



Flaig + Hommel

MILL LINER SEALING SOLUTION

FS[®] KOMBO SAFETY WASHERS



Safe Easy and Reliable Fastening System

IN COOPERATION WITH



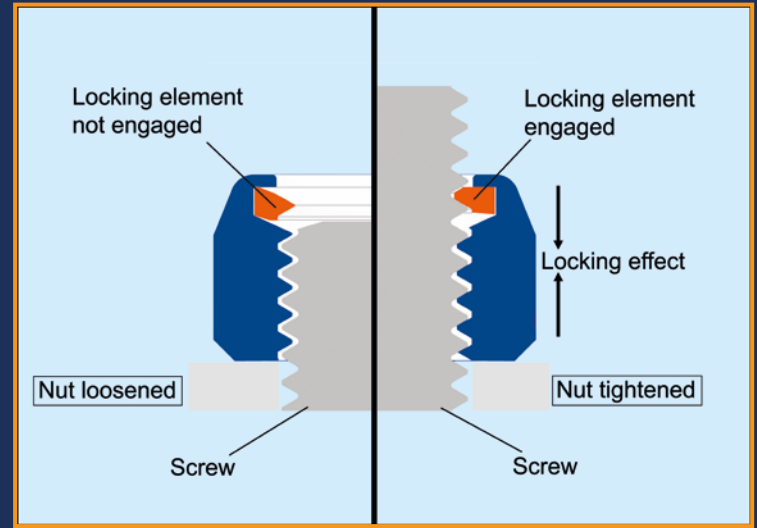
INTRODUCING THE “KOMBO WASHER”

-The New Reusable Mill Liner Locknut Sealing Solution-

Combines - Superior Seal, High Strength Washer and Security of the FS® All-Steel Lock-Nut in a safe compact elegant one piece assembly



FS® All-Steel Lock-Nut



The FS® All-Steel Lock-Nut offers double-safety the locking element works in the **radial and the axial direction** – and produces an even clamping action of the nut from preload to the full range (360°) of the bolt's threads.

BASIC ADVANTAGES

- High Cost Savings
- Only One component to handle
- Reduces Mill Downtime
- Seals bolt and hole completely
- Stays tight for the Life of the liner
- Available in a wide range of sizes



Reusable! -

Like new, even when used the 15th time



Vibration-resistant! -

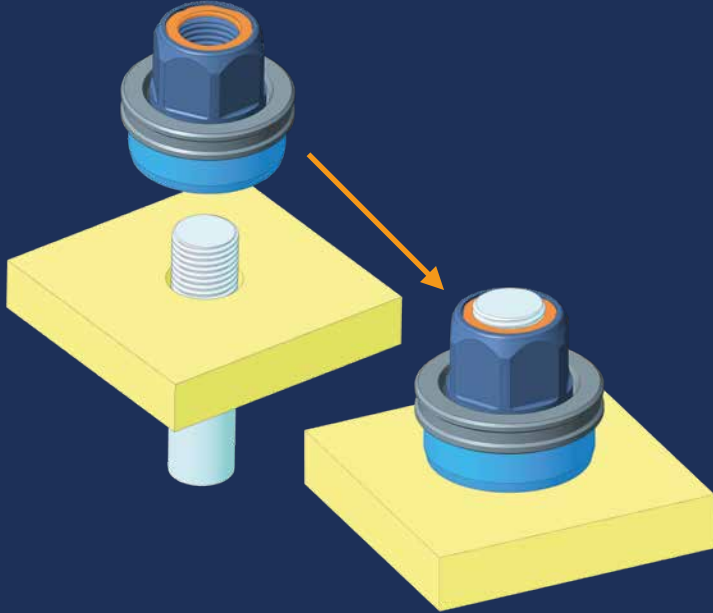
Sturdy, even in extreme cases



THE NEW LOCKNUT MILL LINER SEALING SOLUTION

INSTALLATION AND REMOVAL

KOMBO WASHER Assembly



- Simple one piece assembly is easy to handle
- Fast on and off – Seal won't stick to mill surface
- Install and removal time only 6 seconds each and every time
- This can reduced liner change over time by several hours

Conventional Cup Washer

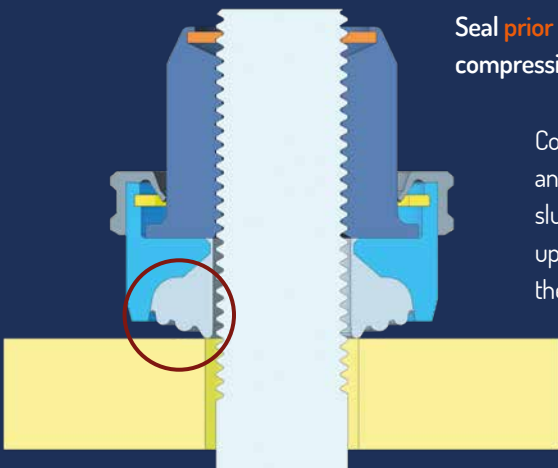


- Installation requires handling 3 parts
- Typically takes 15 to 20 seconds to remove
- Some take up to 6 minutes each to remove and dig off leftover rubber

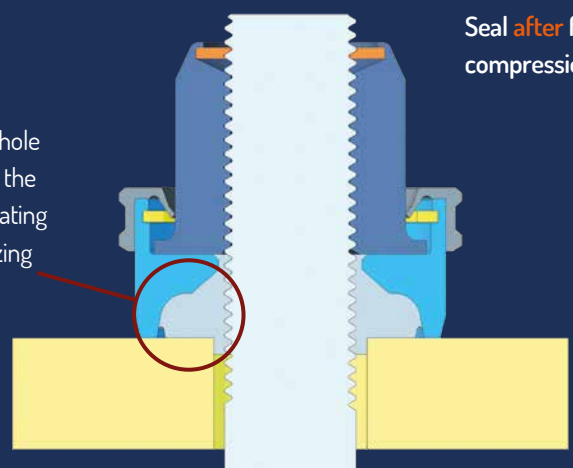


THE ULTIMATE SEAL SOLUTION

Seal **prior** to full compression



Seal **after** full compression



Completely seals bolt hole and thread to prevent the slurry fines from migrating up the thread and seizing the nut to the bolt



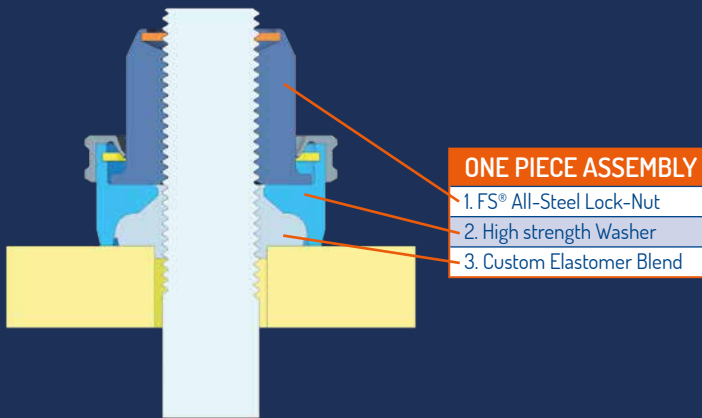
Tight hold prevents hole damage like this



The KOMBO Washer still seals these damaged holes



COMPETITIVE COMPARISON



- Faster Installation & Removal
- Seals Completely
- Holds Tight - Won't back off
- Reuse for 5-10 relines before Refurbishment

KOMBO WASHER (Single Component)

-Faster Installation & Removal-

A simple one piece assembly is easier to handle, to install and remove. The same time it takes to install a Kombo washer, approx. 6 seconds, is the same time to remove. The time saved on the removal stage adds up to several man hours over the reline shut. The ease of removal is due in part to the not stick properties of the elastomer and the thread acting as a jacking bolt pulling the Kombo washer away from the surface of the mill.

-Seals Completely-

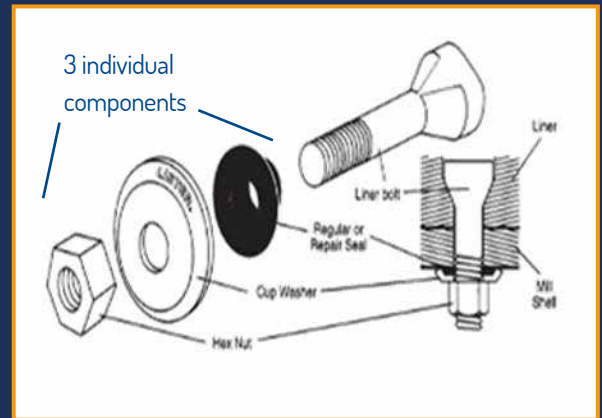
The Patented design of the seal body and seal elastomer has the ability to seal both the surface of the mill and the thread of the bolt. The designed profile of the seal surface is such that it will seal flogged out holes and far from perfect mill surfaces.

-Holds Tight - Won't back off-

Using the FS® All-Steel Lock-Nut technology in the collated nut ensures that "the nut will not move", once it has been torqued up to the desired specification. This will guarantee the clamp pressure remains the same for the entire operational life cycle of the liner without the effects of yield creep.

-Reuse for 5-10 relines before Refurbishment-

The innovation of the design enables each of its integral parts to be refurbished separately and reassembled ready for service once again. The collated FS® All-Steel Lock-Nut has been designed robustly so it can be used up to 15 TIMES. The patented seal profile and elastomer blend has rebound memory properties so it can be used over and over. Can receive „Green“ credit



- Slower Installation & Removal
- Leaks Frequently
- Loosens during operation
- One Off use Only

CONVENTIONAL CUP WASHER (Three Individual components)

-Slower Installation & Removal-

[Installation]

The common Rubber Gasket, Cup Washer, and Nyloc nut all consume time when being assembled individually on to the protruding bolt (approx. 12 sec)

[Removal]

Typically takes 30 - 32 seconds to remove the assembly. However, that's if every thing goes to plan. More often than not, the rubber will stick to the surface of the mill. Some take up to 6 minutes each to remove and dig off leftover rubber.

-Leaks Frequently-

Due to the straight forward design of the rubber gasket it can only seal on the two interfering surfaces and can not fully seal around bolt threads. The design is limited in what it seals when it comes to flogged out holes and irregular surface conditions, as well as skew-whiff bolts.

These conditions result in leaks of very fine slurry and will migrate up the thread causing the nut & bolt to seize together resulting in the nut being cut off.

-Loosens during operation-

Standard commodity locknuts loosens during operation and rely heavily on the elastomer (nylon) to maintain a prevailing torque on the bolt.

The loosening of the nut increases the potential for premature failure of the clamp pressure which intern may result in failure of the bolted joint.

-One Off use Only-

The pressed steel cup washer deforms under full tightening load. The seal degrades and sticks to the mill surface. The Nyloc nuts are a one off use only. The nylon distorts to the form of the thread and compression set and heat degrades the nylon. Discarded after one use.

A STRONG CONNECTION FOR SURE!

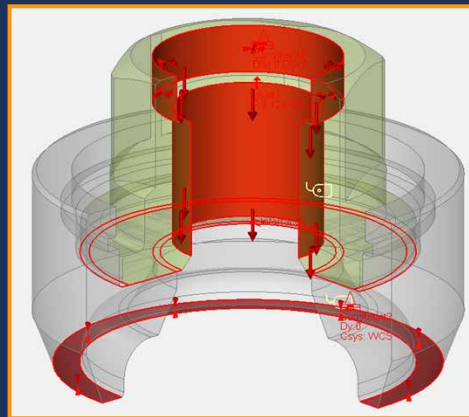
KOMBO WASHER PRODUCT STRENGTH – M36 EXAMPLE

Assembly takes full clamp load without deforming

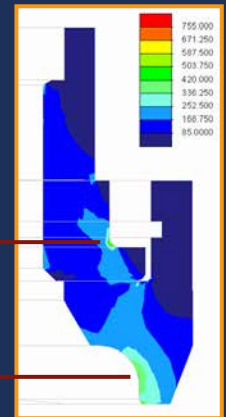
M36 at full installation torque of 2200 Nm will provide 343,000 N clamp force.
This holds the liner plates tightly in place.

FEA (Finite Element Analysis) constraints

Load 343 000 N



FEA Results



550 Mpa max

420 Mpa max

Bottom face of the NUT is fixed
in Z-direction and free in XY

Material Properties:

- Tensile strength, Ultimate 772 Mpa
- Tensile strength, Yield 580 Mpa
- Modulus of elasticity 205 Gpa
- Poisson's ratio 0.29

STANDARD PRODUCT WEAKNESS – M36 EXAMPLE

Washer fails at 50% load

The washer bends beyond the yield point of the material at less than 50% of the design required load value of 343,000 N.

At full required load the washer collapses and permanently deforms.

Resulting bend creep results in loss of load tension on the bolt and loose wear plates.

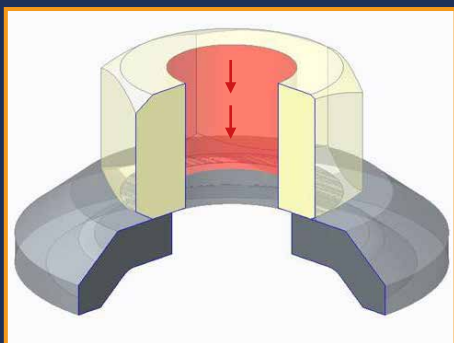
Material Properties:

- Tensile strength, Ultimate 440 Mpa
- Tensile strength, Yield 370 Mpa
- Modulus of elasticity 200 Gpa
- Poisson's ratio 0.29

Standard Product # 1 Analysis

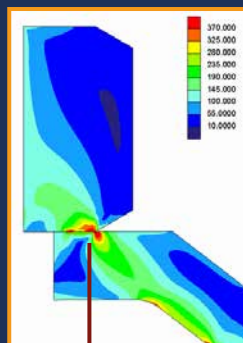
FEA (Finite Element Analysis) constraints

Load 150 000 N



Bottom face of the NUT is fixed
in Z-direction and free in XY

FEA Results

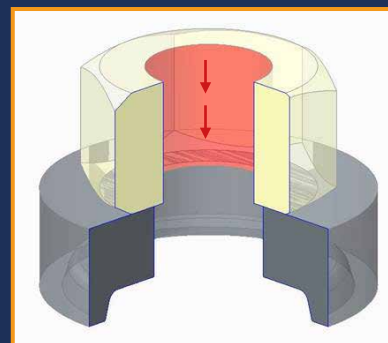


370 Mpa

Standard Product # 2 Analysis

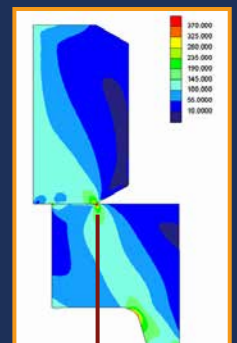
FEA (Finite Element Analysis) constraints

Load 160 000 N



Bottom face of the NUT is fixed
in Z-direction and free in XY

FEA Results



370 Mpa

TECHNICAL DATA

Property class according to DIN EN ISO 898-2:
04, 05, 8, 10, 12

Mechanical properties:

DIN EN ISO 2320 (DIN EN 20898-2/
DIN EN ISO 898-2)

Stainless steels:

A2-035, A2-040, A2-70, A2-80,
A4-035, A4-040, A4-70, A4-80

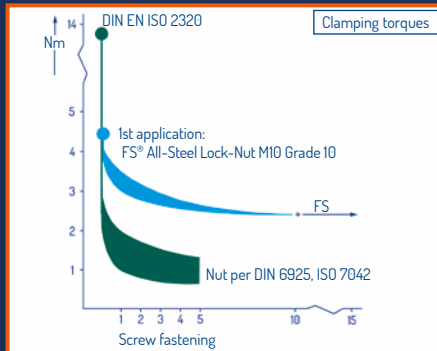
Surface coatings:

Galvanic surfaces according to
DIN EN ISO 4042 (zinc-iron, zinc-nickel, etc.),
zinc flake coating according to DIN EN ISO
10683,

Threads:

Metric and Imperial: standard thread

All other dimensions, materials and surfaces,
per drawing, upon request.



Clamping torques [Nm]			
d	1. Screw fastening	1. Unscrewing	15. Unscrewing
	max.	min.	min.
M 24	56,0	11,5	8,0
M 36	95,0	21,0	16,0
M 48	130,0	40,0	25,0
M 52	160,0	50,0	30,0

After the 5th time of unscrewing the fastener, the clamping torque will remain constant.

Recommended tightening speed is 100-150 rpm for steel and galvanized steel,
a maximum of 30 rpm for stainless steel

Verification calculations are recommended for the locking torques! (VDI 2230-2015).

Further locking torques can be found in the separate FS-data sheet.

FS® All-Steel Lock-Nuts, made of austenitic steel can be bolted together without additional lubricants. The nuts are covered with a special surface coating, preventing them from pitting onto the bolts. This coating has been approved by the Deutsche Bahn AG (German railroad).



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