ROLL COOLING / TRAINING SEMINAR
by BRC GLOBAL ROLLS LTD.
and Darryl Peck, CMC STEEL TEXAS

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BRC Technical Services

BRC Roll qualities audit for any long product mill

BRC Mill Start-up technical support for roll quality progression

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BRC Roll Institute – Roll production and metallurgy

BRC Cooling Seminars

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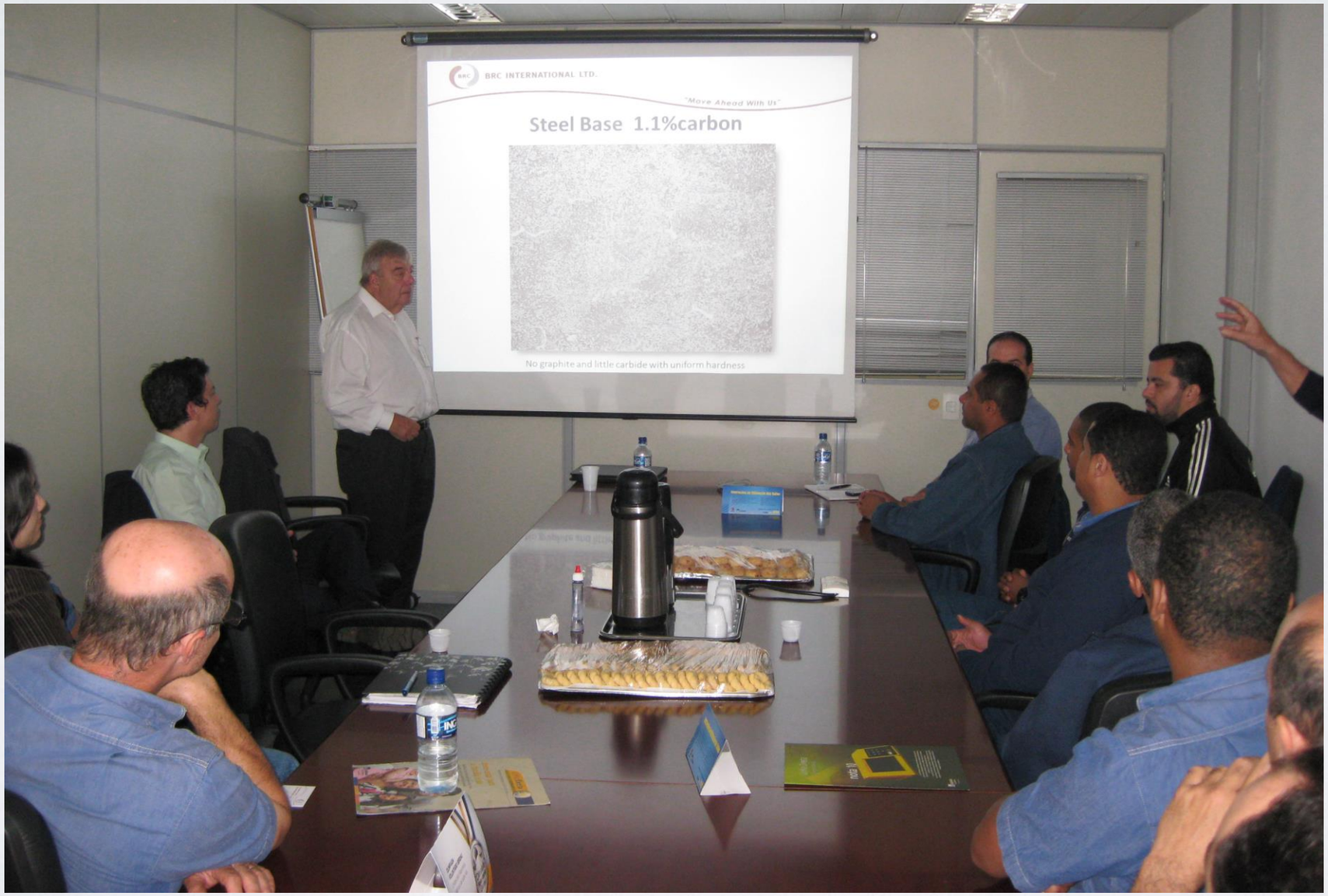


Courses in China, Canada & Brazil

Cooling of Rolls for Long Products

Around 80 courses given in North and South America

And now !

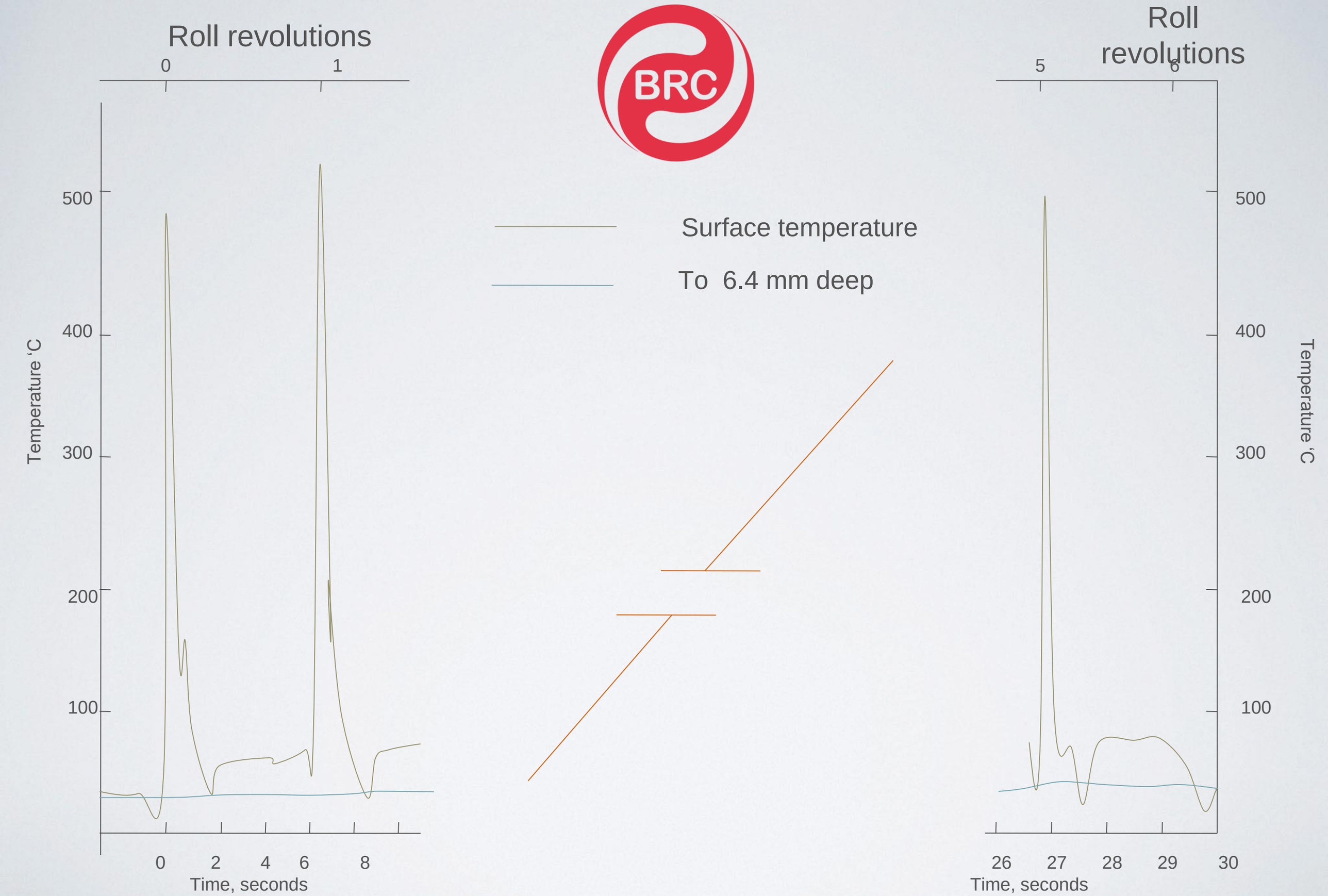
TOTAL COOLING SERVICE

Mill Audit

Plant Personnel Seminar

Detailed Report

Cooling Redesigns Recommendations


Roll revolutions
0
1
Roll revolutions
5
6
Surface temperature
To 6.4 mm deep
Temperature ‘C
500
400
300
200
100
0
2
4
6
8
Time, seconds
26
27
28
29
30
Time, seconds

BRC

Roll Cooling Audit

Overhaul

April 2017

CMC SEGUIN TEXAS

TOTAL COOLING SERVICE

OBJECTIVE

Evaluate current mill roll cooling designs and practices and recommend improvements to obtain higher performances for conventional rolls, as well as higher performance rolls.

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Data collection

		WORK PLAN	
PLANT	**PROJECT**	**DIAGNOSIS AREA**	**INFORMATION TO BE OBTAINED**
CMC TEXAS	OVERHAUL of COOLING	Water plant	Ph, volume, pressure, ppm, temperature, maintenance, tube diameters, etc.
		Main cooling pipes. Nozzles	Diameters, maintenance, trajectory, control, etc.
		Distribution and control	Losses, control, note pressure and volume, diameters, etc.
		Take note of water application in each stand. (**1**)	Application, control, measurements, distances, state of cleanliness, etc.
		Check plant design parameters	Pool, filters, cooling towers, billet section, passes, etc.
		Evalution of worker attitudes to cooling	Worker interviews in production areas

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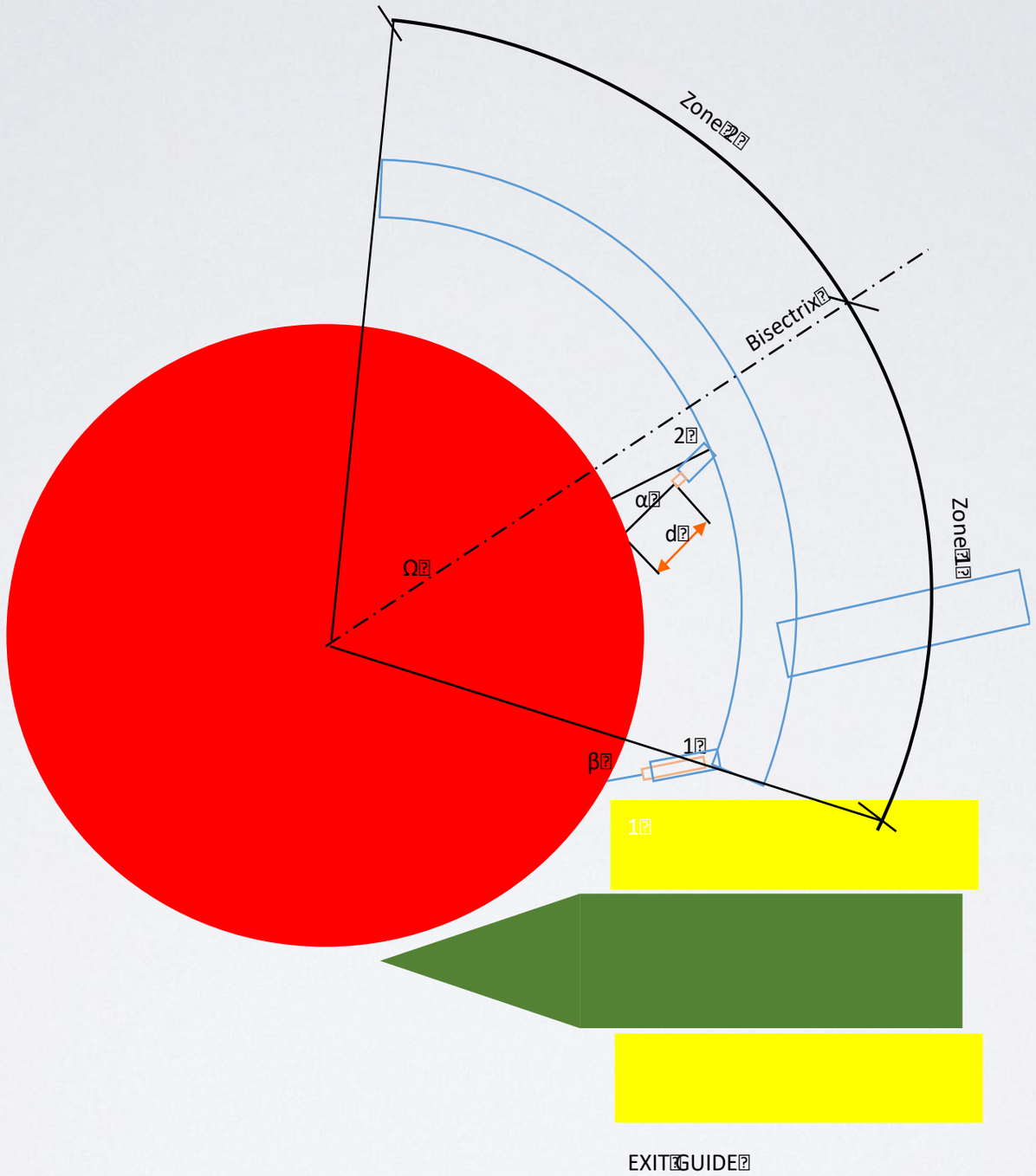

Initial criteria

COOLING TOTAL SERVICE
OVERHAUL

Roughing mill criteria

	Roughing mill		
	P<70 psi	**P≥70 psi**	**Observations**
Shape	Round	Square or Rectangular	SCH 40
Measure	ø ≥ 2"	Area > 4 sq.in	Thickness ≥ 1.1/2" for no round
Arc length of the cooling pipe with nozzles	Max L ≤ 80°	Max L ≤ 70°	The cooling pipes should not deliver water to entry zone of bar, zone 1 should concentrate higher water volume than zone 2
Connection position to feed the cooling pipe	Any position	Any position	
Connection diameter to feed the cooling pipe	ø 2"	ø 2"	
Cooling pipe position	Starts at 1/2" from exit guide		
Alignment & adjustment	Fixed		Aligned (without regulation)
Pressure gauges	One per stand		
Comments	If the exit water is by slots or holes, these ones should be calibrated to know the water volume per time. Water must always be tangentially directed to the roll surface (not perpendicular) and is recommended to have a inclination of 5° to 10°. The use of spray nozzles is recommended.		

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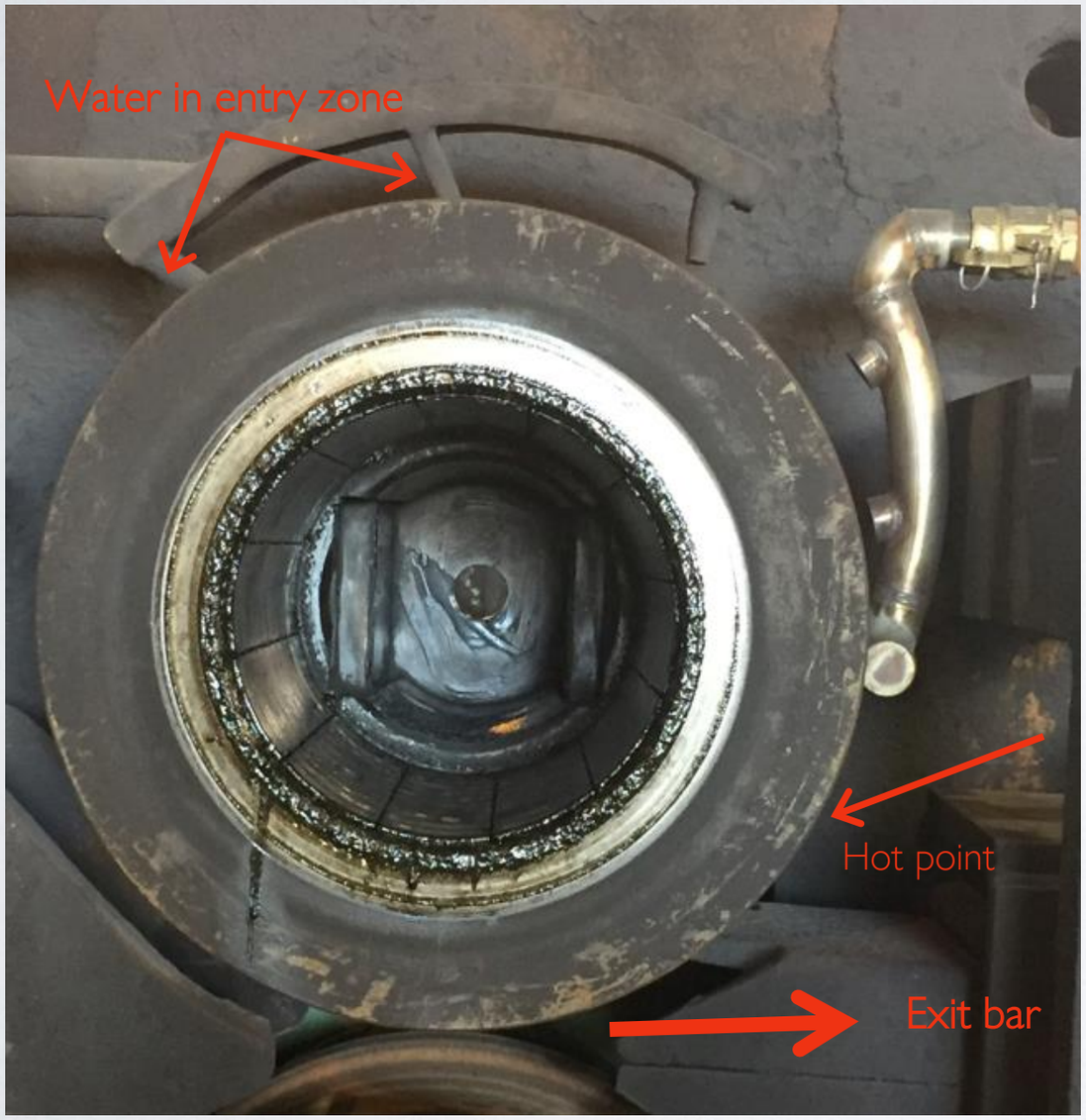
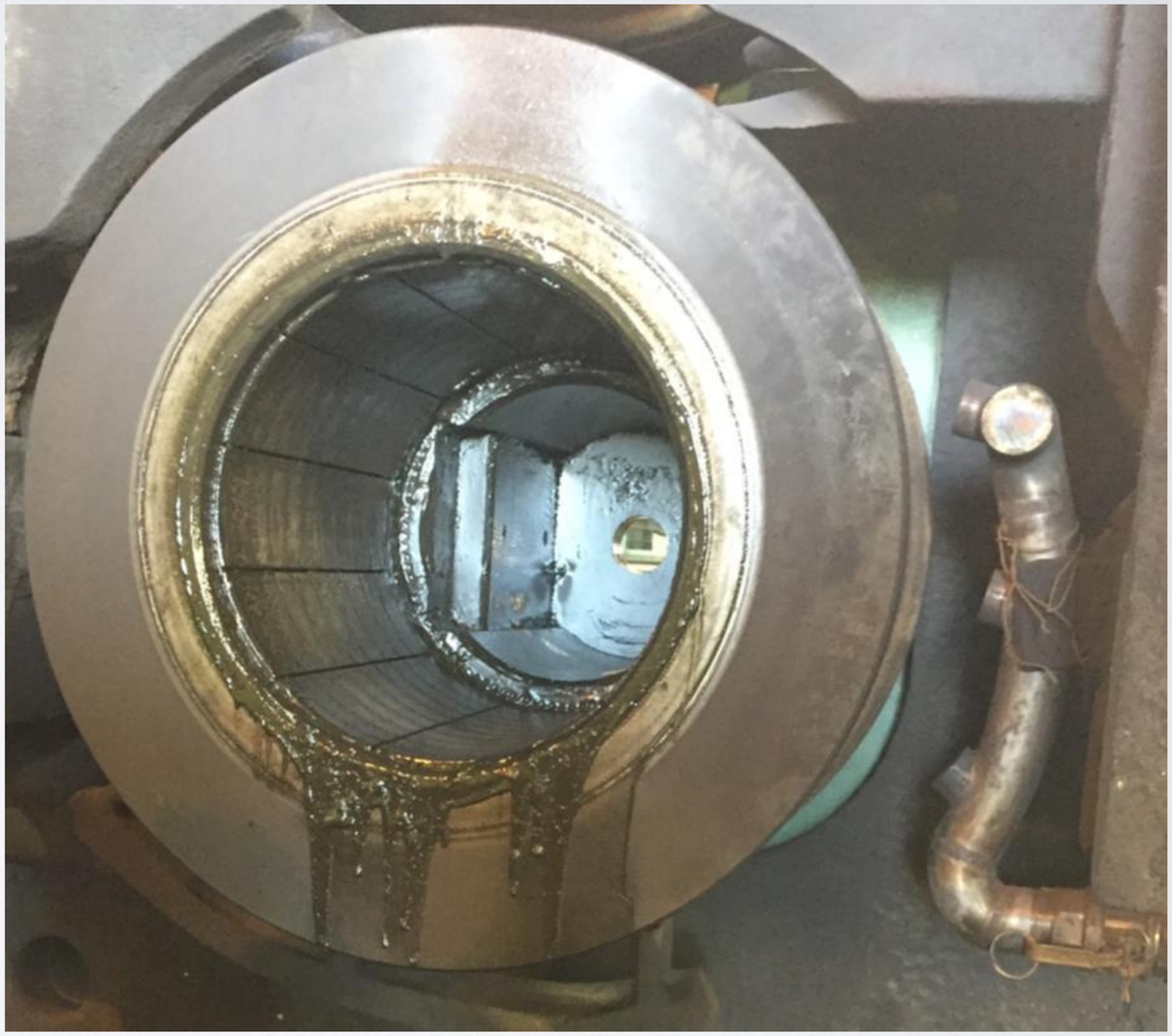
Roughing mill





COOLING TOTAL SERVICE

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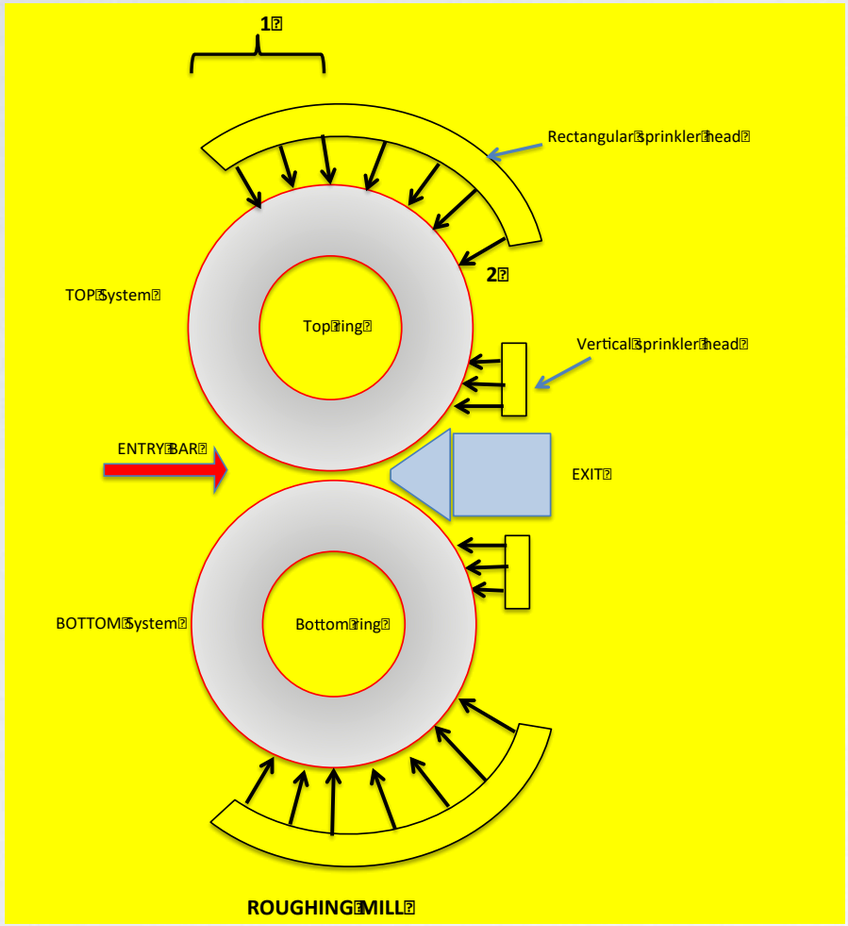
Roughing mill



Original

Title		Roughing stands (1 to 6)		Recommended time for change
		Current setup	BRC Recommendations	
Cooling pipe	Shape	Box	Round	Not urgent
	Measure	☐ 4" x 2"	⦸ 2"	Not urgent
Arc length	degree	90°	80°	Not urgent
	Position	Far from exit guide and over bar entry zone	Close to exit guide and must not go over bar entry zone	Urgent
Connection to cooling pipe	Position	Zone 1	Zone 1	No change
	Diameter	⦸1 1/4"	⦸2"	No urgent
The cooling pipe Alignment to the channel		Aligned	Aligned	No change
Fastening of cooling pipe		Fixed	Fixed	No change
Water Pressure	psi	<40 psi	40>P≥60	Not urgent
Pressure gauge		Not available	Must be available in every stand	Urgent
Water volume	gpm	≈22.5 gpm in each stand	≈50 gpm in each stand	Not urgent
Cooling pipe distance to roll surface	inches	≥ 4"	≈ 4"	Not urgent
Comments	Water application	Two cooling pipes (curved + vertical)	One curved cooling pipe	Not urgent
	Notes	Water exit by slots (usually not tangential to surface)	Sprays are most recommended. If slots or holes are necessary due to high ppm, they need to be cut at an angle tangential to the roll surface (arc wall thickness 1/4" or SCH 40)	Urgent

Recommendations for immediate action:

1. Reducing the arc length of cooling heads from the top position of roll, to prevent water from entering the channel with the bar, and get the arc as close as possible to the exit guide
2. To install a pressure gauge in each stand by process control
3. The arc slots and holes for cooling must be cut at an angle in order to deliver the water tangential to the roll surface. To achieve the desired angle, the pipe wall thickness should be ≥ ¼" (SCH 40)

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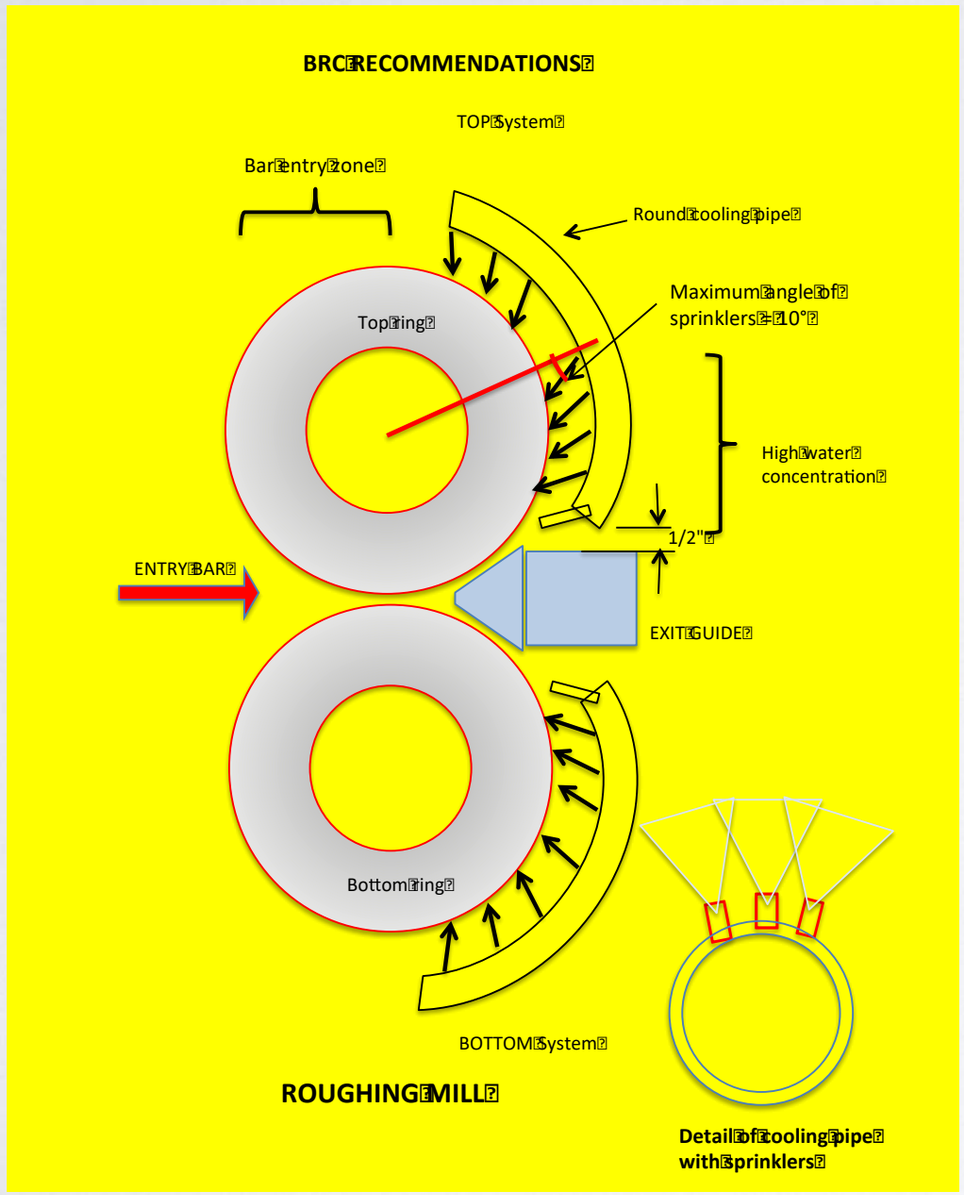
Roughing mill



Updated

Comments:

1. Water application by both vertical and curved pipe is through slots, therefore the water volume can not be calculated.
2. The curved pipe goes further of critical top point over the entry side. When the cooling pipes deliver water to the entry zone of the bar, it becomes steam and this will increase cracks.
3. The cooling pipe in box shape is not recommended when the pressure is lower than 50 psi. In addition if the exit water is by slots, the water pressure drop will be higher.

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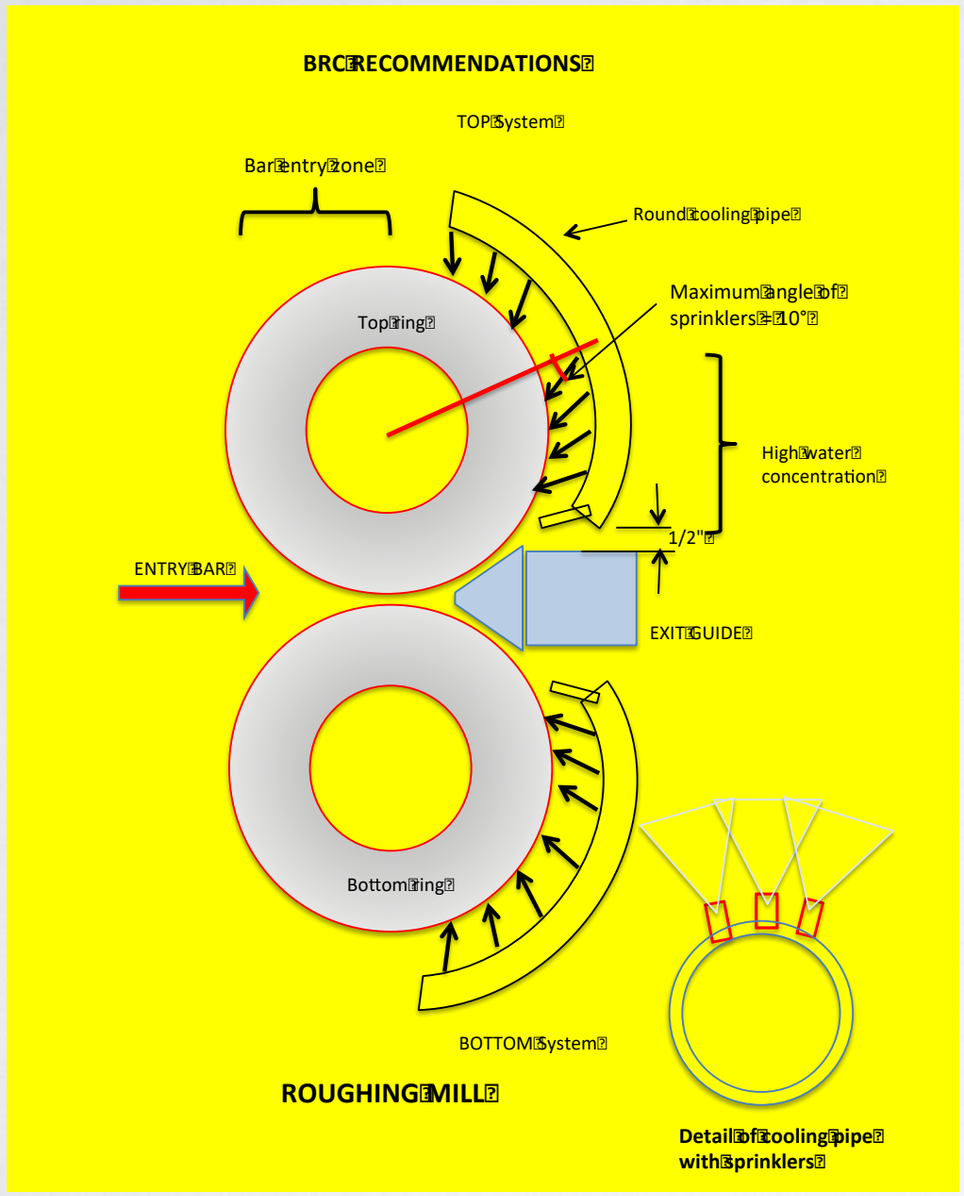
Roughing mill



Updated

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Intermediate & finishing mill criteria

	Intermediate & finishing mill	
	20 psi ≤ P ≤ 100 psi	**Observations**
Shape	Round	SCH 40
Measure	ø ≤ 1 1/4"	
Arc length of the cooling pipe with nozzles	Max L ≤ 100°	The cooling pipes should not deliver water to entry zone of bar, zone 1 should concentrate higher water volume than zone 2
Connection position to feed the cooling pipe	Close to the exit guide	
Connection diameter to feed the cooling pipe	ø 1 1/4"	For big channels or 4 strands there should be 2 feeding water pipes connected to the arc.
Cooling pipe position	Starts at 1" from exit guide	A cooling pipe extension is recommended to reach the contact area of the bar exit
Alignment & adjustment	Fixed	Aligned (without regulation)
Pressure gauges	One per stand	
Comments	Cooling solts and holes are not recommended because of the resulting pressure losses. The use of spray nozzles is always recommended. Water must always be tangentially directed to the roll surface (not perpendicular) and is recommended to have a inclination of 15° to 25°	

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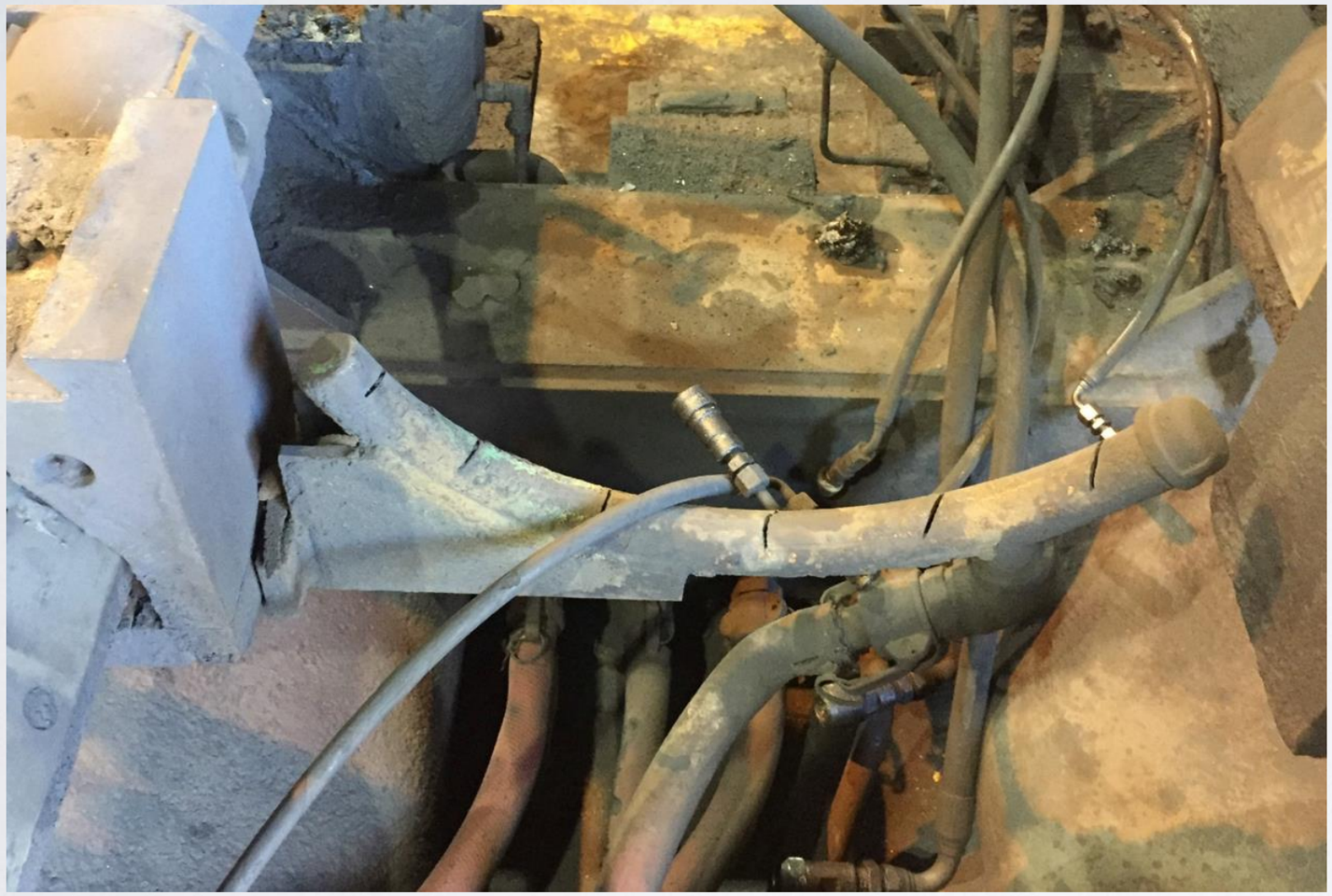
Intermediate & finishing mill



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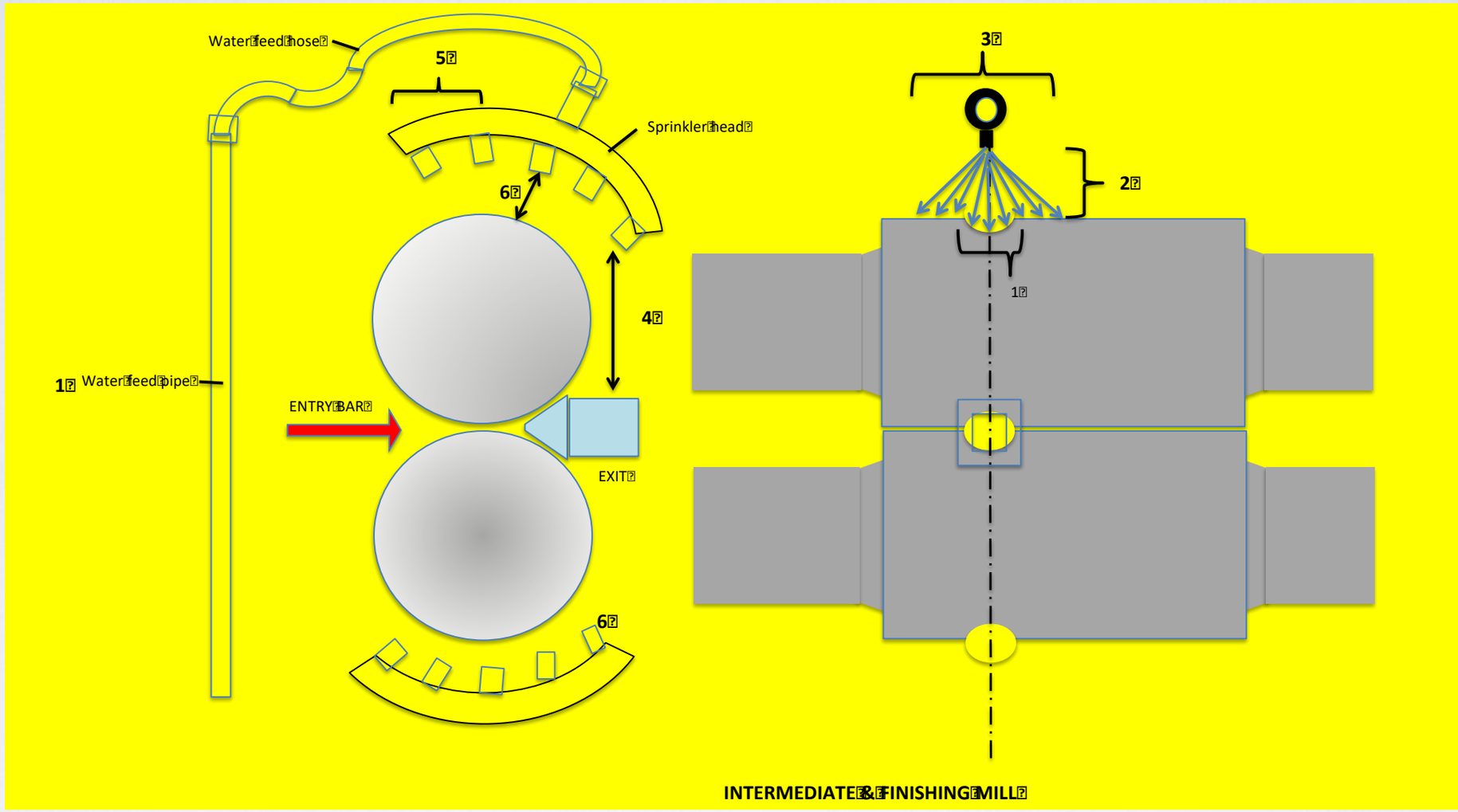
Intermediate & finishing mill (Original)



Current setup drawing notes:

Note 1: The use of hoses is better than vertical pipes because they reduce the pressure loss.
Notes 2 & 6: The distance to roll surface should be regulated according to the channel width.
Note 3: The spray angle is too big for the channel width.
Note 4: The cooling starts too far away from the bar exit contact area.
Note 5: Cooling water is being delivered on bar entry zone, which is not desirable.

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Intermediate & finishing mill

Title		Intermediate & Finishing stands (7 to 16)		Recommended time limits for change
		Current setup	BRC Recommendations	
Cooling pipe	Shape	Round	**Round**	No change
	Measure	⦸1"	**⦸1 1/4" MIN**	Not urgent
Arc length	degree	120°	**90° MAX**	**Urgent**
	Position	Far from exit guide and over bar entry zone	**Close to exit guide and must not go over bar entry zone**	**Urgent**
Connection to cooling pipe	Position	In the middle of zone 1 and zone 2	**Zone 1**	Not urgent
	Diameter	⦸1"	**⦸1 1/4"**	Not urgent
The cooling pipe Alignment to the channel		Aligned	**Aligned**	No change
Fastening of cooling pipe		Fixed	**Fixed**	No change
Water Pressure	psi	<40 psi	**Intermediate 40>P≥70, Finishing ≥70**	No urgent
Pressure gauge		Not available	**Must be available in every stand**	**Urgent**
Water volume	gpm	≈22.5 each stand	**≈50 each stand**	No urgent
Cooling pipe distance to roll surface	inches	≈ 3"	**1" < d < 2.1/2"**	No urgent
Comments	Water application	One curved cooling pipe with sprays	**One curved cooling pipe with sprays**	No change
	Notes	Application angle of sprays is too variable.	**Maximum application angle of nozzles is 15° for Intermediate stands and 25° for Finishing stands**	No urgent

Recommendations for immediate action:

1. Reducing the arc length of cooling heads from the top position to 90° max, to prevent water from entering the channel with the bar, and concentrate more pressure to the exit area
2. To install a pressure gauge in each stand by process control

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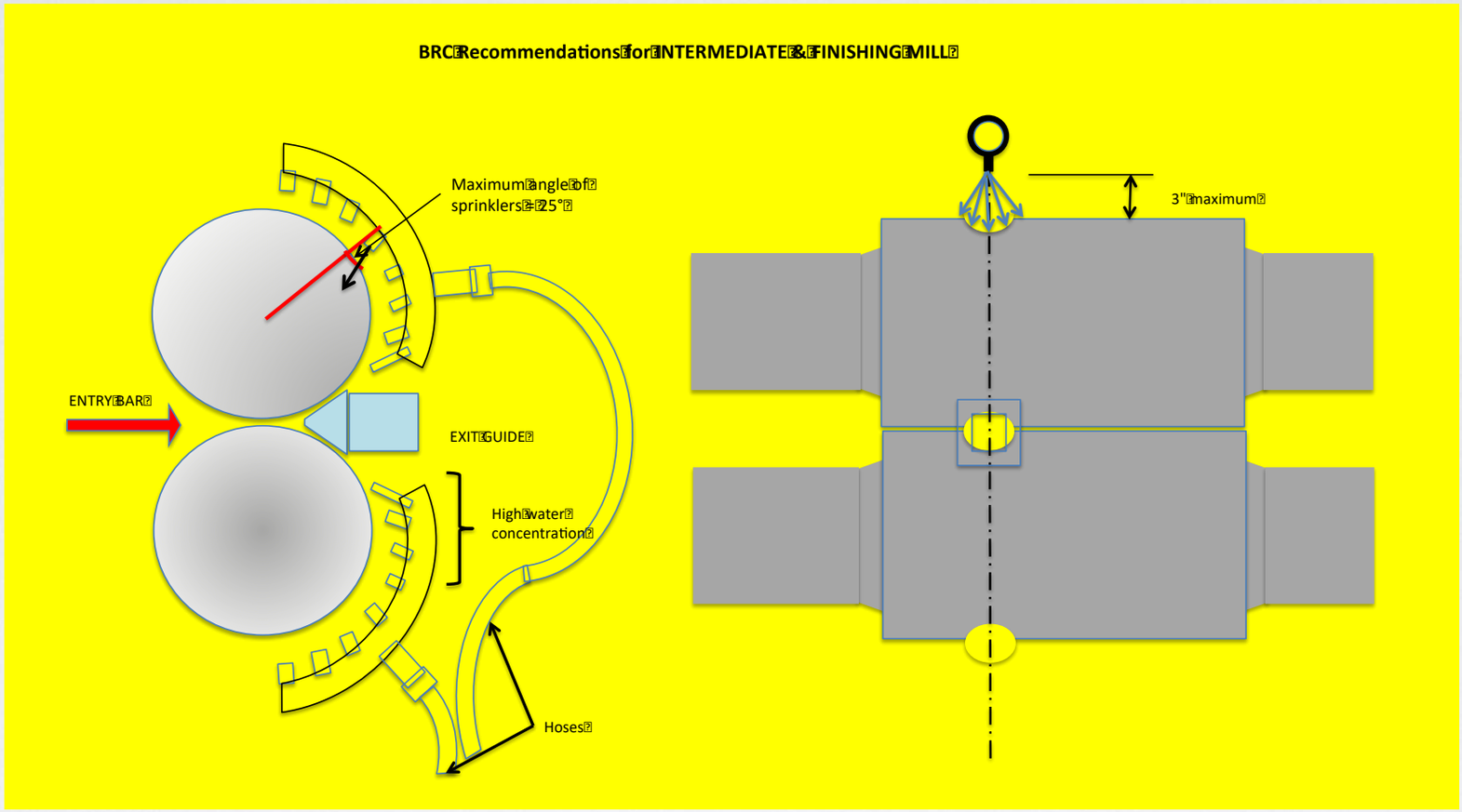
Intermediate & finishing mill (Updated)



Comments:

1. There is considerable water loss when the spray angle is not calculated according to the application distance and channel size. In current setup see points 1, 2, 3 and 6.
2. The curved pipe goes over the critical top point delivering water to entry zone of the bar, which becomes steam and thus will increase cracks. See point 5.
3. The beginning of cooling pipe near of exit guide assures a lesser heat penetration in the roll, which reduces the wear by cracks. See point 4.

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Other recommendations:

3. To regulate the distance between nozzles and the channel surface according to the spray angle and channel size.

i. Start by setting the minimum and maximum distance, minimum with roll start up diameter and the maximum with scrap diameter. i.e. 1" to 2 ½"

ii. Define a spray angle according to the rolling mill products. BRC suggests 50° for sections, angles and flats, and 25° for the slitting rolling of rebars. There is always the possibility of adjusting the nozzle twist angle for lesser water loss.

4. The application angle of the spray nozzles is 15° for intermediate stands and 25° for finishing stands.
5. In case of rolling bigger sections (ie. 5"- 6" Flats) it is recommended to use 2" diameter cooling pipes

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General recommendations:

1. Measure the water pressure in each stand as close as possible to the water feed pipe.
2. It is important to note that there is less water available than required. Each stand has about 22.5 gpm, and we recommend 50 gpm per stand
3. To increase water volume in the finishing stands we recommend that the booster pump is only used for 3 stands instead of 4 stands.

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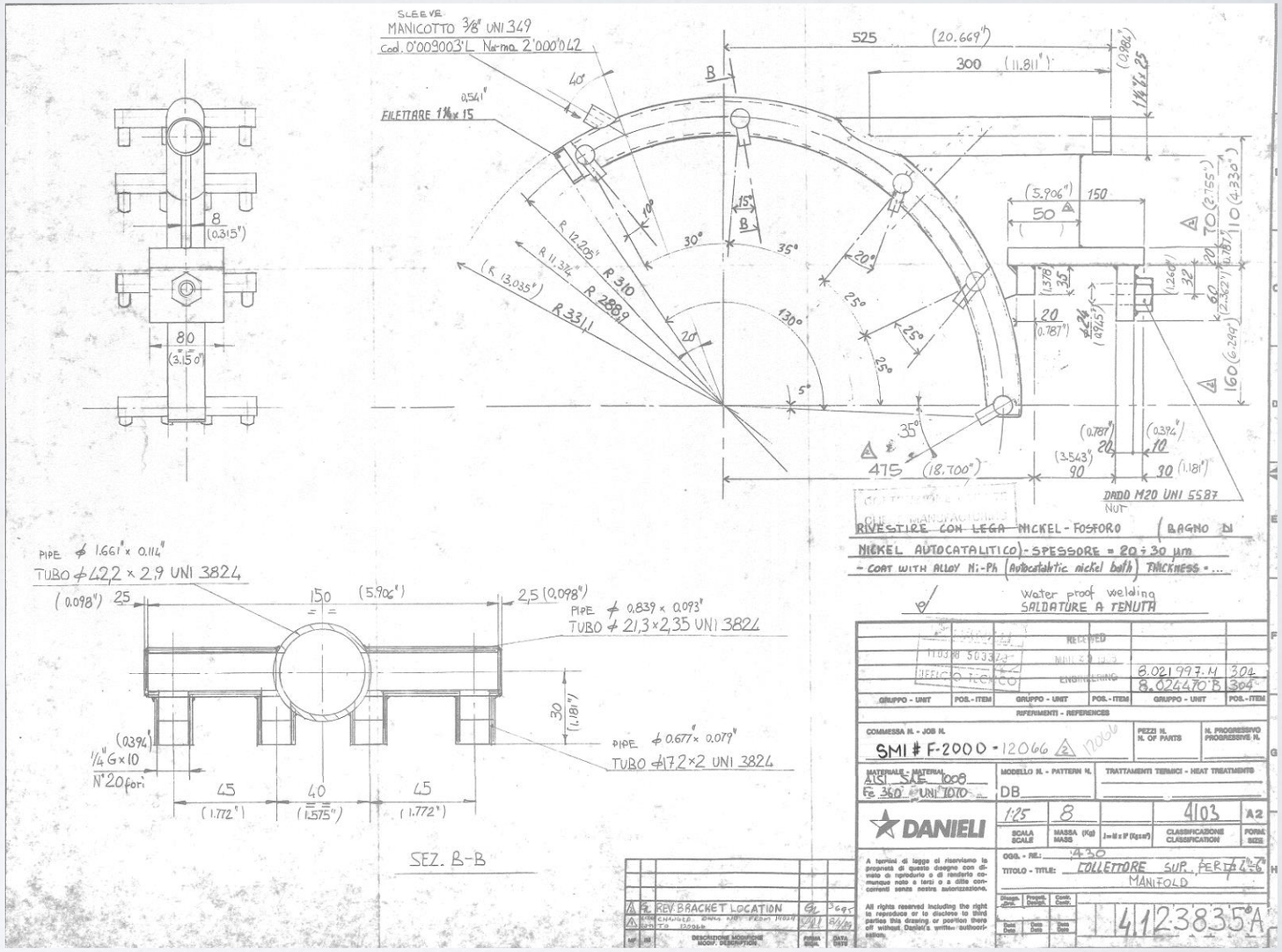
Some examples

Manifold for Flats 4” to 6”



Original

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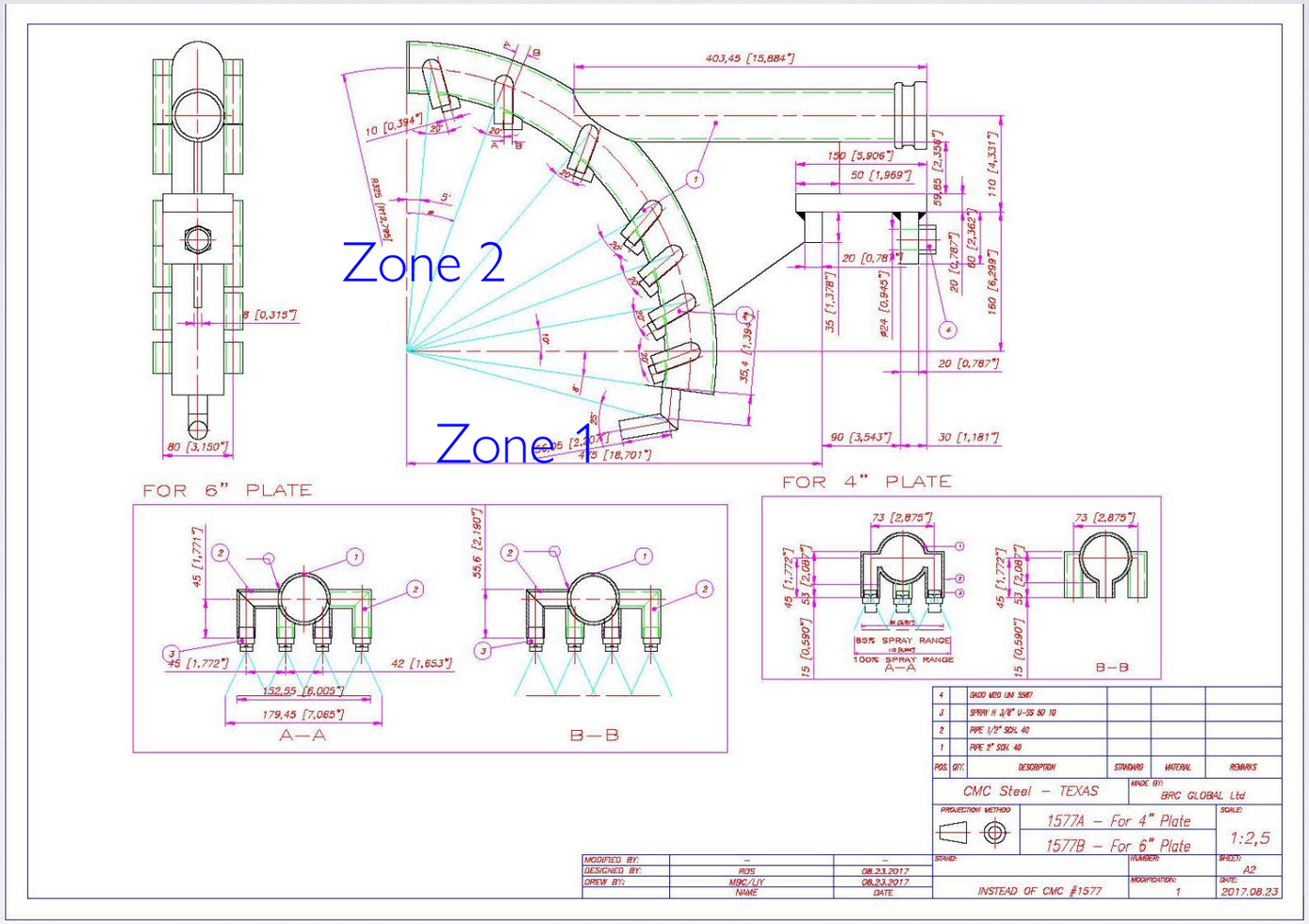
Updated Manifold for Flats 4” to 6”



Change made

The cooling pipe designs are following the channel pass design; the distances between nozzles have been differentiated in two zones mainly for top cooling pipes.

The first zone (#1) is with turbulent water i.e.: Short distance between nozzles.

The second zone (#2) is to cleaning. See generalized suggestion.

The cooling pipe does not deliver water in the entry zone. The pipe length is almost 90°

All analysed drawings have the same features of previous points, i.e. We should apply the same above recommendations also for angles and large flats; these are:

1st from New to Middle diameter.

2nd from Middle to Scrap diameter

As CMC Texas produces large widths products, we suggest that the cooling pipes should be of ø1¼”. Pipes of ø1" should only be for little sections or for rolling of several slitting strands.

COOLING TOTAL SERVICE

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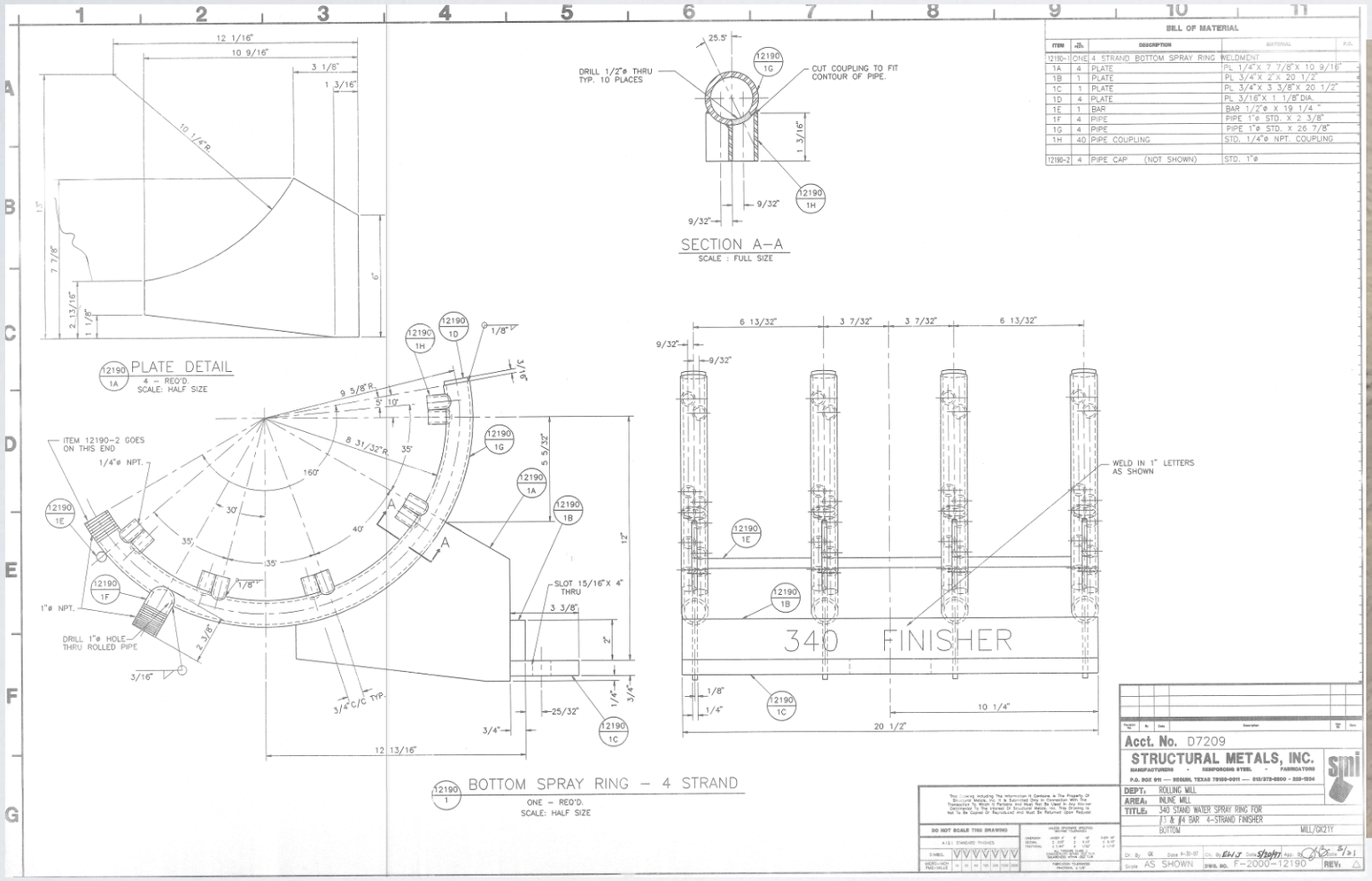
Manifold for four strands rebar



Original

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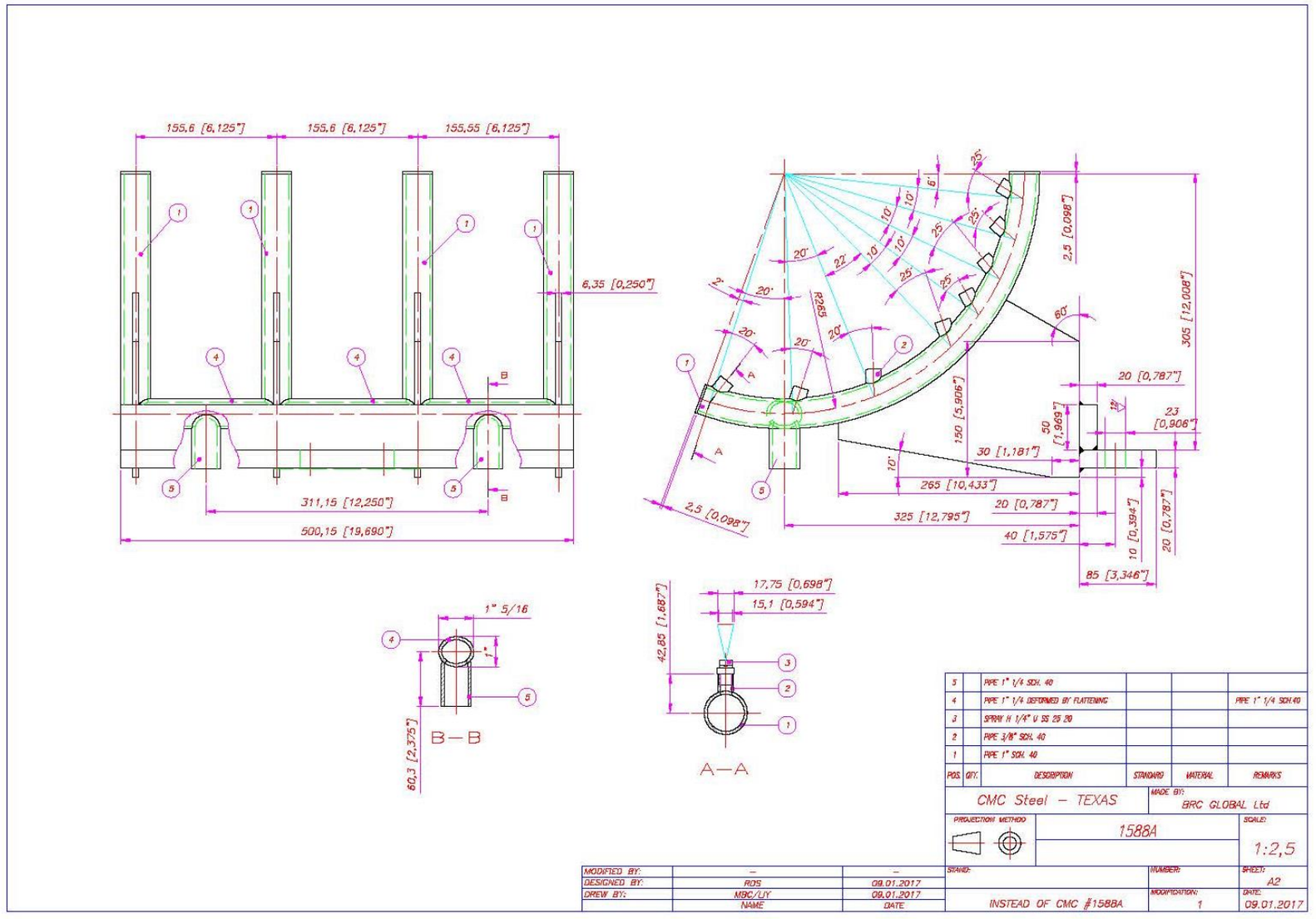
Updated Manifold for Four strands rebar



Change made in bottom pipe

More nozzles and better distribution
Reducing water losses
Zone 1 is well marked

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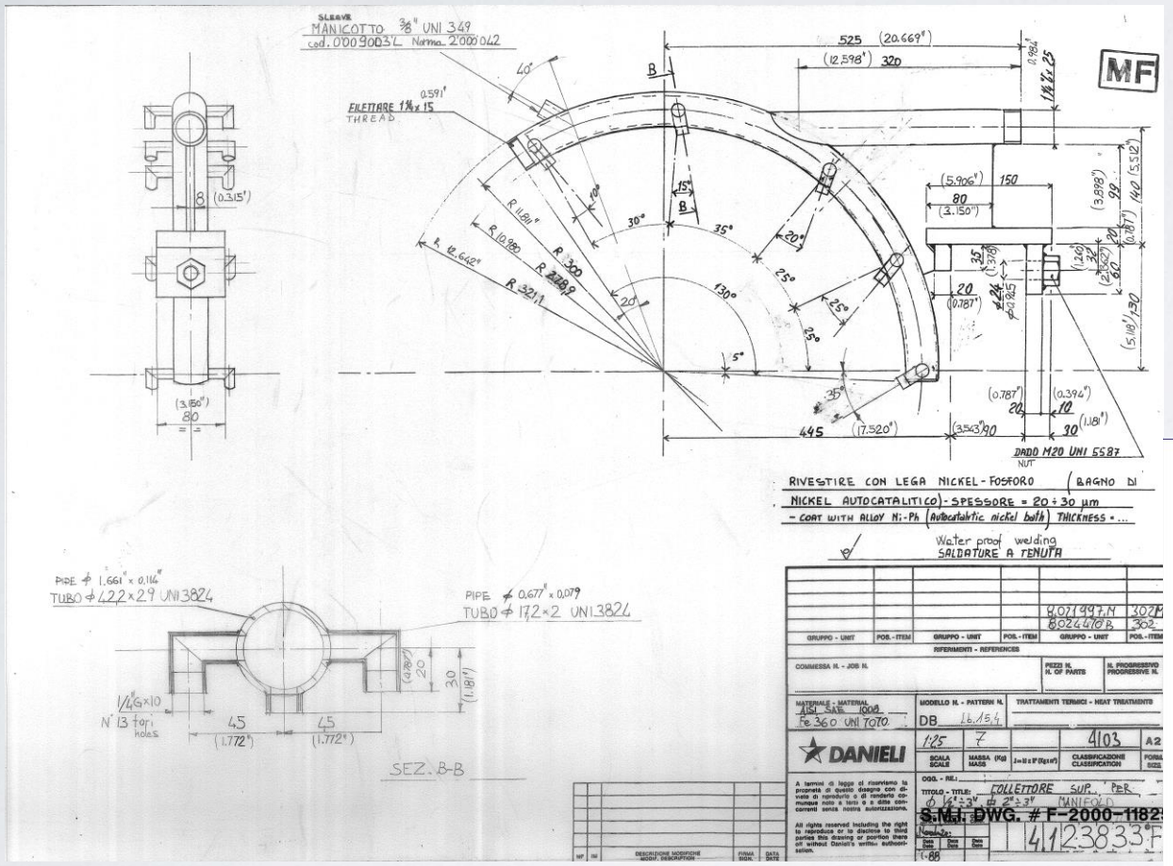
Some modifications of drawings (Total 17 drawings)

⃠ ½” to 2” and Flat 2” to 3”



Original

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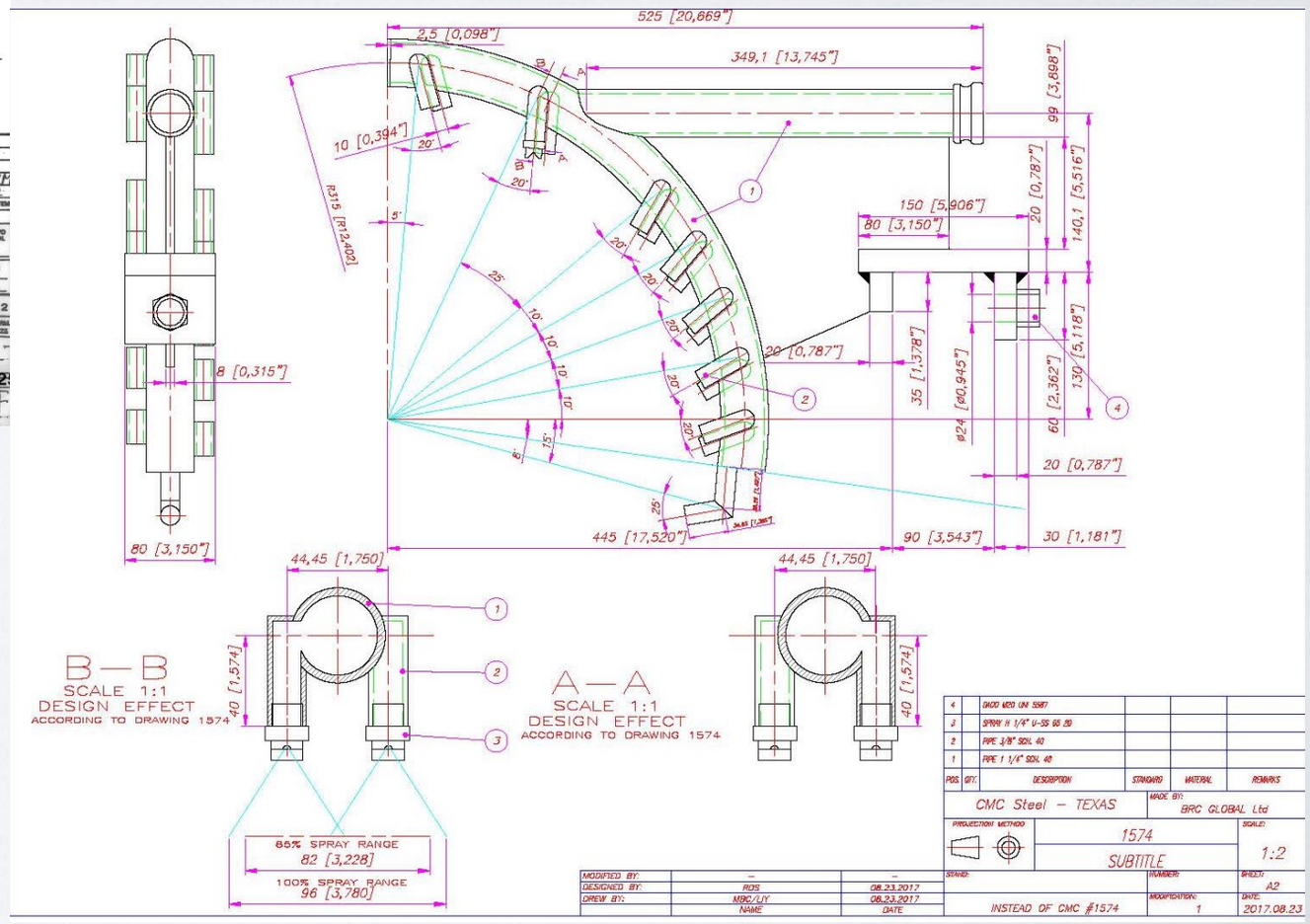

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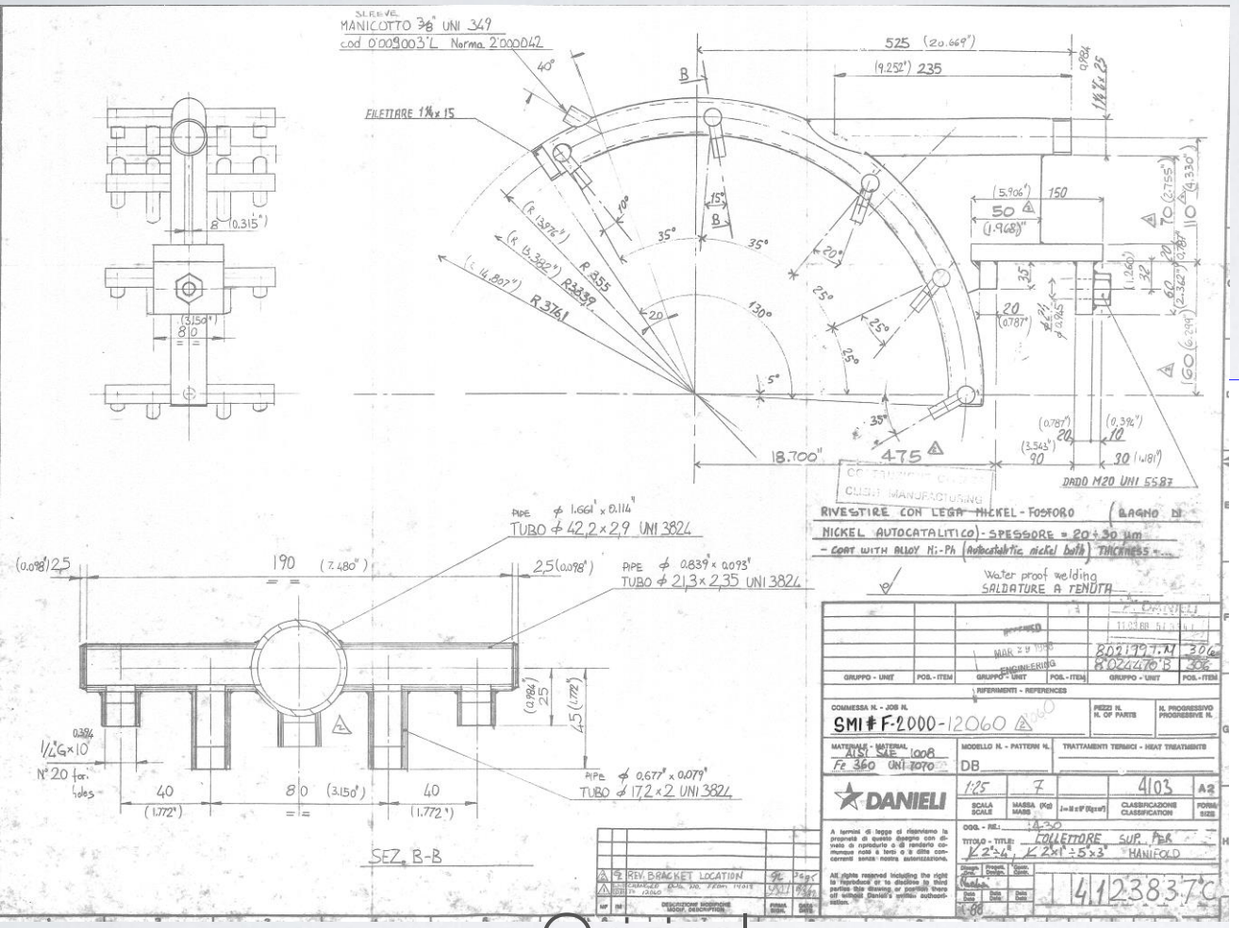
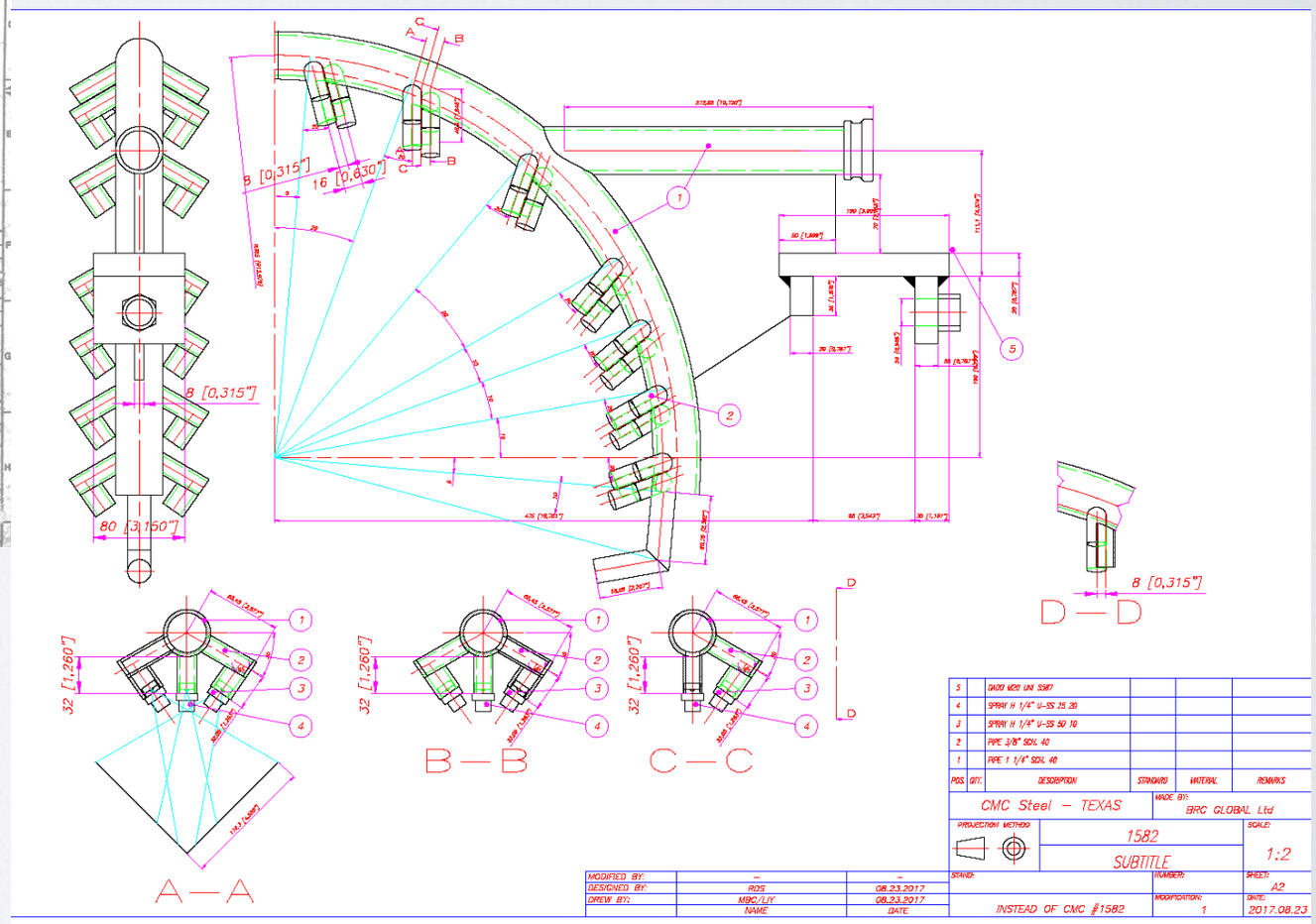
More….

For angles 2” to 4”



Original

Updated



COOLING TOTAL SERVICE
OVERHAUL

ULTIMA®

SUMMARY

Coming back to the TOTAL COOLING SERVICE objective:

Evaluate current mill roll cooling designs and practices and recommend improvements to obtain higher performances for conventional rolls, as well as higher performance rolls.

The higher performance rolls need an efficient cooling system to obtain its maximum performance.

The ULTIMA® rolls are not exempt from this need…...

COOLING TOTAL SERVICE
OVERHAUL

COOLING FOR ULTIMA®

ULTIMA®

The cooling system sets a limit for many mills, when it comes to trials with advanced high performance roll grades. The Ultima® concept provides a solution for rolling mills trying to increase performance and output, but suffering from short comings in the cooling system.

Hot mill work rolls have to provide high wear resistance and thermo mechanical fatigue resistance at the same time.

For maximum wear resistance a roll material with a high content of hard special carbides, precipitated in a highly alloyed martensitic matrix is required, but such a material does not have a good thermal crack resistance with following consequences for the mill's operation:

At the exit side of the pass efficiently designed cooling headers have to guide a high volume flow of cooling water with correct pressure onto the roll surface to extract the absorbed heat from theroll as quick as possible. State of the art cooling arrangements would provide the ideal working situation for a high performance roll. Unfortunately, it is not available in many mills, and actual rolling conditions can be far away from ideal.

COOLING TOTAL SERVICE
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ULTIMA®

ULTIMA® HIGH PERFORMANCE WORK ROLLS

Ultima® rolls have been developed to replace conventional SGP/SGA grades used in intermediate stands and to compliment the increasing use of Carbide and CPM rolls/rings at the finishing stands of rod and bar mills. The working zone of Ultima® roll consists of highly alloyed martensitic structure with a carefully controlled dispersion of high hardness carbides. The complex carbides found in Ultima® rolls exhibit high hardness (up to 3000 HV), and differ significantly from the carbides present in conventional cast iron rolls. The hardness level of all Ultima® variations can be adjusted - from 65 ShC up to 85 ShC (714 to 830 Ld.) - to fit actual mill requirements. The core and necks consist of high strength nodular cast iron with typical neck hardness of 45 +- 3 ShC.

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ULTIMA®

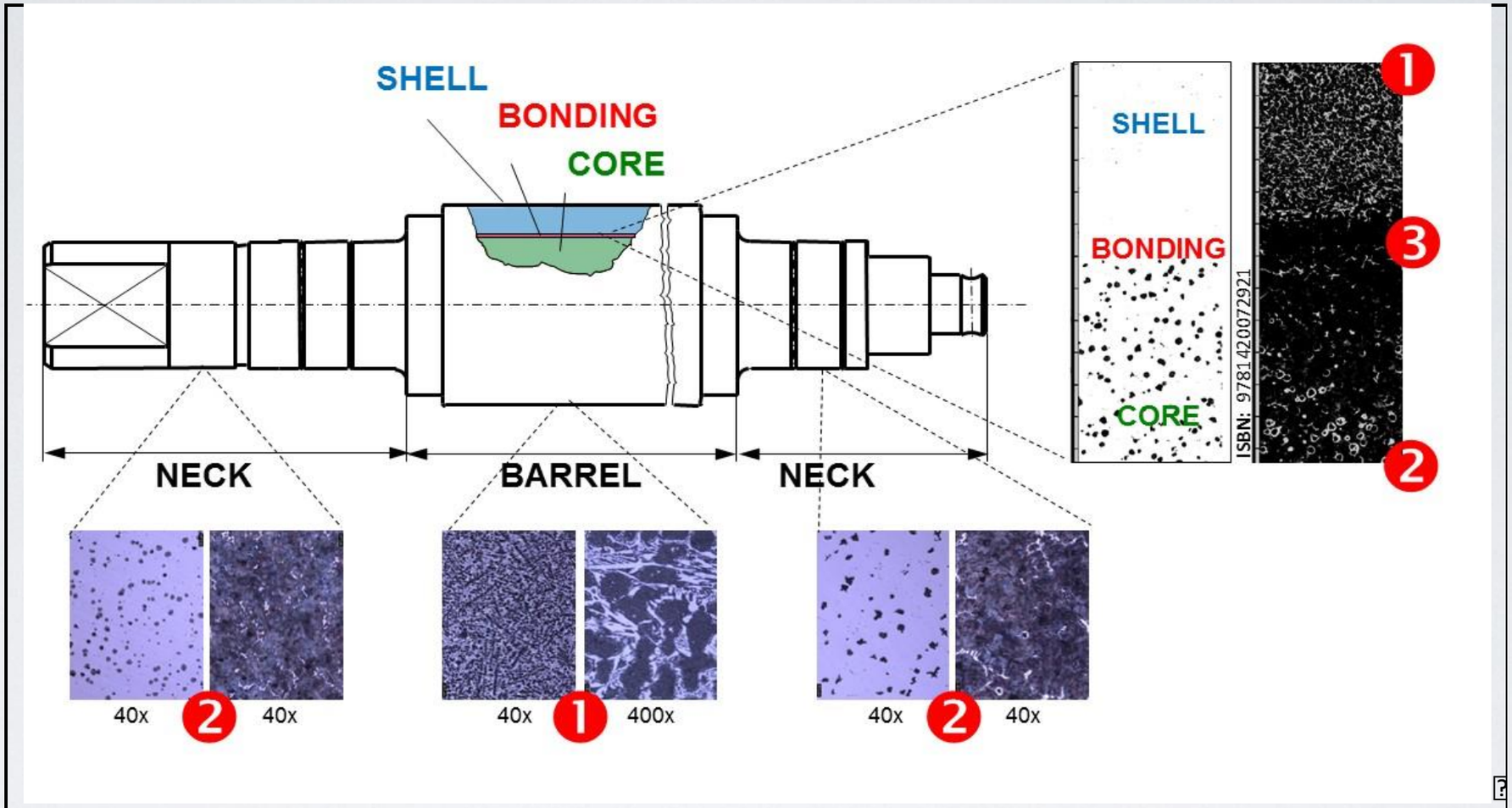

Figure 1: principle of centrifugal cast double poured work roll

 HIGH WEAR RESISTANT – TAILOR MADE WORKING LAYER

❷ HIGH STRENGTH NODULAR CAST IRON ROLL CORE AND ROLL NECKS

 METALLURGICAL BONDED SHELL-CORE INTERFACE

COOLING TOTAL SERVICE
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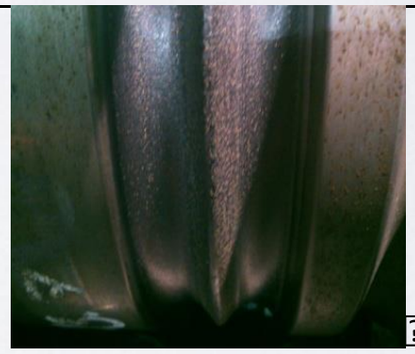
SUMMARY

ULTIMA®

Today, over 2500 Ultima® rolls have been delivered to long product mills and compete successfully even with carbide rolls and rings.
The general feedback from ULTIMA® rolls in rebar finishing compared to SGA / AIC in use:
3 – 5 x pass life!
30 – 50 % less redressing!
“flexible to use“
The high productivity of ULTIMA® rolls easily pays back a higher investment for this high performing rolls in terms of TCO (total cost of ownership).

			
stand 8 – fluted square		stand 9 – dog bone:	
SGP after 3520 tons	ULTIMA® after 12800 tons	SGA after 1500 tons	ULTIMA® after 4800 tons

Note: Pictures of pass grooves 8 and 9 after rolling different tonnages with cast iron rolls and ULTIMA®

ULTIMA®

CMC SEGUIN - PERFOMANCES WORKING WITH ULTIMA

Product	System	Stand	Shape	Comparative results			
				Iron	ULTIMA	CPM	TC
Rebar 10	1 strand	12	Finisher	1,300		2,000	
Rebar 8	1 strand	12	Finisher	400	**1,000**		
Rebar 6	3 strands	14	Slitter	2,500	**7,000**		
		16	Finisher	420	**1,100**		5,000
Rebar 16mm	3 strands	14	Slitter	1,800	**5,000**		
Rebar 5	3 strands	15	Leader	3,100	**5,000**		
		16	Finisher	360	**800**		
Rebar 10mm	4 strands	14	Slitter	1,000	**4,000**		

ULTIMA®

OTHER MILL PERFOMANCES WORKING WITH ULTIMA

Mill	Stand	Pass	Product	Iron (SG) (Tons)	CPM (Tons)	T. Carbide (Tons)	Ultima (Tons)	Comparative Analysis
Mill A	18	Finisher (2S)	#5 Rebar	700	-		3200	Ultima is 4.5 higher than iron
Mill B	12-14-15	Finishers	4.5/8"~2.3/8" Flats		1297		1200	Ultima results similar to CPM
Mill C	12H	Square	15mm Rebar	900	-		3000	Ultima is 3.33 higher than iron
	13V	Dogbone	15mm Rebar	900	-		3000	Ultima is 3.33 higher than iron
	14H	Slitter (2SS)	15mm Rebar	900	-		3000	Ultima is 3.33 higher than iron
	15V	Flat	15mm Rebar	700	-			
	16H	Finisher (2S)	15mm Rebar	350	-		1700	Ultima is 4.85 higher than iron
	16H	Finisher (2S)	15mm Rebar	350	-	8000	1700	Ultima is 20% of T.Carbide
Mill D	17	Dogbone	10mm Rebar	400	-		1380	Ultima is 3.45 higher than iron
	18	Slitter (4SS)	10mm Rebar	400	-		1380	Ultima is 3.45 higher than iron
	19	Oval (4S)	10mm Rebar	200	-		800	Ultima is 4.0 higher than iron
	20	Finisher (4S)	10mm Rebar	200	-		800	Ultima is 4.0 higher than iron
Mill E	A3	Finisher	1 ¼ x ¼" and 1 ¼ x 3/16" (Angles K2A)			1300	650	Utlima is 50% of T.Carbide

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THANK YOU

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