimum requirements for ASME B73.1 pump baseplates and baseplates for general purpose pumps.

Comment: The function of a baseplate is to provide a structure under a pump and its driver that maintains alignment between the two components while accepting published piping loads. A pump properly supported and installed improves pump reliability and extends the operating life of such components as bearings, couplings, and seals.

This Practice describes minimum requirements for horizontal pump baseplates that are not covered in the API standards.

2. References

Applicable parts of the following Practice and 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 RESP002 - Application of ASME B73.1 Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process
- PIP REIE686A - Recommended Practice for Machinery Installation and Installation Design (Supplement to PIP REIE686/API RP686)
- PIP CTCE1000 - External Coating Systems Selection Criteria
- PIP CTSE1000 - Application of External Coatings

2.2 Industry Codes and Standards

- American Society for Mechanical Engineers (ASME)
  - ASME B73.1 - Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process
- Steel Structures Painting Council (SSPC)
  - SSPC SP 6 - Commercial Blast Cleaning

3. Definitions

purchaser: The party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.

supplier: The party responsible for furnishing general purpose pump baseplates
4. Requirements

4.1 General

4.1.1 The style of baseplate and other purchaser options are provided on the purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet.

4.1.2 Baseplate dimensional requirements shall be in accordance with ASME B73.1 except for free-standing baseplate designs and general purpose pump baseplates that are not in accordance with ASME B73.1 design.

4.1.3 If a dimensional conflict occurs between this Practice and ASME B73.1, this Practice shall take precedence.

4.1.4 The baseplate shall be stiff enough to resist distortion and deflection at the equipment mounting pad through installation and after curing of the grout. Baseplates shall be sufficiently rigid to attain and maintain pump and driver alignment specified in PIP REIE686A.

Comment: Caution is required if applying stilt support style base plates in brittle pipe service (e.g., FRP, thermoplastic) because the support may not be rigid enough to prevent breakage of the pipe. If the suction centerline is significantly elevated above grade, excessive stilt height can result in a less stable installation.

4.1.5 If specified, a drain rim shall be provided to route liquid to a low-point drain.

4.1.6 If the process fluid is corrosive or reactive, protection of the baseplate shall be specified.

4.1.7 Final machining of the mounting pads shall be performed in a manner to ensure that all pump mounting pads are co-planar within 0.05 mm (0.002 inch), that all driver mounting pads are co-planar within 0.05 mm (0.002 inch), and that the baseplate is in a free and undistorted position.

4.1.8 The driver and pump mounting pads shall be flat and parallel within 0.15 mm/m (0.002 inch per foot).

4.1.9 Mounting surfaces shall be machined to a 3.20 microns (125 microinch) mm, roughness Ra, or better finish.

4.1.10 To ensure flexibility in achieving the final alignment after baseplate installation, the final machined height of the driver mounting pads shall allow for the installation of a 3 mm thick (1/8 inch) shim pack. The shim pack shall be full bearing, 300 series stainless steel, and the quantity of shims in each pack shall be five or less. The shim packs shall be slotted to allow installation and removal without removing the fasteners.

4.1.11 Before shipment, the pump and driver shall be pre-aligned to within 0.38 mm (0.015 inch) parallel offset and 0.003 mm/mm (0.003 inch/inch) angular offset. The bolts shall be centered in their holes. Shims are not permitted under the pump.

4.1.12 Pump mounting surface shall be drilled and tapped. The useable tapped depth shall not be less than one and one-half times the bolt diameter. Through bolting of pump feet shall not be permitted.
4.1.13 Driver feet may be through bolted if mounted on a raised, preformed, fabricated superstructure where the nut can be reached with ordinary hand tools. If the superstructure is solid blocks, the mounting surface shall be drilled and tapped, the tapped depth being not less than one and one-half times the bolt diameter.

4.1.14 Horizontal driver positioning screws for the transverse direction shall be supplied for all drivers in excess of 20 kg (40 pounds). If specified on the purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet, horizontal positioning screws for the axial direction shall also be supplied. The driver positioning device above the plane of the mounting surface shall be removable without cutting, burning, or grinding.

4.1.15 A minimum of two grounding lugs should be provided on diagonally opposite corners of the base plate.

4.2 Grouted Baseplates

4.2.1 See Figure 1 for a typical PIP baseplate.

![Figure 1. Typical Fabricated PIP Baseplate](image)

4.2.2 Unless otherwise specified on the purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet, carbon steel shall be the material of construction.
4.2.3 Metal joints that may be exposed to chemicals shall be seal welded. Welds shall be visually crack-free.

4.2.4 The pump and driver mounting surfaces shall be continuously welded to the baseplate.

4.2.5 Baseplate welding shall be completed before final machining of the pump and driver mounting surfaces.

4.2.6 The final machined thickness of the mounting pads shall not be less than 13 mm (0.5 inch).

4.2.7 The mounting surfaces shall completely support the entire driver and pump footprints.

4.2.8 If specified on the purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet, each mounting surface shall extend 25 mm (1 inch) beyond the pump and driver feet to facilitate the leveling of the baseplate without removing the pump, drive, or auxiliaries.

4.2.9 The entire baseplate shall be sandblasted to SSPC SP 6 and degreased before painting. Unless otherwise specified on purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet, the baseplate shall be painted in accordance to PIP CTCE1000 and PIP CTSE1000.

Comment: According to industry experience, near white metal is preferred over priming. However, if not grouted immediately, the metallic surface can rust. Grout bonds poorly to rusty steel. For bases that are not pre-grouted, the preference is an epoxy primer (not-zinc rich, not inorganic zinc, but a true epoxy primer), which should avoid the delamination and bond issues that have been experienced on bases primed with primers other than epoxy.

4.2.10 To improve anchoring of the baseplate to the grout, the underside of the baseplate shall have welded members, such as angle, “I,” or “H” beams, or shall be provided with stud anchors (i.e., “J” hooks) to lock into the grout.

4.2.11 Grout Fill Holes

4.2.11.1 Grout fill holes shall be 100 mm (4 inch) minimum diameter.

4.2.11.2 Grout holes shall be located to permit filling the entire cavity under the baseplate. The preferred location of grout fill holes is such that removal of the equipment is not required during grout placement.

4.2.11.3 Grout holes within the drip containment area of the baseplate shall have 13 mm (1/2 inch) raised lip edges.

4.2.11.4 Accessibility for grouting shall be provided under all load-carrying members. If structural members are present, they shall be designed with a 50 mm by 150 mm (2 inch by 6 inch) opening to permit grout flow from one bulkhead section to another.

Comment: For baseplates purchased as pre-grouted, grout fill and vent holes are not required.
4.2.12 Vent Holes

4.2.12.1 Vent holes shall be 13 mm (1/2 inch) minimum in diameter.

4.2.12.2 Vent holes shall be provided at the highest point in each bulkhead section of the baseplate.

4.2.12.3 Vent holes shall be spaced 460 mm (18 inches) maximum apart to prevent air pockets.

4.2.12.4 For the baseplate shown in Figure 1, vent holes shall be placed along both edges and at ends.

4.2.13 Vertical baseplate leveling screw holes shall be located adjacent to each anchor bolt hole and shall be the diameter of the anchor bolt or greater.

4.2.14 If imbedded in grout, the outside corners of the baseplate shall have a nominal minimum radius of 13 mm (1/2 inch).

4.2.15 If specified on purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet, lifting lugs, designed to provide a balanced lift, without permanent distortion, of the complete baseplate, pump, and driver shall be included.

4.3 Free-Standing Baseplates (Non-Grouted)

4.3.1 Baseplate Styles

4.3.1.1 Type I or Type II baseplate configurations are shown in Figures 2 and 3 respectively.

See ASME B73.1. Table 2 for the following baseplate number definitions and applications.

- * 12.7 mm (1/2 inch) minimum through baseplate #258
- 15.9 mm (⅝ inch) minimum baseplate #264, #268, #280
- 19 mm (¾ inch) minimum baseplate #368, #380, #398

Figure 2. Type I Baseplate for Motor Sizes Up To NEMA 364T
4.3.1.2 Type I baseplates are applicable to pumps designated A05, A20, A30, A40, A50, A60, A70, and A80 by ASME B73.1, as well as general service pumps classified within the same size range. This baseplate design shall be limited to drivers no larger than NEMA frame 364.

4.3.1.3 Type II baseplates are applicable to pumps designated A90, A100, A110, and A120 by ASME B73.1, as well as any general purpose pump classified within the same size range.

4.3.2 Stilt Support Styles

Stilt support configurations are shown in Figures 4, 5, and 6. The purchaser shall specify the style to be used.

Comment: Stilt mounted pumps may be more susceptible to vibration.
4.3.3 **Structural Configuration**

4.3.3.1 Unless specified otherwise, carbon steel shall be the material of construction.

4.3.3.2 Metal joints shall be seal-welded. Welds shall be visually crack-free.

4.3.3.3 Baseplates shall have four support points; one pair shall be located so that its centerline passes through the discharge nozzle centerline, and the other pair shall be located at the approximate center of gravity of the driver, as shown in Figure 7.

4.3.3.4 The baseplate shall extend a minimum of 13 mm (1/2 inch) beyond the pump plan outline including process flanges on one end and to the end of the driver on the other end.

4.3.3.5 Gussets, as shown in Figures 2 and 8, shall be required if stilts are located outside the formed section of the baseplate.

4.3.3.6 Configurations for ranges of stilt lengths are shown in Figure 9.
Locate supports beneath center of gravity of the driver and beneath the discharge flange of the pump.

Figure 7. Typical Location of Supports

Figure 8. Typical Gusset Arrangement
Figure 9. Configurations for Various Stilt Lengths

4.3.4 Stiffness

4.3.4.1 Unless otherwise specified, the torsional stiffness about the length axis of the baseplate and the bending stiffness about the horizontal axis transverse to the length axis shall meet the following requirements:

a. The flange forces and moment loads per ASME B73.1, latest edition are for baseplate design and procurement and shall not be used for application of flange loads.

b. When the flange load moments about the X axis are applied to the pump in additive combination with the full load running torque of the driver, the resulting motion of the baseplate shall limit parallel misalignment of the pump shaft to driver shaft (see Figure 10) within the coupling manufacturer’s alignment tolerances.

c. Nozzle load calculations shall be in accordance with the Hydraulic Institute.

4.3.4.2 Alternate criteria shall be approved by the purchaser before manufacturing the equipment.

4.3.5 Testing

4.3.5.1 If specified on purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet, compliance with the stiffness requirements in this Practice shall be demonstrated by testing at least one baseplate from each type developed with a mounted pump and driver.

4.3.5.2 The largest pump and driver combination capable of being mounted on the largest of each type baseplate shall be used for this demonstration.

4.3.5.3 A certified report of the results shall be submitted to the purchaser.
4.4 Pre-Cast Polymer Baseplates/Bases

4.4.1 To suit specific chemical resistance needs, the material to be used for polymer baseplates shall be compatible to the process fluid in accordance with the pump data sheet.

*Comment:* Polymer baseplates are typically fabricated from either a phenolic resin binder and aggregate mix, a vinyl ester resin binder and aggregate mix, or a polymer concrete mix.

4.4.2 The pump and driver threaded inserts shall incorporate design features that prevent pull-out and rotation of the threaded insert to the limit of the hold-down bolt.

4.4.3 The threaded insert material shall be suitable for the intended service. The insert material shall be as specified on purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet.

4.4.4 Unless specified otherwise, the mounting surfaces shall completely support the entire driver and pump footprints. If specified on purchaser’s PIP RESP002-DM or PIP RESP002-D Data Sheet, the entire pad surface area shall be metallic.

4.4.5 The pump and driver mounting pads shall be co-planar within 0.4 mm/m (0.005 inch/ft). If specified on the data sheet, a co-planar tolerance of 0.15 mm/m (0.002 inch/ft) shall apply.

4.4.6 The polymer base shall incorporate features that mechanically lock and bond the base with the filler material.
4.4.7 Filler Holes

4.4.7.1 Filler holes shall be 100 mm (4 inch) minimum diameter.

4.4.7.2 Filler holes shall be located to permit filling the entire cavity under the baseplate. The filler hole shall be located such that removal of the equipment is not required during placement of filler material.

4.4.8 The base shall be self-venting during filling.
BASEPLATE MATERIALS OF CONSTRUCTION:
- CARBON STEEL PER 4.2.2
- STAINLESS STEEL: TYPE: 
- PRE-CAST POLYMER CONCRETE: MATERIAL OF CONSTRUCTION: TYPE: 
- OTHER: TYPE: 

HORIZONTAL POSITIONING SCREWS FOR LONGITUDINAL MOVEMENT REQUIRED (4.1.14)
OVERSIZED PUMP AND DRIVER MOUNTING PADS (4.2.8)

THE UNDERSIDE OF THE BASEPLATE SHALL BE COATED WITH THE FOLLOWING:
- MANUFACTURER’S STANDARD (4.2.9)
- OTHER: 

BASEPLATE LIFTING LUGS REQUIRED (4.2.15)
DRILLED FOR MULTIPLE DRIVER SIZES. MOTOR FRAME SIZES:

THREADED INSERT MATERIALS OF CONSTRUCTION FOR PRE-CAST POLYMER CONCRETE BASEPLATES (4.4.3):
- 316 SS
- ALLOY 20
- OTHER: 
- FULL-SIZED METALLIC PAD (4.4.4)

FREE-STANDING BASEPLATE:
- FREE-STANDING BASE WITHOUT SLIDE PLATES (FIG. 4)
- FREE-STANDING BASE WITH SLIDE PLATES (FIG. 5)
- SPRING-SUPPORTED BASEPLATE (FIG. 6)

BASEPLATE DESIGN:
- TYPE I BASE (UP TO NEMA 364 T MOTOR) (FIG. 2)
- TYPE II BASE (ABOVE NEMA 364 T MOTOR) (FIG. 3)

STILT DESIGN:
- TYPE A STILT (FIG. 9)
- TYPE B STILT (FIG. 9)
- TYPE C STILT (FIG. 9)

TESTING:
- COMPLIANCE WITH THE STIFFNESS REQUIREMENTS IN SECTION 4.3.4 SHALL BE DEMONSTRATED BY TESTING IN ACCORDANCE WITH SECTION 4.3.5.
GROUTED BASEPLATE

Baseplate Materials of Construction:

- Carbon Steel Per 4.2.2
- Stainless Steel: Type:
- Pre-Cast Polymer Concrete: Material of Construction: Type:
- Other:

Horizontal Positioning Screws for Longitudinal Movement Required (4.1.14)
Oversized Pump and Driver Mounting Pads (4.2.8)

The underside of the baseplate shall be coated with the following:

- Manufacturer's Standard (4.2.9)
- Other:

Baseplate Lifting Lugs Required (4.2.15)

Drilled for Multiple Driver Sizes. Motor Frame Sizes:

Threaded Insert Materials of Construction for Pre-Cast Polymer Concrete Baseplates (4.4.3):

- 316 SS
- Alloy 20
- Other:
- Full-Sized Metallic Pad (4.4.4)

FREE-STANDING BASEPLATE

Baseplate Style:

- Free-Standing Base Without Slide Plates (Fig. 4)
- Free-Standing Base with Slide Plates (Fig. 5)
- Spring-Supported Baseplate (Fig. 6)

Baseplate Design:

- Type I Base (Up to NEMA 364 T Motor) (Fig. 2)
- Type II Base (Above NEMA 364 T Motor) (Fig. 3)

Stilt Design:

- Type A Stilt (Fig. 9)
- Type B Stilt (Fig. 9)
- Type C Stilt (Fig. 9)

Testing:

- Compliance with the Stiffness Requirements in Section 4.3.4 shall be demonstrated by testing in accordance with Section 4.3.5.