PIP
Process Industry Practices
Structural

PIP STF05121
Fabrication and Installation of Anchor Bolts
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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1. Introduction

1.1 Purpose
This Practice provides details and requirements for anchor bolt fabricators and installers. This Practice also provides information for the design engineer to standardize bolt lengths. The intent of this Practice is to minimize the use of non-standard bolt lengths.

1.2 Scope
This Practice provides the details and requirements for anchor bolt fabrication and installation. Two standard lengths are shown for each diameter anchor bolt. This Practice also provides requirements for non-standard bolt lengths.

2. References

Applicable requirements in the following Practices 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 will be used herein where appropriate.

2.1 Process Industry Practices (PIP)
- PIP STS03001 - Plain and Reinforced Concrete Specification

2.2 Industry Codes and Standards
- American Society of Testing and Materials (ASTM)
  - ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts
  - ASTM F436 - Standard Specification for Hardened Steel Washers
  - ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- American Society of Mechanical Engineers (ASME)
  - ASME B18.2.1 – Square and Hex Bolts and Screws

3. Requirements

3.1 General
3.1.1 Unless a non-standard bolt length is required, the design engineer shall specify one of the two standard length anchor bolts shown for each anchor bolt diameter in the Anchor Bolt Data Table.

3.1.2 Non-standard bolt lengths may be required for the following reasons:
a. A longer than necessary bolt length may cause the foundation to be deeper than practical.
b. A longer than necessary bolt length may cause the anchor bolt to project into the foundation (mat), which would increase construction costs.
c. To properly transfer load to the reinforcing steel, the anchor bolt may need to be longer than the standard bolt.

3.1.3 If a non-standard bolt length is required, it should be an even dimension (an even number of inches) and should be significantly different in length than the standard length bolt (at least 6 inches shorter or longer than the closest standard length bolt).

3.2 Materials

3.2.1 Bolts shall conform to ASTM F1554, Grade 36, with UNC-2A threads except as otherwise specified on the design drawing.

3.2.2 Nuts shall conform to ASTM A563, Grade A, heavy hex with UNC-2B threads. Washers shall be ASTM F436.

3.2.3 Headed bolts (conforming to Section 3.2.1) of at least the same length above the bottom nut (see “Anchor Bolt Details”) are an acceptable substitution. Bolt head style shall be heavy hex in accordance with ASME B18.2.1.

3.3 Bolt Callout

Anchor bolts shall be identified on design drawings as follows:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Diameter</th>
<th>Type</th>
<th>Projection from top of concrete</th>
<th>Nut quantity at top</th>
<th>Bolt length</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1 - 1/4&quot;Ø</td>
<td>“NSL”</td>
<td>P = 3 - 3/4&quot; W/2 Nuts</td>
<td>L = 3’ - 8&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Comment: For record purposes, lengths of standard length anchor bolts shall be noted either in the call-out or in notes on the drawings. The engineer may duplicate the Anchor Bolt Data Table (this Practice) on the design drawing.

3.4 Fabrication

3.4.1 Unless otherwise specified, all bolts (total bolt length), nuts, and washers shall be hot-dip galvanized after fabrication in accordance with ASTM A153, Class C.

3.4.2 Excess galvanizing material shall be removed from the threaded portions of the bolts by the use of a centrifuge or by mechanical chasing of the threads.
3.4.3 The fit of nuts on threads of anchor bolts shall be verified before shipment.

3.5 Assemblies

3.5.1 Type “A,” “B,” and “N” bolt assemblies shall consist of anchor bolt with tack-welded nut at bottom and nut(s) and washer at top. Refer to “Anchor Bolt Details.”

3.5.2 Type “ASL,” “BSL,” and “NSL” bolt assemblies shall consist of anchor bolt with tack-welded nut at bottom and sleeve, nut(s), and washer at top. Refer to “Anchor Bolt Details.”

3.6 Installation

3.6.1 Unless noted otherwise on the design drawings, tolerances shall be as specified in PIP STS03001.

3.6.2 Unless noted otherwise on design drawings, anchor bolt sleeves for stationary equipment and structural base plates shall be filled with grout after the column or equipment is in place and the anchor bolts are aligned. Water or other loose particles shall not be allowed to collect in the sleeve before the sleeve is grouted.

3.6.3 Unless noted otherwise on the design drawings, anchor bolt sleeves for machinery shall be filled with nonbonding moldable material before grouting.

3.6.4 Anchor bolt threads shall be covered with duct tape or other suitable means to keep them clean and to prevent any damage that might occur during the preparation of the foundation for grouting and the actual grouting of the foundation.

3.6.5 Unless specified otherwise on design drawings, anchor bolts shall be tightened to a snug-tight condition, defined as the tightness that is attained with a few impacts of an impact wrench or with the full effort of a man using an ordinary spud wrench.

3.6.6 At slide plate locations, two top nuts are required. The lower nut shall be hand tightened and then backed off a half turn leaving approximately 1/16-inch clearance between lower nut and base plate. The upper nut shall be installed and jammed against the first nut.
## Appendix

### Anchor Bolt Data Table – Types “A,” “B,” “N,” “ASL,” “BSL,” and “NSL”

(See “Anchor Bolt Details” for locations of dimensions.)

<table>
<thead>
<tr>
<th>Bolt Diameter $d_o$</th>
<th>Allowance for Nuts</th>
<th>Thread Length at Top</th>
<th>Sleeve</th>
<th>Shell Size</th>
<th>Std. Length L</th>
<th>Std. Length L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N1</td>
<td>N2</td>
<td>P1 &amp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thread Length at Bottom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2”</td>
<td>1”</td>
<td>1 1/2”</td>
<td>1”</td>
<td>2 1/4”</td>
<td>2” x 5”</td>
<td>1’-0”</td>
</tr>
<tr>
<td>5/8”</td>
<td>1 1/4”</td>
<td>2”</td>
<td>1”</td>
<td>2 3/4”</td>
<td>2” x 7”</td>
<td>1’-3”</td>
</tr>
<tr>
<td>3/4”</td>
<td>1 1/2”</td>
<td>2 1/4”</td>
<td>1 1/4”</td>
<td>3”</td>
<td>2” x 7”</td>
<td>1’-4”</td>
</tr>
<tr>
<td>7/8”</td>
<td>1 1/2”</td>
<td>2 1/2”</td>
<td>1 1/4”</td>
<td>3 1/4”</td>
<td>2” x 7”</td>
<td>1’-5”</td>
</tr>
<tr>
<td>1”</td>
<td>1 3/4”</td>
<td>2 3/4”</td>
<td>1 1/2”</td>
<td>3 1/2”</td>
<td>3” x 10”</td>
<td>1’-10”</td>
</tr>
<tr>
<td>1 1/4”</td>
<td>2 1/4”</td>
<td>3 1/2”</td>
<td>1 3/4”</td>
<td>4 1/4”</td>
<td>3” x 10”</td>
<td>2’-0”</td>
</tr>
<tr>
<td>1 1/2”</td>
<td>2 1/2”</td>
<td>4”</td>
<td>2”</td>
<td>4 3/4”</td>
<td>4” x 15”</td>
<td>2’-8”</td>
</tr>
<tr>
<td>1 3/4”</td>
<td>3”</td>
<td>4 3/4”</td>
<td>2 1/4”</td>
<td>5 1/2”</td>
<td>4” x 15”</td>
<td>2’-10”</td>
</tr>
<tr>
<td>2”</td>
<td>3 1/4”</td>
<td>5 1/4”</td>
<td>2 1/2”</td>
<td>6”</td>
<td>4” x 18”</td>
<td>3’-4”</td>
</tr>
<tr>
<td>2 1/4”</td>
<td>3 3/4”</td>
<td>6”</td>
<td>2 3/4”</td>
<td>6 3/4”</td>
<td>4” x 18”</td>
<td>3’-6”</td>
</tr>
<tr>
<td>2 1/2”</td>
<td>4”</td>
<td>6 1/2”</td>
<td>3”</td>
<td>7 1/4”</td>
<td>6” x 24”</td>
<td>4’-2”</td>
</tr>
<tr>
<td>2 3/4”</td>
<td>4 1/2”</td>
<td>7 1/4”</td>
<td>3 1/4”</td>
<td>8”</td>
<td>6” X 24”</td>
<td>4’-4”</td>
</tr>
<tr>
<td>3”</td>
<td>4 3/4”</td>
<td>7 3/4”</td>
<td>3 1/2”</td>
<td>8 1/2”</td>
<td>6” x 24”</td>
<td>4’-6”</td>
</tr>
</tbody>
</table>

*Note to designer:* It is intended that the “A” and “ASL” bolts be used unless a longer length is required. If a longer length is required, use the “B” and “BSL” bolts. If neither is suitable, designate the bolt as type “N” (no sleeves required) or as type “NSL” (sleeves required), and specify the required length on the design drawing.

**Note to fabricator:** Type “N” and “NSL” bolts have no standard length. See the design drawings for anchor bolt length.
ANCHOR BOLT DETAILS

(FOR DIMENSIONS, SEE "ANCHOR BOLT DATA TABLE")

* PROJECTION – P AND GROUT THICKNESS AS SPECIFIED ON THE DESIGN DRAWINGS

CUT OFF TOP OF SLEEVE BEFORE SETTING EQUIPMENT

TOP OF ROUGH CONCRETE

ANCHOR BOLT SLEEVE

ANCHOR BOLT

ANCHOR BOLT SLEEVE DETAIL