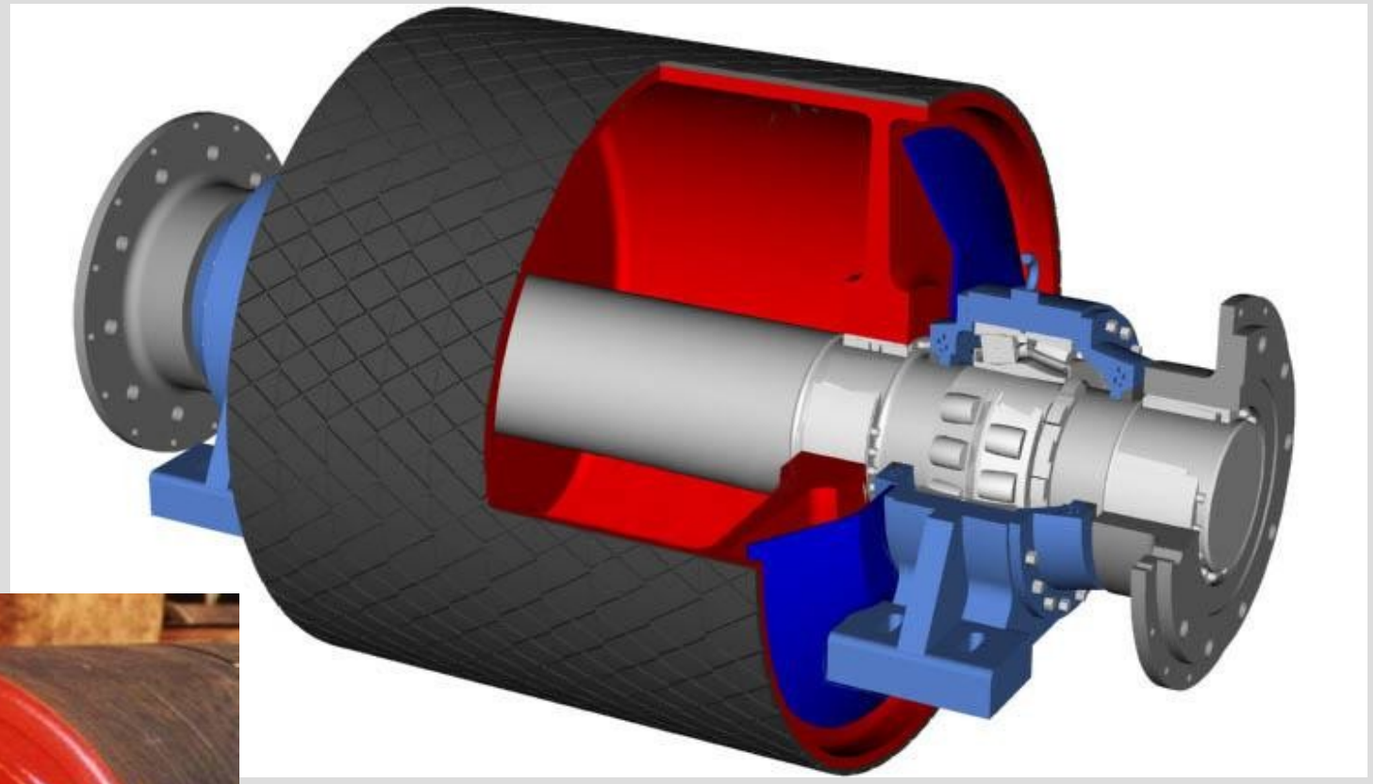
MAV Locking Assemblies in conveyor pulleys



MAV Locking Assemblies in conveyor pulleys

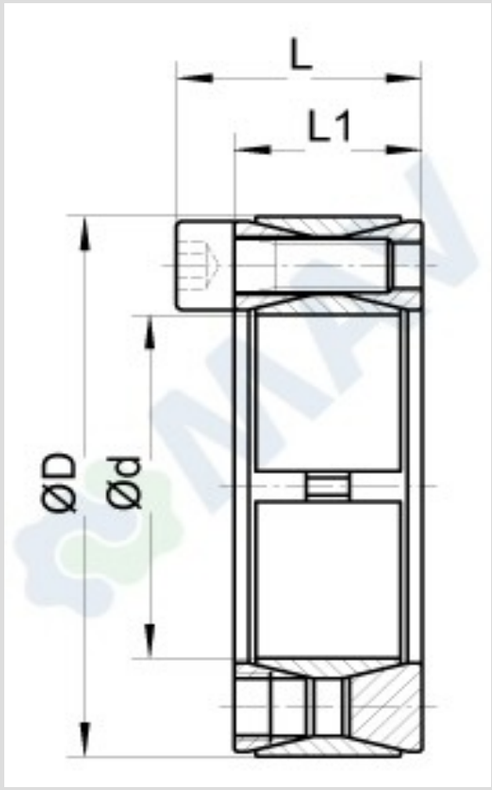
2. The most common Locking Assembly types

MAV 2005:

Positive features:
- Low volume
- Easy removal
- No axial movement during installation

Negative features:
- Self releasing, not self locking (due to steep taper angle)
- Not self centering, needs support of hub
- Very high number of tightening screws
- High contact pressure
- Screws are under permanent dynamic stress
- Fretting corrosion

Other characteristics:
- Bending moment compensation: 22% of Mt (with Ma=100%)
- Max shaft deflection: 1.5 min (0.00044 rad)
- Typ. shaft deflection: 0.7 to 0.8 min
- Stress concentration factor on shaft kn = 2.0 – 2.3
- Recommended shaft / hub bore tolerance: h7-h11 / H7-H11
- Recommended surface roughness Ra ≤ 3.2µm



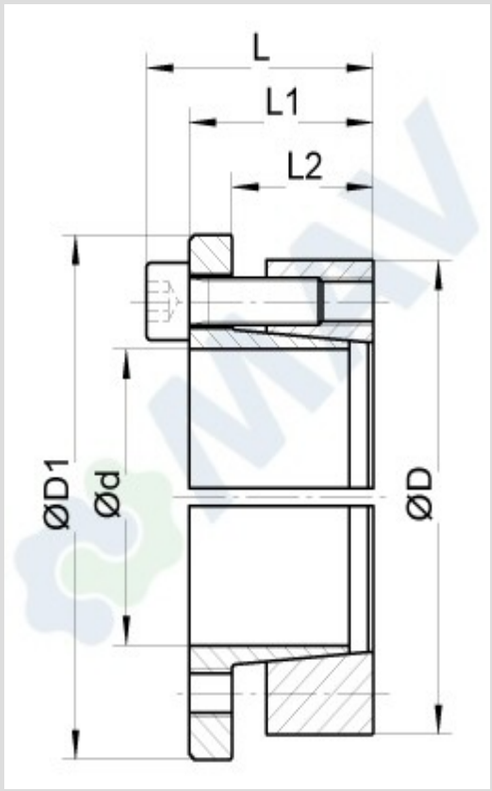
MAV Locking Assemblies in conveyor pulleys

MAV 1061:

Positive features:
- Self locking; screws are not under permanent dynamic stress
- Number of screws ca ½ of series 2005
- Reduced installation time
- Self centering; no hub support required
- Better bending compensation than 2005 series
- Medium-low contact pressure
- No fretting corrosion

Negative features:
- Removal only with push off screws possible

Other characteristics:
- Bending moment compensation: 35% of Mt (with Ma=100%)
- Max shaft deflection: 3 min (0.00087 rad)
- Typ. shaft deflection: 0.8 to 0.9 min
- Stress concentration factor on shaft kn = 2.0 – 3.7
- Recommended shaft / hub bore tolerance: h8 / H8
- Recommended surface roughness Ra ≤ 3.2µm



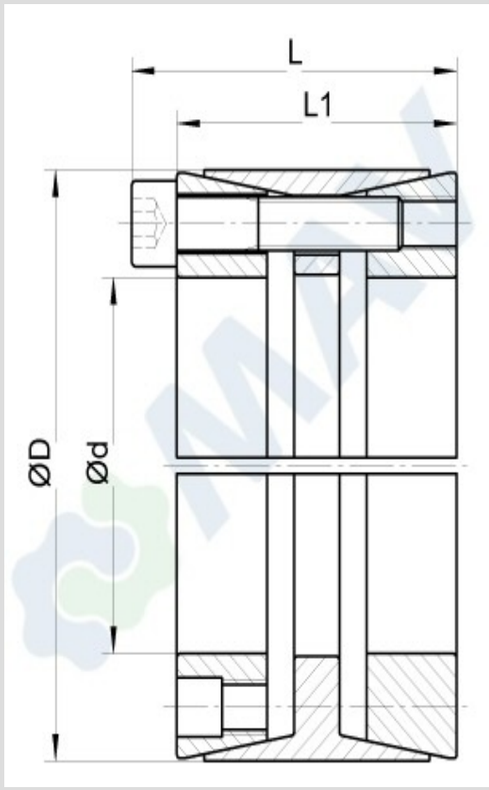
MAV Locking Assemblies in conveyor pulleys

MAV 1008:

Positive features:
- Self locking; screws are not under permanent dynamic stress
- Very high compensation of bending moment
- Self centering; no hub support required
- Medium contact pressure
- No fretting corrosion

Negative features:
- Axial movement possible during installation
- Removal only with push off screws possible
- Requires more space than series 2005 and 1061

Other characteristics:
- Bending moment compensation: 40% of Mt (with Ma=100%)
- Max shaft deflection: 6 min (0.00175 rad)
- Typ. shaft deflection: 4 to 5 min
- Stress concentration factor on shaft kn = 2.0 – 2.3
- Recommended shaft / hub bore tolerance: h7-h11 / H7-H11
- Recommended surface roughness Ra ≤ 3.2µm



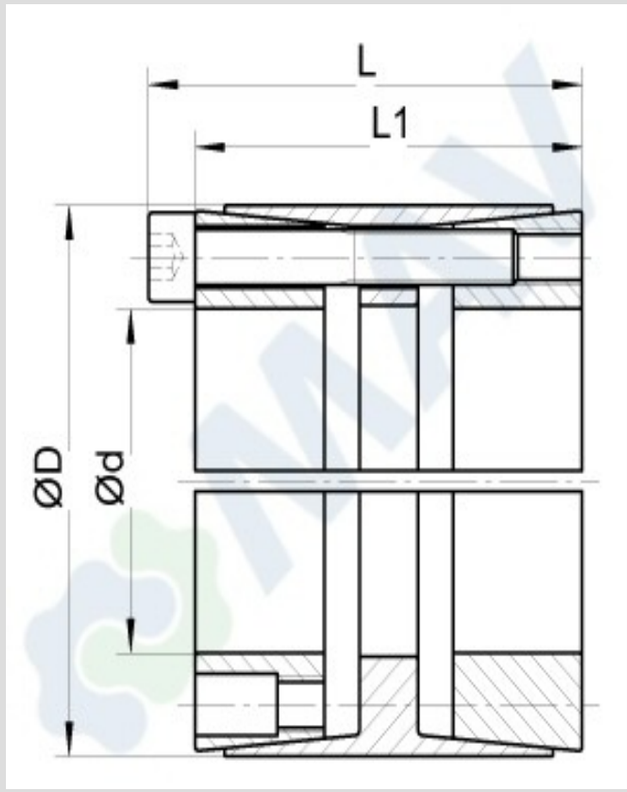
MAV Locking Assemblies in conveyor pulleys

MAV 4061:

Positive features:
- Self locking; screws are not under permanent dynamic stress
- Very high compensation of bending moment
- Self centering; no hub support required
- Medium contact pressure
- No fretting corrosion

Negative features:
- Axial movement possible during installation
- Removal only with push off screws possible
- Requires more space than series 2005 and 1061

Other characteristics:
- Bending moment compensation: 50% of Mt (with Ma=100%)
- Max shaft deflection: 8 min (0.00233 rad)
- Typ. shaft deflection: 4 to 5 min
- Stress concentration factor on shaft kn = 2.0 – 2.8
- Recommended shaft / hub bore tolerance: h8 / H8
- Recommended surface roughness Ra ≤ 3.2µm



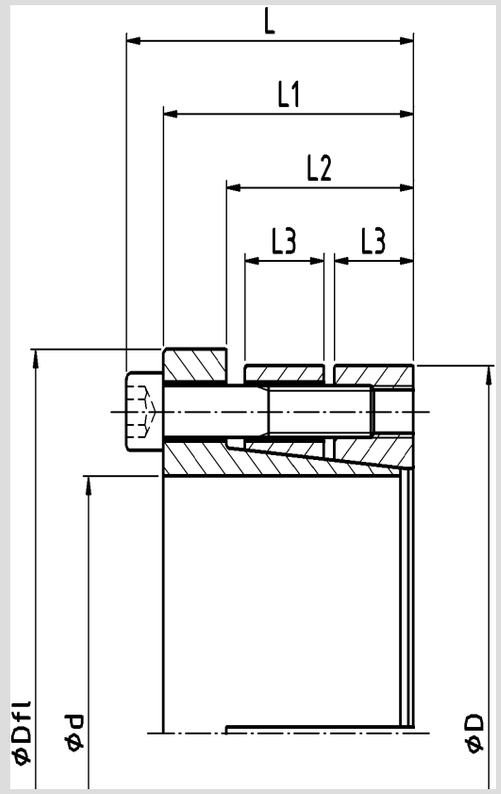
MAV Locking Assemblies in conveyor pulleys

MAV 6002:

Positive features:
- Self locking; screws are not under permanent dynamic stress
- Very high compensation of bending moment
- Self centering; no hub support required
- Medium contact pressure
- No fretting corrosion

Negative features:
- Removal only with push off screws possible

Other characteristics:
- Single taper design with two outer rings
- Designed for connection of engineered class end discs
- Bending moment compensation: 65% of Mt (with Ma=100%)
- Max shaft deflection: 8 min (0.00233 rad)
- Recommended shaft / hub bore tolerance: h8 / H8
- Recommended surface roughness Ra ≤ 3.2µm



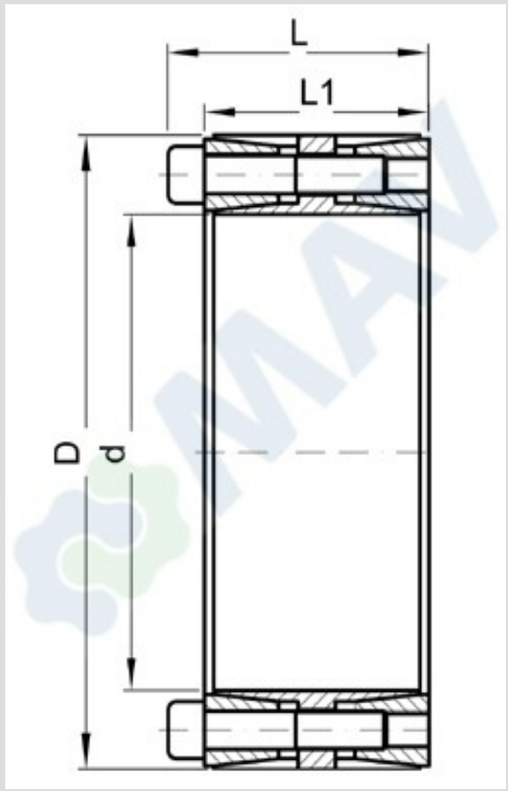
MAV Locking Assemblies in conveyor pulleys

MAV 4071:

Positive features:
- Self locking and self centering
- No axial movement during installation
- Medium contact pressure
- No fretting corrosion

Negative features:
- Removal only with push off screws possible

Other characteristics:
- Double taper design with two thrust rings
- Bending moment compensation: 22-25% of Mt (with Ma=100%)
- Recommended shaft / hub bore tolerance: h8 / H8
- Recommended surface roughness Ra ≤ 3.2µm



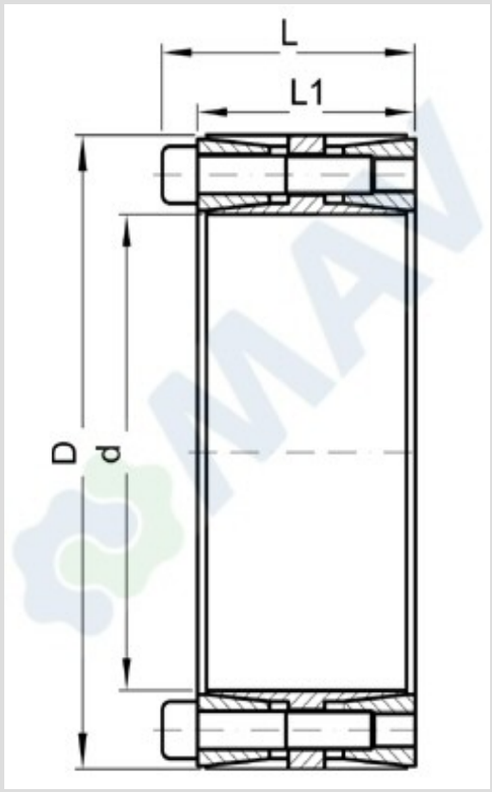
MAV Locking Assemblies in conveyor pulleys

MAV 1800:

Positive features:
- Self locking and self centering
- No axial movement during installation
- Low contact pressure
- No fretting corrosion

Negative features:
- Removal only with push off screws possible

Other characteristics:
- Double taper design with two thrust rings
- Bending moment compensation: 22-25% of Mt (with Ma=100%)
- Recommended shaft / hub bore tolerance: h8 / H8
- Recommended surface roughness Ra ≤ 3.2µm



MAV Locking Assemblies in conveyor pulleys

3. Evaluation of typical questions

What is the bending moment compensation of MAV Locking Assemblies?

MAV 2005: 22% of Mt (with Ma=100%)
MAV 1061: 35% of Mt (with Ma=100%)
MAV 1008: 40% of Mt (with Ma=100%)
MAV 4061: 50% of Mt (with Ma=100%)
MAV 6002: 65% of Mt (with Ma=100%)
MAV 4071: 22-25% of Mt (with Ma=100%)
MAV 1800: 22-25% of Mt (with Ma=100%)

How to select the adequate locking assembly:
T = applied torque
B = applied bending moment (see MAV calculation program)
Mt = locking assembly transmissible torque
k_b = locking assembly bending compensation (% of Mt)
Calculate the composed applied torque, according to:

$$Mtc = \sqrt{T^2 + (2 \cdot B)^2}$$

Calculate the bending capacity of locking assembly, according to:

$$Mb = k_b \cdot Mt$$

Verify the following:
a) Mt > Mtc (for drive pulleys only)
b) Mb > B (for non-drive and drive pulleys)

MAV Locking Assemblies in conveyor pulleys

What is the maximum allowed deflection of MAV Locking Assemblies?

MAV 2005: α = 1.5 min
MAV 1061: α = 3 min
MAV 1008: α = 6 min
MAV 4061: α = 8 min
MAV 6002: α = 8 min

The deflection angle of shaft at LA depends on:
- bearing - LA distance
- end disc 1 - end disc 2 distance
- force
- Young modulus of shaft material
- area moment of inertia (from shaft dia.)

Once bearing - LA distance & forces are fixed, it can be calculated:
- max applied bending, considering same rigidity factor for shaft and end disc
- applied bending on LA (see attachment “Locking Device Bending”), considering different rigidity factors for shaft and end disc (to be compared with transmissible bending of LA)
- shaft deflection (free shaft subject to 4-point bending configuration with concentrated loads)

The shaft deflection, once bending is fixed, may vary depending on distance between end disc 1 and end disc 2.

For this reason, MAV recommends:
- base the selection of LA only on max transmissible bending moment
- check that deflection angles are comparable with the values listed above

MAV Locking Assemblies in conveyor pulleys

What are the stress concentration factors on the shaft for MAV Locking Assemblies?

MAV 2005: kn = 2.0 - 2.3
MAV 1061: kn = 2.0 - 3.7
MAV 1008: kn = 2.0 - 2.3
MAV 4061: kn = 2.0 - 2.8

Min and max limits depend on shaft dia. (see Calculating Pressure Concentration Factors In Keyless Locking Assemblies for full explanation)

What is the recommended surface roughness?

Ra ≤ 3.2 µm for shaft and hub bore, valid for all series.

What is the recommended shaft / hub bore tolerance?

MAV recommends for shaft h8 and for hub H8 tolerance for series 1061, 4061, 6002, 4071 and 1800.
The types 2005 and 1008 can bridge clearances from h7 to h11 for shaft and from H7 to H11 for hub bore.

MAV Locking Assemblies in conveyor pulleys

Which Locking Device has the lowest contact pressure?

Contact pressure could be an issue, as end disc hub size requires sometimes low contact pressure.
Between the types described above, the series MAV 1800 and MAV 1061 show the lowest contact pressure.
MAV 1008, 4061, 6002, 4071 feature medium pressure, series 2005 features the highest values.

Is it possible a reduction of the screws tightening torque Ma?

Yes, but we recommend not to go below:
0.6 x Ma for series MAV 2005, MAV 1008, and MAV 4061
0.8 x Ma for series MAV 1061, MAV 6002, MAV 4071, and MAV 1800
A given reduction of tightening torque will reduce of same amount the torque and bending capacities as well as contact pressures.

MAV Locking Assemblies in conveyor pulleys

What is the temperature range in which Locking Assemblies are reliable?

All MAV Locking Assemblies and Shrink Discs can be used from **-20 °C up to +150 °C** without problem. Higher or lower temperature will affect the mechanical properties of screws and components and is **not** recommended.

Why screw heads can fail by using series MAV2005?

High bending load promotes the disengagement of self releasing tapers, which causes additional dynamic tensile stress on the screws. After a period of time, screw heads will break due to fatigue failure. It is almost impossible to estimate the theoretical life time of the screws, since the amount of additional dynamic tensile stress is unknown.
The problem of screw fatigue failure is solved by using self locking series, which avoids the dynamic stress on the screws.

MAV Locking Assemblies in conveyor pulleys

4. Advantages using MAV1061 series versus RFN7012

Using the 1061 series brings a lot of advantages for the end user, especially regarding the installation time. Unfortunately there are still many users that prefer the old fashioned type RFN7012, MAV2005 or TAS3020. The following arguments should help to promote our series MAV1061.
Please note that the torque capacity of the MAV1061 type is lower than series MAV2005 (RFN7012), but the MAV1061 offers higher compensation of bending moment, which is a key factor for conveyor pulleys connections.

The bolts of a RNF7012 device can fail due to fatigue. The cyclic stress on screws is generated by the bending moment, which promotes a disengagement of the self releasing thrust rings and causes additional cyclic tensile load on the screws. After a period of time, the screws can break (see pic. 2). The rating of bolt's life time is very difficult, since the estimation of amount of additional cyclic load is almost impossible. The use of special, very high grade screws (as 14.9 or similar) can solve only partially the problem of fatigue failure by increasing the life time of the bolts. Anyway it doesn't eliminate the problem, as the additional cyclic stress on the screws is caused by the disengagement of the self releasing tapers. Also, we make the user aware that very high strength bolts can be subjected to brittle fracture and can feature lower fatigue limit than expected (for ex., bolts of grade 12.9 or higher are not allowed in aviation industry and civil engineering).

To avoid screws failure, MAV recommends the applied bending moment not to exceed **0.22 x Mt** for series MAV2005, where Mt is the listed transmissible torque (see MAV catalogue).

MAV Locking Assemblies in conveyor pulleys

The main advantages of the MAV1061 series:

- MAV 1061 contains less screws → approximately ½ of MAV 2005
- For this reason the installation time is substantially less (especially for big dimensions)
- It is not necessary to centre or extend the hub as the series 1061 is self centering
- MAV 1061 is self locking → there are no screw failures caused by permanent dynamic stress like type MAV 2005
- No fretting corrosion occurs
- Lower contact pressure
- MAV 1061 does not require additional room (see picture below)
- Substantial cost savings regarding installation time, replacement and overhaul / repair
- If required, existing push-off threads can be used for Locking Assembly cover