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Power Transmission & Linear Motion Systems

WHITE PAPER

The 10 Most Common Mistakes in Multiple Jack System Design — and How to Avoid Them

A practical engineering reference for OEM and MRO teams specifying multi-jack lifting and positioning systems.

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INTRODUCTION

About This White Paper

A multiple screw jack system, defined by two or more mechanically or electrically synchronized jacks working together to lift, lower, push, or pull a load, is one of the most reliable and versatile motion solutions available to engineers. Applications range from food and beverage processing and automated assembly to packaging machinery, web converting equipment and material handling.

Yet despite their mechanical simplicity, multi-jack systems are often specified or installed incorrectly. The consequences range from premature maintenance intervals to structural failure, personnel safety hazards, and costly production downtime — most of which are entirely avoidable.

This white paper draws on decades of application experience to identify the 10 most common mistakes when designing and commissioning multiple jack systems, and, more importantly, how to avoid each one.

The guidance that follows is manufacturer-neutral. Where specific components or configurations are referenced, they represent common industry practice, rather than an endorsement of any single brand. All applications should be reviewed by a qualified engineer.

MISTAKE #1

Selecting the Wrong Type of Screw Jack

The Common Failure Mode

Engineers frequently focus on load capacity while overlooking factors such as travel speed, duty cycle, efficiency, positioning accuracy, operating environment, and load-holding requirements. A screw jack that appears suitable on a data sheet may fail to deliver the required performance or service life in the actual application.

What to Do Instead

For example, a worm gear screw jack may be an excellent choice for occasional positioning applications, while a ball screw jack is better suited for higher-speed, higher-duty-cycle applications. Ball screw designs offer higher efficiency and generate far less heat, but require an external brake for load holding. For even higher efficiency requirements and travel rates, a bevel gear ball screw jack may be the best solution. Selecting the proper jack technology early in the design process optimizes performance, efficiency, reliability, and overall system cost.

Key Considerations

- Load capacity and safety factor
- Travel distance and travel speed
- Duty cycle and thermal limits
- Positioning accuracy requirements
- Load-holding and backdrive characteristics
- Environmental conditions (washdown, temperature, contamination)

> **KEY QUESTION:** Does the selected jack technology match not just the load — but the duty cycle, speed, environment, and load-holding requirements — of this specific application?

MISTAKE #2

Undersizing the Screw Jacks

The Common Failure Mode

A common mistake is sizing the system based solely on the static load. In reality, screw jack selection must account for dynamic loading, shock loads, acceleration forces, travel distance, duty cycle, and column strength under extension.

What to Do Instead

Long screw extensions introduce buckling considerations that significantly affect allowable loading. In a multi-jack system, load rarely distributes evenly — eccentric or cantilevered loads can cause one or two jacks to carry a disproportionate share of the total load. An undersized system may function initially but experience excessive wear, reduced service life, or unexpected failure as operating conditions change. Use a minimum 2:1 safety factor on static load for routine lifting; 3:1 or higher for shock-prone or dynamic applications.

Key Considerations

- Calculate actual load per jack — not just total load ÷ number of jacks
- Account for eccentric and cantilevered loading in multi-jack configurations
- Evaluate column strength for extended travel lengths
- Apply dynamic load factors for accelerating or high-cycle applications
- Use manufacturer application review services to validate sizing

RULE OF THUMB: Apply a minimum 2:1 safety factor on static load. For dynamic, shock-prone, or eccentric applications, 3:1 or higher is appropriate.

MISTAKE #3

Ignoring Side Loads and Load Guidance

The Common Failure Mode

Screw jacks are designed to transmit force along the axis of the lifting screw — not to guide or align the load. When loads are not properly constrained by an external guidance system, lateral forces are introduced into the screw, nut, bearings, and gearbox. Even relatively small side loads can dramatically reduce performance and component life.

What to Do Instead

Side loading often occurs because of structural deflection, thermal expansion, poor alignment, or uneven load distribution. The correct approach is to let dedicated external guides — rails, rollers, linear bearings, or structural members — carry side loads while the screw jack provides the lifting or positioning force. In a multi-jack system, misalignment between jack bases compounds side loading and accelerates wear across all jacks simultaneously.

Key Considerations

- Provide dedicated external guidance for all platforms, tables, and carriages
- Do not rely on the jack screw or nut to maintain alignment
- Account for structural deflection and thermal growth in the guide design
- Ensure all jack bases remain co-planar under full operating load
- Use flexible couplings at jack inputs to absorb minor misalignment

FIELD TIP: A dial indicator check at commissioning — measuring lateral runout of the screw shaft over its full stroke — catches alignment problems before they cause damage. Many field service calls could be avoided with this single step.

MISTAKE #4

Overlooking Synchronization Requirements

The Common Failure Mode

Synchronization is one of the most critical aspects of any multi-jack system. When multiple jacks are connected through shafts and bevel gearboxes, the direction of shaft rotation must be carefully analyzed. Depending on the arrangement, certain gearboxes and shafts may need to rotate in opposite directions to ensure all jacks extend and retract together.

What to Do Instead

Mechanical synchronization via a common line shaft constrains all jacks to the same rotational input, but this is reliable only within limits. Torsional windup in long shaft runs means jacks at the far end can lag under heavy load. If one jack binds, the shaft will continue driving the others, creating racking forces. For large systems or long spans, electrically synchronized drives with closed-loop position feedback provide greater flexibility, but require careful control architecture and fault detection. Common configurations include I, H, and U arrangements, each requiring analysis of rotational direction and power transmission.

Key Considerations

- Verify shaft rotation direction at every jack in the system — do not assume
- Account for torsional windup in long line shaft configurations
- Define maximum permissible synchronization lag before selecting architecture
- For 4+ jacks over large spans, evaluate electrically synchronized drives
- Add position feedback for all critical systems regardless of sync method

> **DESIGN REQUIREMENT:** Always diagram the complete drivetrain and verify direction of shaft rotation at every jack input in the system.

MISTAKE #5

Selecting the Wrong Supporting Components

The Common Failure Mode

The screw jack is only one component within the overall system. Performance and reliability depend on the proper selection of motors, reducers, bevel gearboxes, connecting shafts, couplings, bearings, guides and drive components. A single mismatched or undersized component can limit the performance of the entire assembly.

What to Do Instead

A poorly selected shaft may experience excessive torsional deflection under load. An improperly rated gearbox can limit torque capacity or introduce backlash. A coupling selected without considering misalignment or shock loading may fail prematurely — and take adjacent components with it. The drive motor must supply the sum of all jack input torques plus losses from the line shaft and right-angle gearboxes. In worm gear systems operating at 20–50% efficiency, this means the motor must supply 2–5x the output power at the jack screw. Successful systems are engineered as complete assemblies, not collections of individual catalog selections.

Key Considerations

- Calculate required motor torque from first principles — do not rely on catalog HP tables alone
- Sum all jack input torques when sizing the drive motor for multi-jack systems
- Account for worm gear efficiency (typically 20–50%) in the drivetrain calculation
- Add a minimum 25% service factor for continuous duty applications
- Size couplings for speed, torque capacity and misalignment requirements

> **COMMON TRAP:** Using a jack manufacturer's listed 'required HP' without accounting for multi-jack torque summation and line shaft losses can result in a drive motor that is undersized.

MISTAKE #6

Ignoring Duty Cycle and Thermal Limits

The Common Failure Mode

Screw jacks are intermittent-duty devices. Worm gear designs generate significant internal heat during operation that must dissipate during a rest period before the next cycle. Engineers who size a jack correctly for load, but fail to evaluate duty cycle are often surprised when the system overheats, lubricant breaks down, and wear accelerates — all while operating within the rated load.

What to Do Instead

Every major jack manufacturer publishes duty cycle ratings specifying maximum on-time and minimum required rest at rated load. These limits tighten as load, speed, and ambient temperature increase. Most standard worm gear screw jacks are rated for 10–25% duty cycle at full load. For higher duty cycle applications, ball screw jacks operate at 90%+ efficiency and generate far less heat, but always require an external brake for load holding. Synthetic lubricants generally extend thermal limits compared to petroleum-based greases and are worth specifying in high-cycle applications.

Key Considerations

- Calculate actual duty cycle (on-time ÷ total cycle time) and compare to manufacturer's published rating
- Account for ambient temperature, a hot plant environment reduces allowable duty
- For high duty cycle applications, evaluate ball screw jacks
- If duty cycle exceeds worm gear rating, derate to a larger model or add fan cooling
- Never assume a static load safety factor covers thermal performance

> **RULE OF THUMB:** Most standard worm gear screw jacks are rated for 10–25% duty cycle at full load. For higher duty cycles, ball screw jacks are the correct technology — but always require an external brake or load-holding device.

MISTAKE #7

Failing to Account for Maintenance and Serviceability

The Common Failure Mode

A system that performs well on paper can become costly and difficult to maintain if serviceability is not considered during the design phase. Engineers should evaluate access to lubrication points, couplings, gearboxes, motors, and other wear components before the system is built — not after it is installed.

What to Do Instead

Equipment layouts should allow routine inspection and maintenance without requiring extensive disassembly. The bronze nut in a worm gear screw jack is a finite-life wear component. Tracking cumulative load-travel cycles allows proactive nut replacement before catastrophic failure. Backlash measurement at each PM interval is a reliable early indicator of nut wear. Thoughtful maintenance planning reduces downtime, lowers operating costs, and extends equipment life — but it must be built into the design, not retrofitted.

Key Considerations

- Design physical access to lubrication points, couplings, and gearboxes
- Track load-travel cycles to predict bronze nut service life
- Establish backlash inspection intervals — increasing backlash indicates nut wear
- Trend motor current draw over time to identify rising friction early
- Plan for proof load testing on safety-critical vertical lift applications

OPERATIONAL INSIGHT: The most common cause of sudden jack system failure is a bronze nut worn through its thread height. A $200 nut becomes a $20,000 downtime event. Track cycles and replace proactively.

MISTAKE #8

Not Accounting for Structural Deflection

The Common Failure Mode

The supporting structure is often overlooked during multi-jack system design. Even when screw jacks are properly selected, frame deflection, platform distortion, and uneven loading can introduce side forces and synchronization issues that negatively impact performance and service life.

What to Do Instead

Structural analysis should consider expected loading conditions, support locations, and the interaction between the frame and the jack system. In elevated-temperature environments, thermal expansion of the structural frame can push rigidly mounted jacks out of alignment during operation. The entire assembly should be viewed as a single mechanical system — not a collection of individually specified components. A structurally adequate frame is as important to long-term reliability as the jack selection itself.

Key Considerations

- Perform structural analysis of the complete frame under full operating load
- Evaluate deflection at each jack mounting point, not just maximum load
- Account for thermal expansion in elevated-temperature environments
- Size the support structure to maintain co-planarity of all jack bases
- Consider the jack system and its structure as a single integrated assembly

> **DESIGN PRINCIPLE:** The entire assembly — structure, jacks, drive, and guidance — is a single mechanical system. Optimizing the jacks, while under-engineering the frame, is one of the most common sources of field failures.

MISTAKE #9

Inadequate Lubrication Planning

The Common Failure Mode

Lubrication is the single most important factor in screw jack service life — and it is consistently treated as a maintenance afterthought rather than a design decision. The worm gear set and the screw/nut interface both depend on a proper lubricant film to minimize friction, prevent metal-to-metal contact, and carry heat away from the contact zone.

What to Do Instead

When the wrong lubricant is used, intervals are missed, or access points are inaccessible, the bronze nut pays the price. Most worm gear screw jacks require grease or gear oil (AGMA 8 or EP 90) in the housing and grease on the screw. In food and beverage environments, standard lubricants are not acceptable in food-contact zones. NSF H1 certified food-grade lubricants must be specified at the design stage, not substituted in the field.

Key Considerations

- Specify lubricant type, quantity, access points, and re-lubrication interval in the design package
- Use grease or oil in the housing and grease on the screw
- For difficult-to-access jacks, specify automatic lubricators at design stage
- Establish PM intervals based on cycles or hours — not calendar time alone
- Food and beverage applications require NSF H1 certified food-grade lubricants throughout

> **COST PERSPECTIVE:** A lubrication failure that destroys a bronze nut can cost $500–$5,000 in parts and hours of downtime per jack. An automatic lubricator costs $50–$150 installed. The math is simple.

MISTAKE #10

Relying on Multiple Suppliers for System Components

The Common Failure Mode

Many projects source screw jacks, bevel gearboxes, motors, shafts, couplings, and related components from multiple vendors. While this may appear to offer flexibility or cost savings, it often creates additional engineering effort, multiple purchase orders, longer lead times, compatibility concerns, and uncertainty about overall system responsibility.

What to Do Instead

When a problem occurs — and in a multi-component system, something always does — the question of whose component caused the failure becomes time-consuming and contentious. Working with a supplier experienced in complete screw jack systems simplifies design, procurement, documentation, and long-term support while reducing project risk. A single point of accountability for system performance is worth more than the marginal savings from shopping each component independently.

Key Considerations

- Evaluate total cost of ownership — not just individual component unit price
- Identify a single engineering-responsible supplier for the complete system
- Require compatibility verification across all drive, transmission, and jack components
- Simplify procurement with kitted systems from a single source where possible
- Establish a single point of contact for warranty, spare parts, and service

RISK CONSIDERATION: When a multi-vendor system fails, determining root cause — and responsibility — is expensive and slow. A single system-responsible supplier eliminates that risk entirely.

QUICK REFERENCE

10 Mistakes at a Glance

#	MISTAKE	KEY PREVENTIVE ACTION
1	Selecting the Wrong Type of Screw Jack	Match technology to duty cycle, speed, and load-holding requirements — not just load.
2	Undersizing the Screw Jacks	Calculate per-jack load including eccentricity and dynamics. Use 2:1 safety factor minimum.
3	Ignoring Side Loads and Load Guidance	Provide external guides. Never rely on the jack screw or nut to maintain alignment.
4	Overlooking Synchronization Requirements	Define max allowable lag. Verify rotation direction. Add position feedback on critical systems.
5	Selecting the Wrong Supporting Components	Sum all jack input torques. Account for worm gear efficiency. Add 25% service factor on motor.
6	Ignoring Duty Cycle and Thermal Limits	Calculate actual duty cycle vs. rated. For high duty, select ball screw or derate.
7	Failing to Account for Maintenance	Track load-cycles. Schedule bronze nut replacement proactively. Trend motor current and backlash.
8	Not Accounting for Structural Deflection	Analyze full frame under load. Maintain co-planarity of all jack bases. Design as one system.
9	Inadequate Lubrication Planning	Specify lubricant type, interval, and access in the design package. Use food-grade in F&B apps.
10	Relying on Multiple Suppliers	Identify a single system-responsible supplier. Evaluate total cost of ownership.

Work With Candy Controls

Candy Controls assists OEMs and end users with complete screw jack system design and component selection — from jack sizing and synchronization strategy to shaft specification, bevel gearbox selection, motor recommendations, drawings, and complete system kitting.

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Tell us your load, stroke, speed, duty cycle, and environment. We'll do the rest.