

QNP_{HD} Series

Single-Axis, High-Dynamic Piezo Nanopositioning Stages

Closed-loop travels from 10 μm to 40 μm

Direct-drive actuation enables fast response times and higher-throughput processes

High-precision, frictionless flexure guidance

Long device lifetime

Superior positioning resolution and linearity with direct-metrology capacitive sensor option

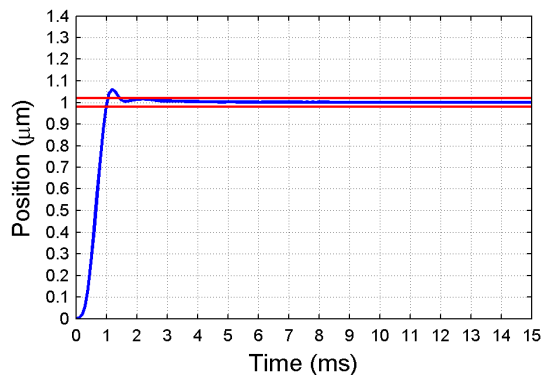
Open-loop and vacuum versions

Aerotech's QNP_{HD} piezo nanopositioning stages provide the benefits of both a stage and actuator in one compact, high-stiffness package. With a direct-metrology, capacitive sensor feedback option, high resonant frequencies and high load capacity, the QNP_{HD} is ideal for a wide range of high-speed and high-precision applications such as scanning probe microscopy, disc-drive testing, or semiconductor wafer articulation.

Fast Response with Exacting Precision

The QNP_{HD} employs a direct-drive actuation design and an optimized structure enabling millisecond-level response and move-and-settle times.

Guided by precision flexures that are optimized using finite element analysis to ensure high-stiffness and long device



QNP_{HD}30L-25-C move-and-settle plot for a 1 μm step, 200 gram payload and a settle window of ± 20 nm. All QNP_{HD} exhibit excellent dynamic performance enabling higher-throughput processes.



The QNP_{HD} stages are available in three closed-loop travel options.

life, the QNP_{HD} provides high-dynamics while maintaining excellent geometric performance (straightness and angular errors) for critical nanopositioning applications.

High-Resolution and Positioning Accuracy

The QNP_{HD} has the option of closed-loop feedback (-C) using a unique capacitive sensor design that allows for sub-nanometer resolution and single-digit nanometer linearity errors. The capacitive sensors measure the output of the positioning carriage directly enabling superior accuracy and repeatability.

Ultra-Precision Control

When coupled with Aerotech's Q-series controllers and drives, the QNP_{HD} demonstrates sub-nanometer positioning resolution and high-positioning bandwidth. Software options such as Aerotech's Dynamic Controls Toolbox and Motion Designer packages provide a host of advanced yet easy-to-use tools such as Learning Control, Harmonic Cancellation, and Command Shaping, providing improved tracking errors and faster step-and-settle times.

Automatic parameter and calibration identification is accomplished using Aerotech's FlashConfig feature.

The stage is automatically identified and all operational parameters including axis calibration data are uploaded into the controller ensuring safe, accurate and true "plug-and-play" operation.

Mounting Flexibility

The QNP_{HD} is available with rear and side cable exit options along with mounting features for both horizontal and vertical orientations. This flexibility allows the user to orient and package the stage for the most optimal arrangement without designing various adapter plates and brackets that increase size and design complexity.

An optional mounting plate provides direct mounting to English or metric optical breadboard tables. Custom designs and vacuum-prepared versions are available upon request.

QNP_{HD} Series SPECIFICATIONS

| Mechanical Specifications | | QNP _{HD} 30L-10 | QNP _{HD} 30L-25 | QNP _{HD} 30L-40 |
|---|-------------|--------------------------|--------------------------|--------------------------|
| Closed-Loop Travel | | 10 μm | 25 μm | 40 μm |
| Open-Loop Travel, -30 to +150 V ⁽¹⁾ | | 12 μm | 32 μm | 50 μm |
| Resolution ⁽²⁾ | Closed-Loop | 0.05 nm | 0.10 nm | 0.10 nm |
| | Open-Loop | 0.02 nm | 0.03 nm | 0.05 nm |
| Linearity ^(3,4) | | 0.02% | 0.02% | 0.02% |
| Bidirectional Repeatability ⁽⁵⁾ | | 1 nm | 1 nm | 2 nm |
| Pitch/Yaw | | 5 μrad (1.0 arc sec) | 5 μrad (1.0 arc sec) | 7.5 μrad (1.5 arc sec) |
| Stiffness (in direction of motion) ⁽⁶⁾ | | 60 N/μm | 31 N/μm | 29 N/μm |
| Unloaded Resonant Frequency ⁽⁶⁾ | | 7000 Hz | 4100 Hz | 3500 Hz |
| Resonant Frequency (200 g load) ⁽⁶⁾ | | 2500 Hz | 1900 Hz | 1700 Hz |
| Max Payload ⁽⁷⁾ | Horizontal | 2 kg | 2 kg | 2 kg |
| | Vertical | 7 kg | 10 kg | 10 kg |
| Maximum Acceleration (Unloaded) ⁽⁸⁾ | | 2250 m/s ² | 1250 m/s ² | 750 m/s ² |
| Moving Mass (Unloaded) | | 39 g | 54 g | 77 g |
| Stage Mass | | 0.11 kg | 0.15 kg | 0.20 kg |
| Material | | Stainless Steel | | |
| MTBF (Mean Time Between Failure) | | 30,000 Hours | | |

Notes:

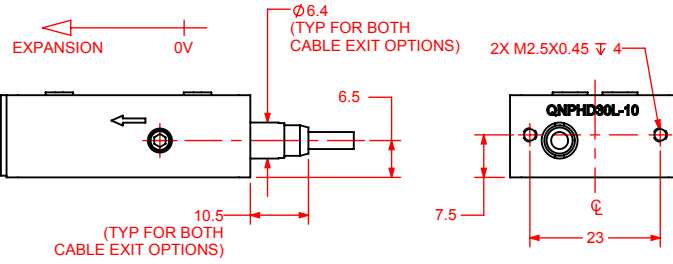
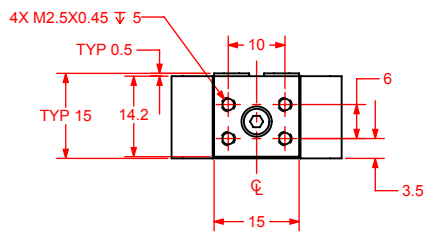
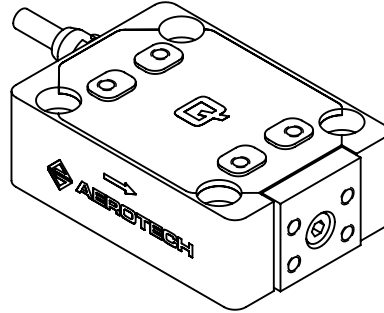
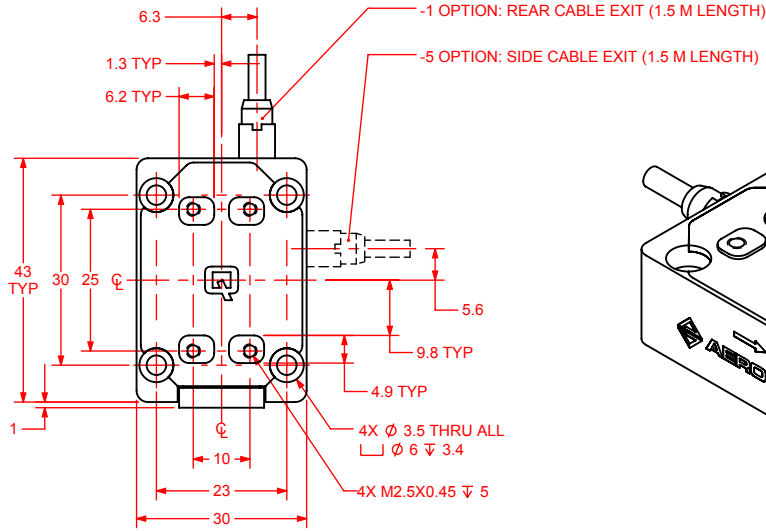
1. Value ±10%
2. See Piezo Engineering reference section 4.2 for description of resolution.
3. Certified with each stage (closed-loop feedback models only).
4. Measured approximately 15 mm above the carriage by an external metrology device. See Piezo Engineering reference section 4.1 for description of linearity specifications.
5. Specified as a 1 sigma (standard deviation) value. See Piezo Engineering reference section 4.3 for description of bidirectional repeatability.
6. Values ±20%.
7. On-axis loading listed.
8. Requires the selection of an appropriate amplifier to achieve the listed values.

| Electrical Specifications | QNP _{HD} 30L-10 | QNP _{HD} 30L-25 | QNP _{HD} 30L-40 |
|--|---|--------------------------|--------------------------|
| Drive System | Piezo Multi-Layer Stack Actuator | | |
| Feedback | Closed-loop: Integrated Capacitive Sensor (-C) Open-loop: None (-) | | |
| Max Voltage | -30 V to +150 V | | |
| Piezo Stack Capacitance ⁽¹⁾ | 0.7 μF | 2.3 μF | 3.4 μF |

1. Value ±20%.

QNP_{HD} Series DIMENSIONS

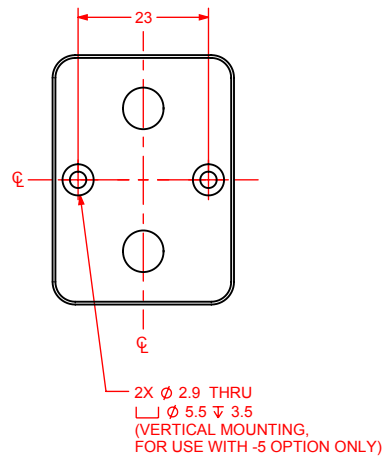
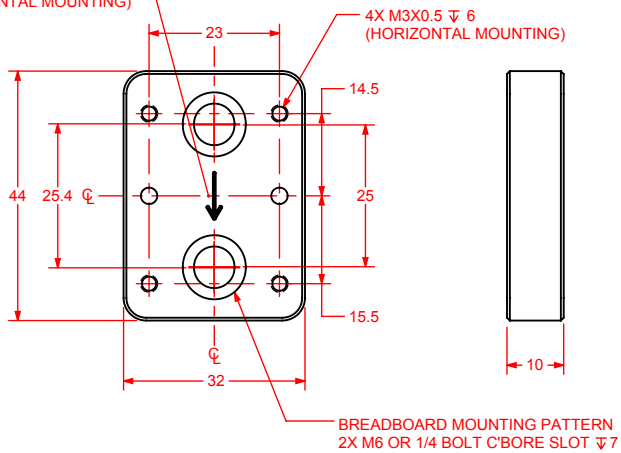
QNP_{HD}-30-10L



STAGE SHOWN AT MID-TRAVEL

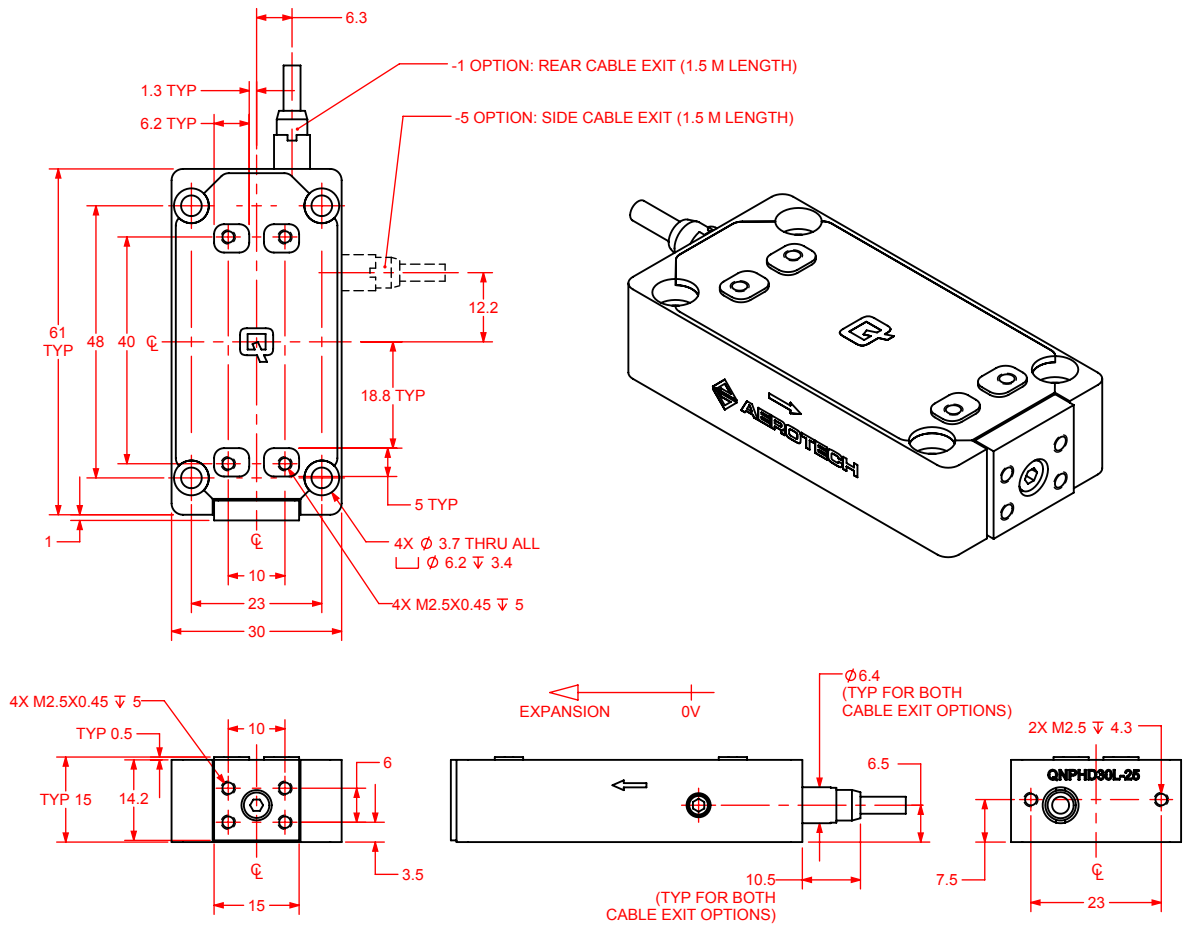
-MP (MOUNTING PLATE, BREADBOARD)
MATERIAL: STAINLESS STEEL

MATCH SCRIBED ARROW
WITH STAGE EXPANSION
(HORIZONTAL MOUNTING)



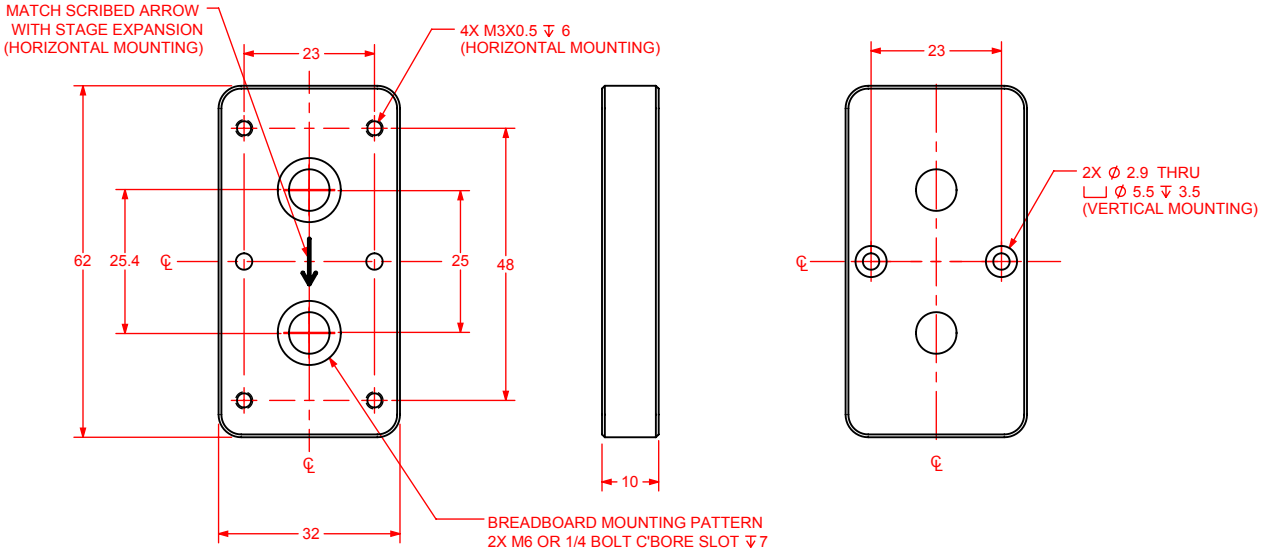
DIMENSIONS: MILLIMETERS

QNP_{HD}-30-25L



STAGE SHOWN AT MID-TRAVEL

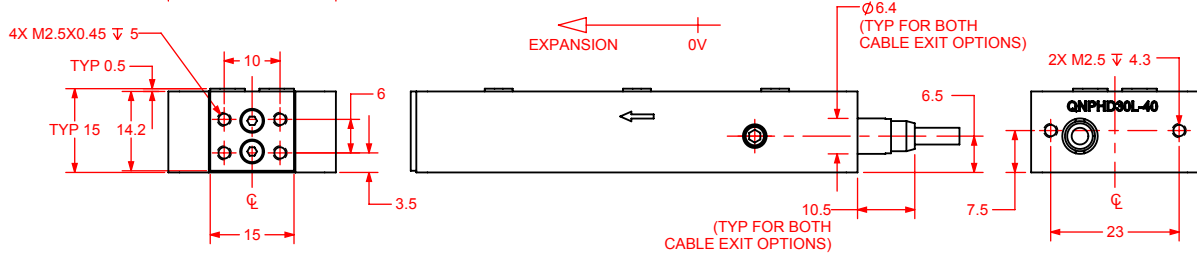
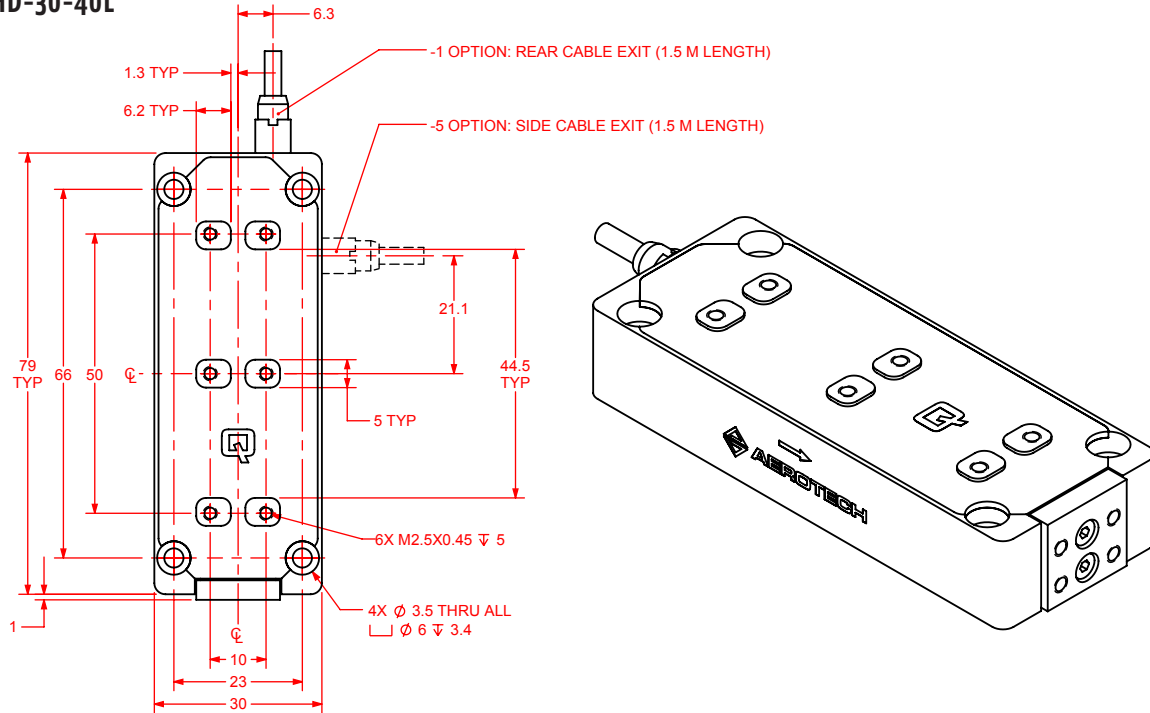
-MP (MOUNTING PLATE, BREADBOARD)
MATERIAL: STAINLESS STEEL



DIMENSIONS: MILLIMETERS

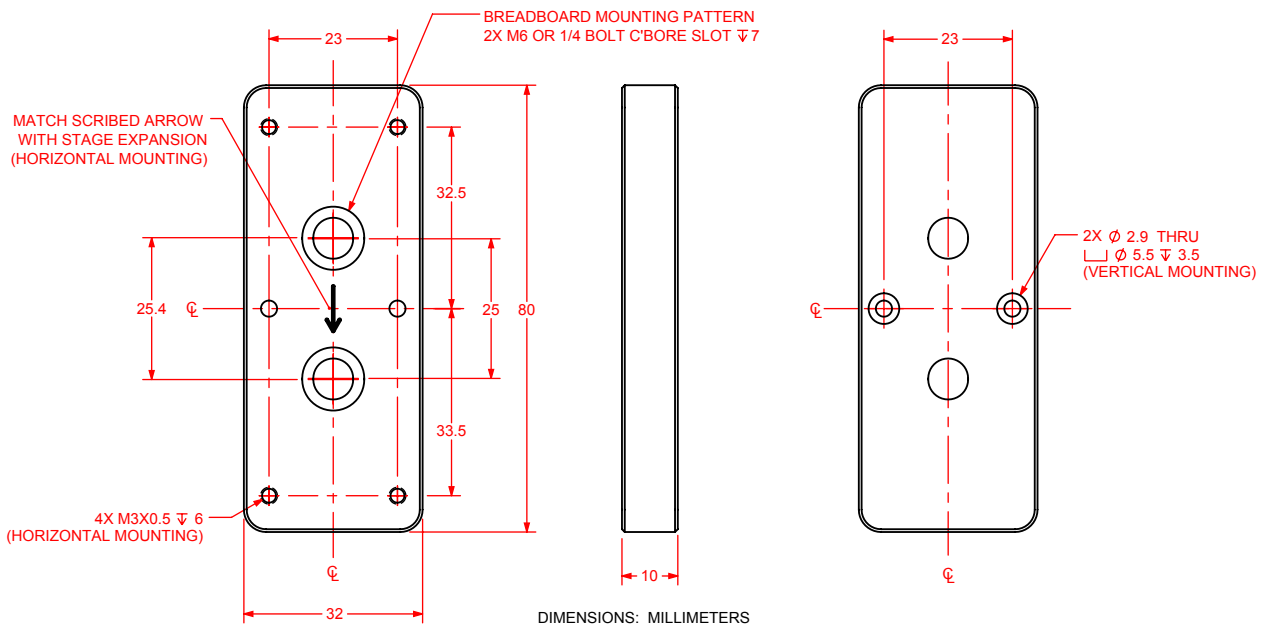
QNP_{HD} Series DIMENSIONS

QNP_{HD}-30-40L



STAGE SHOWN AT MID-TRAVEL

-MP (MOUNTING PLATE, BREADBOARD)
MATERIAL: STAINLESS STEEL



DIMENSIONS: MILLIMETERS

QNP_{HD} Series ORDERING INFORMATION

QNP_{HD}30L Single-Axis, High-Dynamic Piezo Nanopositioning Stages

Travel (Required)

| | |
|-----|--|
| -10 | 10 μm closed-loop travel, 12 μm open-loop travel |
| -25 | 25 μm closed-loop travel, 32 μm open-loop travel |
| -40 | 40 μm closed-loop travel, 50 μm open-loop travel |

Feedback (Optional)

| | |
|----|-----------------------------|
| -C | Capacitance sensor feedback |
|----|-----------------------------|

Cable Exit (Required)

| | |
|----|----------------------|
| -1 | Rear cable exit |
| -5 | Left side cable exit |

Mounting Plate (Optional)

| | |
|-----|---|
| -MP | Mounting plate for English and metric optical breadboard tables |
|-----|---|

Integration (Required)

Aerotech offers both standard and custom integration services to help you get your system fully operational as quickly as possible. The following standard integration options are available for this system. Please consult Aerotech if you are unsure what level of integration is required, or if you desire custom integration support with your system.

| | |
|------|---|
| -TAS | <p>Integration - Test as system</p> <p>Testing, integration, and documentation of a group of components as a complete system that will be used together (ex: drive, controller, and stage). This includes parameter file generation, system tuning, and documentation of the system configuration.</p> |
| -TAC | <p>Integration - Test as components</p> <p>Testing and integration of individual items as discrete components that ship together. This is typically used for spare parts, replacement parts, or items that will not be used together. These components may or may not be part of a larger system.</p> |

