The profitability of any company and the vitality of our industry are dependent on developing and maintaining a skilled work force. This will allow Mills to remain competitive, assure continued growth and achieve long-term improvements. “The disruptions of this downturn has resulted in extra personnel turnover due to cutbacks & retirement”. Effective training of both new & experienced Operators can help improve the situation because it can “Get Operators believing it can be done.”

One of the most cost-effective investments that can be made is helping your operators get more production out of your existing equipment and processes. Training can focus your operators to help them achieve this objective.

Quad Engineering delivers Customized Operator Training. Pass design and rolling theory is discussed, then applied to the actual products you roll using your pass designs and mill setup sheets. This allows the Operators to apply what they have learned in the classroom to the mill environment they work in every day.

The on-site course is typically delivered to all the Rolling Crews. By applying the course topics to your actual mill operation, a list of ideas and action items are created by the participants.

A summary report outlining the improvement opportunities and crew discussions typically include:

- production improvements
- faster startups
- reduced cobbles
- improved yield & quality.

### Stop hook by working short leg more

<table>
<thead>
<tr>
<th>% Reduction</th>
<th>50.0%</th>
<th>45.0%</th>
<th>40.0%</th>
<th>35.0%</th>
<th>30.0%</th>
<th>25.0%</th>
<th>20.0%</th>
<th>15.0%</th>
<th>10.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Average</td>
<td>Long leg</td>
<td>Short leg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Higher Red’n on short leg to balance forces &amp; keep bar straight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1st pass will hook towards short leg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Quad Engineering
75 Scarsdale Road, Toronto, ON, Canada M3B 2R2
Tel: 416-391-3755 Fax: 416-391-3645
www.QuadEng.com
On-Site Operator Training  
To Improve your Operation

Operators that understand why things happen during rolling can make better decisions resulting in fewer mistakes.

What Operators have told us:

- “Tips and suggestions will help us roll more” CMC Steel
- “Transformed theory into practical applications” Hamilton Specialty Bar
- “Each person was able to ask questions and get answers that they understood” Gerdau Ameristeel
- “It made me realize other people’s efforts in getting a mill to work well” Charter
- “I was able to gain an understanding of how and why steel rolls. It was interesting to look at explanations and ways to correct or attack areas in rolling before they attack you” Gerdau Ameristeel
- “I could do this course 10 times and still learn more each time” CMC Steel
- “I was very happy with the instructors and method because I learned a lot from them, and they know their stuff” Nucor
- “Breaking down the setup sheets and being able to find their inaccuracies was most interesting” Gerdau Ameristeel
- “I was interested in R-Factors and how our speed control system can be used to help us identify problems” Nucor
- “It was interesting to learn about improvements that can be made in pass designs of round and square passes” Timken

What We Discuss in Class:

- Focus on current rolling issues using examples from the mill
- Getting more out of the pass design & Setup Sheets from an operator’s viewpoint
- How to set and adjust passes to make a quality product
- Basic principles of heat transfer and how to improve roll cooling
- Using speed control to help troubleshoot rolling problems

Contact Joe Kennedy (416-391-3755 ext 226) (j.kennedy@quadeng.com) for more information on how you can improve your bottom line without capital spending.
Quad has been presenting and continuously improving specialized Operator Roller training since 1985. Courses have been developed to explain why things happen, from an Operator’s point of view. The math and science involved in rolling is explained in real terms that can be understood and used by Operators to help them achieve & maintain section and improve productivity.

A combination of technical presentations, work sessions and open discussion are used to effectively communicate the course material. A comprehensive textbook is included, for use as a reference document back at the plant.

**Training Affects Your Bottom Line**

Effective Operator Training is no accident. It must be planned and executed like any other issue at your plant. People produce steel, so the most cost effective way to improve your operation is to produce more using existing equipment. Operator training is an important component to helping your Operators get the most out of each shift. Operator training translates directly into improved production, higher yield and increased profit.

**What Participants have said about Quad’s Training Program:**

- Good discussions around real world problems  (Mill Manager, Gerdau Ameristeel)
- I have a better understanding of the process of pass design and also picked up some tips to improve our rolling process  (Roller, Gerdau Ameristeel)
- I felt we got a lot of information in just a few days  (Roller, Nucor Steel)
- Being new to mill, information was very useful. Material matched current practices & applied to most everything at our plant  (Prod Engineer, Mittal Steel)
- Opened my eyes to why I am doing a lot of things to get good section. Now I’ll have a purpose behind what I do.  (Asst Roller, CMC Steel)

**Course Objectives:**

To help the participants develop a more in depth understanding of the principals of rolling steel, to address pass design methods from an operator’s point of view and develop an understanding of how to get the most out of your pass design.
Benefits:
Improved productivity & cost effective production decisions resulting from a better understanding of the overall process. Experience is passed on to your operators from interaction with personnel from other plants. The comprehensive course textbook can be used as a reference guide back at your mill.

Course Outline:

Principles of Pass Design:
Terminology is reviewed. The pass design process is described and examples given to illustrate how a pass design is created from first principles.

Rounds Pass Design:
Rounds pass design sequences and applications include oval-round, oval-square, and diamond-square. The finished round and leader oval passes are designed from first principles. Work sessions are used to reinforce understanding of important concepts.

Flats Pass Design:
Flats pass design sequences and applications include flat & edge and how much work should be done in the edging passes. The edging pass is designed from first principles. A rolling schedule for the flat and edge method is developed. Work sessions are used to reinforce understanding.

Speed Control:
The basic principles of mill speed control are reviewed from the pass design point of view. Terminology and definitions are developed for the key speed control parameters. The speed control equation is developed and an actual speed sheet is developed. Using speed control feedback information to verify and improve the setup sheet is discussed.

Guiding:
Basic function and types of guides are defined including static-friction, roller and twisters. Pros and cons of each guide type plus selection criteria are discussed.

Roll Cooling:
Basic principles of heat transfer and the roll cooling temperature cycle. Design considerations that make for an effective roll cooling system.

Who Should Attend:
Mill Managers, Shift Supervisors, Rollers, Assistant Rollers, Pulpit Operators, Engineers, Quality Control, Roll & Setup, Support Personnel
Quad has been presenting and continuously improving specialized Hands-on Operator/Roller training since 1985. The Hands-on courses use the math and science involved in rolling explained in real terms that can be understood and used by Operators. Actual rolling on Quad’s Training Mill reinforces theory with reality to help participants improve productivity at your mill.

**Training Affects Your Bottom Line**

Operator training is an important component to helping your operators get the most out of each shift. The hands-on approach ensures that concepts are understood and reinforced in the familiar mill environment. All aspects of rolling, from pass design and setup sheets through to mill setup and bar measurements are covered. The bar is studied after each pass. The Operators get to try things and “see for themselves”. Defects encountered are discussed and solutions are implemented to ensure complete understanding. A comprehensive textbook is included, for use as a reference back at the plant.

**What Participants have said about our Training Program:**

- *I liked seeing the effect of our predictions*  (Roller, Nucor Steel)
- *Helped with problem solving & why things happen*  (Pass Designer, Steel of West Virginia)
- *The “hands-on” aspect of the class was excellent*  (Roller, Gerdau Ameristeel)
- *Instructor made it easy to understand & took extra time to explain things in more detail when needed*  (Roller, Mittal Bar Mill)
- *Applicable to our rolling mills, much will be useful in the future*  (AR, Slater Stainless)

**Course Objectives:**

To help the participants develop a more in depth understanding of the fundamental principals of rolling rounds and flats. To address the various pass design methods from an operator’s point of view and develop an understanding of how to set and adjust passes to make a quality product.
Hands-on Rolling of Rounds & Flats

Over 75% of North American Mini Mills have used Quad for Training

Benefits:
Hands on rolling experience, allowing participants to “see for themselves". Improved productivity due to increased technical knowledge and understanding of how pass design and setup sheets work. Cost effective production decisions due to improved problem solving skills.

Course Outline:

Rolling Process:
Review of rolling process from pass design & setup through to operation & feedback.

Rounds Pass Design & Setup Sheet:
Rounds pass design sequences and applications include oval-round and oval-square. The finished round and leader oval passes used in the mill are designed from first principles. A rolling schedule is developed for both oval-square and oval-round pass sequences. All aspects of a product setup sheet including gap settings and adjusting for mill spring.

Rounds Rolling:
The pass sequence developed in the classroom is applied on Quad’s 8” lab mill using lead billets. The participants set the mill & guides and roll the bar. The bar is analyzed and measured after each pass and compared to the setup sheet plan. Any corrective action is applied to the next pass. Defects created are discussed and corrective action applied. Multiple billets are rolled so lessons learned can be applied and the results observed.

Flats Pass Design & Setup Sheet:
Flats pass design sequences and applications for flat & edge method. The edging pass is designed from first principles. A rolling schedule is developed for producing a flat product from a square billet using two different edging pass constraints to illustrate how edging passes affect section quality. All aspects of producing a product setup sheet including gap settings and adjusting for mill spring.

Flats Rolling:
Each pass sequence developed is rolled on Quad’s 8” lab mill using lead billets.

Who Should Attend:
Mill Managers, Shift Supervisors, Rollers, Assistant Rollers, Pulpit Operators, Engineers, Pass Designers, Roll and Setup Shop Supervisors, Quality Control.
Quad has been presenting and continuously improving specialized Operator Roller training since 1985. Hands-on courses use the math and science involved in rolling explained in real terms that can be understood and used by Operators. Actual rolling on Quad’s Training Mill Stand reinforces theory with reality to help participants improve productivity at your mill.

**Training Affects Your Bottom Line**
Operator training is an important component to helping your operators get the most out of each shift. Operator training translates directly into increased production and profit. Quad’s operator training program is designed to combine technical knowledge with management and troubleshooting skills in a hands-on rolling mill environment.

**What Participants have said about our Training Program:**

- *We were able to try things and see for ourselves* (Roller, Nucor Steel)
- *The “hands-on” aspect of the class was excellent* (Roller, Gerdau Ameristeel)
- *Instructor made it easy to understand & took extra time to explain things in more detail when needed* (Roller, Mittal Steel)
- *I have a better appreciation of what guides can do and can’t do* (Operator, Gerdau Ameristeel)
- *I have a better understanding of angle rolling problems* (Mill Adjuster, Nucor)

**Course Objectives:**
To help the participants develop a more in depth understanding of the fundamental principals of rolling Angles. To address the various pass design methods from an operator’s point of view and develop an understanding of how to set and adjust passes to make a quality product.
QRC3
Hands-on Rolling of Angles

Over 70% of North American Mini Mills have used Quad for Training

Benefits:
Hands on rolling experience, allowing participants to “see for themselves”. Improved productivity due to increased technical knowledge and understanding of how pass design and setup sheets work. Experience is passed on to your operators through interaction with personnel from other plants.

Course Outline:

Angle Pass Design:
Angle pass design sequences and applications include butterfly and open pass methods. The method used to determine the number of shaping passes needed is reviewed and applied. The benefits of using multiple leader passes for different leg thickness of angles.

Butterfly Angle Pass Sequence:
The finished angle and leader passes are designed from first principles. Work sessions are used to reinforce the understanding of these important concepts. A rolling schedule is developed for both thin and thick leg angles. All aspects of producing a product setup sheet including gap settings and adjusting for mill spring are included.

Butterfly Angle Rolling:
The pass sequence developed in the classroom is applied on Quad’s 8” lab mill using lead billets. The participants set the mill, set the guides and roll the bar. The bar is analyzed and measured after each pass and compared to the setup sheet plan. Any corrective action is applied to the next pass setting. Defects created are discussed and corrective action applied as required. Multiple billets are rolled so lessons learned can be applied and the results observed.

Open Angle Pass Sequence:
A rolling schedule is developed for open leg angles. All aspects of producing a product setup sheet including gap settings and adjusting for mill spring are included. The use of verticals to control the leg length is applied.

Open Angle Rolling:
The pass sequences are applied on Quad’s 8” lab mill using lead billets.

Who Should Attend:
Mill Managers, Shift Supervisors, Rollers, Assistant Rollers, Pulpit Operators, Engineers, Quality Control.
Quad has been presenting specialized Hands-on Operator/Roller training since 1985. The Hands-on Rolling of Slit Rebar course covers all aspects of rolling, from pass design and setup sheets through to mill setup and bar measurements. Actual rolling on Quad’s Training Mill allows the participants to experiment and “see for themselves”. Defects encountered are discussed & solutions implemented, increasing understanding which results in improved productivity back at your mill.

Training Affects Your Bottom Line
Operator training is an important component to helping your operators get the most out of each shift. The hands-on approach ensures that concepts are understood and reinforced in the familiar mill environment. The bar is studied after each pass. A comprehensive textbook is included, for use as a reference back at the plant.

What Participants have said about our Training Program:

- I liked seeing the effect of our predictions  (Roller, Nucor Steel)
- The “hands-on” aspect of the class was excellent  (Roller, Gerdau Ameristeel)
- Great hands on knowledge, with a lot of useful information that would benefit more people from our plant. Very knowledgeable & easy to understand instructors.  (Pulpit Operator, Nucor Steel)
- Good Job explaining theory and then putting it into practice on the mill (Controller, Nucor Steel)
Course Objectives & Benefits:
Hands-on rolling experience, allowing participants to “see for themselves”. Improved productivity due to a more in depth understanding of the fundamental principals of rolling slit rebar. Address various slitting design methods from an operator’s point of view to develop an understanding of how to set and adjust passes to make a quality product. Cost effective production decisions due to improved problem solving skills.

Course Outline:
Rolling Process:
Review of rolling process from pass design & setup through to operation & feedback.

2-Strand & 3-Strand Rebar Slitting Pass Design & Setup Sheet:
Rebar slitting pass design sequences and applications include, oval-square, slab & edge, dogbone-slitter, and flat oval-rebar. The finished rebar and leader oval passes used in the mill are designed from first principles. A rolling schedule is developed for feeding the dogbone pass with a square, fluted square and rectangle shaped bar. The operating differences of these various slitting methods are demonstrated and discussed. All aspects of a product setup sheet including gap settings and adjusting for mill spring are used.

Rebar Rolling:
The various pass sequences developed in the classroom are applied on Quad’s 8” lab mill using lead billets. The participants set the mill & guides and roll the bar. The bar is analyzed and measured after each pass and compared to the setup sheet plan. Any corrective action is applied to the next pass. Defects created are discussed and corrective action applied. Multiple billets are rolled so lessons learned can be applied and the results observed. The behavior and location of the slit seam is observed. The sensitivity of the specialized slitting sequence passes is demonstrated on the mill. The finishing pass design and how it affects the bar shape and the capability of rolling light are discussed and demonstrated.

Who Should Attend:
Mill Managers, Shift Supervisors, Rollers, Assistant Rollers, Pulpit Operators, Engineers, Pass Designers, Roll & Setup Shop, Quality Control, Support Personnel.