Top 11 Mistakes

- Introduction
- Basics of Linear Motion Systems
- Step by Step Design of a System
- **Top 11 Mistakes**
- Question & Answer

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes

1. **Lack of Clearly Defined Requirements**
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #1

Lack of Clearly Defined Requirements

- Day 1 Requirements?
- End of Life Requirements?
- What does the motion profile look like? What is the maximum acceleration and velocity? What is the dwell time?

For Distributors/Integrators

- What does the customer ***really*** need? Sometimes "*wants*" are "*needs*" and "*needs*" are really "*nice to haves*".

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. **Accuracy –vs.– Repeatability**
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #2

Accuracy –vs. – Repeatability

Accuracy – Difference between actual and theoretical position.

Repeatability – The difference in actual position when a system returns to the same theoretical position under identical circumstances.

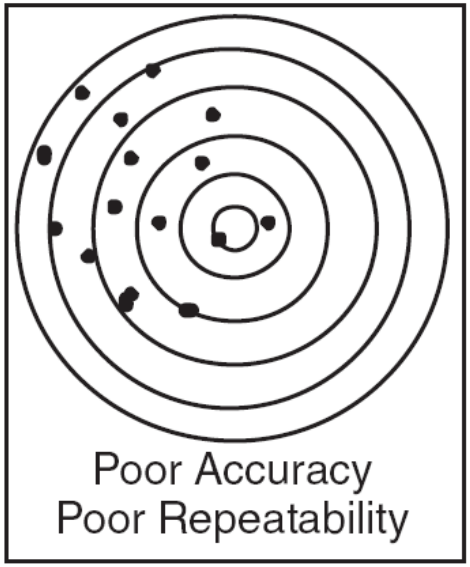
*Note: There is a **BIG** difference between **Uni-**Directional & **Bi-**Directional Repeatability!*

Top 11 Mistakes - #2

Accuracy
–vs. –
Repeatability

TIP:

For MOST applications, repeatability is more important than accuracy

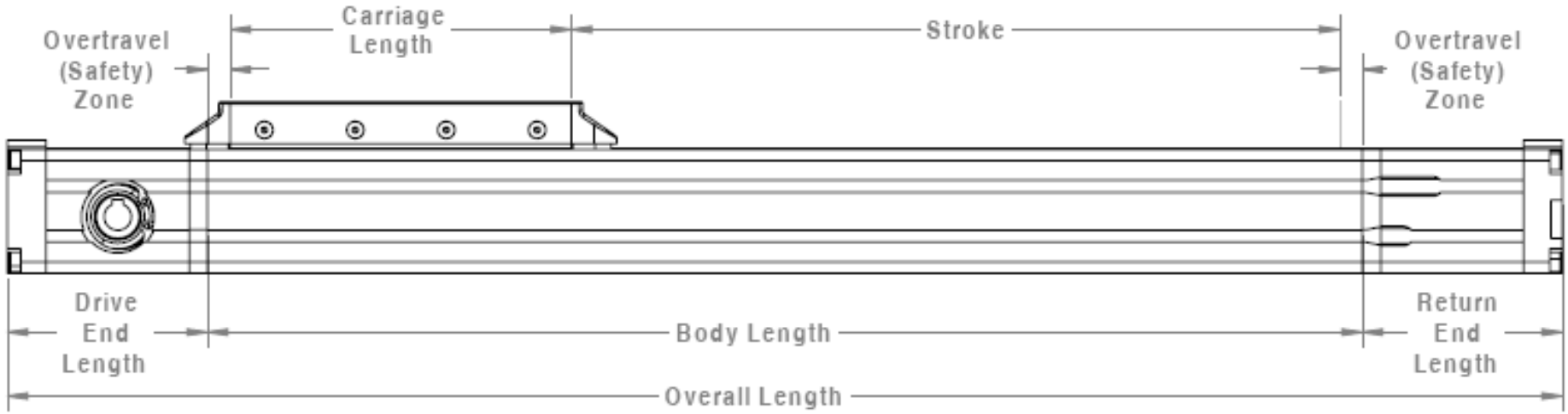


Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. **Wrong Stroke/Body/Overall Length**
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #3

Wrong Stroke/Body/Overall Length



Common Mistakes:

- Not Leaving Additional Body Length for Installation variance
- Not Leaving Additional Overtravel (Safety) Zone
- Not Accounting for Accessories Inside an Enclosure

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. **Theoretical –vs.– Actual Stiffness (Rigidity)**
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #4

Theoretical –vs.– Actual Stiffness (Rigidity)

- Deflection vs. Load Capacity
- Tolerance Stack up
- Wrongly assuming infinite stiffness
- Overdesigned and constrained systems
- Parallelism issues

- Controls (EE's) Engineers are more likely to assume infinite stiffness and forget about sources of compliance and errors (including in the controls!)

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. **Static & Dynamic Calculations**
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #5

Static & Dynamic Calculations

- Too high moment loads (typically during accel/decel at joints)
- Not Understanding load geometry and impact loads from fast accel and decel.
- Insufficient machine structure to accommodate the dynamic performance.
- Effects of Gravity on the Vertical portion of the machines.

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. **Incorrect Sizing of Components (FoS/MS Too Small)**
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #6

Incorrect Sizing of Components (FoS/MS Too Small)

Factor of Safety, Safety Factor, Margin of Safety Too Small

- Failure to Account for the Unknown
- Failure to Account for Drag from Cable Carriers
- Incorrectly Reading Speed-Torque Curves (for Motors)
- Forgetting Break-Away Torque (especially in small systems)
- Not Accounting for All Forces/Moments

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. **Forgetting the Environment**
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #7

Forgetting the Environment

Failure to Account for Environmental Considerations, such as:

- Dirt/Chips/Contamination
- Lubrication
- Moisture
- Corrosion Effects
- Vibration
- Extreme Temperature
- Particulate – given off by system

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. **Forgetting Accessories**
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #8

Forgetting Accessories

Failure to include early in the design the following accessories:

- Way Covers/Protection
- Cable Carriers
- Machine Guarding
- Sensors *&* their mounting location/hardware

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. **Forgetting PM/Serviceability (after installation)**
10. Basic Math/Unit Errors
11. Going Cheap

Top 11 Mistakes - #9

Forgetting PM/Serviceability (after installation)

Remember the mechanic's saying:

"If it moves, it gets lubed. And if it needs lube, then it will eventually wear out and need to be replaced."

2 Biggest Issues:

- Not designing in maintenance access
- Not giving proper instructions

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. **Basic Math/Unit Errors**
11. Going Cheap

Top 11 Mistakes - #10

Basic Math/Unit of Measure Errors

- Algebraic Errors
- Unit Conversion Errors
  (imperial to metric, metric to imperial, etc)

Speaker's Note:

I feel bad having to include this; however, the reality is that these problems still occur, even with all the advances in computers and technology… mistakes still happen. Be sure to ask yourself "DOES THIS MAKE SENSE?"

Top 11 Mistakes

1. Lack of Clearly Defined Requirements
2. Accuracy –vs.– Repeatability
3. Wrong Stroke/Body/Overall Length
4. Theoretical –vs.– Actual Stiffness (Rigidity)
5. Static & Dynamic Calculations
6. Incorrect Sizing of Components (FoS/MS Too Small)
7. Forgetting the Environment
8. Forgetting Accessories
9. Forgetting PM/Serviceability (after installation)
10. Basic Math/Unit Errors
11. **Going Cheap**

Top 11 Mistakes - #11

Going Cheap

- Undersizing Components (Too Small of Safety Factor)
- Not Adding a Secondary/Supporting (Parallel) Axis (when required)
- Using Sheet Metal for Critical Components (mounting)
- Not Using Gearboxes or Cable Carriers (when required)

DESIGNER'S TIP:

In high performance systems, cable failure is the #1 cause for downtime and unexpected maintenance issues.

www.pbclinear.com • 1-800-962-8979