EZSLAMX
Training Program

CHAPTER 11
B Graphs and Metrics

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B Graphs and Metrics

A. Energy Concept
B01. Opening Action
B02. Minimum Closing Action
B03. Typical Closing Action
B04. Sensitivity Latch
B05. Open Sweep Energy
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B07. Closing Energy

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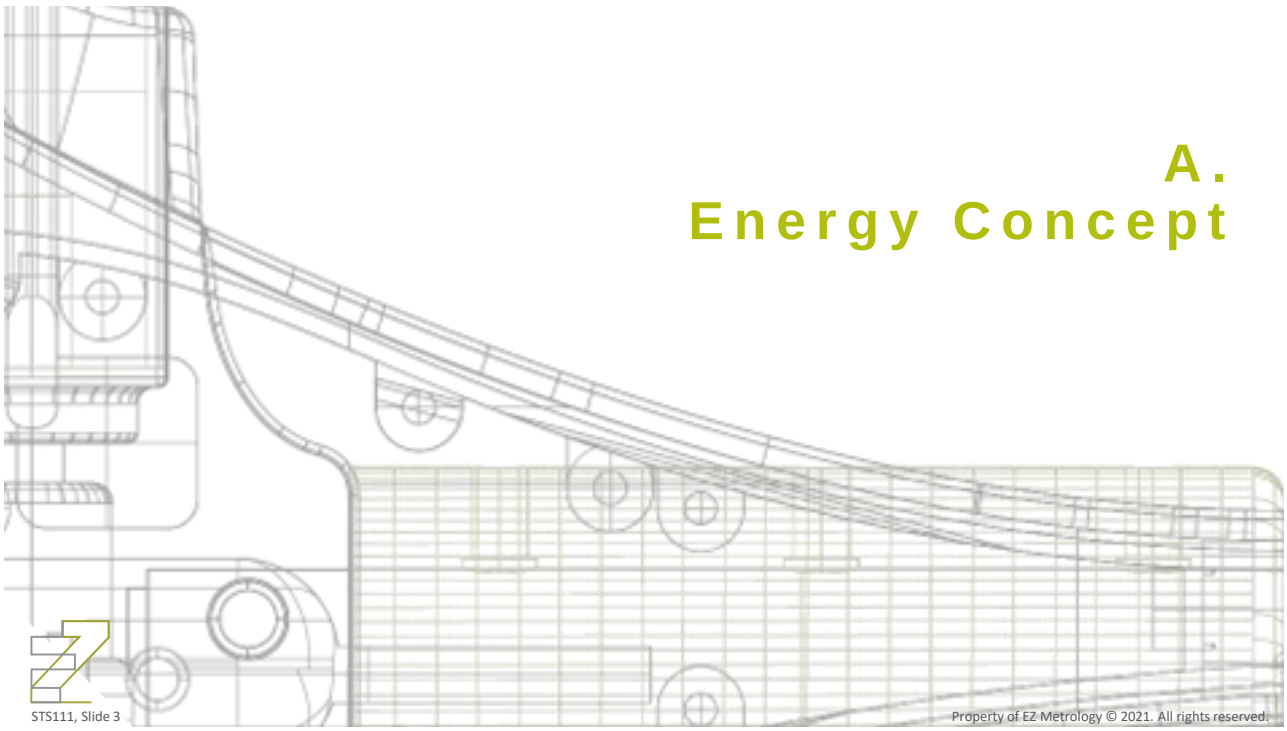

A.
Energy Concept

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A. Energy Concept
1. Incomparable Metrics

Problem

Many characteristics are expressed in different units, making it impossible to understand the relative importance of one in the overall system.

Solution

Converting all to an Energy equivalent, makes the comparison possible.

1. User Input	N	→	Joule
2. Speed	m/ sec	→	Joule
3. Hinge Inclination	Degrees	→	Joule
4. Friction	Nm	→	Joule
5. Pressure	mbar	→	Joule
6. Seal	N / mm	→	Joule

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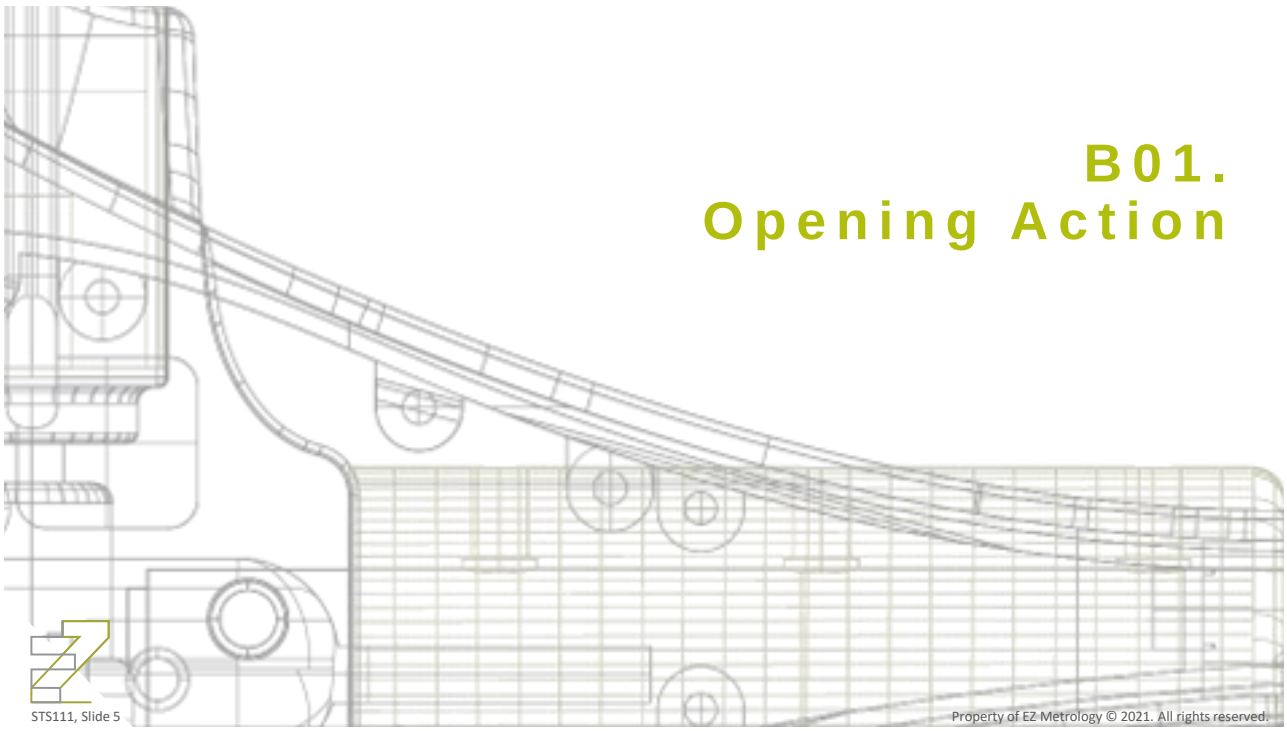

B01. Opening Action

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B01. Opening Action

1. Pie Chart

Definition

Represents the energy distribution for opening the door to fully open position.

Provided

All elements that can contribute to opening the door

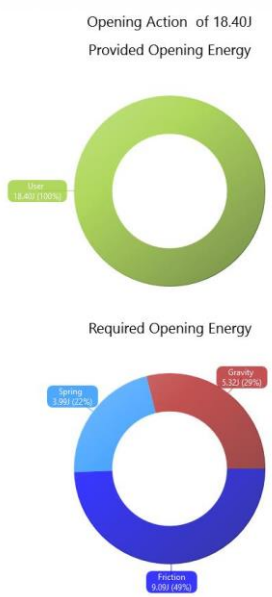
- User
- Gravity (*)
- Spring (*)

Required

All elements that will resist the opening the door

- Friction
- Gravity (*)
- Spring (*)

(*) In function of the door design these contributors can assist or resist. When they are assisting, resisting value will be '0' and the other way around.



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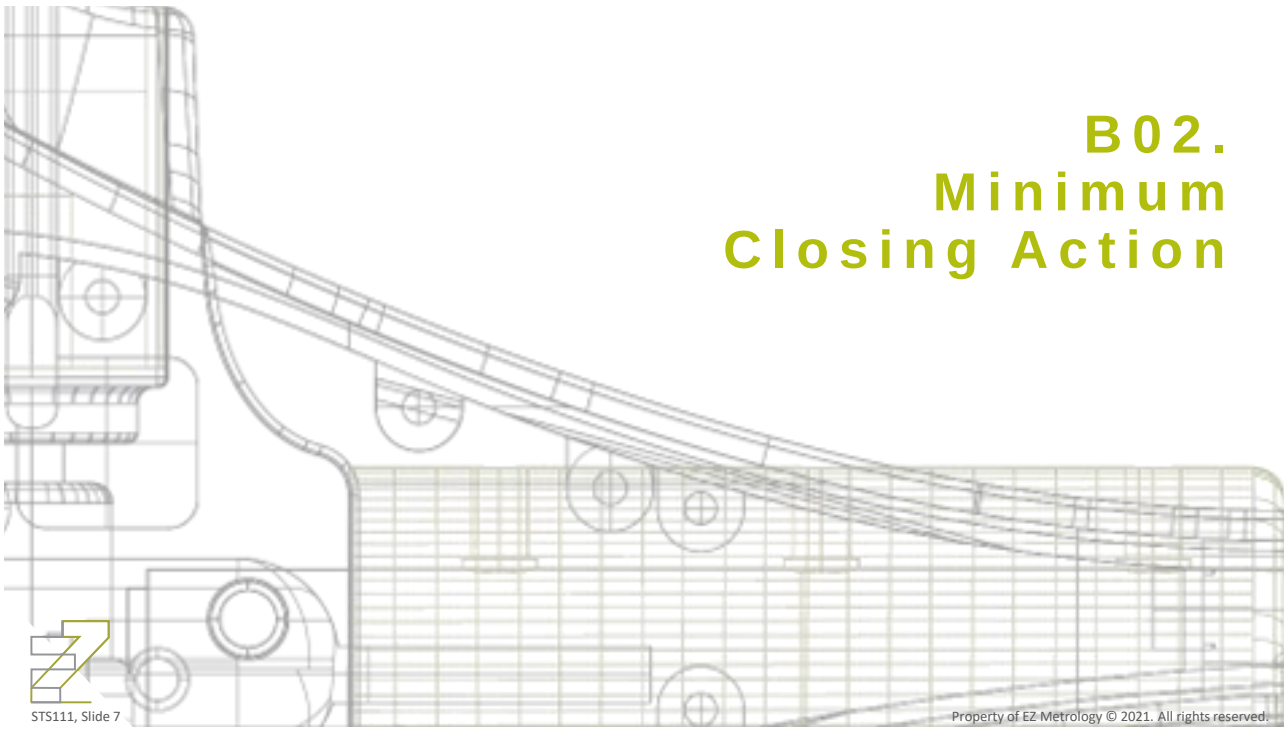

B02. Minimum Closing Action

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B02. Minimum Closing Action

1. Pie Chart

Definition

Represents the energy distribution for closing the door with minimum speed from open to fully latched position.

Provided

All elements that can contribute to opening the door

- User
- Gravity (*)
- Spring (*)

Required

All elements that will resist the opening the door

- Friction
- Gravity (*)
- Spring (*)
- Drag
- Seal Dynamics
- Cabin Dynamics
- Seal Compression

(*) In function of the door design these contributors can assist or resist. When they are assisting, resisting value will be '0' and the other way around.

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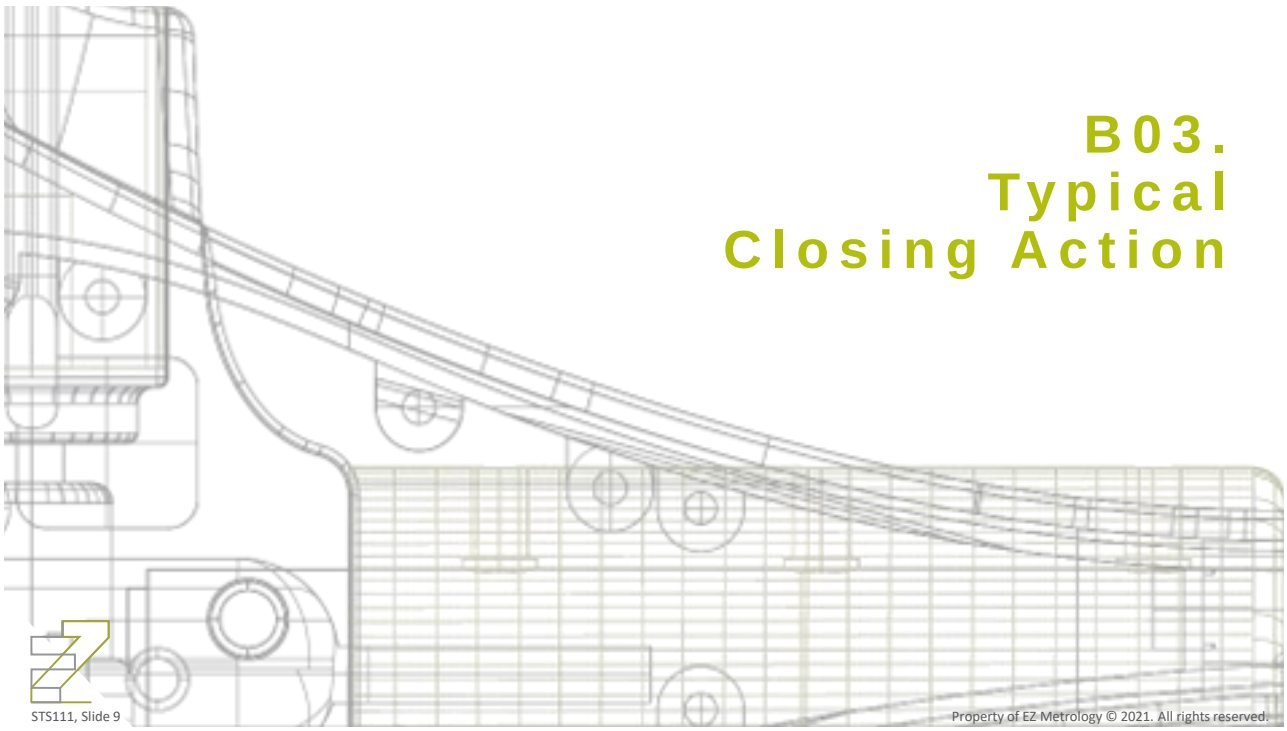

B03. Typical Closing Action

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B03. Typical Closing Action

1. Pie Chart

Definition

Represents the energy distribution for closing the door from open to fully latched position at a reference speed

Provided

All elements that can contribute to opening the door

- User
- Gravity (*)
- Spring (*)

Required

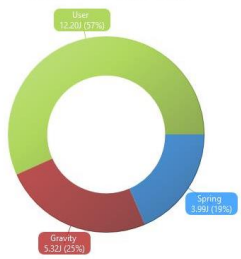
All elements that will resist the opening the door

- Friction
- Gravity (*)
- Spring (*)
- Drag
- Seal Dynamics
- Cabin Dynamics
- Seal Compression

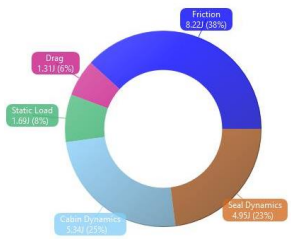
(*) In function of the door design these contributors can assist or resist. When they are assisting, resisting value will be '0' and the other way around.

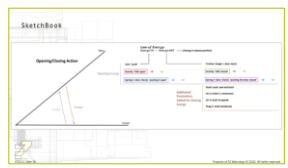
Typical Closing Action at 1.30m/sec or 21.50J

Provided Closing Energy



Required Closing Energy





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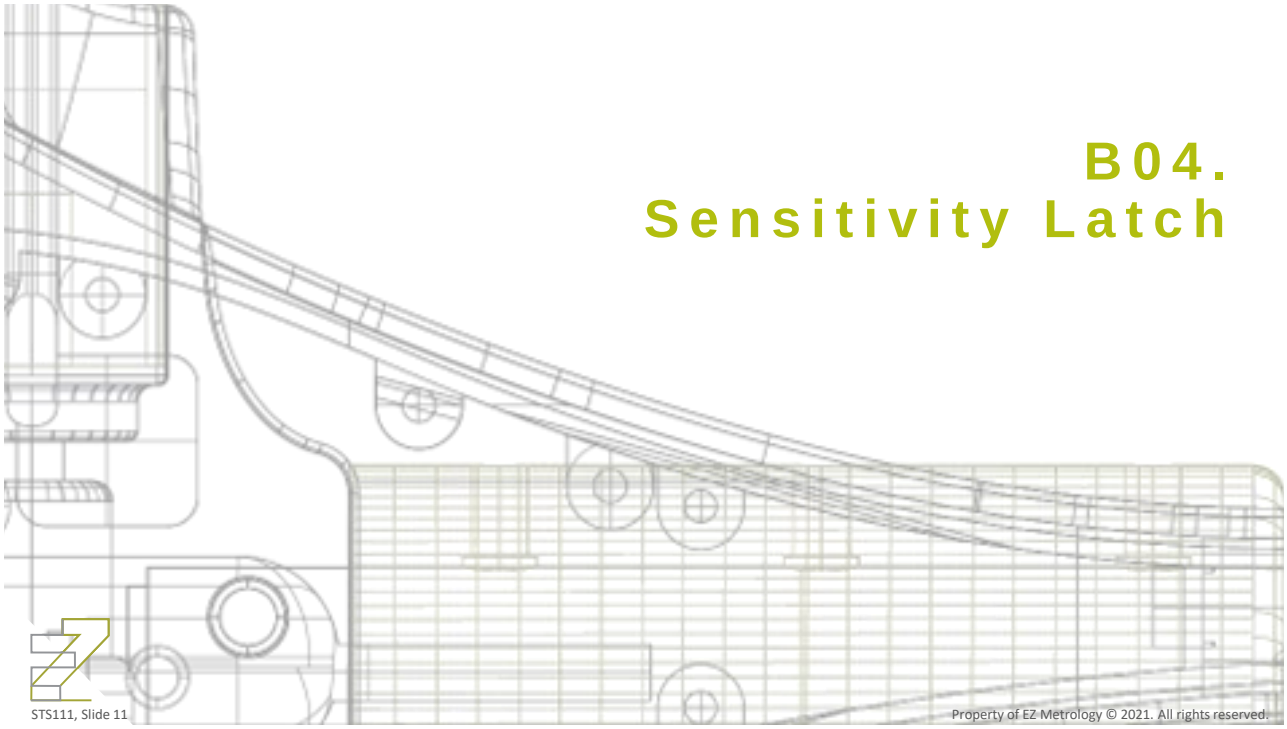

B04. Sensitivity Latch

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B04. Sensitivity Latch

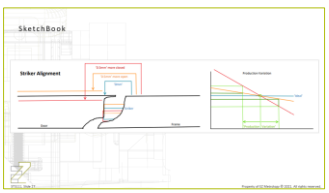
1. Points of Interest

Definition

Represents the expected change in closing energy when the striker is moved for 0.5mm inboard and 0.5mm outboard.

Points of Interest

1. **Current**: Current striker position and matching energy distribution.
2. **Out for 0.5mm**: Energy distribution when the striker is moved outboard >> Decrease in closing Energy.
3. **In for 0.5mm**: Energy distribution when the striker is moved inboard >> Increase in Closing Energy.



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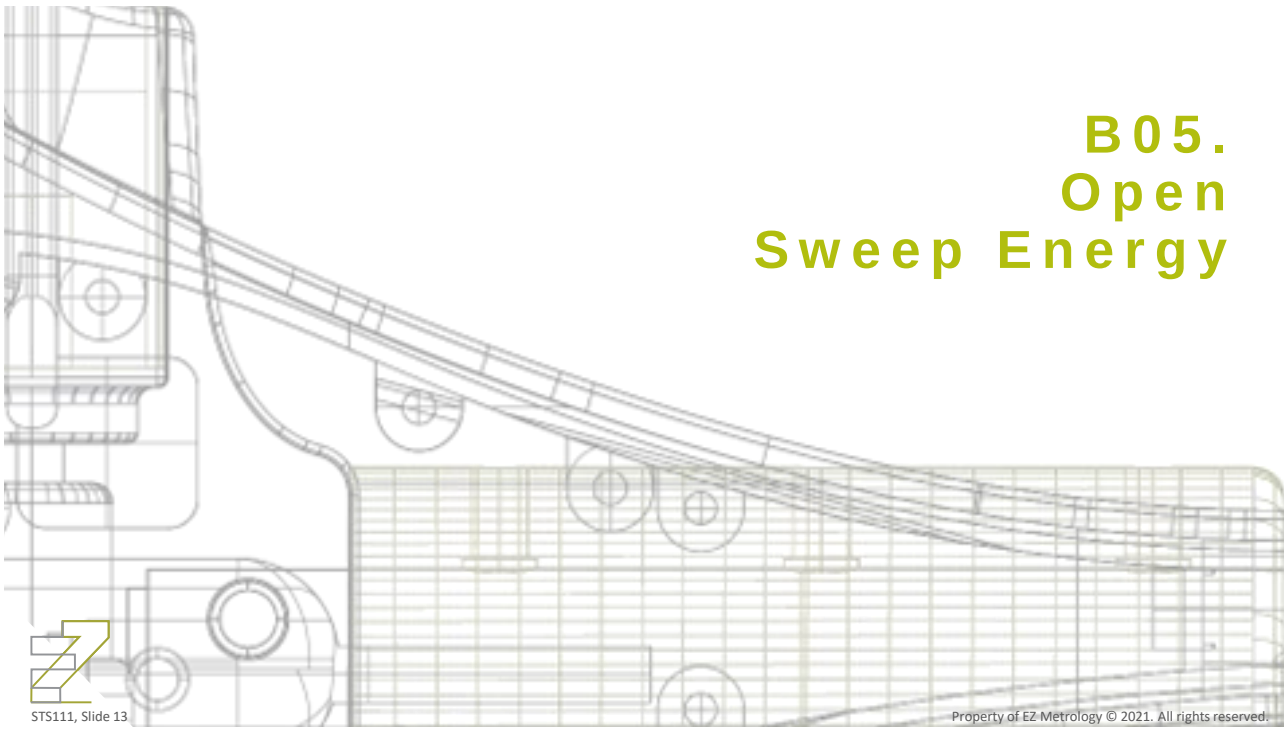

B05. Open Sweep Energy

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B05. Open Sweep Energy

1. Curve Data

Definition

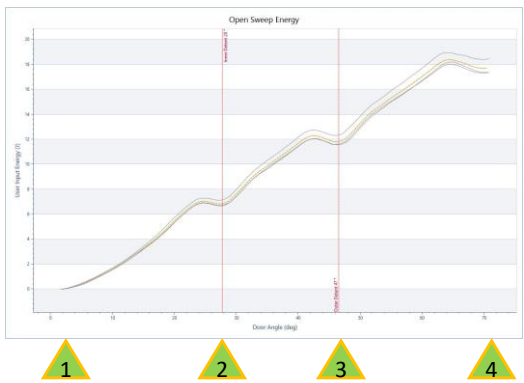
Represents the cumulative force or energy the user has to provide while opening the door.

Grey lines represent the data, the yellow curve is the average line.

Points of Interest

1. **Start**: Door starts sitting against the seals.
2. **Inner Detent**: A dimple in the curve can be found at the detent angle.
3. **Outer detent**: A dimple in the curve can be found at the detent angle.
4. **End:** The door ends in the full open position.

As the door opens, the user will gradually spend more and more energy.



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B05. Open Sweep Energy

2. Energy Flow

This is an opening sweep, so the movement reads from right (close) to left (open).

(1) Going Up

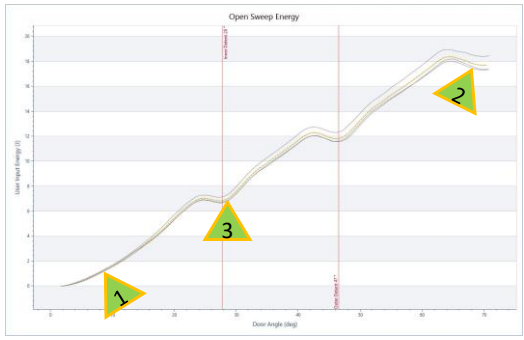
When the line goes up the user is pulling from the outside or spending energy.

(2) Going Down

When the line goes down the user is pushing or, the doors wants to accelerate. The user or door gets energy from the door check.

(3) Detent (Down and Up)

Detent is like a valley; the door falls in the pit and the user needs to push it out.



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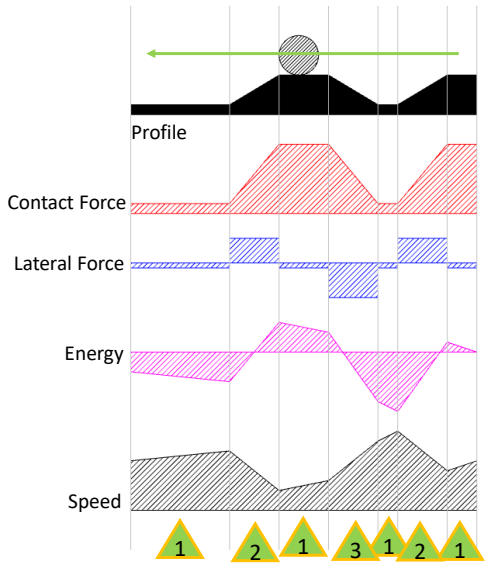
B05. Open Sweep Energy

3. Door Check Detail

Specific sections of the Door check profile will translate in different slopes in the different curves.

1. **Flats**
   - Friction Force >>
   - Absorbs a little Energy >>
   - Slight speed decrease
2. **Downhill**
   - Extra Force >>
   - Contributes significant Energy >>
   - Door accelerates >>
   - Speed increase
3. **Uphill**
   - Opposite Force >>
   - Absorbs significant Energy >>
   - Door decelerates >>
   - Speed decrease



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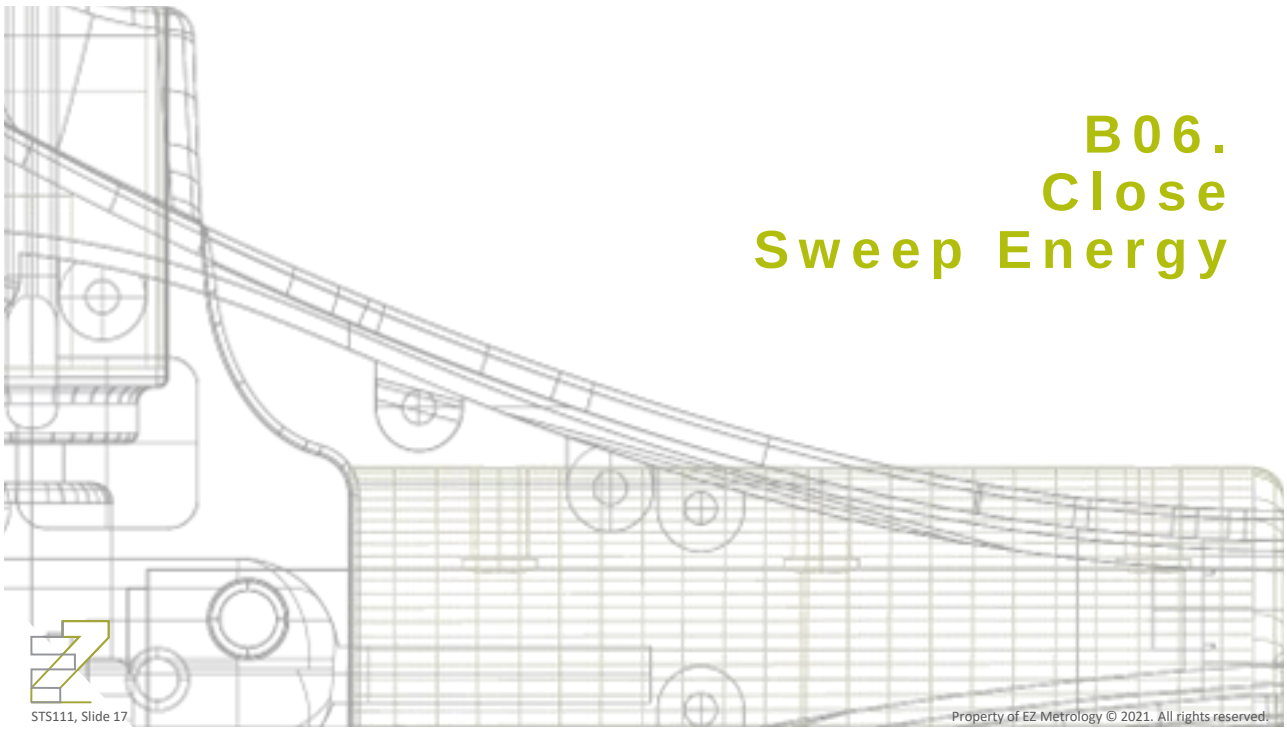

B06. Close Sweep Energy

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B06. Close Sweep Energy

1. Curve Data

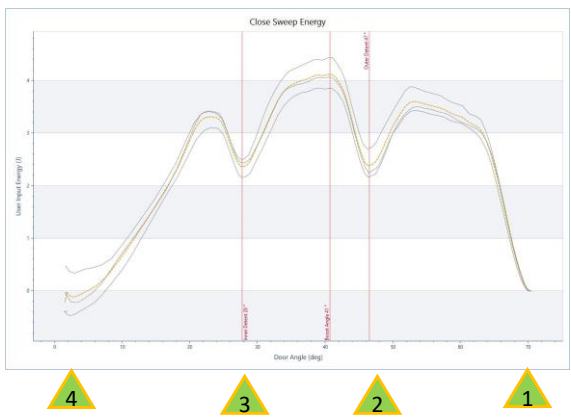
Definition

Represents the cumulative force or energy the user has to provide while opening the door.

Grey lines represent the sweep runs. The yellow curve is the average line.

Points of Interest

1. **Start**: Door starts sitting in the full open angle.
2. **Inner Detent**: A dimple in the curve can be found at the detent angle.
3. **Outer detent**: A dimple in the curve can be found at the detent angle.
4. **End:** The door ends at rest near the seals.



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B06. Close Sweep Energy

2. Energy Flow

This is a closing sweep, so the movement reads from right (open) to left (close)

(1) Going Up

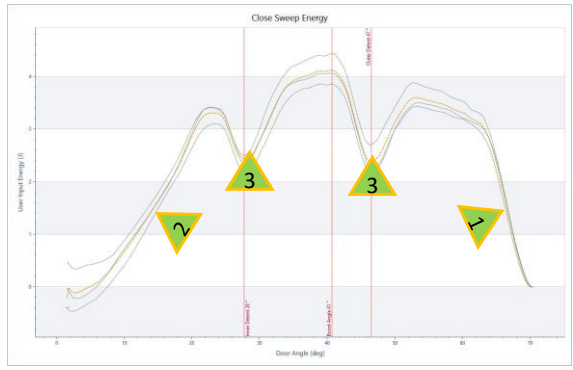
When the line goes up the user is pushing or spending energy.

(2) Going Down

When the line goes down the user is pulling or the doors wants to accelerate. The user or door gets energy back from the door check.

(3) Detent (Down and Up)

Detent is like a valley; the door falls in the pit and the user needs to push it out.



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B06. Close Sweep Energy

3. Boost

The boost is the angle of the highest energy. As a consequence, it always goes down from there to the end point.

(1) Boost Angle

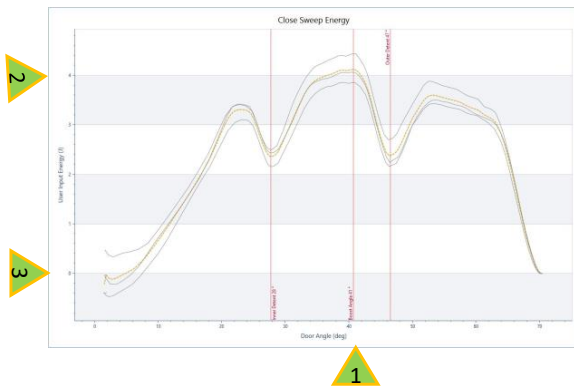
The angle of the highest point.

(2) Boost Energy

Energy difference from the highest point (2) to the end point (3).

In practical world this means that, once the door reaches the boost angle, it will 'roll down the hill' all the way to the near close position. During this period, the door speed increases.

Whether the door closes or not depends on the resistance from seal, latch and dynamics.



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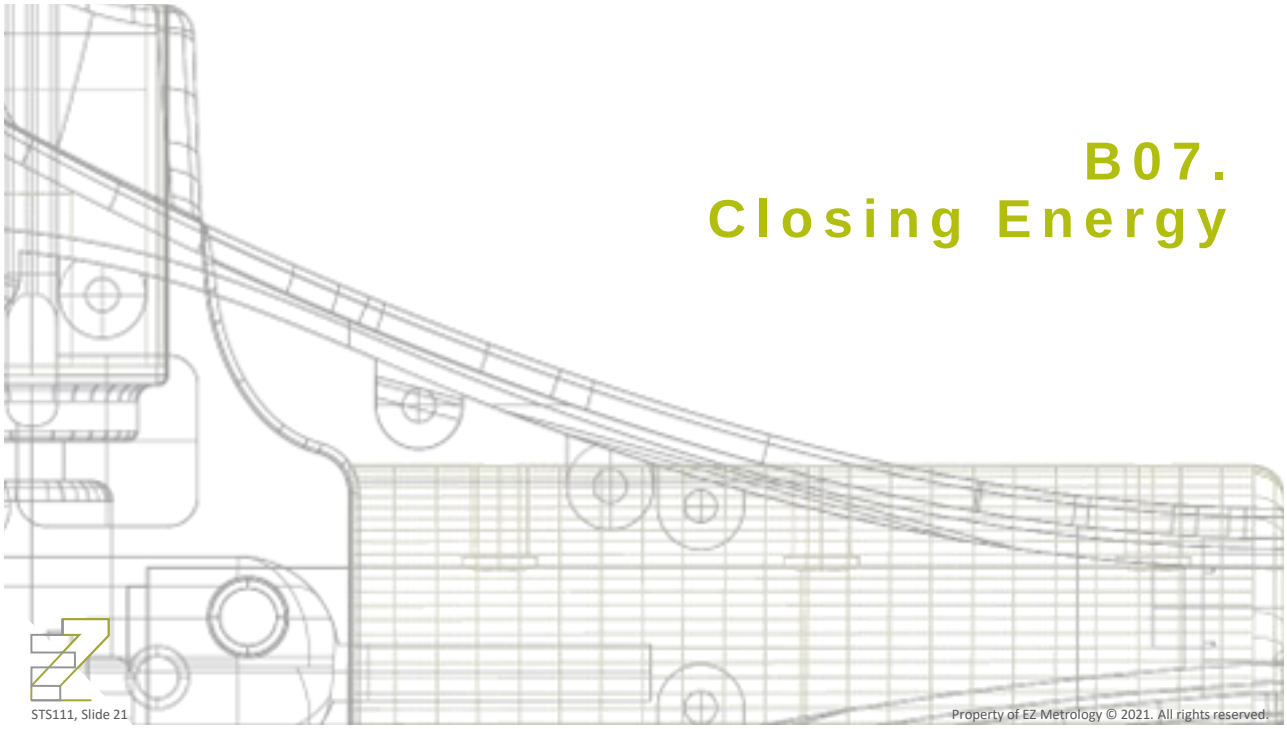

B07. Closing Energy

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B07. Closing Energy

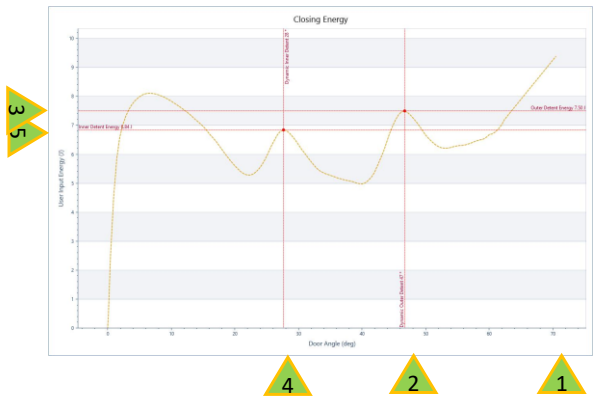
1. Curve and Points

Definition

Represents the energy the user has to provide to the door system to latch the door from any possible angle.

Points of Interest

1. **Open**: Energy required to close the door from full open angle.
2. **Outer Detent**: Outer detent angle.
3. **Outer Detent Energy**: Energy required to close the door from outer detent.
4. **Inner Detent** :Inner detent angle.
5. **Inner Detent Energy**: Energy required form the user to close the door from inner detent angle.



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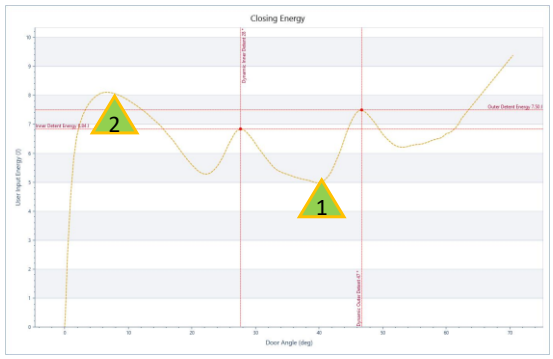
B07. Closing Energy

2. Application

The curve is uninterrupted over the full angle range. The door can only be positioned at rest in the 'peaks'; the detents or against the seals.



Particularities

1. **Just out of the detent**: It can be understood that it requires less energy to close once the door is out of the detent.

2. **Near seals**: To close the door from a position near the seals is harder as there is no additional energy from the door check that will help the closing efforts.

C. Review

C. Review

1. Chapter 11

Topics addressed during this chapter:

Energy Concept
Understand the different components in energy pie graph.

Sensitivity graph

Sweep Graphs

Closing energy

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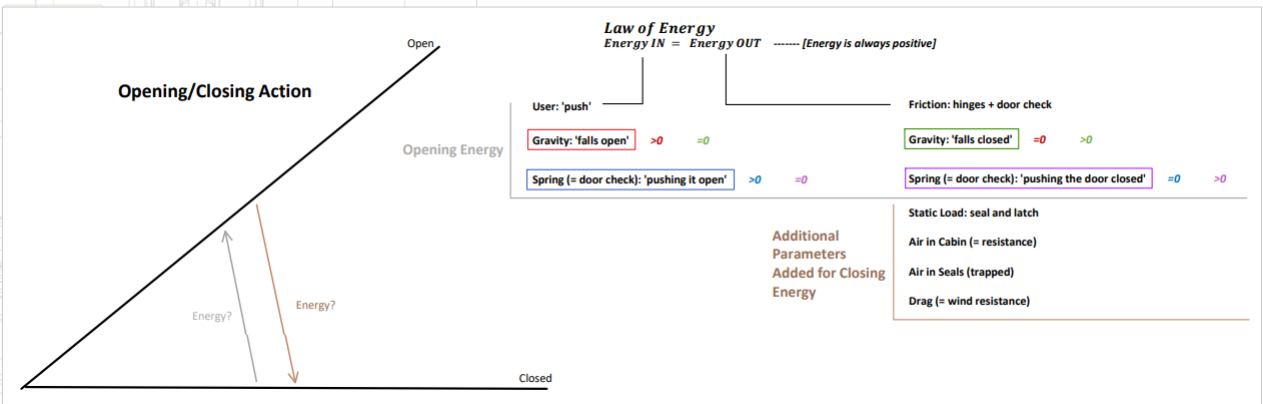
SketchBook



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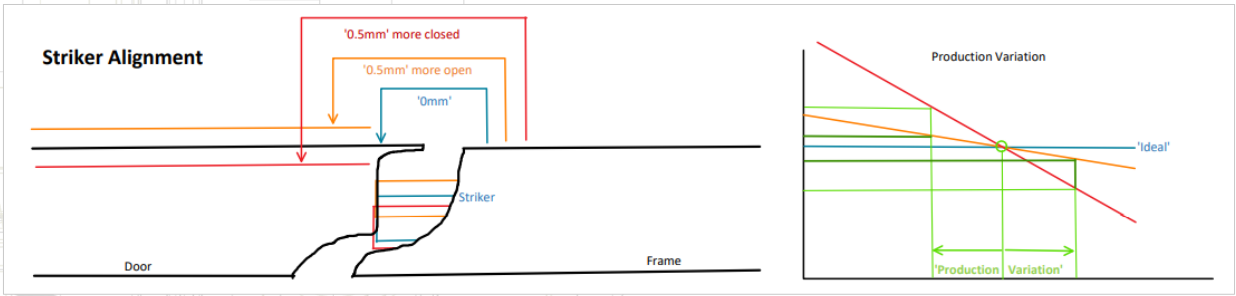
SketchBook



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