

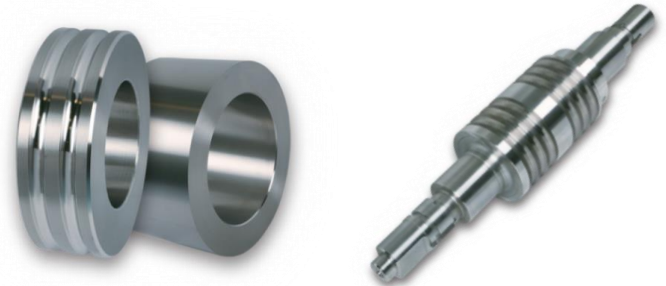
New Technology in Carbide Roll

Rolls for Intermediate mill



TaeguTec
The Design Team

- ✓ **Introduce TaeguTec**
 - History, Berkshire Hathaway, TaeguTec products
- ✓ **Carbide Rolls**
 - Roll requirements, TaeguTec Roll products
- ✓ **Composite Roll Structure**
 - Hydraulic clamping system
- ✓ **Rolls for Intermediate mill**
 - Design components
- ✓ **Case study of FEA**
 - Rolling torque prediction, Slip problem
- ✓ **Roll applications**
 - Cantilever Roll



Introduce TaeguTec



HISTORY



● **1916. 04**
Tungsten ore discovered
Sangdong Mine establish

● **1952. 09**
Korea Tungsten Company
exports amount to US\$16
of South Korean GNP



1960's

● **1968. 02**
Korea Tungsten and the Korean

The New York Times

Berkshire Hathaway to Acquire the Rest of IMC for \$2 Billion

BY MICHAEL J. DE LA MERCED MAY 1, 2013 8:44 AM 1



Kim Kyung-Hoon/Reuters Warren Buffett, left, with Eitan Wertheimer, the chairman of IMC, in 2011.

Berkshire Hathaway has agreed to buy the 20 percent of the IMC International Metalworking Companies that it does not already own for \$2.05 billion, giving it full control of the company.

Tool holder plant starts operation (Daegu)

Ceramic plant starts operation (Daegu)

2000. 03

Established TaeguTec India and opened the TaeguTec cutting tools factory in India

PRE
API
For

new R&D Center

new TechCenter and
actory

00. 12 - 2010. 11

established TaeguTec China,
TeguTec Brazil, TaeguTec Italy,
TeguTec Japan, TaeguTec Australia,
TeguTec Turkey, TaeguTec Slovakia,
TeguTec Thailand, TaeguTec Malaysia,
TeguTec Spain, TaeguTec Indonesia,
TeguTec Poland, TaeguTec Romania,
TeguTec Russia, TaeguTec Ukraine, Tae-
Tec South Africa, TaeguTec Czech Rep.,
TeguTec Hungary, TaeguTec Argentina

, chaired by Warren
in 80 percent stake in

port Tow
vermen

● **2013. 05**
Berkshire Hathaway acquired the
remaining 20 percent of the IMC Group to
become sole owner



2010's

● **2010. 10**
TaeguTec granted the Company-Specific
Approved Exporter

● **2012. 04**
TaeguTec Plant 2 Inauguration

● **2012. 05**
TaeguTec awarded Authorized Economic
Operator "A" level certification

● **2012. 12**
TaeguTec awarded the "\$300 million

Established TaeguTec Taiwan

● **2015. 05**
TaeguTec upgraded to Authorized
Economic Operator "AA" level certification

Introduce TaeguTec



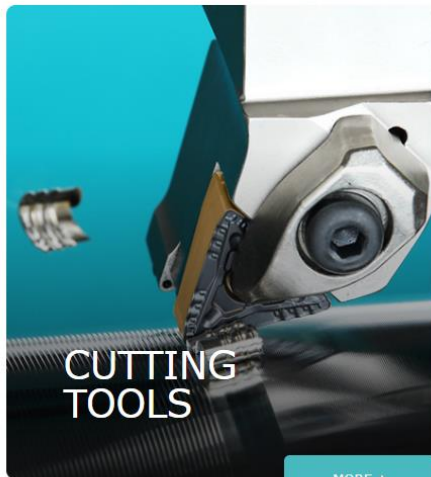
Cutting Tools

Industry



Products

- Gradi
- Comp
- Torqu
- Canti
- Secti
- Block
- Tri Rc
- Tubin
- Quad



CUTTING TOOLS

MORE +



INDUSTRIAL PRODUCTS

MORE +



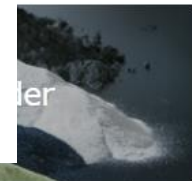
TUNGSTEN POWDER

MORE +

ADVANCE CUTTING
TaeguTec



ler



ler

Features by Product



Thread Making

- Thread Making Line
- T-THREAD (Thread Turning)
- TS-THREAD (Thread Milling)
- T-TAP (Tapping)



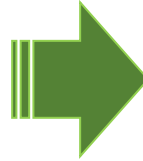
Tooling System

- Tooling System Line
- Chuck & Holder
- Face Mill Arbor
- High RPM Spindle

Roll Requirements

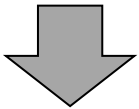


- Resistance of wear
- Strength
- Surface finish
- Rigidity



- Cast Iron Rolls
- Adamite Rolls
- Ductile Iron Rolls
- High Speed Steel Rolls
- Tungsten Carbide Rolls

*Tungsten
Carbide*



- Highest Melting Point (6,170 °F)
- Superior Heat-resisting property
- High Hardness (HrA 72 ~ 90) & Strength
- Good Wear Resistance
- High Compressive Strength (768 ~ 1,000 ksi)

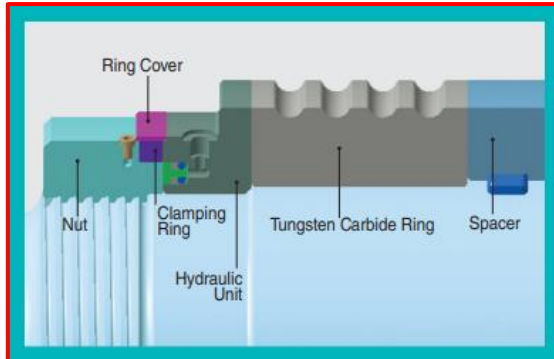
- *Brittle & Low Tensile Strength*

Used in the Steel Industry which requires properties in High Temperature and Pressure !!

Tungsten Carbide Rings

Tungsten carbide rings are mainly used in Prefishing mill, No twist mill, Reducing sizing mill, Reducing sizing block, Tube ring, Pinch ring and Guide ring.

Solid Ring



Tungsten Carbide Rolls

Tungsten carbide rolls are mainly used in Rounding mill, Intermediate mill and Finishing mill.

Composite Roll

- ▶ Hydraulic clamping Roll
- ▶ Hydraulic and Mechanical clamping Roll
- ▶ Mechanical clamping Roll

Cantilever Roll

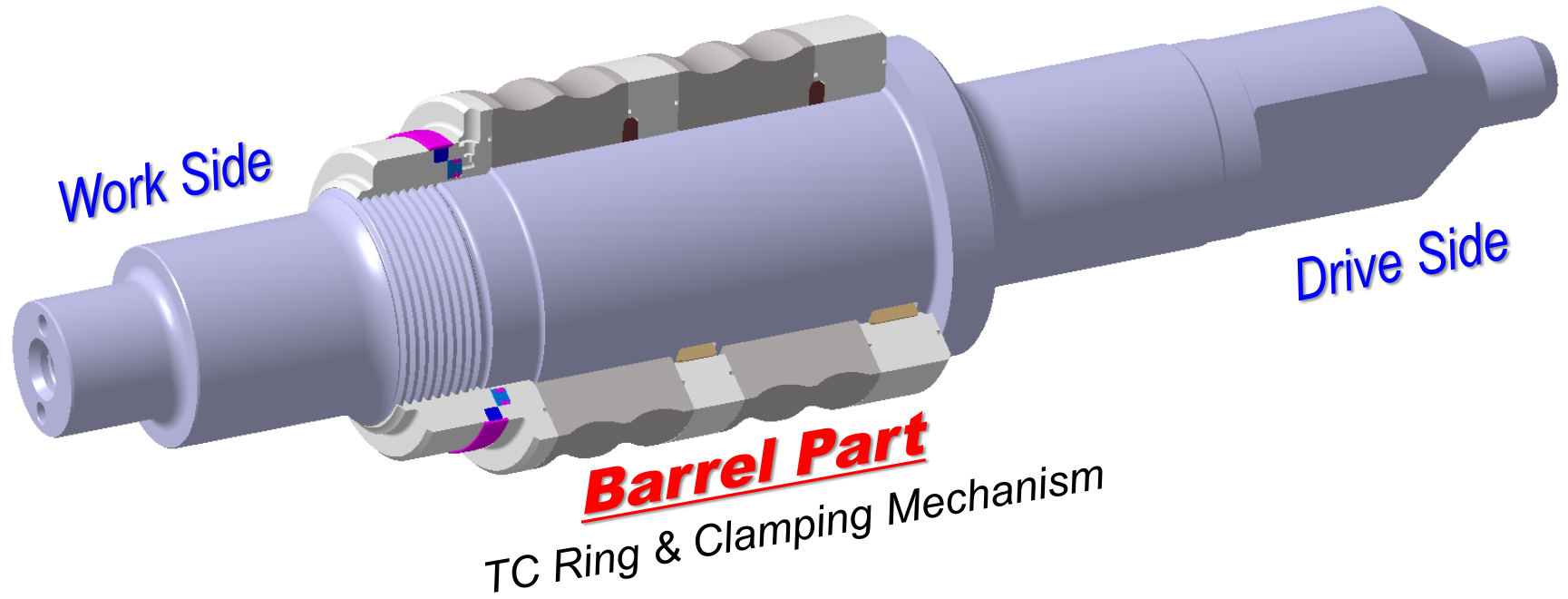
- ▶ Mechanical Roll
- ▶ Shrinkage fitting Roll

3-Roll

- ▶ Mechanical Roll
- ▶ Shrinkage fitting Roll



Composite Roll



Composite Roll



CompositeRoll

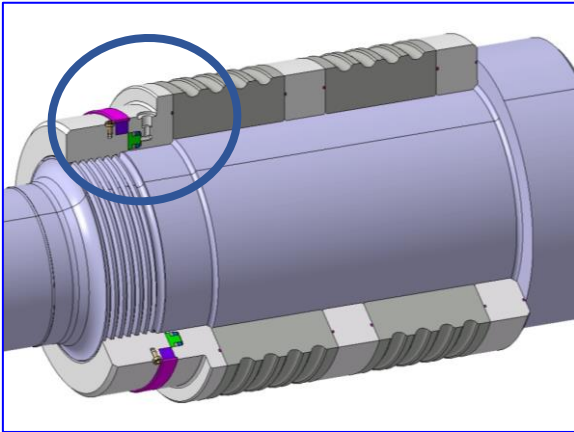


Type of Composite Roll

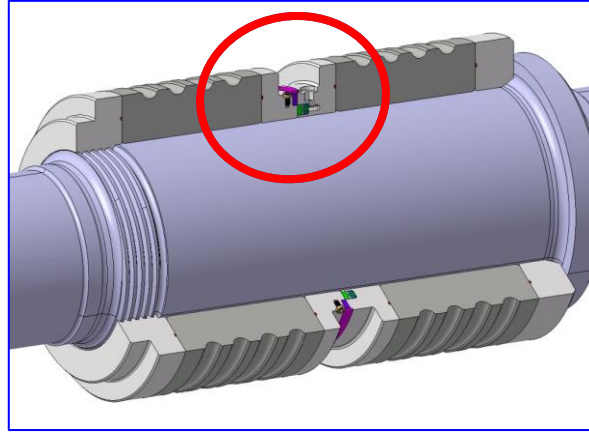
Barrel part will be designed by Customer's request

- Strand pitch, T.C ring width, Number of grooves etc.

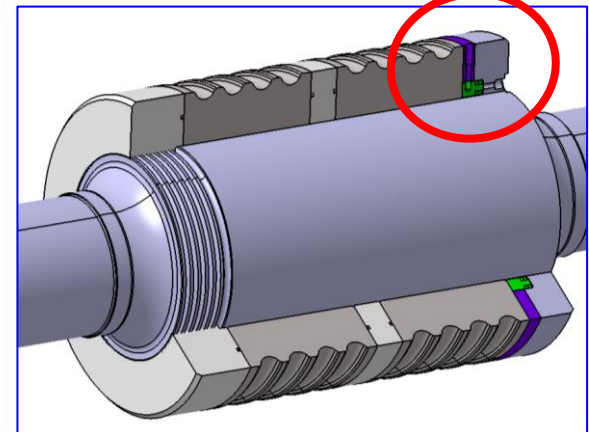
Normal Type



Center Type



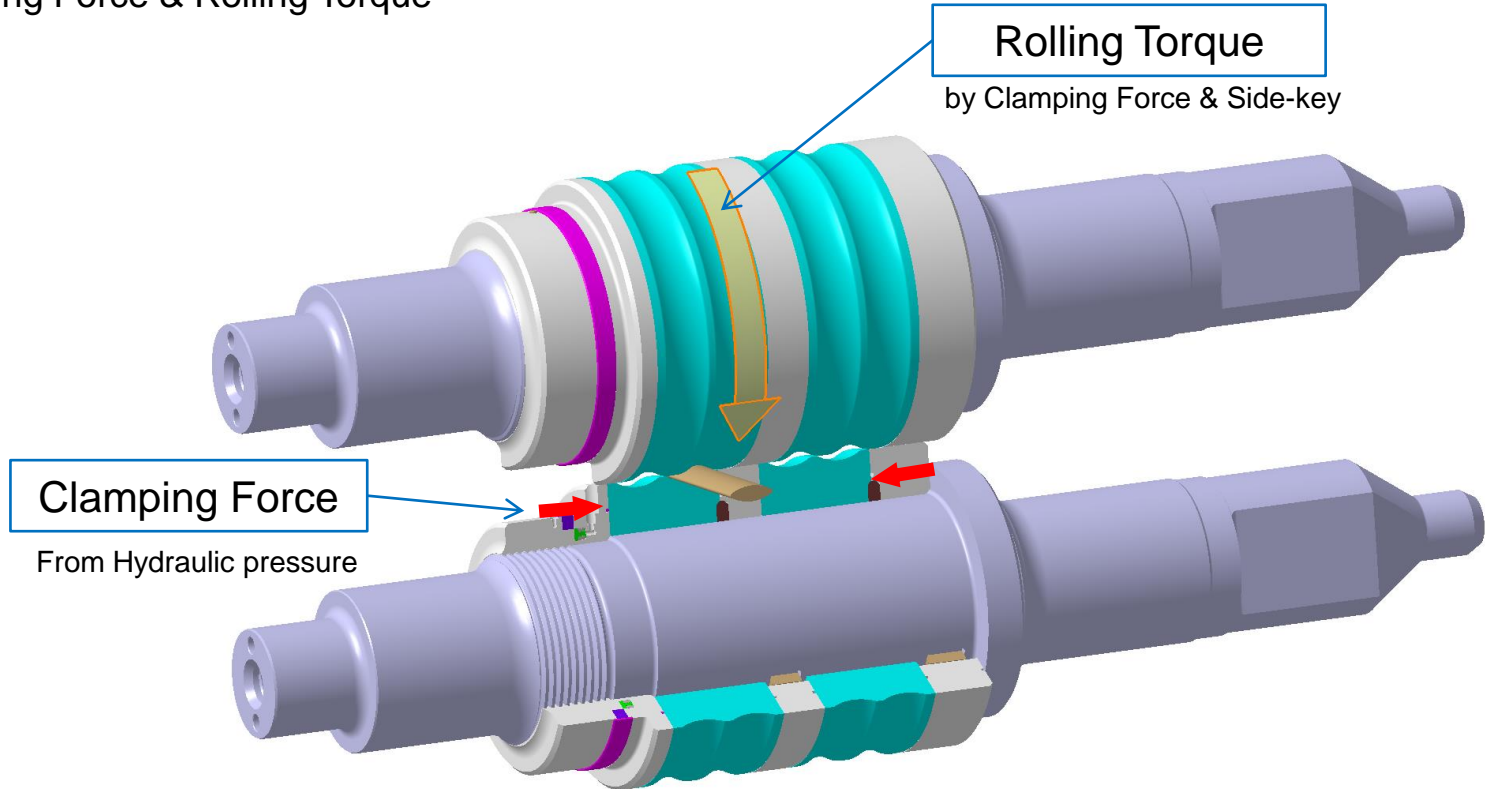
Shaft Type



Rolling torque, Clamping force

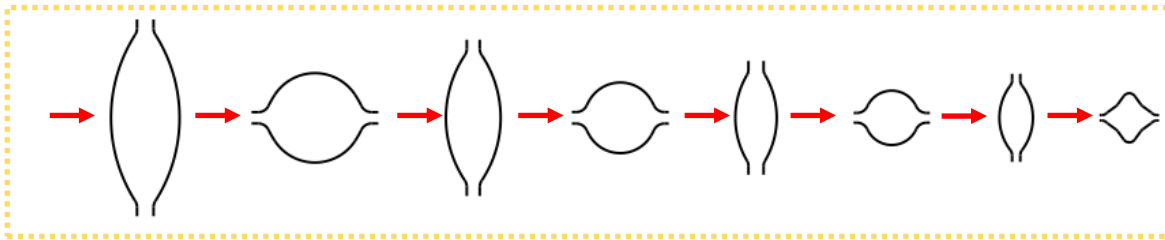
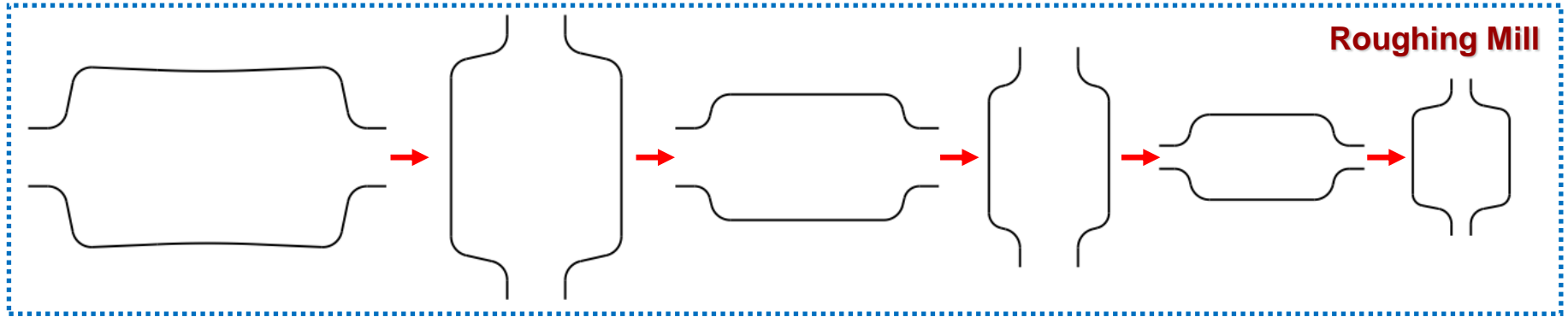
Important factors to consider when designing slip-free assembly rolls

- Clamping Force & Rolling Torque



Rolls for Intermediate Mill

Ex) Roll pass : Reinforcing bar Mill

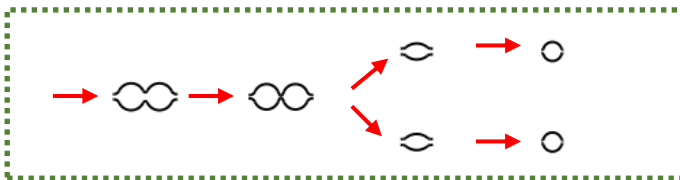


Intermediate Mill

Rolling torque: 10,000 ~ 60,000 *lbf.ft*

Rolling speed : 2.5 ~ 13 *ft/sec*

Maximum Roll Diameter : $\varnothing 20.85$ in



Finishing Mill

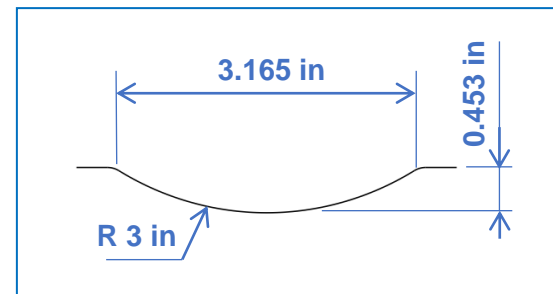
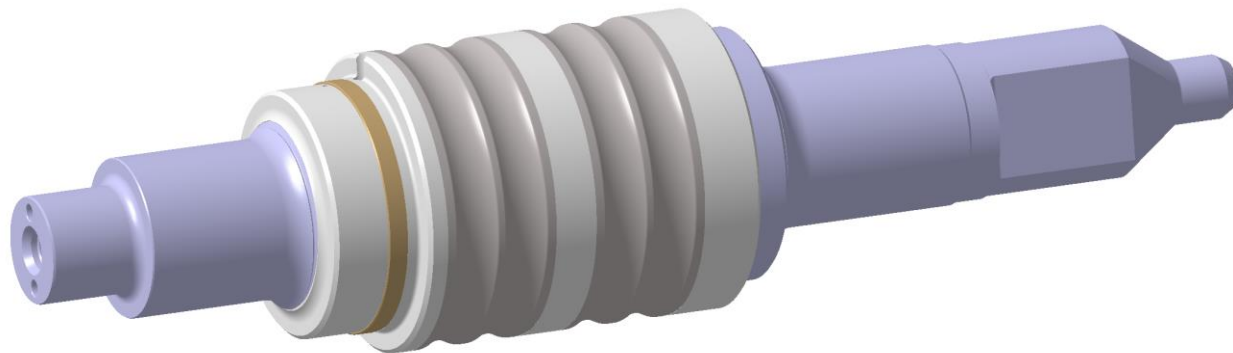
Rolling torque $\leq 10,000$ *lbf.ft*

Rolling speed : 10 ~ 100 *ft/sec*

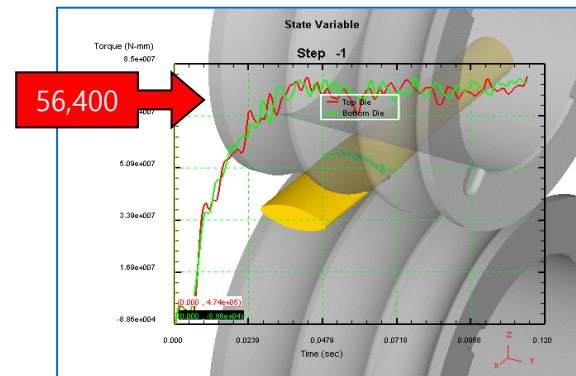
High-Torque Composite Roll



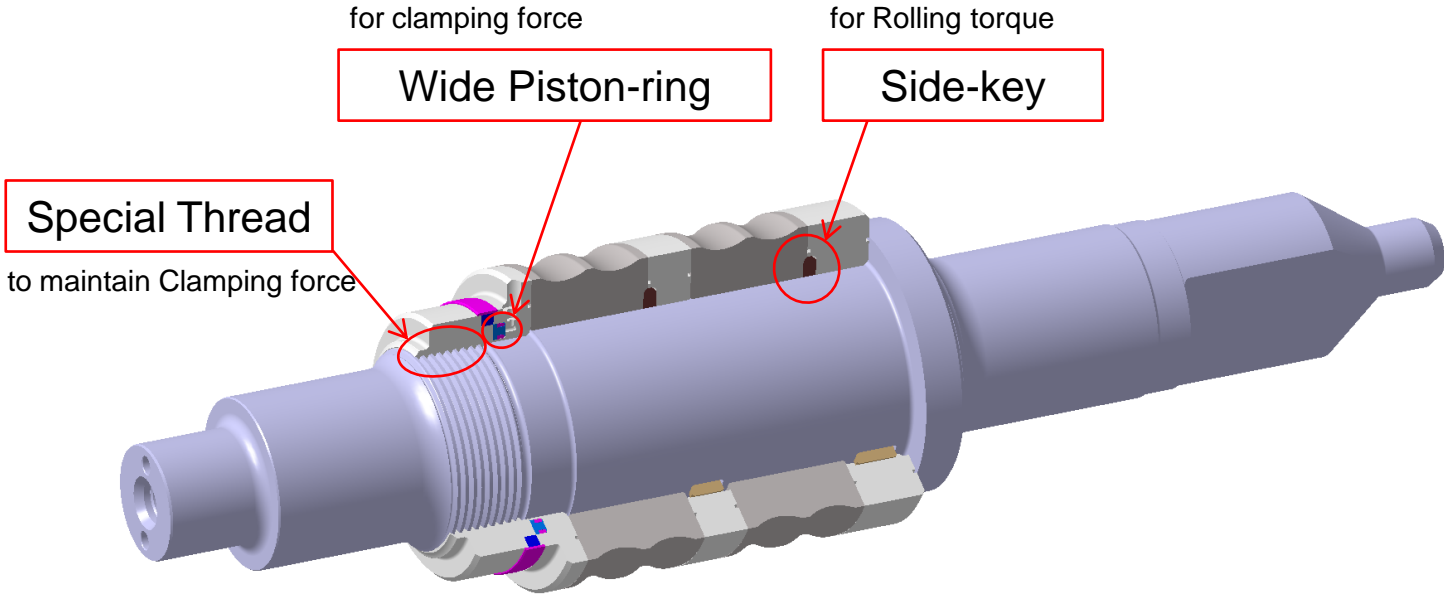
TorqueRoll[®] for Intermediate mill
Applicable Torque : 10,000 ~ 60,000 lbf.ft



- Rolling Torque : about **56,400 lbf.ft**
- Rolling Speed : 8.2 ft/sec



Design Components



Wide Piston-ring

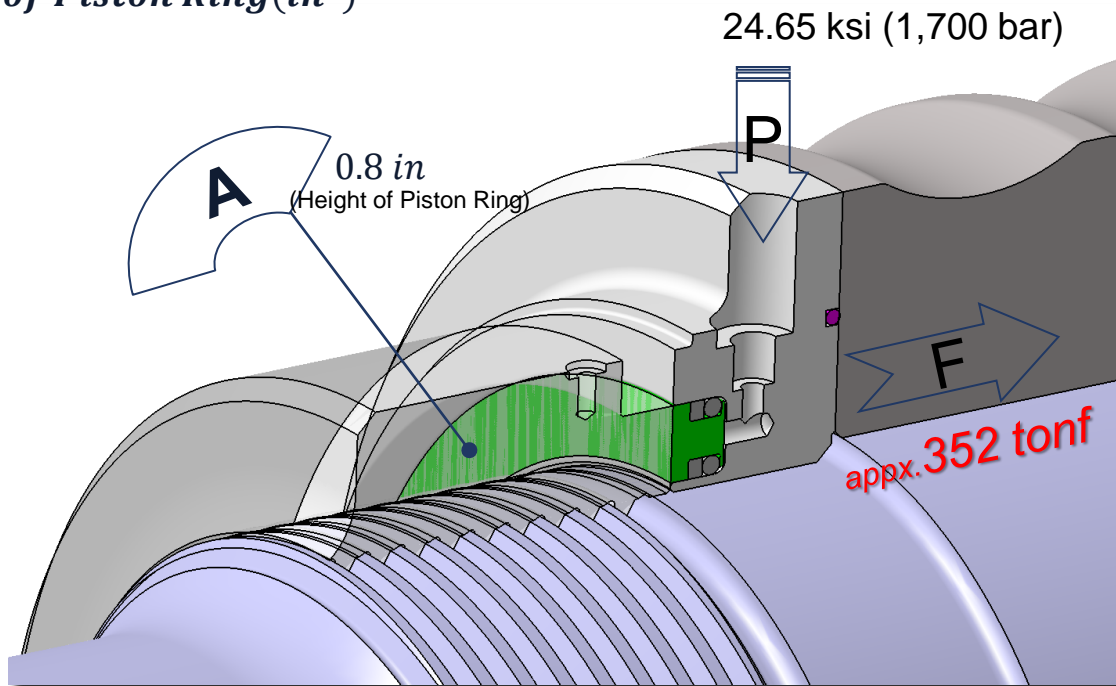
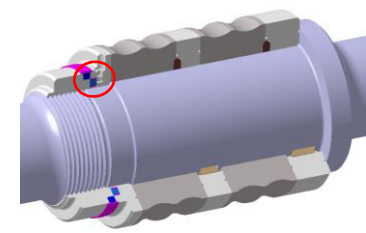


$$F = P \times A$$

F ; Clamping Force (tonf)

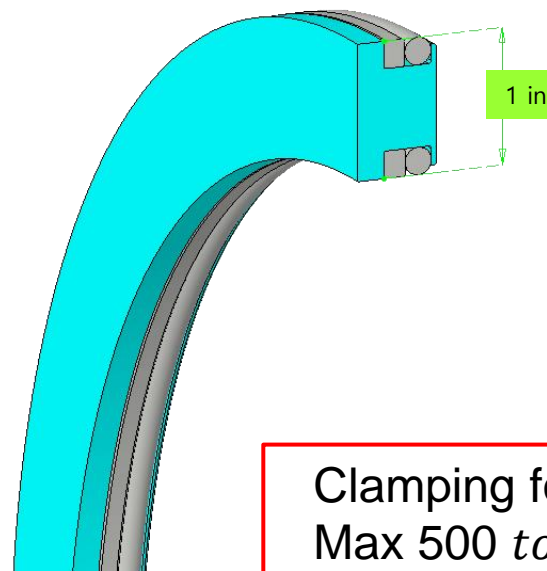
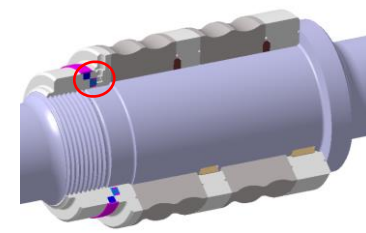
P ; Hydraulic Pressure through the HD Unit(ksi)

A ; Area of Piston Ring(in^2)



Wide Piston-ring

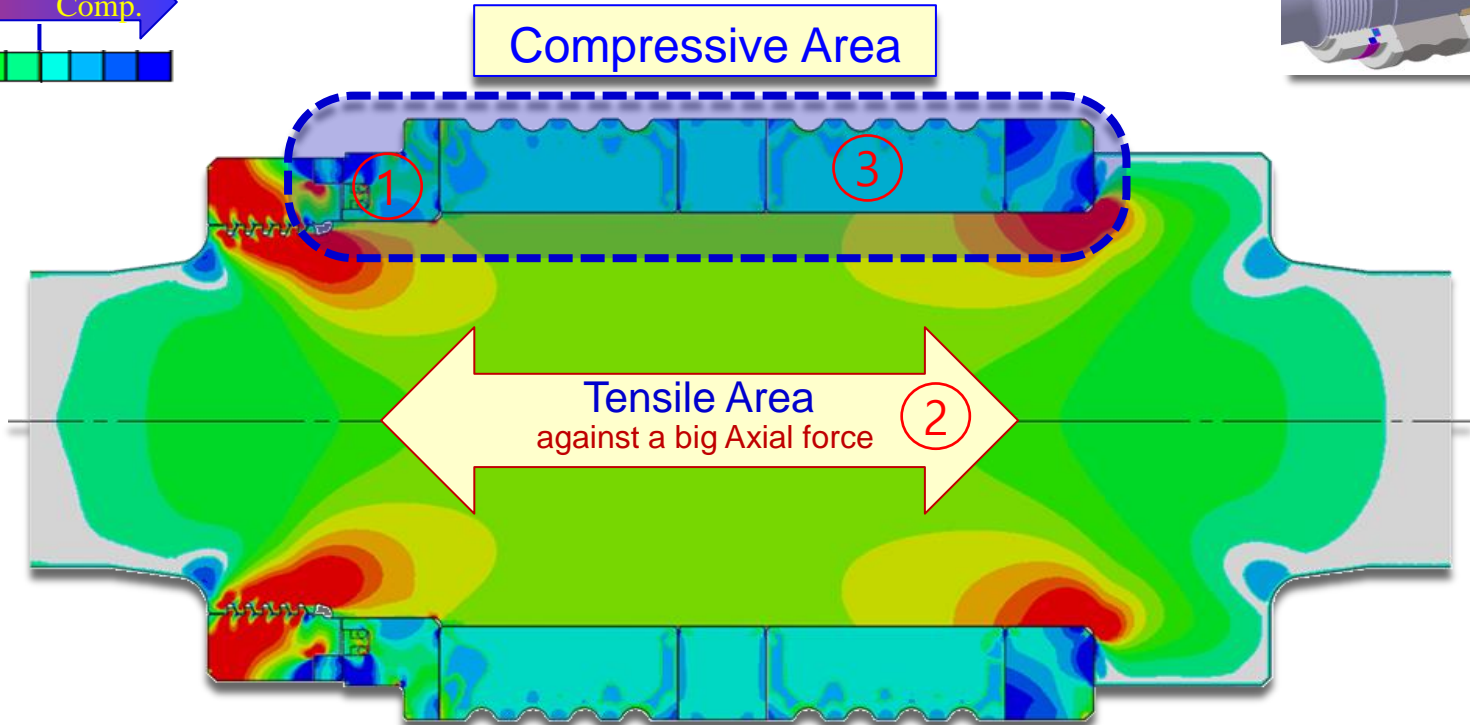
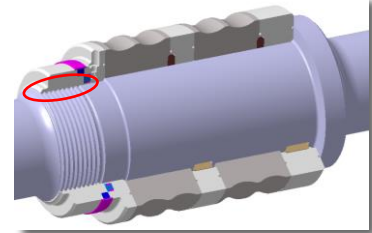
- High Hydraulic Pressure ; Max **27.56** ksi (1,900 bar)
- Wide Piston-ring ; Max **1** in



Special Thread

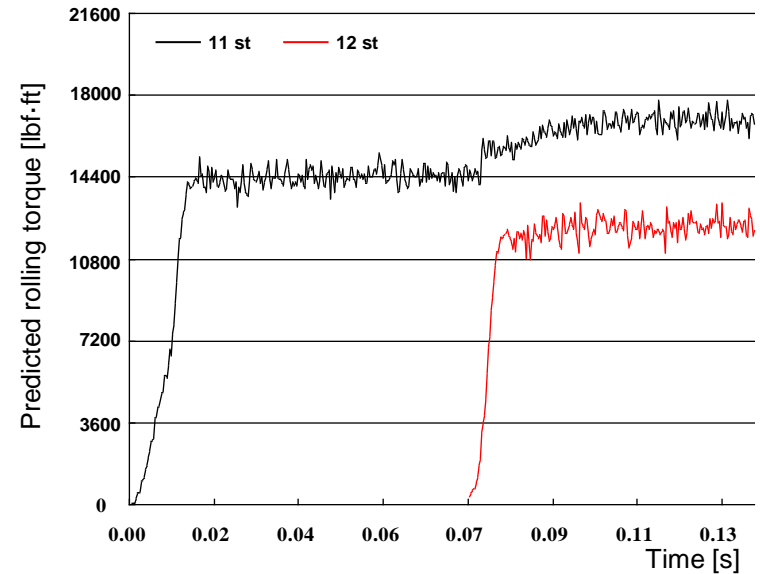
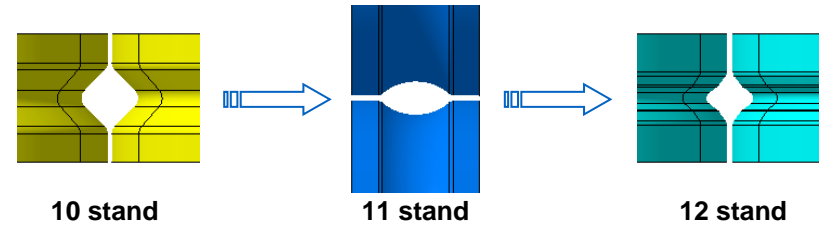
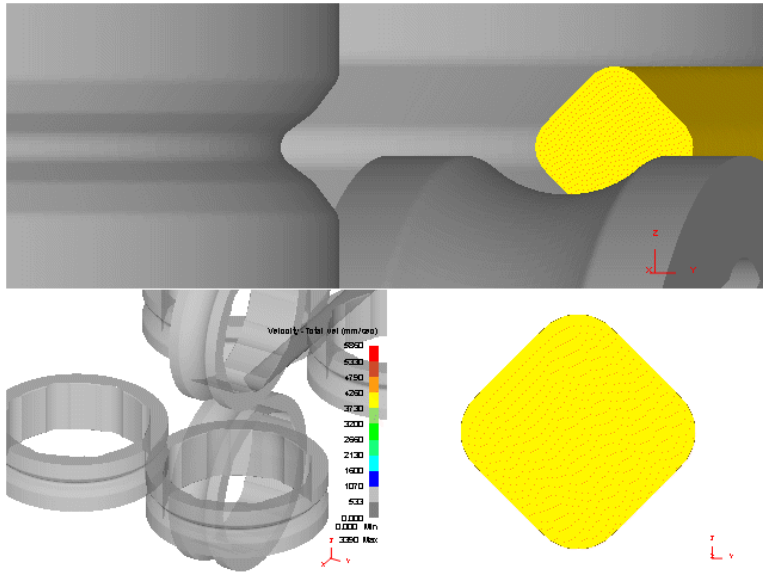


Stress diagram after assembled by Side clamping



Case study – FEA

Rolling Torque Analysis



Case study – FEA



Rolling Torque Analysis – Torque reversal phenomenon



8 Stand

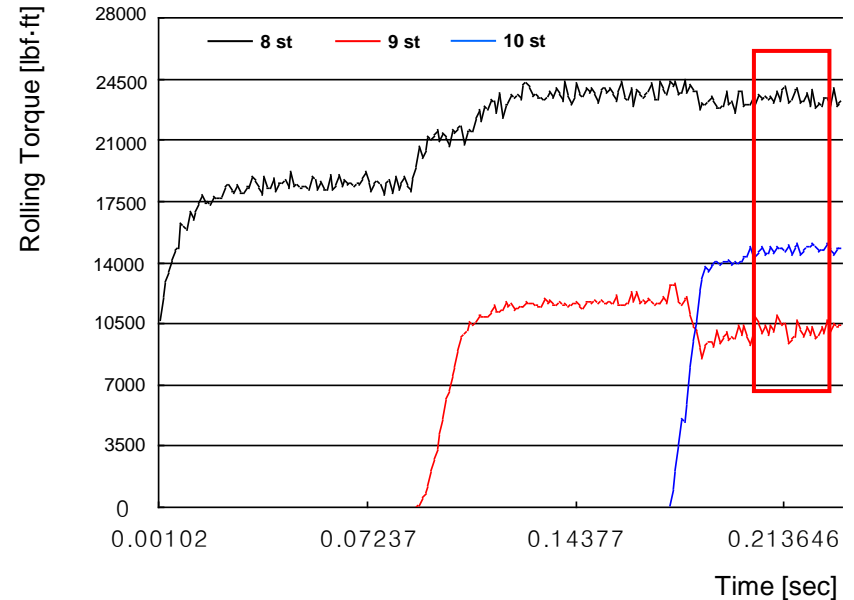
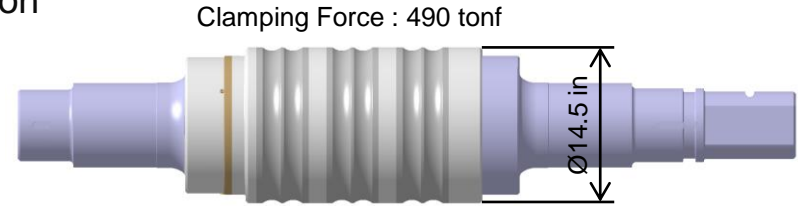
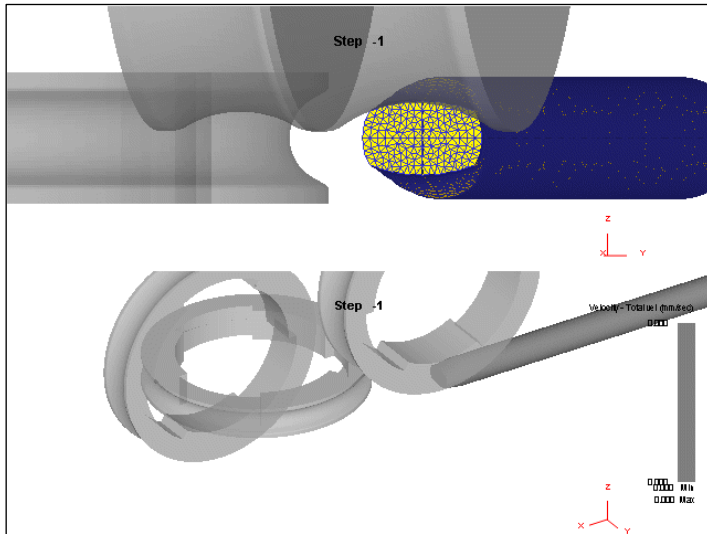
9 Stand

10 Stand

6.43 ft/sec

8.43 ft/sec

11.48 ft/sec



Case study – FEA



Rolling Torque Analysis – Torque reversal phenomenon



8 Stand

9 Stand

10 Stand

6.43 ft/sec

8.43 ft/sec

11.48 ft/sec



8 Stand

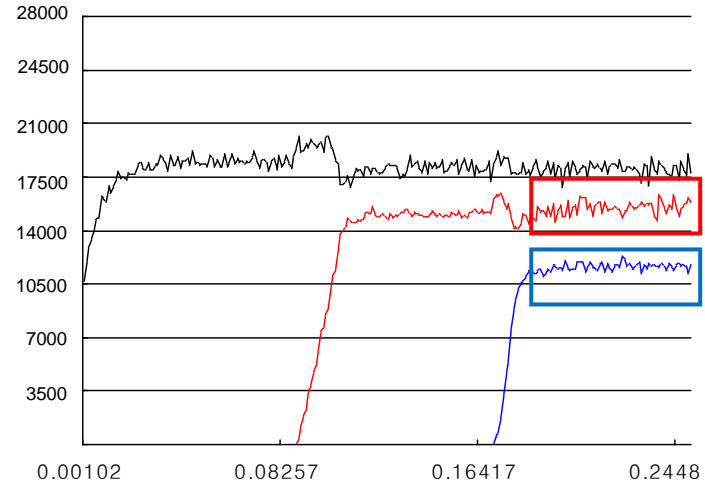
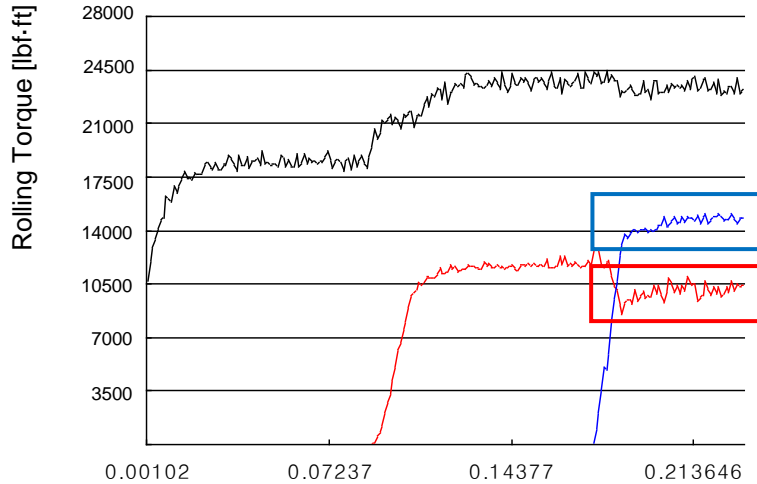
9 Stand

10 Stand

6.43 ft/sec

9.18 ft/sec

11.48 ft/sec



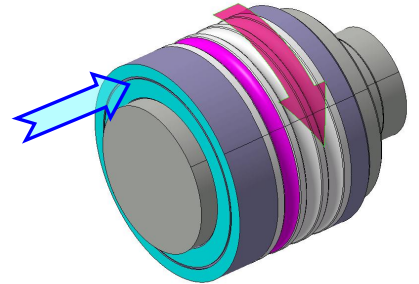
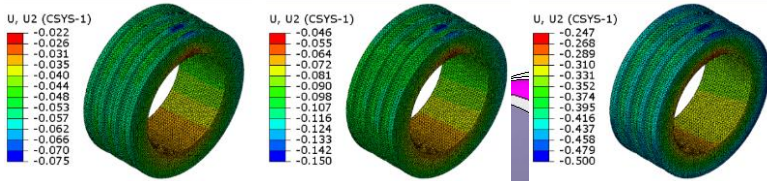
Case study – FEA



Rolling Torque Analysis – Slip problems

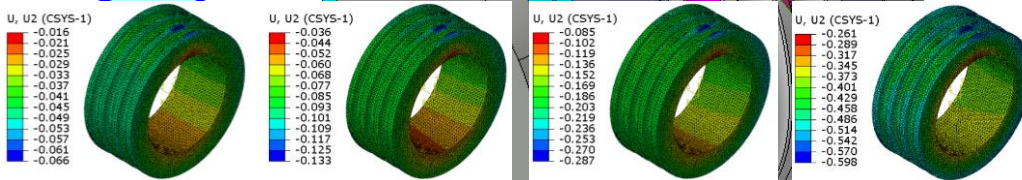
CF=220 tonf

Torque = 10,850 lbf.ft Torque = 21,700 lbf.ft Torque = 32,550 lbf.ft



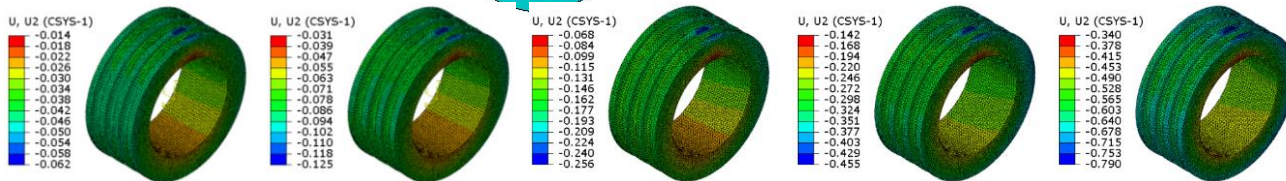
CF=350 tonf

Torque = 10,850 lbf.ft Torque = 21,700 lbf.ft Torque = 43,400 lbf.ft Torque = 52,000 lbf.ft



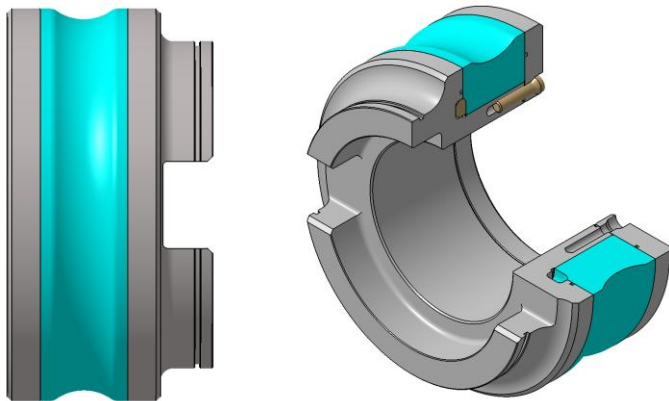
CF=475 tonf

Torque = 10,850 lbf.ft Torque = 21,700 lbf.ft Torque = 43,400 lbf.ft Torque = 65,100 lbf.ft Torque = 72,300 lbf.ft



Roll applications

Cantilever Roll – Screw clamping + Side-Key



Rolling torque : 36,000 *lbf.ft*

Roll Diameter : \varnothing 17.7 in

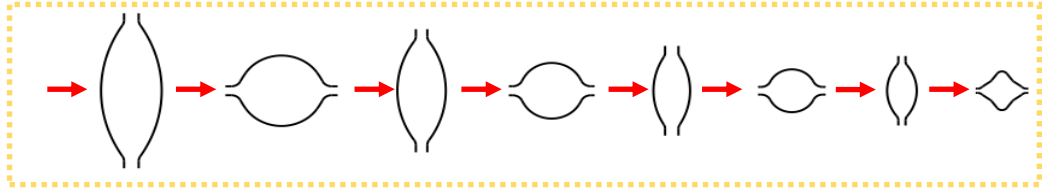


1. What is Intermediate mills?

Rolling torque: 10,000 ~ 60,000 lbf.ft

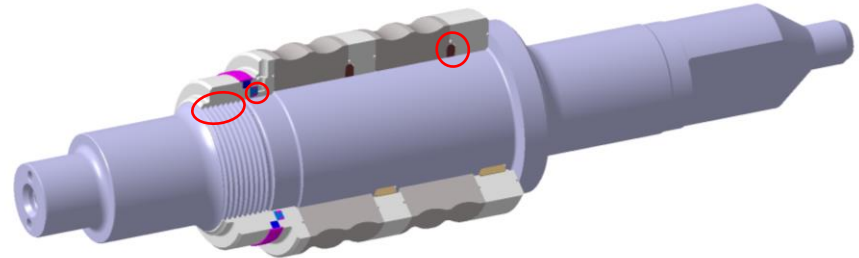
Rolling speed : 2.5 ~ 13 ft/sec

Maximum Roll Diameter : Ø20.85 in



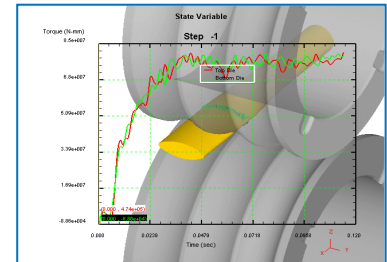
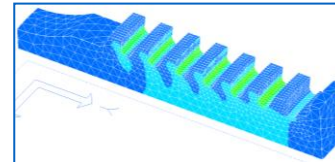
2. What is Rolls for Intermediate mill?

- 1) Wide Piston-ring
- 2) Special Thread
- 3) Side-Keys



3. How can Rolls for Intermediate mill be designed?

- 1) Rolling torque analysis
- 2) Structural analysis





Thank you