ROLLING MILLS

www.waterburyfarrel.com
WATERBURY FARREL, an ISO 9001:2000 registered division of MAGNUM INTEGRATED TECHNOLOGIES is a world renowned leader in the design and manufacture of Rolling Mills and related steel equipment since 1851.

Waterbury Farrel’s mills and Hydraulic Automatic Gauge Control systems are successfully commissioned all around the world and have yielded top-quality finished metal products for decades.

Over 650 Waterbury Farrel installations throughout the five continents are producing the finest end products in the world...more than any other manufacturer of Cold Rolling Mills.

Waterbury Farrel offers a complete line of cold rolling mills, together with material handling, HAGC cylinders, thermal covers, down coilers and work roll side-shifting systems. No one can match the performance record of Waterbury Farrel Rolling Mills.
Designed for hot or cold rolling of ferrous and non-ferrous metals, these 2-high mills are ideal for breakdown, rundown, tempering and skin pass operations. All mills are built to customer specifications, and are furnished with rolls of forged steel, cast steel or chilled cast alloy iron to meet application requirements. Complete lines of accessories for both new and existing mills are available.
These mills may be converted for either 2-High or 4-High operation by the removal or insertion of work rolls. This permits great versatility of rolling capability on the same mill. When production requirements are relatively small, a single mill of this type can be used for breakdown, rundown and finish rolling.
4-High Mills may be used as Non-reversing Mills for intermediate rolling and as Reversing Mills for finish rolling. The smaller rolls reduce the thickness of the metal being rolled more easily and with much less pressure than the large rolls of a 2-High Mill. This decreased pressure reduces the roll bending and separating forces and permits the rolling of wider and thinner materials with a more uniform gauge.

4-High Mills are a cost-effective means for industry to produce a wide range of sheet products with in-house control of finished product quality. These Reversing Mills offer considerable advantages to Multiple-Stand Mills, such as smaller investment, installation, operating and maintenance costs as well as reduced roll and coil stock inventory.
These Mills provide improved flatness due to their workroll bending mechanism and intermediate roll adjustment in an axial direction. Their main advantages are improved shape of rolled strip, increased reductions and greater rolling efficiency.

6-High Mills can replace the first stand of Tandem 4-High Mills due to their smaller work rolls. This would result in fewer stands, allowing the Mills to accept thicker hot-rolled strip.

However, a 4-High Mill using smaller diameter work rolls may achieve the same results without some of the drawbacks associated with 6-High Mills. These drawbacks are related to their complicated and hard-to-maintain roll cluster unit and cooling problems resulting from the smaller circumferential area of their working rolls.

Waterbury Farrel’s 4-High / 6-High Mills offer a combination of both types of mills, providing all the advantages of each Mill type without the related complications.
SKIN-PASS TEMPER MILLS

The quality and yield of hot-rolled sheets in coils are greatly improved with WATERBURY FARREL's modern Skin-Pass Temper Mills. A light cold-rolling operation on a 2-High Temper Mill, skin passing may involve leveling, trimming or slitting and shearing to length.

Skin-Passing allows material elongation of less than 1%, thus improving gauge, uniformity, flatness and surface hardness without compromising ductility or surface finish. Skin-Pass Temper Mills also eliminate the abrupt yield point variation which exists in low-carbon sheet steel, thus creating an ideal material for cold-forming operations.
This cluster-type mill is the most flexible and powerful of its kind. It is used to roll both ferrous and non-ferrous metals and is designed to make heavy reductions at high speeds. The roll cluster contains 12 rolls and 8 backing bearing assemblies. Four of the rolls are driven by intermediate rolls.

Rigid, compact mill housing eliminates deflection of work rolls and produces a uniformly close gauge tolerance strip. We supply 20-High Mills in either reversing or one-way operations.

All of these cluster mills use hydraulic servo-controlled screwdowns. A standard feature of most of these mills is a mechanically operated crown adjustment (a patent feature of Waterbury Farrel). Some of the larger mills of this type may be equipped with “AS-U-ROLL” power crown adjustments.
The exclusive design features of Waterbury Farrel Z-Mills offer significant advantages over 4-high and other types of cluster mills. Major advantages of Z-Mills are:

- Extreme accuracy of gauge
- Highest standard of surface finish
- Shape instantly adjustable
- No limitation of width of strip
- Minimum number of passes
- Reduction (or elimination) of intermediate anneals
- Quick & easy roll changes
- Small work rolls make tungsten carbide rolls economical to use
- Freedom from camber and edge cracking
- Compact design
- Low foundation costs
- Smaller roll grinder
- Economy in maintenance
- Unique crown control system
- Rapid roll opening in case of strip break

<table>
<thead>
<tr>
<th>Mill Type</th>
<th>Work Roll Diameter (Nom.)</th>
<th>Backing Bearing Diameter</th>
<th>Strip Width, Max.</th>
<th>Typical Product</th>
<th>Minimum Gauge</th>
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<tbody>
<tr>
<td></td>
<td>Inch</td>
<td>mm</td>
<td>Inch</td>
<td>mm</td>
<td>Narrowest Mill</td>
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Due to the demands set forth by the stainless steel industry for better quality strip, Waterbury Farrel made another revolutionary change in the traditional monoblock ZR-22 Mill by including bottom power crown control and by substantially increasing the mass of the housing to achieve higher mill rigidity. The mill, as shown below, can roll stainless strip of 0.1mm thick and 1300mm wide at very high speeds while maintaining close tolerances.
**Stelco Coilbox**

Waterbury Farrel, under Stelco licence, has provided Coilbox technology to many steel industries around the world. This innovative technology greatly improves the uniformity of thickness, mechanical properties and critical tolerances along the entire length of the hot strip. The Coilbox system produces a dramatic uniformity of temperature from one end of the strip to the other. This enables steel producers to roll a much wider product to thinner gauges. It also improves gauge control and mill productivity. The advantages of using a Coilbox system by far exceed the installation costs. Tangible benefits include wider product range, reduction in number of stands to a single reversing rougher and four finishing stands, more efficient furnaces, improved material properties and gauge control.

**Tension-Leveling Systems for Processing Lines (Pickling, Galvanizing & Tinning)**

Waterbury Farrel's custom built Tension Leveling Systems serve to upgrade quality and yield of existing process lines. Strip flatness and shape are greatly enhanced through this process which yields a uniform product for subsequent processing lines. Through a combination of controlled tension and reverse bending, Waterbury Farrel Tension Leveling Systems eliminate or greatly reduce problems of unequal stress in material width which can cause loose centers, wavy edges, quarter buckles, strip camber, etc.

Our systems tension level strip in thickness ranges from .002” to .250”...widths up to 112”...yields as high as 200,000 p.s.i. ...with pulling forces up to 242,000 pounds.
Roll control is the key to strip quality. It can also be an important factor in rolling mill profits. Now, Waterbury Farrel has improved on the conventional mechanical roll screwdown with electro hydraulic servo screwdown systems. These advanced systems maintain constant roll pressure and/or constant roll position.

This schematic drawing (opposite) illustrates the basic electro hydraulic servo system as applied to either a 2-High or a 4-High mill. Note that two systems are required. One for the front of the mill and one for the rear of the mill. The operator’s functions are identical to those on a conventional motorized screwdown. Under normal control you drive both screws in synchronization and have the ability to offset either the front or the back rolls to take care of shape conditions. Under gauge control, both screws are driven up and down together and should remain in perfect or near perfect synchronization. This is achieved by using two stepping motors and giving them both the same commands at the same time.

In the case of a 2-High or 4-High or a combination 2-High / 4-High mill, position rolling is done in the 4-High mode to get the material to the proper gauge. With a 2-High mill, the normal operation is to skin pass or temper roll. To best do this, a constant separating force is desired. This is accomplished by simply switching to a constant pressure system. The pressure can be independently adjusted. You can adjust the front, the back, or adjust both and maintain the initial relationship between the two.

The electro-hydraulic screwdown is actuated by hydraulic cylinders through a servo mechanism. The operation involves hydraulic cylinders acting directly on the upper roll bearing chocks. There is much less “breakaway torque” than with conventional screwdown systems. This highly responsive roll control is ideally suited for receiving and following minute signals from an automatic gauge control system. It is much more effective and accurate than the screwdown design used on most mills with their conventional screws and inherent “backlash”.
Advantages:

- Eliminate backlash, and time for its control
- Better Control with quick response when changing gauge.
- Fast response with automatic gauge control.
- Better control for longer roll life.
- Constant, fool-proof temper control.
- Eliminate elongation measurements.
- Consistant roll pressure for uniform skin pass finish.

Operational Characteristics:

- High response: 7.5 cycles per sec.
- High resolution: .00005"
- High acceleration rate: 5.2'/sec.
- Speed: 162'/sec.
- Power: direct acting hydraulic
These computerized Hydraulic Automatic Gauge Control systems permit the production of close tolerance strip merely by pushing a button. The system automatically and consistently maintains extremely tight tolerance throughout the length of every coil, regardless of speed. Basically, the AGC System, one of the most sophisticated and successful computerized control systems in the world, patented by WATERBURY FARREL, monitors the strip gauge and corrects variations within milliseconds. Corrections are transmitted to an accurate, highly-responsive electro-hydraulic servo-screwdow.

Other components of the system include precision high-response gauges, a state-of-the-art industrial computer and appropriate interface and operational software, as well as management printout data and automated rolling schedule.

**Right:** Demonstrates ability to use either upper or lower power crowns. Shows ability to manipulate crown consoles from any one of 3 touch screens two at the mill and one in the pulpit.

**Below:** Sample Screen from the Operator Interface Graphic Software.

**Bottom Right:** AccuVision 1st intermediate control touch screen.
With the Waterbury Farrel AGC system, you can practically product close tolerance strip at the press of a button. Simply wind on the coil, set for correct shape and hardness, choose your preset automated rolling schedule and hit the start button. From there it can be a "hands off" operation.

**Maximum gauge consistency throughout the coil.** To increase your yield of on-spec strip, the AGC system checks the gauge twice...going into the mill and coming out. Roll position is automatically adjusted every 4" (100mm), if necessary, to compensate for incoming gauge variations. Result: gauge tolerance of +-.00005" (.00127mm) is common.

**Increase daily production.** A high degree of automation is available by adding options to AGC. One of these features permits the operator to pre-program all control settings for the optimum rolling schedules on jobs run more than once. This saves considerable setup time and assures consistent results. With other options, the system can track the location of bad spots or welds. It will slow the mill just long enough for these spots to go through, and then resume speed.

**Less scrap on ends.** AGC system monitors thickness of incoming strip, and adjusts screw-down before the leading edge enters the mill. You are essentially on gauge in the first three feet (1m) of rolled length.

Improved management data. There is data logging for the strip on every pass. There is also data management with a record of mill productivity.

**A compatible system.** The AGC system can be supplied on all new Waterbury Farrel 2-High, 4-High and Sendzimir Cold Mills. It can also be retrofitted on mills which can be equipped with Waterbury Farrel electro-hydraulic screwdown. Its an economical way to up-grade an older mill to today’s performance standards.
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