

**Multiphase Pump Chapter - Rev. 8**

6.1.15 The equipment (machine, driver, and ancillary equipment) shall perform on the test stand and on their permanent foundation within the specified acceptance criteria. After installation, the performance of the combined units shall be the joint responsibility of the purchaser and the vendor who has unit responsibility. The performance of the machine shall also take into account the following:

- a) NPSH testing is not applicable for multiphase pumps.
- c) If specified, the MPP supplier shall confirm that the unit is capable of start-up at settle-out or elevated suction pressure.

[TF reword of API 619]

6.5.1.1 For twin-screw multiphase pumps the maximum allowable rotor deflection under the worst operating condition (consider temperature, pressure, particulate, etc, as specified on the data sheet) shall be calculated and able to be demonstrated to show non-contact between rotors and surrounding pump casing."

Note: Purchaser should be able to review these calculations, if they request to do so.  
[ TF reword of API 619]

Timing gears shall be made of forged steel and shall be a minimum of ISO/AGMA 1328 Quality 5. ISO/AGMA service factor shall be a minimum of 2.0. [TF reword of API 619]

Table 3—Vibration Limits for Multiphase Pumps

Measurement on Bearing housing	Rolling Element Bearings
Steady State Vibration at any speed within operating range	$V_u < 5.5$ mm/s RMS (0.22 in/s RMS)
Overall - liquid or at any GVF during testing	$V_u < 7.1$ mm/s RMS (0.28 in/s RMS)

6.1.3 A coordination meeting...

- k. Thrust and journal-bearing sizing, estimated loading and specific configurations.

Note: In multiphase pumps this is especially important for the AF bearings to insure proper L10 life and meeting the full range of bearing loading under all operating conditions. Special attention should be given to minimum loading conditions.

- l. The rotor dynamics analysis (torsional and transient torsional, as required) [From API 617]

6.2.4.2 Performance curves for MPP's shall include the following:

- a. Curves of the differential pressure, power, and efficiency versus flow rate at a given speed, GVF, and viscosity, for the complete range of operating conditions. Curves shall be used to determine the maximum horsepower. [Modified from 617]

6.4.1 For twin screw MPP's, the pressure-containing parts shall be designed in accordance with 6.4.1.1 (or 6.4.1.2, as selected by the vendor) and 6.4.1.3 to achieve the following:

a) operate without leakage or internal contact between rotating and stationary components (other than bearings and seals) while subject simultaneously to the MAWP (and corresponding temperature) and the worst case combination of maximum allowable nozzle loads applied to all nozzles.

b) withstand the hydrostatic test.

Note: a) does not apply to PC pumps. Continuous contact between rotor and stator for these pumps is absolutely necessary for this pump design to be effective.

6.8.1.1 Unless otherwise specified, replaceable liners shall be provided.

7.3.1 Multiphase pumps shall be direct driven. The use of belts or chains are not permissible.

## 7.5 Controls and Instrumentation

### 7.5.1 General

The controls and instrumentation scope of supply shall be supplied and installed as per the purchaser's specifications and on the data sheets.

Note: See Annex G (Informative) for typical self-contained P&IDs for MPP control systems.

## 7.7 Pulsation and Vibration Control Requirements

### 7.7.1 General

Note 1: The interaction of the dynamic flow generated by the multiphase pump with acoustical resonance in piping systems can result in excitation in the pump and piping, with acoustical resonance in piping systems. This energy can result in pump and piping failures.

Note 2: The responsiveness of a pump/piping system depend on factors such as the following:

- a) complexity of the piping system layout
- b) number of pumps
- c) operating speeds
- d) rate of change of operating conditions
- e) pump type
- f) pump size (power)
- g) number of screw leads (starts)
- h) system operational conditions
- i) screw geometry
- j) fluid properties

7.7.1.2 To minimize the likelihood of detrimental vibrations in a pumping system, the pump supplier shall use basic techniques including the following:

- a) The fluid properties and potential for slug flows. (See Note 4 below.)
- b) Review comparable pumping applications

c) For piping within his scope of supply, the pump supplier shall design the piping layout addressing the following:

1. Maintaining near-ground level routing of piping when possible to facilitate effective (relatively stiff) restraints.
2. Minimizing the number of direction and elevation changes to reduce the potential for coupling pulsations into a mechanical shaking force.
3. Using adequate dynamic restraints on pulsation suppression devices to ensure vibration control of these devices.
4. Using sufficient number of piping restraints (clamp spacing) and proper restraint design.

design.

•d) If specified by purchaser, conduct a dynamic simulation of the pumping system across the specified operating conditions.

Note 1: Clamps are preferred to U-bolts; weight-only type supports should be avoided.

Note 2: Normally control of system vibration needs coordination between the pump manufacturer and the piping system designer in order to ensure that the pump system characteristics meet the specified requirements.

Note 3: Dynamic simulation may be specified to be performed by a third party entity.

Note 4: The supplier may be requested to comment on the purchaser's piping system that the pump will be part of. See Annex C.

#### • 8.3.8 Optional Tests

##### • 8.3.8.X Multiphase Fluid Mechanical Test

If specified, a fluid of defined GVF, simulating contract multiphase conditions, will be introduced into the pump/pumping system inlet during this test. Data gathered is as per the mechanical run test. Test stand conditions and acceptance criteria shall be mutually agreed between the supplier and purchaser. The supplier shall provide a recommended test procedure as part of the proposal.

##### • 8.3.8.X Gas Slug Test (Dry Run Test)

If specified, a slug test (rapid change from 30% to 100% GVF at pump/pumping system inlet) will be performed following the multiphase fluid mechanical test for the designed period of time. Data gathered is as per the multiphase fluid test. Test stand conditions and acceptance criteria shall be mutually agreed between the supplier and purchaser. The supplier shall provide a recommended test procedure as part of the proposal.

##### • 8.3.8.X Factory Acceptance Test

If specified, controls and instrumentation shall undergo a functional acceptance test, which includes verification of functionality of instrumentation, control, PLC control logic, alarm and shutdown set points.