Guidelines for Applications with Offset (Moment) Loads

1. Introduction

Depending on the application conditions, significant forces can act on the clamp, potentially causing gap formation or product damage.

This document provides reference information for calculating the load applied to the clamp and comparing it with the specified clamping force and holding force. Please use this information to select an appropriate product for your application.

For clamping force, holding force, and clamping mechanism details of each product, please refer to the product overview list:

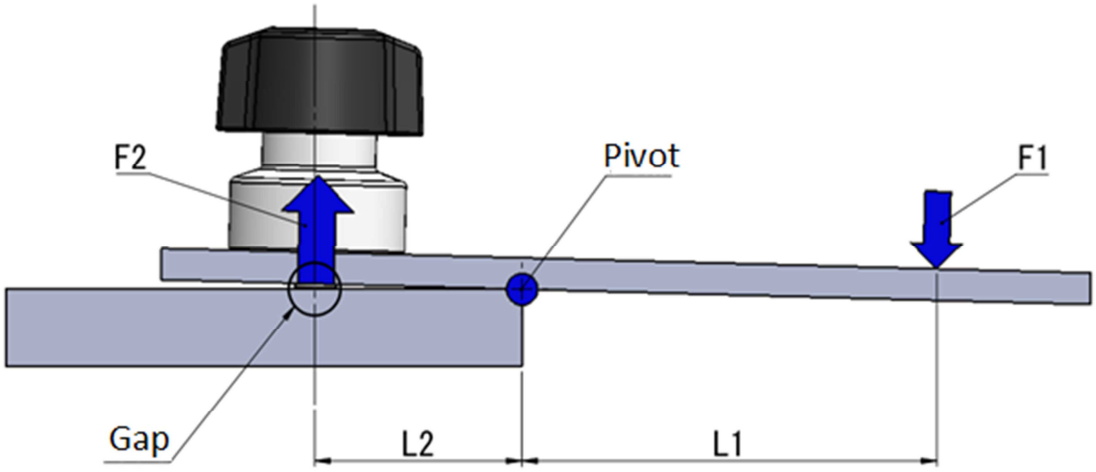
https://www.imao.com/files/en/pdf/pr-onetouchchakudatsu-list-e.pdf

Products with a Ball Lock Type clamping mechanism feature high holding force and are capable of maintaining minimal gap even when the applied load exceeds the clamping force.

For products with a Cam & Spring Type clamping mechanism, the clamping force is equal to the holding force.

2. Relationship Between Applied Load and Gap Formation

When the load applied to the clamp exceeds the clamping force, a gap occurs.



F1: External load

F2: Load applied to the clamp

Note: The “gap” refers to thedisplacement directly beneath the clamp. It does not represent the displacement at the tip of the workpiece.

(1) When F2 < Clamping Force

No gap occurs.

Note: For locations where firm contact must be maintained, or where movement or vibration is present, an appropriate safety factor should be considered.

(2) When Clamping Force < F2 < Holding Force

A slight gap (approximately 0 to 0.1 mm) occurs.

Note: For locations subject to movement or vibration, an appropriate safety factor should be considered.

(3) When Holding Force < F2 < Tensile Strength

A gap greater than 0.1 mm will occur.

The maximum gap varies depending on the product (approximately 0.5 to 2 mm).

Note: A safety factor should be applied when considering tensile strength.

(4) When F2 > Tensile Strength

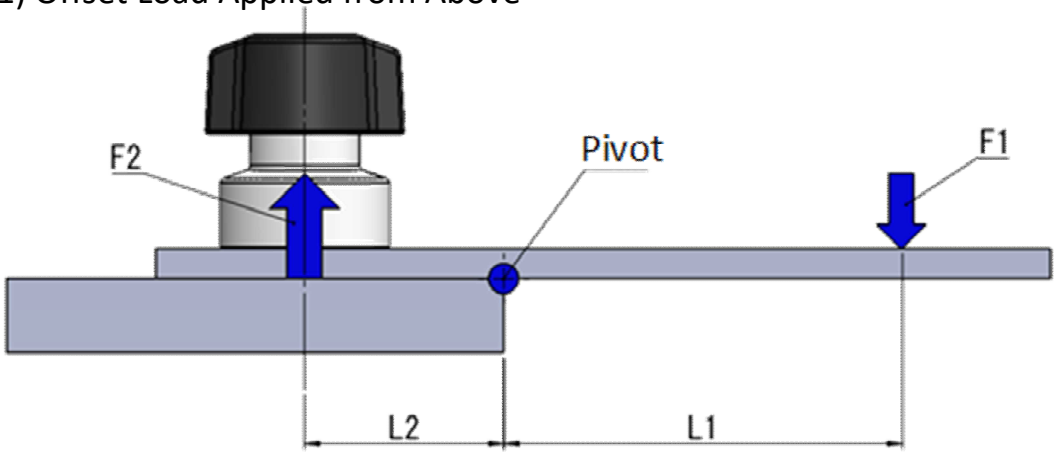
The product cannot be used under this condition due to the risk of clamp failure.

Ensure that F2 remains below the tensile strength.

Note: A safety factor should be applied when considering tensile strength.

3. Calculation Method for Load Applied to the Clamp (F2)

(1) Offset Load Applied from Above



The load F2 can be calculated using the following equation:

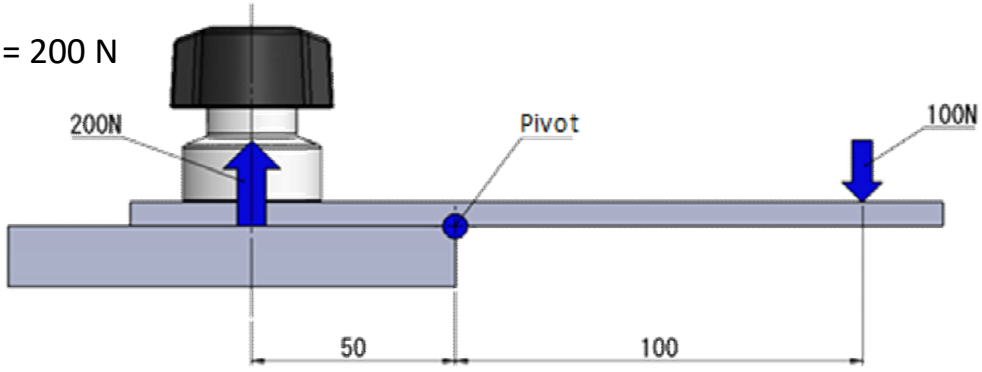
F2 = F1 × L1 / L2

When L1 is longer than L2, F2 increases according to the principle of leverage.

Increasing L2 improves the operating condition.

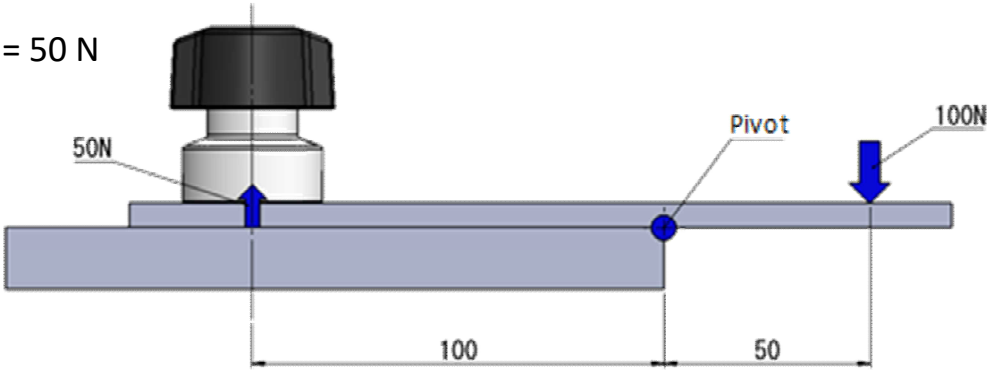
Example 1: F1 = 100 N, L1 = 100 mm, L2 = 50 mm

F2 = 100 × 100 / 50 = 200 N

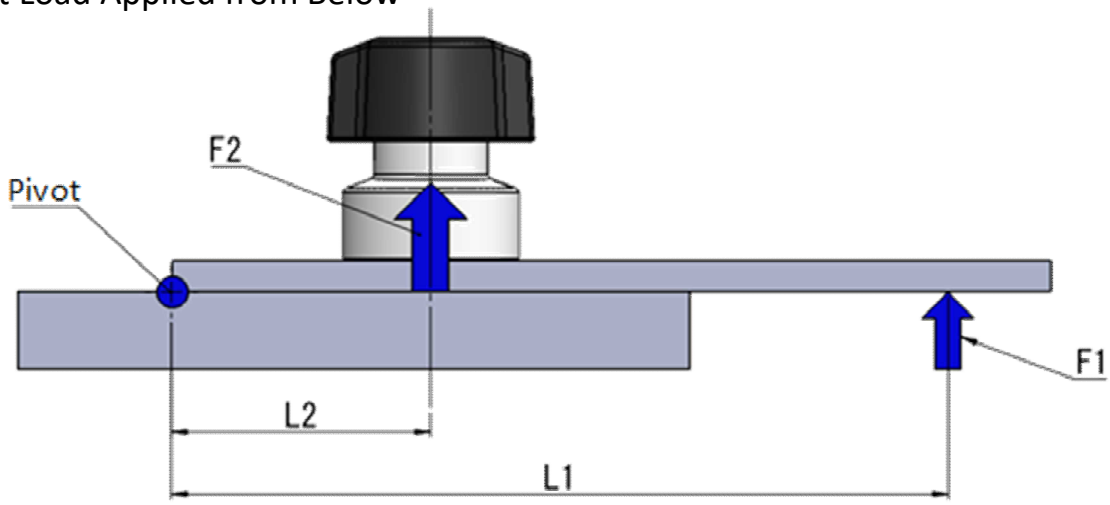


Example 2: F1 = 100 N, L1 = 50 mm, L2 = 100 mm

F2 = 100 × 50 / 100 = 50 N



(2) Offset Load Applied from Below



The load F2 can be calculated using the same equation:

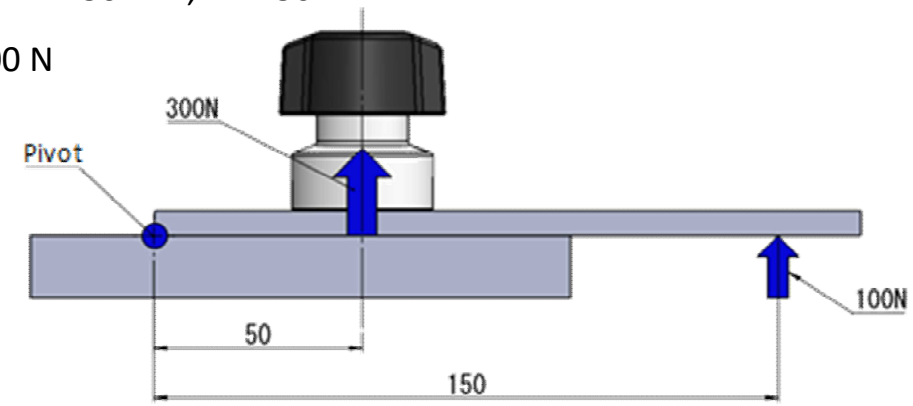
F2 = F1 × L1 / L2

When L2 is short, F2 increases significantly due to the principle of leverage.

Although increasing L2 improves the condition, L1 is always longer than L2 in this configuration. Therefore, F2 will be greater than F1.

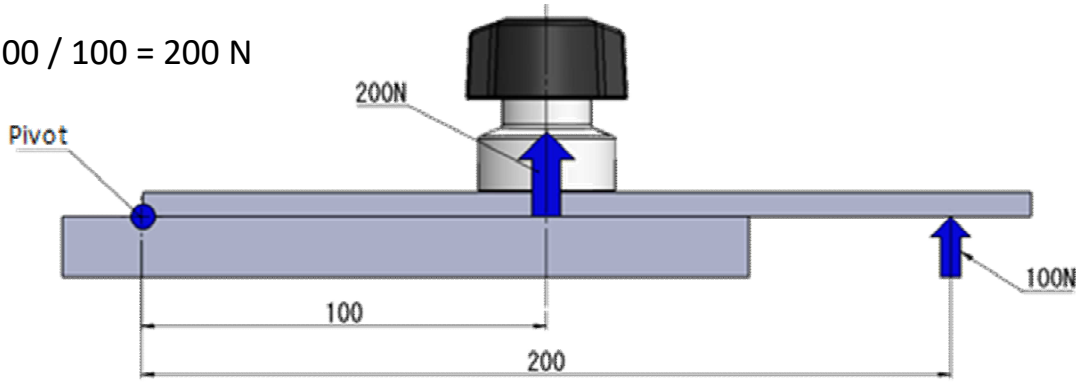
Example 1: F1 = 100 N, L1 = 150 mm, L2 = 50 mm

F2 = 100 × 150 / 50 = 300 N



Example 2: F1 = 100 N, L1 = 200 mm, L2 = 100 mm

F2 = 100 × 200 / 100 = 200 N



4. Design Considerations

The calculated load (F2) shall be quantitatively compared with the specified clamping force, holding force, and tensile strength of the selected product.

Product selection shall be based on the most severe expected loading condition, including static and dynamic components.

When vibration, cyclic loading, or impact loads are present, the influence of fatigue and repeated displacement should be evaluated in addition to static load comparison.

An appropriate safety factor shall be applied in accordance with the required reliability level and operating environment.

This document provides a mechanical reference model based on lever principles. Final validation shall be performed through design verification under actual operating conditions.