Shoulder Bolt Application Guide

> **Tip:** Set your PDF viewer to "Actual size" before printing to maintain scale.

Common Applications

Application	Description	Key Benefits
Pivot Points	Mechanical linkages, robotic joints, articulated arms	Low friction rotation, precise clearance, repeatable motion
Bearing Surfaces	Bushing mounting, rotating wheels, oscillating assemblies	High load capacity, replaceable bushings, smooth operation
Sliding Mechanisms	Linear guides, adjustable brackets, drawer slides	Smooth sliding, position accuracy, minimal wear
Die & Mold Work	Stripper plates, mold assemblies, progressive dies	Precise alignment, heavy duty, long service life
Jigs & Fixtures	Welding fixtures, assembly jigs, inspection fixtures	Repeatable setup, precise location, durable
Cams & Followers	Cam follower mounting, timing mechanisms	Smooth operation, accurate timing, reduced vibration

Bushing Selection Guide

Bushing Type	Material	Best For	Max Speed
Bronze	SAE 660	General purpose, moderate loads	Medium
Oilite	Sintered bronze	Self-lubricating, low maintenance	Medium
PTFE/Teflon	Plastic composite	Low friction, corrosive environments	Low-Med
Acetal/Delrin	Engineering plastic	Quiet operation, dry running	Medium
Needle Bearing	Steel rollers	High loads, compact design	High

Clearance Fits

- **Close clearance fit:** 0.001"-0.002" for precise positioning with minimal play
- **Running fit:** 0.002"-0.004" for smooth rotation under load
- **Sliding fit:** 0.003"-0.005" for easy linear motion with some clearance

Material Selection

Material	Advantages	Typical Applications
Alloy Steel (Heat Treated)	High strength (Rc 45-53), wear resistant, economical, black oxide or zinc plated	Most general applications, indoor machinery, moderate loads
304 Stainless (18-8)	Corrosion resistant, non-magnetic, food-safe, clean appearance	Outdoor equipment, food processing, marine applications
316 Stainless	Superior corrosion resistance, chemical resistant, marine grade	Harsh environments, chemical plants, salt water exposure

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Thread Engagement Requirements

Base Material	Minimum Thread Depth	Recommended
Steel or Cast Iron	1.0 × thread diameter	1.5 × thread diameter
Aluminum or Brass	1.5 × thread diameter	2.0 × thread diameter
Plastic	2.0 × thread diameter	2.5 × thread diameter

Torque Specifications

Thread Size	Steel Base	Aluminum Base	Stainless Bolt	Lubricated
#10-32	20-25 in-lbs	15-18 in-lbs	15-20 in-lbs	12-15 in-lbs
1/4"-20	60-75 in-lbs	45-55 in-lbs	50-65 in-lbs	40-50 in-lbs
3/8"-16	15-18 ft-lbs	11-13 ft-lbs	12-15 ft-lbs	10-12 ft-lbs
1/2"-13	35-40 ft-lbs	25-30 ft-lbs	28-33 ft-lbs	22-26 ft-lbs

Important Notes

- Do NOT over-tighten - excessive torque can deform the precision shoulder or strip threads
- Torque values assume clean, dry threads unless "Lubricated" column specified
- Use torque wrench for critical applications to ensure proper clamping force
- Thread locker may be used but reduces required torque by approximately 20%

Common Design Errors to Avoid

- **Insufficient shoulder length** - shoulder must extend through entire component thickness
- **No clearance at shoulder end** - leave 0.030"-0.060" gap to prevent binding
- **Inadequate thread engagement** - minimum 1× diameter in steel, 1.5× in aluminum
- **Wrong clearance fit** - too tight causes binding, too loose creates excessive play
- **Damaged shoulder surface** - nicks or burrs cause premature bushing wear