Frequently Asked Questions

What is "Residual Mode" on Exacta and Exacta 2 and how does it work?

Considerations in Torque Auditing and Residual Mode in Exacta Products

Sturtevant Richmont®
Torque Measurement Systems

Division of Ryeson Corporation
555 Kimberly Drive
Carol Stream, IL 60188
International: (011)847.455.8677
Domestic: 800-877-1347
Fax: 847-455-0347
email: customerservice@srtorque.com

Torque auditing is one of the most challenging audits there is. It is an audit that does not fall neatly into the "destructive" versus "non-destructive" testing category. A torque audit changes the item being audited, just as indentation hardness testing or voltage checking does. At the same time, it is usually necessary to perform the audit without destroying the item (joint) being audited.

Torque auditing in also difficult to perform accurately because of the numerous factors that affect the force (torque), and the fact that there are interactions among the components in the joint and the forces involved.

In this paper we will discuss some of the factors that affect the torque that is retained in the joint by the initial tightening, and how they affect the audit and audit results. Note that this paper is not intended as a comprehensive discourse, nor is it in any way a substitute for performing torque audit experiments on the actual joints that you will be auditing.

Fastener Motion

To audit torque it is necessary to move the installed fastener. Traditionally, this has led to one of three methods of auditing.

- **Method 1 - First Motion in the Tightening Direction**
  In this method, a variable-reading type torque wrench (dial, beam, or digital) is used to apply force to the fastener in the tightening direction until motion is detected. The detected peak torque is regarded as and recorded as the residual torque.
- **Method 2 – First Motion in the Loosening Direction**
  In this method a variable-reading type torque wrench (dial, beam, or digital) is used to apply force to the fastener in the removal direction until motion is detected. The detected peak torque is regarded as and recorded as the residual torque.
- **Method 3 – Comparison of Rotation Endpoint**
  In this method the location of a point on the fastener in relation to an item in the grip of the fastener is marked. The fastener is then loosened, and the torque required to rotate the fastener back to that same point in relationship to the marked item in the grip is measured and recorded as the residual torque.

Each of these methods has numerous risks and sources of error. Method 1 is the most popular and most commonly-used method for a variety of reasons, and is the method we will examine the most here.

The fastener does not engage the torque wrench directly. There is a fastener engagement device attached to the torque wrench, and it is this device that connects the two. When this device is a socket, there is literally a "hidden" source of error in the measurement of the residual torque.

The socket usually covers the fastener head completely. When the fastener being audited is a nut that is on a bolt or stud, it is not possible to see the top of the nut because the nut is covered by the socket. As a result, it is common practice to mark the socket and the item(s) in the grip of the joint to assist in detecting motion of the nut. The auditor engages the torque wrench to the nut, marks the socket and grip item(s) with an almost continuous line, and starts applying torque. When the line on the socket begins to rotate in relationship to the line on the item(s) in the grip, first motion of the nut is visually detectable.

Unfortunately this tells us nothing of the relationship between the nut and the bolt or stud. It is the rotation of the nut in relationship to the bolt or stud that creates the clamping force that holds the joint together, and the nut can rotate in relationship to the items in the grip without rotating in relationship to the bolt or stud.