SPINNAKER CORPORATION
EQUIPMENT AND PROCESS SOLUTIONS

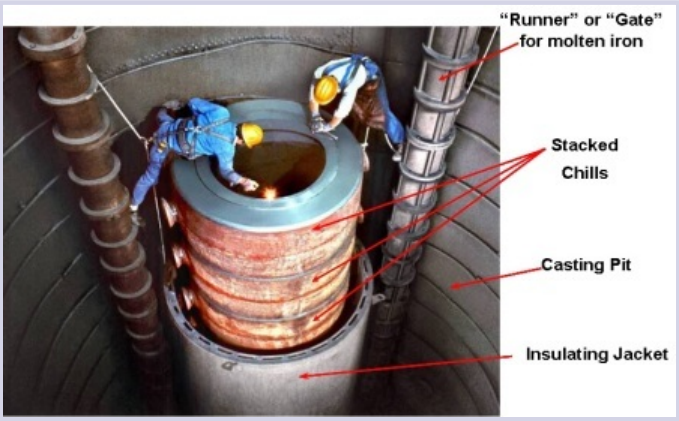
SpinTech Newsletter

Volume 10 April 2014

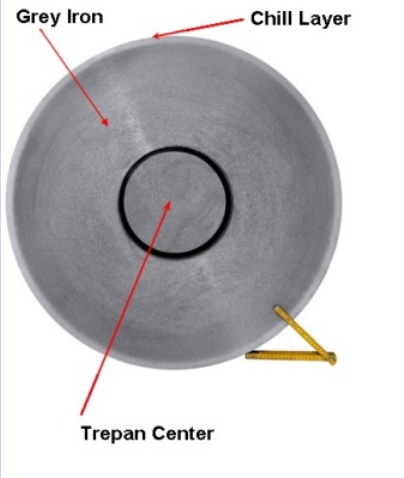
Chilled Iron Calendar Rolls

Casting Process

Calendar rolls are cast in a pit, similar to how paper machine dryer cylinders are cast. The molten iron is poured down twin "runners" to the bottom of the mold and enter the mold tangentially, creating a swirling motion as the iron fills to the top. The centrifugal force associated with the circular motion sends the clearer iron to the periphery and the impurities to the center, where they will be cored out.



"Chill" in iron casting refers to the process of preferentially controlling the solidification rate of the molten iron to obtain specific properties. For calendar rolls the "chills" are stacked to form the outer casting mold. The term "chills" is somewhat misleading in that the chill rings are not cooled. They are thick rings of material that have high mass, density, and thermal conductivity so that the iron in contact with the chills solidifies at a more rapid rate than the iron in the center. This brings the "clear", harder, iron to the surface and forms the chilled iron layer. You'll note in the photo below that calendar rolls are cast as a solid cylindrical body. In the case of non-integral rolls, the center is trepanned (cored) and then bored & honed in the machining processes. The roll body is then ground to be concentric with center.



The chilled iron is significantly harder than steel and non-chilled iron. And it is this hardness that is desirable in calendar rolls as it improves the roll's ability to maintain a good profile for a longer period of time.

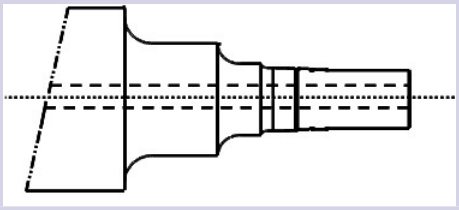
	Rockwell C	Shore C
Steel AISI 4100	31	43
Chilled Iron Alloy GH550	53	70
Chilled Iron Alloy GH650	56	77

Chill depth is determined by the cross sectional mass of the roll. The larger the roll diameter the thicker the clear chill layer.

Roll Diameter	Usable Chill
6" - 12"	.375"/side
12" - 24"	.500"/side
24" - 48"	.625"/side

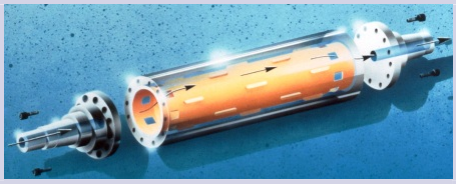
Roll Designs

The simplest calendar roll design is the integral roll where the roll & journals are machined from the solid cast roll body. This roll typically does not have the capability for liquid circulation. Integral rolls are used extensively in on-machine, multi-nip calendars for core board, tube stock, and other brown grades where profile and density are the key sheet characteristics (rather than gloss).



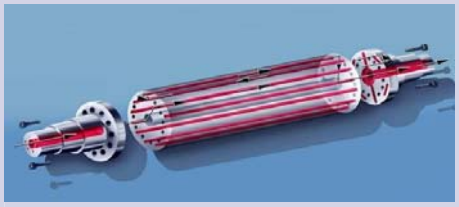
Integral Roll Journal

The majority of rolls used in on-machine calendars and off-line hot/soft or super calendars (exclusive of crown compensating and resilient covered rolls) are one of two designs that include provisions for liquid circulation for temperature control.



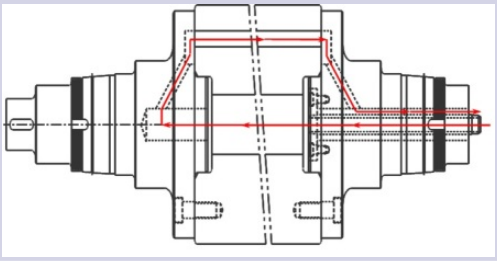
Aquitherm-V Roll

The **Aquitherm-V** roll incorporates a displacer inside the roll shell. The displacer has precision spacers that center it equidistant from the roll ID creating a passage for liquid circulation. In non-driven rolls the liquid flows in through one journal, across the displacer and out the other journal (Mono-flow). For driven rolls the liquid flows in the through the tending side journal, across the displacer, and into the roll core where it is removed back out the tending side journal via a siphon and the rotary union (Duo-flow).

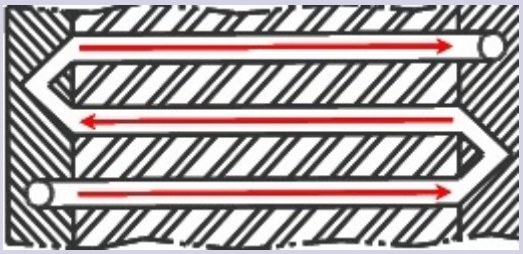


Aquitherm-P Roll

The **Aquitherm-P** roll incorporates longitudinal holes drilled through the roll shell from end to end. This provides a bit more uniform and faster heat transfer, flow, and ease of cleaning if plugging occurs. In the patented SHW design, the roll heads are machined with passageways that direct the liquid flow. While most peripherally drilled rolls are referred to as "Tri-Pass" rolls, this is somewhat of a misnomer. Flow in SHW peripherally drilled rolls can be: 1) in one end and out the other (Mono Flow); 2) in & out the tending side end for drive rolls (Duo-Flow); and 3) in the tending side, back to the tending side, and then out the drive side (Tri-Pass).



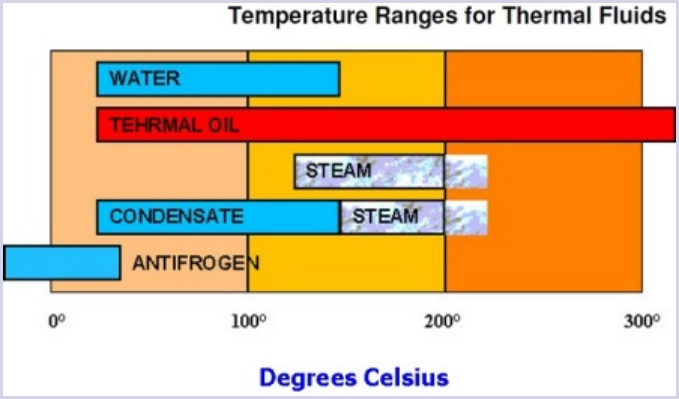
Duo Flow Schematic



Tri-Pass Flow

Operating Conditions

Displacer type rolls are generally limited to the use of water as the temperature control medium. Peripherally drilled rolls on the other hand can use water or hot oil. SHW also manufactures a peripherally drilled roll that can use steam or water interchangeably. The chart below provides some rules of thumb as to the operating ranges for the different media:



The roll temperature is often determined by the liquid control and circulating system. In many coated paper mills this has resulted in the calendar rolls operating at lower temperatures than they are capable of. Increasing the calendar roll temperature in coated papers can have a beneficial affect on gloss.

For a more detailed presentation on how chilled cast iron rolls are manufactured, and on the differences between displacer type and peripherally drilled calendar rolls, click the link below:

http://attachment.benchmarkemail.com/c104065/Chilled_Cast_Iron_Roll_Manufacturing.pdf

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Maintenance Tips

Checking Chill Depth

Accurately checking a calendar roll's chill depth requires removing one of the roll heads to gain access to the shell cross section and this is not practical in most cases. A rough estimate can be made by comparing the roll's current diameter with it's diameter when new, and then using the chill depth chart in the previous article to determine if grinding over the years has resulted in a critical loss of chill depth.

If the roll begins to have trouble maintaining profile and the interval between profile restorative grinds begins decreasing, this is almost always a sure indication that the roll body is past or close to getting past the clear chill layer. Lead time for a new roll or crown compensating roll shell is 6-8 months. So early planning and budgeting for a replacement is essential.

Checking Hardness

The surface of chilled iron rolls work-hardens in operation. For accuracy the hardness should be tested after a fresh grind. (Keep in mind that this indicates only the surface hardness and is not an indication of chill depth.)

New Product Section

Felt Guide

Installed in a Minnesota mill, this Spinnaker felt guide features all stainless steel components and includes manual and automatic guiding, and custom designed stainless steel support framing.

Spinnaker Felt Guide

Wire Tensioner

Recently installed at a local mill, this Spinnaker/Miami Machine wire tensioner includes stainless steel frames, cross shaft & mounting plates; maintenance free air-bag loading; controls and safety interlocks.

Spinnaker Wire Tensioner

New Activity Section

(Since Last Newsletter)

Sonoco installed a Spinnaker hands-free tailing system for tailing between the last dryer and calendar on their DePere WI machine. Spinnaker also improved the tail release at the reel to reduce tail build up on the reel doctor.

Domtar ordered a new profile bar and apron blade for the PM4 headbox at the Nekoosa WI mill. A Spinnaker hands-free tailing system was installed on PM2 to transfer the tail from the last press to the dryer section ropes.

RockTenn installed new Spinnaker/Miami Machine felt stretchers on PM4 at the St. Paul MN mill.

Sappi Fine Paper in Cloquet MN contracted with Spinnaker for the supply of new idler rolls for the converting area.

Neenah Paper contracted Spinnaker for the rebuild of two gearboxes used in the press and dryer sections at the Appleton WI mill.

Graphic Packaging purchased a new titanium slice lip for the K1 coated board machine at the Kalamazoo MI mill.

Wisconsin Paperboard in Milwaukee WI installed new Spinnaker/AirTrim systems to convey trim from the two machine winders to the pulpers.

Spinnaker recently improved the tailing effeciency at the size press on the two fine paper machines at Neenah Paper's Munising MI mill.

NewPage utilized Spinnaker for custom designed, paper roll mounted, free-wheeling rope sheaves to improve the tailing efficiency on the two coated paper machines at the Stevens Pt. WI mill.

Graphic Packaging in Kalamazoo MI contracted Spinnaker to reverse engineer and fabricate new calendar roll bearing housings, and bolt-on dryer rope rings, for the K3 coated board machine.

The Newark Group purchased a Spinnaker/AirTrim pneumatic trim system to convey trimmings from the sheeter/slitter to a baler in their Chicago book cover converting facility.

RockTenn in St. Paul MN ordered Spinnaker rope sheaves.

Spin-Tech Newsletter is published by Spinnaker Corporation International and is intended to supply information to paper mills to help operate and maintain production equipment.

Spinnaker is a manufacturer of rope tailing components, bearing housings, new rolls, roll repairs, chrome plating, gearbox rebuilds, and many custom built components for paper mills. We also provide field service for rope tailing systems; and trim conveying systems.

Spinnaker also distributes and provides local engineering, parts, field service and sales for:

SHW Casting Inc. World leader in chilled iron calendar rolls; crown compensating roll shells & rebuilds; calendar roll hard coatings; and calendar roll grinding.

Miami Machine Corp. Presses, reels, calendars, dryer sections, machine rebuilds, suction rolls, and custom designed and manufactured equipment for paper mills.

AirTrim, Inc. Pneumatic trim conveying systems for winders, sheeters, rereelers, coaters, napkin lines, etc. Dust capture and removal systems. Pulper air management systems.

Vail Rubber Works. Suppliers of exceptional quality in rubber and poly roll covers, suction roll cover drilling & rebuilds, roll grinding and general roll services. Locations in St. Joseph MI and Middletown OH.

Parason Machinery Ltd. Stock prep equipment including screens, screen baskets, pulper rotors, refiners, conical tackle (ConFlo, TriConic, Claflin, etc.).

Power Train Services. N. America's premier source for cast iron, ductile iron, nylon and steel dryer gears; line shaft cone pulleys; and ASME coded dryer heads.

Paper Machine Services. Headbox field services including tune-ups, in-place polishing & refurbishing of slice and apron lips, Teflon coating, and repairs. Manufacturers of new slice lips, profile bars, apron blades & lips, and cheeking pieces.

For more information, contact:

Spinnaker Corporation International
3876 Whitetail Court
Hobart, Wisconsin 54155
Ph.: 920-265-0941 Fax: 920-227-4178 Email: info@spin-corp.com

Click the link below to download product information.

http://attachment.benchmarkemail.com/c104065/Spinnaker_Info.pdf