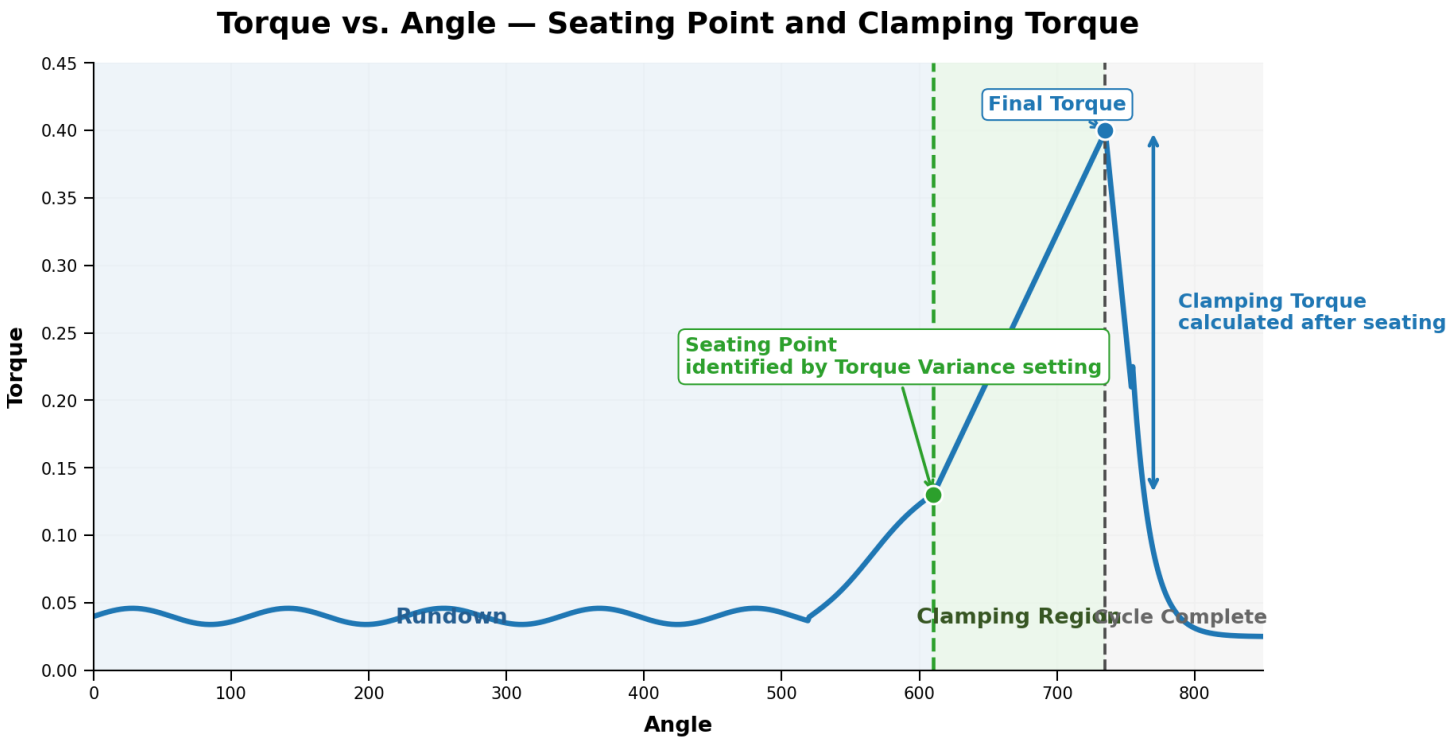
IQI Clamping Torque Monitoring Feature Overview & Application Guide

1. Purpose

Clamping Torque Monitoring is a process validation feature available within IQI torque strategies. The feature evaluates joint behavior during tightening and provides an additional measure of process consistency beyond final torque achievement.

During the tightening cycle, the controller analyzes the torque signature and calculates a Clamping Torque value. This value is compared against user-defined acceptance limits to identify tightening cycles that deviate from the expected clamping behavior of a known-good assembly.



Setup focus: tune Torque Variance until the seating point is consistently detected at the true transition into clamping.

2. Feature Overview and Operation

Clamping Torque Monitoring evaluates joint behavior during tightening by identifying the transition from seating into the clamping phase and calculating a Clamping Torque value for process validation.

During a tightening cycle, torque is consumed through thread engagement, friction, component seating, joint compression, and clamp load generation. As the joint progresses from rundown through seating and into the clamping phase, the torque signature exhibits characteristic changes.

The IQI controller continuously monitors the tightening signature and uses a user-configurable Torque Variance setting to identify the Seating Point, which marks the transition into the clamping region of the joint. Once the Seating Point is identified, the controller calculates a Clamping Torque value representative of the joint's clamping behavior.

The calculated Clamping Torque value is then compared against programmed High and Low acceptance limits to verify that the tightening cycle falls within the expected operating range of the application.

A configurable Filter can be applied to smooth the torque signal and improve Seating Point detection stability in applications with higher process noise or variation.

Key Parameters

Parameter	Purpose
Torque Variance	Used to identify the Seating Point and transition into the clamping region
Filter	Improves detection stability by reducing signal noise
Clamping Torque High Limit	Maximum acceptable Clamping Torque
Clamping Torque Low Limit	Minimum acceptable Clamping Torque

3. Clamping Torque Monitoring Setup

Step 1 - Enable Clamping Torque Monitoring

- Enable Clamping Torque Monitoring within the Torque Step.
- Enter an initial Torque Variance and Filter value.

Step 2 - Tune the Seating Point

- Run 5-10 known-good assemblies.
- Review the Torque vs. Angle curve.
- Verify that the detected Seating Point occurs at the transition from Rundown into the Clamping Region.

  Adjustment Guidelines:

- Seating Point detected too early → Increase Torque Variance
- Seating Point detected too late → Decrease Torque Variance

Step 3 - Optimize the Filter

- Increase the Filter value if the torque signal is noisy.
- Decrease the Filter value if Seating Point detection becomes delayed.
- The goal is repeatable Seating Point detection across multiple assemblies.

Step 4 - Establish Clamping Torque Limits

- Run a minimum of 30 known-good assemblies.
- Record the calculated Clamping Torque values.
- Configure High and Low limits based on normal process variation.

Step 5 - Validate the Setup

- Verify repeatable Clamping Torque results across multiple assemblies.

- Confirm that assemblies with known faults produce Clamping Torque values outside the acceptance window.

Quick Troubleshooting

Observation	Recommended Action
Seating Point detected too early	Increase Torque Variance
Seating Point detected too late	Decrease Torque Variance
Inconsistent Seating Point detection	Adjust Filter and re-evaluate
High variation in Clamping Torque values	Verify Seating Point detection before changing limits

When to Use Clamping Torque Monitoring

Clamping Torque Monitoring is most valuable in applications where assembly variation must be detected and controlled. The feature can help identify abnormal joint conditions such as missing components, incorrect stack-up conditions, damaged threads, cross-threading, or other assembly variations that may not be detected through final torque monitoring alone.