# How QMOS Helps With Maintaining an Even Rolling Rate

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## *Introduction*

Maintaining an even rolling pace is important to any rolling mill to ensure consistency in the finished product. Rolling a mill too quickly can result in billets not being heated to the proper temperature for rolling, which can lead to things like roll breakage, cobbles, and unfilled passes causing bar sizes to be out of specification. Rolling too slowly allows for excessive scale buildup which is either removed causing a decrease in yield, or ends up being rolled into the bar creating defects. If the finishing end can't keep up with a quick rolling rate that the mill is trying to maintain, rolling will have to be stopped continually, leading to inconsistent rolling temperatures, cooling bed times, and therefore erratic bar sizes and unpredictable quality.

QMOS contains a number of features and reports to help with constantly monitoring the pace of rolling and alert operators to any variations that may cause problems with the finished bar.

## *Product Setup Data*

The first step in being able to roll at an expected rate is to define the necessary data that goes into it. For each shape and size combination that a mill rolls, a number of known factors are stored. This includes the size and length of the billet, the expected head-to-head time, (called Billet Cycle Time in QMOS), and the finishing speed.

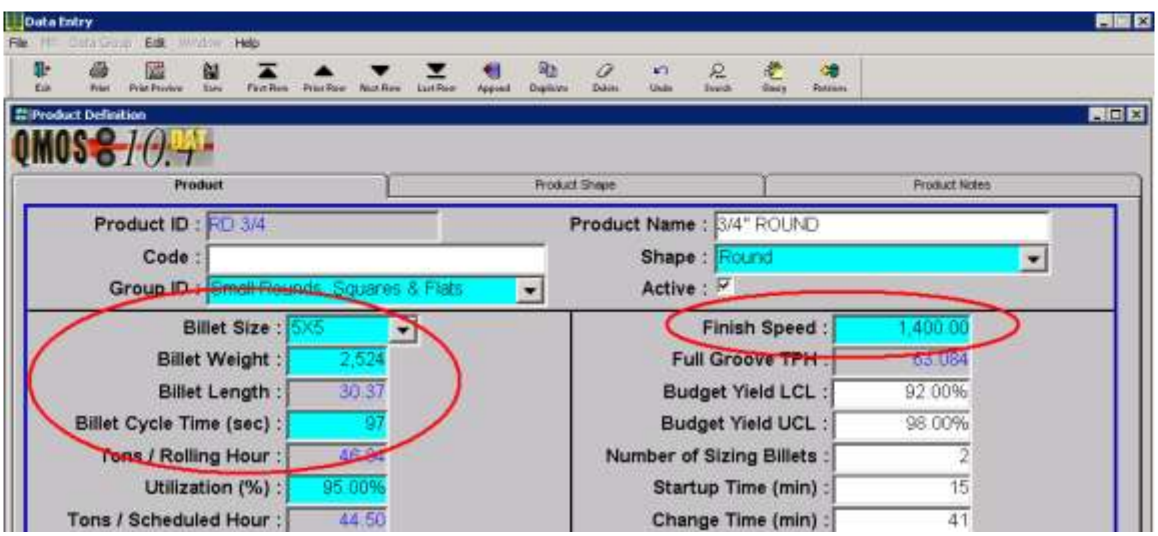



***Figure 1:*** *QMOS Product Definition Screen*

From this information, we can determine how long the bar will take to roll, and how much of a gap is expected between bars. In this example for ¾" round, the 2,524 lb. bar traveling at 1,400 feet/minute will take approximately 72 seconds to roll, and with a Billet Cycle Time of 97 seconds will leave a 25 second gap between each two billets.

## *PRR – The Heart of Recording Production Results*

The PRR or the Production Reporting .module is in many ways the heart of QMOS in the rolling mill, and so it's not surprising that it plays a key role in maintaining an even rolling pace. PRR is used by the Speed Pulpit operator to monitor mill production, billet consumption and down time. By receiving signals directly from rolling mill PLC's, it knows when the head of each billet enters the mill and when the tail drops out. Thus, the duration of each and every bar, and the time between each pair of bars is known. This information is all presented to the operator live up-to-the-minute.

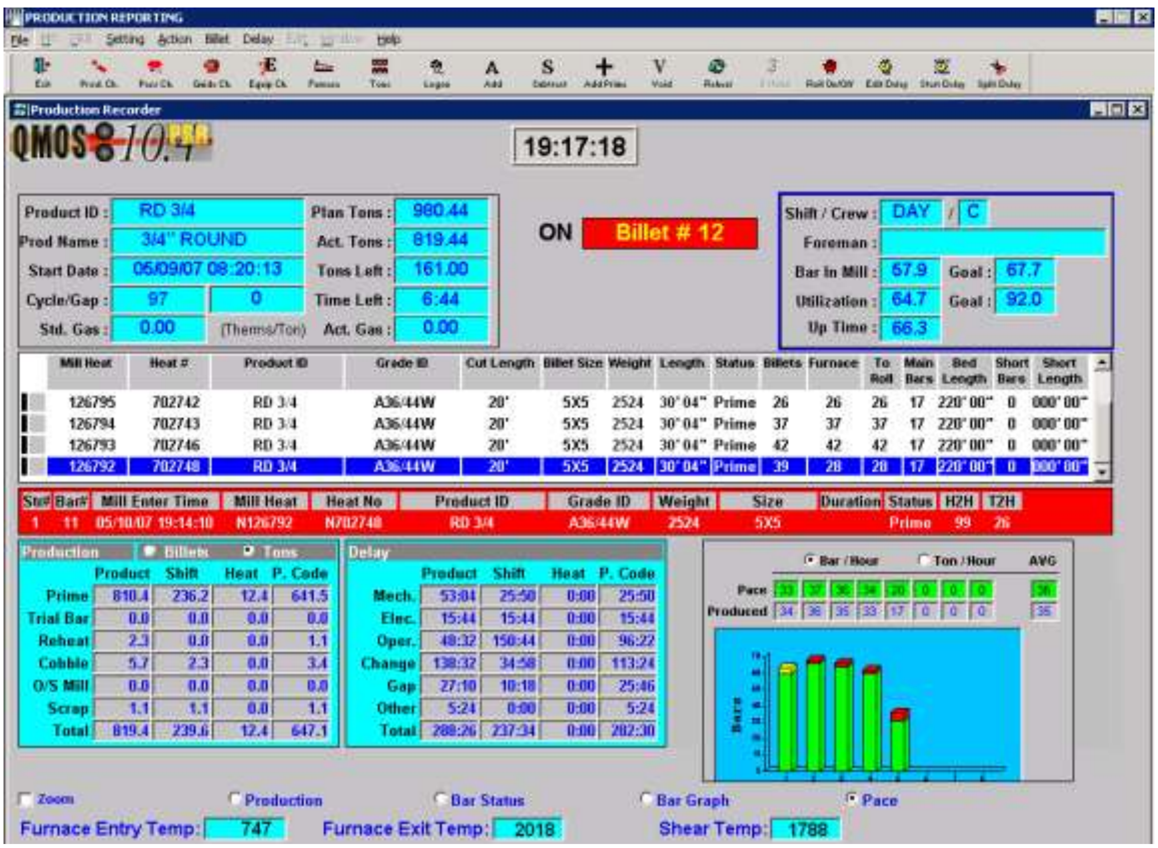



***Figure 2:*** *PRR Screen*

QMOS categorizes the expected gap time between two bars as Planned Gap. If the mill is running slower than the expected pace, any time between bars that is in excess of the Billet Cycle Time is called a Gap Time delay. If the Gap Time delay reaches a length of time determined by the mill, (usually two or three minutes), it becomes a delay on its own, and the cause of the delay must be recorded. The diagram below illustrates this concept.

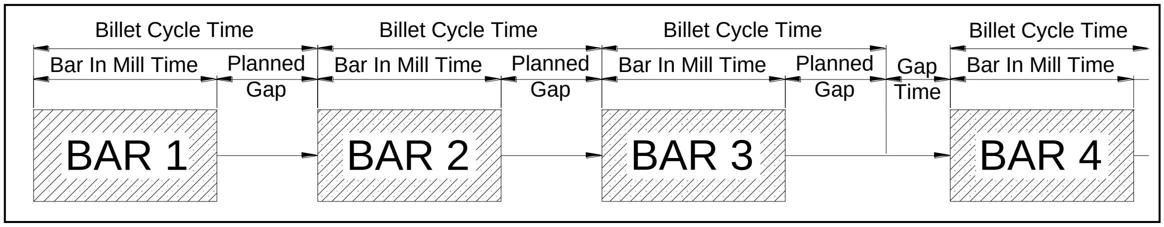



***Figure 3:*** *Rolling Mill Time Distribution*

## *Gap Time*

The Gap Time concept in QMOS tracks all the little bits of lost time during a shift or the rolling of a product. This is time that is never accounted for in any manual Delay Tracking system and often falls through the cracks. Mill Utilization in QMOS reflects this, and initially all mills new to QMOS notice a drop in this calculation because of it. Since most Gap Time can be directly attributed to rolling slower than the expected pace, it's time that can easily be recovered. QMOS customers have achieved marked increase in overall production just by paying attention to their rolling pace, and have seen increases in Utilization back to previous levels in a very short period of time.

## *Reporting Mill Pace*

When all of this data is combined with the expected Billet Cycle Time for the product being rolled, QMOS can easily indicate how close the mill is to running at the desired pace. Since a mill can't roll when it is in delay, the total duration of all recorded delays is removed from the equation, allowing for an accurate prediction of the expected number of bars throughout a shift. The Shift Report screen in QMOS includes a graph of the number of bars rolled each hour of the shift compared to the number expected.

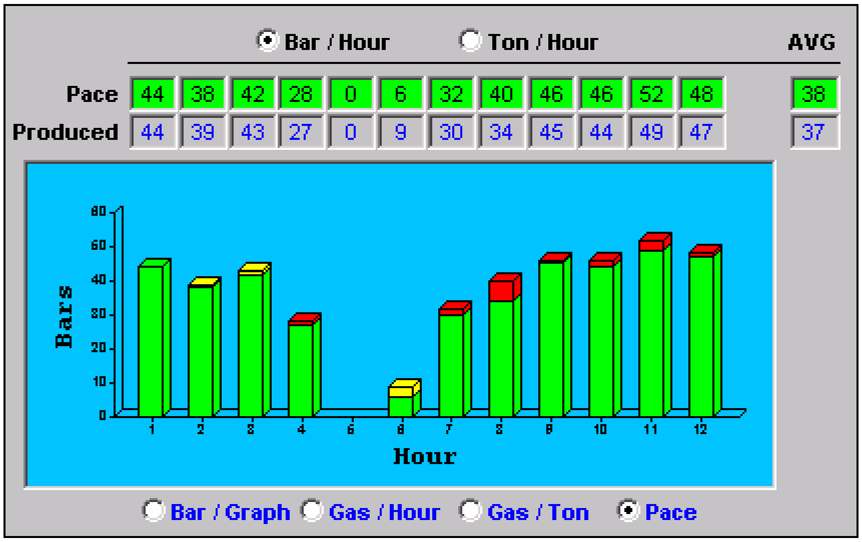
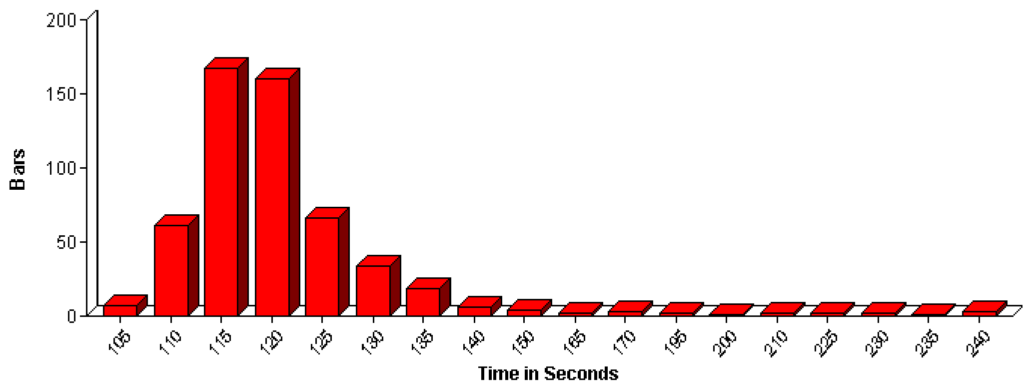



***Figure 4:*** *Bars Per Hour Graph from the QMOS Shift Report screen*

Numerous reports in QMOS can also be used to compare expected rolling rates with actual rates.  Head To Head and Tail To Head Distribution can be graphed by shift  to indicate the frequency of variance from the expected targets.

| | |
|---|---|
| Page 1 of 1 | *QUAD Mill Operation System [QMOS]* |
| Date : 05/10/2007 | H2H and T2H Count Distributions |
| Time : 21:18:41 | |

## Head to Head Distribution




**From Date:** 4/2/2007 07:00:00 **To Date:** 4/2/2007 19:00:00 **Crew:** A

**Products:** RD 1/4

| Head to Head | | Tail to Head |
|---|---|---|
| 541.00 | **Number of Billets Included** | 535.00 |
| 569.00 | **Total Number of Billets Ran** | 569.00 |
| 122.19 | **Average Time (s)** | 15.45 |
| 17.87 | **Standard Deviation (s)** | 12.13 |
| 18.36 | **Accumulated Production Time (hrs)** | |
| 5.00 | **Excluded Time (hrs)** | |
| 95.08 | **Percentage of Billets Included** | |
| **120** | **Product Billet Cycle Time** | |

## Tail to Head Distribution

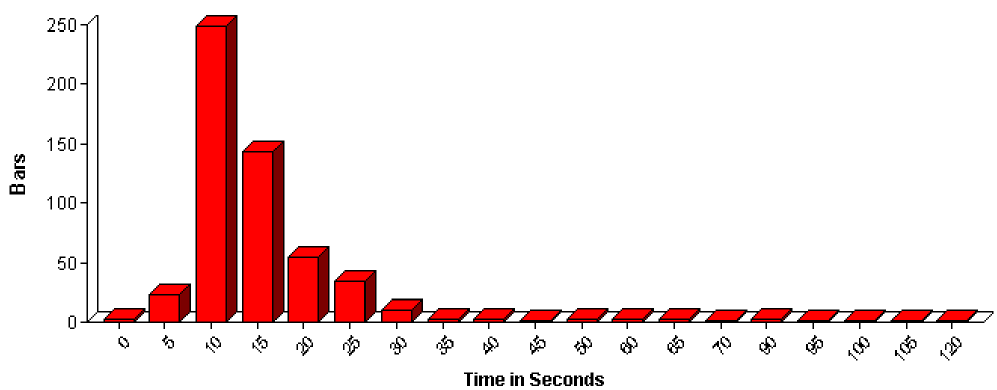



***Figure 5:*** *Head To Head and Tail To Head Distribution*

The Average Tail To Head Time Report is another example that shows how the mill was run throughout a shift, heat by heat.

| Page 1 of 1 | QUAD Mill Operation System [QMOS] | |
|---|---|---|
| Date : 05/10/20 | Heat Average Tail to Head Time Shift Report | |
| Time : 21:03:58 | | |

**Date :** 03/13/2007 **Shift :**DAY

| Melt Heat | Number of Bars | Average T2H Time |
|---|---|---|
| 071611 | 36 | 8.6 |
| 071566 | 68 | 5.9 |
| 071635 | 69 | 5.3 |
| 071636 | 59 | 5.4 |
| 071637 | 60 | 5.4 |
| 071638 | 65 | 4.8 |
| 071639 | 56 | 8.5 |
| 071640 | 38 | 5.6 |
| 071641 | 58 | 5.7 |
| 068054 | 70 | 5.4 |
| 068053 | 60 | 6.8 |
| 071642 | 67 | 5.3 |
| 071643 | 66 | 7.8 |
| 071644 | 66 | 4.8 |
| 068052 | 59 | 6.7 |
| 071646 | 66 | 4.2 |
| 071647 | 71 | 3.8 |
| 068051 | 67 | 4.4 |
| 071648 | 7 | 1.1 |
| **Shift Totals** | **1108** | **5.7** |

***Figure 6:*** *Average Tail To Head Time*

## *Conclusion*

QMOS possesses many means to allow any mill to roll at the pace consistent with optimal practices which have been deigned to improve bar quality, yield, production rates, and roll life. At Quad Infotech our goal is to provide rolling mills with the tools to produce the most high quality steel possible. The features described here are just one part of this solution.