

API 676 3rd Edition Comparative Summary – Section 8 – Rev. 8

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<p>Positive Displacement Pumps— Rotary Manufacturing, Distribution and Marketing Department API Standard 676 Second Edition, DECEMBER 1994</p> <p>SECTION 4—INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT</p> <p>4.1 General</p> <p>4.1.1 The purchaser will specify the extent of participation in the inspection and testing and the amount of advanced notification required.</p> <p>4.1.2 When specified, the purchaser’s representative, the vendor’s representative, or both shall indicate compliance in accordance with the inspector’s checklist (Appendix C) by initialing, dating and submitting the completed checklist to the purchaser before shipment.</p> <p>4.1.3 After advance notification of the vendor by the purchaser, the purchaser’s representative shall have entry to all vendor and sub-vendor plants where manufacturing, testing, or inspection of the equipment is in progress.</p> <p>4.1.4 The vendor shall notify sub-vendors of the purchaser’s inspection and testing requirements.</p> <p>4.1.5.1 When shop inspection and testing have been specified by the purchaser, the purchaser and the vendor shall meet to coordinate manufacturing hold points and inspectors’ visits.</p> <p>4.1.5.2 Witnessed means that a hold shall be applied to the production</p>	<p>Positive Displacement Pumps— Rotary Manufacturing, Distribution and Marketing Department API Standard 676 Third Edition, TBA</p> <p>8 Inspection, Testing and Preparation for Shipment</p> <p>8.1 General</p> <ul style="list-style-type: none">• 8.1.1 The purchaser shall specify the extent of participation in the inspection and testing.• 8.1.2 If specified, the purchaser’s representative, the supplier’s representative or both shall indicate compliance in accordance with an inspector’s checklist such as that provided in Annex F by initialing, dating, and submitting the completed checklist to the purchaser before shipment. <p>8.1.3 After advance notification to the supplier, the purchaser’s representative shall have entry to all supplier and sub-supplier plants where manufacturing, testing or inspection of the equipment is in progress.</p> <p>8.1.4 The supplier shall notify sub-supplier of the purchaser’s inspection and testing requirements</p> <ul style="list-style-type: none">• 8.1.5 If specified, the supplier shall provide their standard inspection and test plan to the purchaser for review and acceptance.• 8.1.6 If shop inspection and testing have been specified by the purchaser, the purchaser and the supplier shall coordinate manufacturing hold points and inspector’s visits.
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schedule and that the inspection or test shall be carried out with the purchaser or his representative in attendance. For mechanical running or performance tests, this requires written notification of a successful preliminary test.

4.1.5.3 Observed means that the purchaser shall be notified of the timing of the inspection or test; however, the inspection or test shall be performed as scheduled, and if the purchaser or his representative is not present the vendor shall proceed to the next step.

Note: The purchaser should expect to be in the factory longer than for a witnessed test.

4.1.5 The vendor shall provide sufficient advance notice to the purchaser before conducting any inspection or test that the purchaser desires to be witnessed or observed.

8.1.7 The expected dates of testing shall be communicated at least 30 days in advance and the actual dates confirmed as agreed. Unless otherwise agreed, the supplier shall give at least five working days advanced notification of a witnessed or observed inspection or test.

Note: For smaller pumps where set-up and test time is short, five days notice may require the pump to be removed from the test stand between preliminary and witness tests.

Note: All witnessed inspections and tests are hold points. For observed tests, the purchaser should expect to be in the factory longer than for a witnessed test.

- 8.1.8 If specified, witnessed mechanical and performance tests shall require a written notification of a successful preliminary test. The supplier and purchaser shall agree if the machine test set up is to be maintained or if the machine can be removed from the test stand between the preliminary and witnessed tests.

Note: Many purchasers prefer not to have preliminary tests prior to witnessed tests to understand any difficulties encountered during testing. If this is the case, purchasers should make it clear to the supplier.

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<p>4.1.6 Equipment for the specified inspection and Tests shall be provided by the vendor.</p> <p>4.1.7 The purchaser's representative shall have access to the vendor's quality program for review.</p> <p>4.2 Inspection</p> <p>4.2.1 General</p> <p>4.2.1.1 The vendor shall keep the following data available for at least twenty years for examination or reproduction by the purchaser or his representative upon request.</p> <p>a. When specified, necessary certification of materials, such as mill test reports.</p> <p>b. Test data to verify that the requirements of the specification are being met.</p> <p>c. Results of documented tests and inspections, including fully identified records of all heat treatment and radiography.</p> <p>d. When specified, final-assembly maintenance and running clearances.</p> <p>4.2.1.2 Pressure-containing parts shall not be painted until the specified inspection of the parts is completed.</p> <p>4.2.1.3 In addition to the requirements of 2.9.4.1, the purchaser may specify the following:</p> <p>a. Parts that shall be subjected to surface and subsurface examination.</p> <p>b. The type of examination required, such as magnetic particle, liquid penetrant, radiographic, and ultrasonic examination.</p>	<p>8.1.9 Equipment, materials and utilities for the specified inspections and tests shall be provided by the supplier.</p> <p>8.1.10 The purchaser's representative shall have access to the supplier's quality program for review and all major sub-suppliers.</p> <p>8.2. Inspection</p> <p>8.2.1. General</p> <p>8.2.1.1 The supplier shall keep the following data available for at least 20 years:</p> <p>a) Necessary or specified certification of materials, such as mill test reports.</p> <p>b) Test data and results to verify that the requirements of the specification have been met.</p> <p>c) Fully identified records of all heat treatment and NDE whether performed in the normal course of manufacture or as part of a repair procedure.</p> <p>d) Results of quality control tests and inspections.</p> <p>e) Details of all major weld repairs including weld maps.</p> <p>• f) If specified, final assembly maintenance and running clearances.</p> <p>g) Other data specified by the purchaser or required by applicable codes and regulations. (See 5)</p> <p>h) Non conformance reports and corrective actions.</p> <p>8.2.1.2 Pressure-containing parts shall not be painted until the specified inspection and testing of the parts is complete.</p> <p>• 8.2.1.3 In addition to the requirements of 6.11.4.1, the purchaser may specify the following:</p> <p>a) Parts that shall be subjected to surface and subsurface examination.</p> <p>b) The type of examination required, such as magnetic particle, liquid penetrant, radiographic and ultrasonic examination.</p>
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4.2.2 Material Inspection

4.2.2.1 General

When radiographic, ultrasonic, magnetic particle or liquid penetrant inspection of welds or materials is required or specified, the criteria in 4.2.2.2 through 4.2.2.5 shall apply unless other criteria are specified by the purchaser. Cast iron may be inspected in accordance with 4.2.2.4 and 4.2.2.5. Welds, cast steel, and wrought material may be inspected in accordance with 4.2.2.2 through 4.2.2.5.

4.2.2.2 Radiography

4.2.2.2.1 Radiography shall be in accordance with ASTM E 94 and ASTM E 142.

4.2.2.2.2 The acceptance standard used for welded fabrications shall be Section VIII, Division 1, UW-51 (100 percent) and UW-52 (spot), of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7, of the ASME Code.

4.2.2.3 Ultrasonic Inspection

4.2.2.3.1 Ultrasonic inspection shall be in accordance with Section V, Articles 5 and 23, of the ASME Code.

4.2.2.3.2 The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 12, of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7, of the ASME Code.

4.2.2.4 Magnetic Particle Inspection

4.2.2.4.1 Both wet and dry methods of magnetic particle inspection shall be in accordance with ASTM E 709.

4.2.2.4.2 The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 6 and Section V, Article 25, of the ASME Code. The acceptability of defects in castings shall be based on a comparison with the photographs in ASTM E 125. For each type of defect, the degree of severity shall not exceed the limits specified in Table 2.

8.2.1.4 All running tests and mechanical checks shall be completed prior to the purchaser's final inspection.

8.2.2 Materials Inspection

8.2.2.1 General

8.2.2.1.1 NDE shall be performed as required by the material specification. If additional radiographic, ultrasonic, magnetic particle or liquid penetrant examination of the welds or materials is specified by the purchaser, the methods and acceptance criteria shall be in accordance with the standards shown in Table 11. Alternative standards may be proposed by the supplier or specified by the purchaser and they shall be mutually agreed to by both purchaser and supplier. The welding and material inspection data sheet in Annex D may be used for this purpose.

Table 11 — Material Inspection Standards

Type of inspection	Methods	Acceptance Criteria	
		For fabrications	For castings
Radiography	Section V, Articles 2 and 22 of the ASME Code	Section VIII, Division 1, UW-51 (for 100 % radiography) and UW-52 (for spot radiography) of the ASME Code	Section VIII, Division 1, Appendix 7 of the ASME Code
Ultrasonic inspection	Section V, Articles 5 and 23 of the ASME Code	Section VIII, Division 1 Appendix 12, of the ASME Code	Section VIII, Division 1, Appendix 7, of the ASME Code
Magnetic particle inspection	Section V, Articles 7 and 25 of the ASME Code	Section VIII, Division 1, Appendix 6 of the ASME Code	Section VIII, Division 1, Appendix 7, of the ASME Code

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	Liquid penetrant inspection	Section V, Articles 6 and 24 of the ASME Code	Section VIII, Division 1, Appendix 8 of the ASME Code	Section VIII, Division 1, Appendix 7, of the ASME Code																																										
<p>Table 2—Maximum Severity of Defects in Castings</p> <table border="1"> <thead> <tr> <th>Type</th> <th>Defect</th> <th>Maximum Severity Level</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Linear discontinuities</td> <td>1</td> </tr> <tr> <td>II</td> <td>Shrinkage</td> <td>2</td> </tr> <tr> <td>III</td> <td>Inclusions</td> <td>2</td> </tr> <tr> <td>IV</td> <td>Chills and chaplets</td> <td>1</td> </tr> <tr> <td>V</td> <td>Porosity</td> <td>1</td> </tr> <tr> <td>VI</td> <td>Welds</td> <td>1</td> </tr> </tbody> </table> <p>4.2.2.5 Liquid Penetrant Inspection</p> <p>4.2.2.5.1 Liquid penetrant inspection shall be in accordance with Section V, Article 6, of the ASME Code.</p> <p>4.2.2.5.2 The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 8 and Section V, Article 24, of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendices 7 and 24, of the ASME Code.</p> <p>Note: Regardless of the generalized limits in 4.2.2, it shall be the vendor’s responsibility to review the design limits of the equipment in the event that more stringent requirements are necessary. Defects that exceed the limits imposed in 4.2.2 shall be removed to meet the quality standards cited, as determined by the inspection method specified.</p> <p>4.2.3 Mechanical Inspection</p>	Type	Defect	Maximum Severity Level	I	Linear discontinuities	1	II	Shrinkage	2	III	Inclusions	2	IV	Chills and chaplets	1	V	Porosity	1	VI	Welds	1				<p>8.2.2.1.2 The acceptability of defects in castings shall be based on a comparison with the photographs in ASTM E 125. For each type of defect, the degree of severity shall not exceed the limits specified in Table 12.</p> <p>Table 12—Maximum Severity of Defects in Castings</p> <table border="1"> <thead> <tr> <th>Type</th> <th>Defect</th> <th>Maximum Severity Level</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>Linear discontinuities</td> <td>1</td> </tr> <tr> <td>II</td> <td>Shrinkage</td> <td>2</td> </tr> <tr> <td>III</td> <td>Inclusions</td> <td>2</td> </tr> <tr> <td>IV</td> <td>Chills and chaplets</td> <td>1</td> </tr> <tr> <td>V</td> <td>Porosity</td> <td>1</td> </tr> <tr> <td>VI</td> <td>Welds</td> <td>1</td> </tr> </tbody> </table> <p>8.2.3 Mechanical Inspection</p>	Type	Defect	Maximum Severity Level	I	Linear discontinuities	1	II	Shrinkage	2	III	Inclusions	2	IV	Chills and chaplets	1	V	Porosity	1	VI	Welds	1
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<p>4.2.3.1 During assembly of the equipment and before testing, each component (including cast-in passages of these components) and all piping and appurtenances shall be cleaned chemically or by another appropriate method to remove foreign materials, corrosion products, and mill scale.</p> <p>4.2.3.2 Any portion of the oil system furnished shall meet the cleanliness requirements of API Standard 614.</p> <p>4.2.3.3 When specified, the purchaser may inspect for cleanliness the equipment and all piping and appurtenances furnished by or through the vendor before heads are welded to vessels, openings in vessels or exchangers are closed, or piping is finally assembled.</p> <p>4.2.3.4 When specified, the hardness of parts, welds, and heat-affected zones shall be verified as being within the allowable values by testing of the parts, welds, or heat-affected zones. The method, extent, documentation, and witnessing of the testing shall be mutually agreed upon by the purchaser and the vendor.</p> <p>4.3 Tests</p> <p>4.3.1 Testing</p> <p>4.3.1.1 Equipment shall be tested in accordance with 4.3.2 and 4.3.3. Other tests that may be specified are described in 4.3.4.</p> <p>4.3.1.2 At least six weeks before the first scheduled running test, or at some mutually agreed upon time, the vendor shall submit for the purchaser's review and comment detailed procedures for the mechanical running test and all specified running optional tests (4.3.4), including acceptance criteria for all monitored parameters.</p> <p>4.3.1.3 The vendor shall notify the purchaser not less than five working days before the date the equipment will be ready for testing. If the</p>	<p>8.2.3.1 During assembly of the equipment, each component, (including integrally cast-in passages) and all piping and auxiliaries shall be inspected to ensure they have been cleaned and are free of foreign materials, corrosion products and mill scale.</p> <p>8.2.3.2 All oil system components supplied shall meet the cleanliness requirements of API STD 614, Chapter 3.</p> <p>Note: For the purposes of this provision ISO 10438-3 is equivalent to API STD 614, Chapter 3.</p> <ul style="list-style-type: none">• 8.2.3.3 If specified, the purchaser may inspect the equipment and all piping and auxiliaries for cleanliness before heads are welded onto vessels, openings in vessels or exchangers are closed, or piping is finally assembled.• 8.2.3.4 If specified, the hardness of parts, welds, and heat-affected zones shall be verified as being within the allowable values by testing. The method, extent, documentation, and witnessing of the testing shall be mutually agreed upon by the purchaser and the supplier. <p>8.3 Testing</p> <p>8.3.1 General</p> <p>8.3.1.1 Equipment shall be tested in accordance with 8.3.2, 8.3.3, or 8.3.4 as appropriate.</p> <ul style="list-style-type: none">• 8.3.1.2 If specified, the supplier shall submit to the purchaser, for review and comment, detailed procedures and acceptance criteria for all required tests. The time period between submittal of the documents and the running test shall be at least 6 weeks, unless otherwise agreed <p>8.3.1.3 Notification requirements are covered in 8.1.6, however hydro</p>
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testing is rescheduled, the vendor shall notify the purchaser not less than five working days before the new test date.

4.3.2 Hydrostatic Test

4.3.2.1 Pressure-containing parts (including auxiliaries) shall be tested hydrostatically with liquid at a minimum of 1 1/2 times the maximum allowable working pressure but not less than gauge pressure of 1.5 bar (20 psig). The test liquid shall be at a higher temperature than the nil-ductility transition temperature of the material being tested.

4.3.2.2 If the part tested is to operate at a temperature at which the strength of a material is below the strength of the material at room temperature, the hydrostatic test pressure shall be multiplied by a factor obtained by dividing the allowable working stress for the material at room temperature by that at operating temperature. The stress values used shall conform to those given in ASME B31.3 for piping or in Section VIII, Division 1, of the ASME Code for vessels. The pressure thus obtained shall then be the minimum pressure at which the hydrostatic test shall be performed. The data sheet shall list actual hydrostatic test pressures.

and running test requirements shall be not less than 5 working days before the date the equipment will be ready for testing. If the testing is rescheduled, the supplier shall notify the purchaser not less than 5 working days before the new test date.

8.3.2 Hydrostatic Testing

8.3.2.1 All pressure casing components shall be assembled as a single unit and tested hydrostatically with liquid at a minimum of 1.5 times the MACP (maximum allowable working pressure), but not less than a gauge pressure of 150 kPa (1.5 bar) (20 psi).

8.3.2.1.1 The test liquid shall be at a higher temperature than the ductile-brittle transition temperature of the material being tested.

Note: The ductile-brittle transition temperature is the highest temperature at which a material experiences complete brittle fracture without appreciable plastic deformation.

8.3.2.2 If the component handling the pumped liquid is to operate at a temperature at which the strength of a material is below the strength of that material at the testing temperature, the hydrostatic test pressure shall be multiplied by a factor obtained by dividing the allowable working stress for the material at the testing temperature by that at the rated operating temperature. The stress values used shall be determined in accordance with those of 6.4.4. For piping, the stress shall conform to ISO 15649. The pressure thus obtained shall then be the minimum pressure at which the hydrostatic test shall be performed. The supplier shall list actual hydrostatic test pressures on data sheets.

Note 1: For the purposes of this provision, ISO 15649 is equivalent to ASME B31.3.

Note 2: Applicability of this requirement to the material being tested should be verified before hydro-test, as the properties of many grades of steel do not change appreciably at temperatures up to 200°C (390°F).

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<p>4.3.2.3 Where applicable, tests shall be in accordance with the ASME Code. In the event that a discrepancy exists between the code test pressure and the test pressure in this standard, the higher pressure shall govern.</p> <p>4.3.2.4 The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 parts per million. To prevent deposition of chlorides as a result of evaporative drying, all residual liquid shall be removed from tested parts at the conclusion of the test.</p> <p>4.3.2.5 Tests shall be maintained for a sufficient period of time to permit complete examination of parts under pressure. The hydrostatic test shall be considered satisfactory when neither leaks nor seepage through the casing or casing joint is observed for a minimum of 30 minutes. Large, heavy castings may require a longer testing period to be agreed upon by the purchaser and the vendor. Seepage past internal closures required for testing of segmented cases and operation of a test pump to maintain pressure is acceptable.</p>	<p>8.3.2.3 If applicable, tests shall be in accordance with the code or standard to which the part has been designed. In the event that a discrepancy exists between the code test pressure and the test pressure in this standard, the higher pressure shall govern.</p> <p>8.3.2.4 The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 parts per million (ppm by mass). To prevent deposition of chlorides on austenitic stainless steel as a result of evaporative drying, all residual liquid shall be removed from tested parts at the conclusion of the test.</p> <p>Note: Chloride content is limited in order to prevent stress corrosion cracking.</p> <p>8.3.2.5 Tests shall be maintained for a sufficient period of time to permit complete examination of parts under pressure. The hydrostatic test shall be considered satisfactory when neither leaks nor seepage through the pressure containing part or joints is observed for a minimum of 30 minutes. Large, heavy pressure-containing parts may require a longer testing period to be agreed upon by the purchaser and the vendor. Gaskets used during the hydrostatic testing shall be of the same design as supplied with the pump. Seepage past internal closures required for testing of segmented cases and operation of a test pump to maintain pressure is acceptable. See also 8.3.2.1</p> <p>8.3.2.6 All water-side cooling passages shall be tested at a minimum gauge pressure of 1000 kPa (10 bar) (150 psi).</p> <p>8.3.2.7 Casings with dual pressure ratings may be segmentally tested. Seepage past internal closures or gaskets and operation of a test pump to maintain pressure is acceptable. [Adapted from ISO 13709]</p> <p>8.3.3 Pre-Testing Check</p> <p>8.3.3.1 Oil system components downstream of the filters shall meet the cleanliness requirements of ISO 10438-3 before any test is started.</p> <p>Note: For the purposes of this provision API STD 614, Chapter 3, is</p>
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<p>4.3.4.1 Performance Test</p> <p>When specified, the vendor shall operate the complete pump in his shop for a sufficient period to obtain complete test data, including speed, discharge pressure, suction pressure, efficiency, capacity, and power.</p> <p>Tests apply to the pump only, and the values of power and efficiency shall be taken as referring to the pump. The recorded data and final report may, however, include information on the complete unit, including the driver and auxiliary equipment.</p> <p>Note: If dismantling is necessary to correct pump deficiencies, the pump characteristics affected by the correction shall be reestablished by test.</p> <p>4.3.3 Mechanical Running Test</p>	<p>equivalent to ISO 10438-3.</p> <p>8.3.3.2 All joints and connections shall be checked for tightness and any leaks shall be corrected.</p> <p>8.3.3.3 All warning, protective and control devices used during the test shall be checked and adjusted as required.</p> <p>8.3.4 Performance Test</p> <p>8.3.4.1 Unless otherwise specified, tests shall be conducted in accordance with the standards of the Hydraulic Institute Pump Standards, Section 3.6. The manufacturer shall operate the pump in his shop for sufficient period to obtain complete test data, including speed, discharge pressure, suction pressure, power, and capacity.</p> <p>8.3.4.2 If specified, and if the pump is to be operated at variable speeds, the pump shall be tested at speeds within five percentage points of 30, 60, 90 and 100 of the rated speed.</p> <p>8.3.4.3 The tests specified in 8.3.5.1 apply to the pump only, and the values of power are to be taken as referring to the pump. However, the recorded data and final report may include information on the complete unit, including driver and auxiliary equipment. The purchaser and the supplier shall agree to the test measurements to be recorded on both the driver and the auxiliary equipment.</p> <p>8.3.4.3.1 If the test facility does not have the capability to meet the rated conditions, the tests shall be run at both the specified discharge pressure with reduced speed and at the rated speed with reduced discharge pressure. The purchaser and the supplier shall agree to the test methods and their limitations prior to performing the tests.</p> <p>8.3.4.4 If dismantling is necessary to correct pump deficiencies, the pump characteristics affected by the correction shall be reestablished by testing.</p> <p>8.3.5 Mechanical Run Test</p>
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The vendor shall conduct a standard mechanical running test on all pumps to ensure satisfactory operation at the specified operating conditions. Such tests need not be performed with the specified liquid or at the specified conditions.

4.3.4.2 Test Tolerances

When operated on the test stand, pumps shall be within the following tolerances of the rated characteristics or the test equivalent:

Characteristic	Tolerance (Percent)
Capacity	
@ 100 % speed	+3.0, -0 of rated capacity
@ 90 % speed	+3.3, -0 of rated capacity
@ 60 % speed	+5.0, -0 of rated capacity
@ 30 % speed	+10.0, -0 of rated capacity
Rated power (at rated pressure and capacity)	+0

NPSHR

- 8.3.5.1 If specified, a mechanical run test shall be performed either before or consecutively following the performance test. The mechanical run test shall be one hour or until oil temperatures have stabilized.
- 8.3.5.2 If specified, the pump shall be mechanically run for four hours. Unless otherwise specified or agreed, this shall be performed at the rated flow.

8.3.5.3 Unless otherwise agreed, the contract shaft seals and bearings shall be used in the machine for the mechanical running test.

8.3.5.4 If replacement or modification of bearings or seals or dismantling of the case to replace or modify other parts is required to correct mechanical or performance deficiencies, the initial test will not be acceptable and the final shop tests shall be run after these deficiencies are corrected.

8.3.6 Test Tolerances

Unless otherwise agreed or specified, when operated on the test stand, pumps shall be within the tolerances as given in Table 13.

Table 13 — Test tolerances

Characteristic	Tolerance (Percent)
Capacity	
@ 100 % speed	+3.0, -0 of rated capacity
@ 90 % speed	+3.0 , -0 of rated capacity
@ 60 % speed	+5.0, -0 of rated capacity
@ 30 % speed	+10.0, -0 of rated capacity
Rated power (at rated pressure and capacity)	+4

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(at rated capacity)	+0	(at rated capacity)	+0
4.3.4 Optional Tests		<ul style="list-style-type: none"> • 8.3.7 Optional Tests <p>If specified, the shop tests described in 8.3.7.1 through 8.3.7.4 shall be performed. Test details shall be mutually agreed upon by the purchaser and the supplier.</p> <p>8.3.7.1 NPIP/NPSH Test</p> <p>If specified, the pump shall be tested for NPSH. At rated speed and with NPSHA equal to quoted NPSHR, the pump capacity shall be within three percent of the non-cavitating capacity.</p> <p>Warning - The pump shall not be run while cavitating.</p> <p>Note: The supplier must confirm if the mechanical seal included in their scope can operate in a suction lift condition.</p> <ul style="list-style-type: none"> • 8.3.7.2 Complete Unit Test <p>If specified, such components as pumps, gears, drivers and auxiliaries that make up the complete unit shall be tested together. The complete unit test may be performed in place of or in addition to separate tests of individual components.</p> <ul style="list-style-type: none"> • 8.3.7.3 Sound Level Test <p>If specified, the sound level test shall be performed in accordance with ISO 3744 or other agreed standard.</p> <ul style="list-style-type: none"> • 8.3.7.4 High Discharge Pressure Test <p>If specified, the pump will be operated at the pressure-limiting valve set pressure at the maximum rated pump speed and a fluid viscosity agreed to by the Supplier and the User to confirm that the pump does not seize under these conditions. A single data point will be collected.</p>	
4.3.4.3 NPSH Test			
When specified, the pump shall be tested for NPSH. At rated speed and with NPSHA equal to quoted NPSHR, the pump capacity shall be within three percent of the non-cavitating capacity.			
4.3.5 Test data		8.3.9 Test data	

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<p>Immediately upon completion of each witnessed mechanical and performance test, copies of the data logged shall be given to the witness.</p> <p>4.4 Preparation For Shipment</p> <p>4.4.1 Equipment shall be suitably prepared for the type of shipment specified. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals. If storage for a longer period is contemplated, the purchaser will consult with the vendor regarding the recommended procedures to be followed.</p> <p>4.4.2 The vendor shall provide the purchaser with the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before startup.</p> <p>4.4.3 The equipment shall be prepared for shipment after all testing and inspection have been completed and the equipment has been released by purchaser. The preparation shall include that specified in 4.4.3.1 through 4.4.3.9.</p> <p>4.4.3.1 Exterior surfaces, except for machined surfaces, shall be given at least one coat of the manufacturer's standard non-lead and non-chromate paint.</p> <p>4.4.3.2 Exterior machined surfaces, except for corrosion-resistant material, shall be coated with suitable rust preventive.</p>	<p>Immediately upon completion of each witnessed mechanical and performance test, copies of the data logged shall be given to the witness.</p> <p>8.4 Preparation for Shipment</p> <p>8.4.1 Equipment shall be suitably prepared for the type of shipment specified. Unless otherwise specified, the preparation shall make the equipment suitable for 6 months of outdoor storage from the time of shipment, with no disassembly required before installation, except for inspection of bearings and seals. If storage for a longer period is contemplated, the purchaser will consult with the supplier regarding the recommended procedures to be followed. Removal of the inhibitor and periodic rotation of the pump shaft (per the supplier's recommended procedure) to ease seal and bearing movement, shall be the responsibility of the purchaser.</p> <p>8.4.2 The supplier shall provide the purchaser with the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before start-up, as described in Chapter 3 of API 686 "Recommended Practices for Machinery Installation and Installation Design."</p> <p>8.4.3 The equipment shall be prepared for shipment after all testing and inspection has been completed and the equipment has been released by the purchaser. The preparation shall include that specified in 8.4.3.1 through 8.4.3.10.</p> <p>8.4.3.1 Except for machined surfaces, all exterior surfaces that may corrode during shipment, storage, or in service, shall be given at least one coat of the manufacturer's standard paint, unless otherwise specified. The paint shall not contain lead or chromates.</p> <p>Note: Austenitic stainless steels are typically not painted.</p> <p>8.4.3.2 Exterior machined surfaces except for corrosion-resistant material shall be coated with rust preventive.</p>
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<p>4.4.3.3 The interior of the equipment shall be clean; free from scale, welding spatter, and foreign objects; and sprayed or flushed with suitable rust preventive that can be removed with solvent.</p> <p>4.4.3.4 Internal steel areas of bearing housings and carbon steel oil systems' auxiliary equipment such as reservoirs, vessels, and piping shall be coated with suitable oil-soluble rust preventive.</p> <p>4.4.3.5 Flanged openings shall be provided with metal closures at least 5 mm (3/16-inch) thick, with elastomeric gaskets and at least four full-diameter bolts. For studded openings, all nuts needed for the intended service shall be used to secure closures Each opening shall be car sealed so that the protective cover cannot be removed without the seal being broken.</p> <p>4.4.3.6 Threaded openings shall be provided with steel caps or round-head steel plugs. In no case shall nonmetallic (such as plastic) caps or plugs be used.</p> <p>Note: There are shipping plugs. Permanent plugs are covered in 2.3.5.</p> <p>4.4.3.7 Lifting points and lifting lugs shall be clearly identified on the equipment or the equipment package. The recommended lifting arrangement shall be identified on the boxed equipment.</p> <p>4.4.3.8 The equipment shall be identified with item and serial numbers. Material shipped separately shall be identified with securely affixed corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, crated equipment shall be shipped with duplicate packing lists, one inside and one on the outside of the shipping container.</p> <p>4.4.3.9 Exposed shafts and shaft couplings shall be wrapped with</p>	<p>8.4.3.3 The interior of the equipment shall be clean; free from scale, welding spatter and foreign objects; and, except for corrosion-resistant material, sprayed or flushed with rust preventive that can be removed with solvent. The rust preventive shall be applied through all openings while the shaft is rotated.</p> <p>8.4.3.4 Internal surfaces of bearing housings and carbon steel oil systems' components shall be coated with glycol or epoxy or alternatively coated with oil-soluble rust preventive that is compatible with the lubricating oil.</p> <p>8.4.3.5 Flanged openings shall be provided with metal closures at least 5 mm (3/16 in.) thick with elastomeric gaskets and at least four full-diameter bolts. For studded openings, all nuts needed for the intended service shall be used to secure closures.</p> <p>8.4.3.6 Threaded openings shall be provided with steel caps or hex head steel plugs. In no case shall non-metallic (such as plastic) caps or plugs be used.</p> <p>Note: These are shipping plugs; permanent plugs are covered in 6.5.11.</p> <p>8.4.3.7 Lifting points, lifting lugs and baseplate center of gravity shall be clearly identified on the equipment, equipment drawing, or equipment package. The recommended lifting arrangement shall be as described in the installation manual.</p> <p>8.4.3.8 The equipment shall be identified with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. Crated equipment shall be shipped with duplicate packing lists, one inside and one on the outside of the shipping container.</p> <p>8.4.3.9 Exposed shafts, and shaft couplings shall be protected with a</p>
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<p>waterproof, moldable waxed cloth or volatile-corrosion-inhibitor paper. The seams shall be sealed with oil-proof adhesive tape.</p> <p>4.4.4 Auxiliary piping connections furnished on the purchased equipment shall be impression-stamped or permanently tagged to agree with the vendor's connection table or general arrangement drawing. Service and connection designations shall be indicated.</p> <p>4.4.5 Bearing assemblies shall be fully protected from the entry of moisture and dirt. If vapor-phase-inhibitor crystals in bags are installed in large cavities to absorb moisture, the bags must be attached in an accessible area for ease of removal. Where applicable, bags shall be installed in wire cages attached to flanged covers, and bag locations shall be indicated by corrosion-resistant tags attached with stainless steel wire.</p> <p>4.4.6 One copy of the manufacturer's standard installation instructions shall be packed and shipped with the equipment.</p> <p>4.4.7 Connections on auxiliary piping removed for shipment shall be match marked for ease of reassembly.</p>	<p>corrosion barrier followed by a separate barrier material to protect against incidental mechanical damage.</p> <p>8.4.3.10 Loose components shall be placed in plastic bags (or dipped in wax) and contained by cardboard boxes. Loose boxes are to be securely blocked in the shipping container.</p> <p>8.4.4 Auxiliary piping connections supplied on the purchased equipment shall be impression-stamped or permanently tagged to agree with the supplier's connection table or general arrangement drawing. Service and connection designations shall be indicated.</p> <p>8.4.5 Bearing assemblies shall be fully protected from the entry of moisture and dirt. If vapor-phase-inhibitor crystals in bags are installed in large cavities to absorb moisture, the bags must be attached in an accessible area for ease of removal. If applicable, bags shall be installed in wire cages attached to flanged covers and bag locations shall be indicated by corrosion-resistant tags attached with stainless steel wire.</p> <p>8.4.6 One copy of the manufacturer's installation instructions shall be packed and shipped with the equipment.</p> <p>8.4.7 Connections on auxiliary piping that are removed for shipment, shall be match marked for ease of reassembly.</p> <ul style="list-style-type: none">● 8.4.8 If specified, the fit-up and assembly of machine-mounted piping, intercoolers etc. shall be completed in the supplier's shop prior to shipment.
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