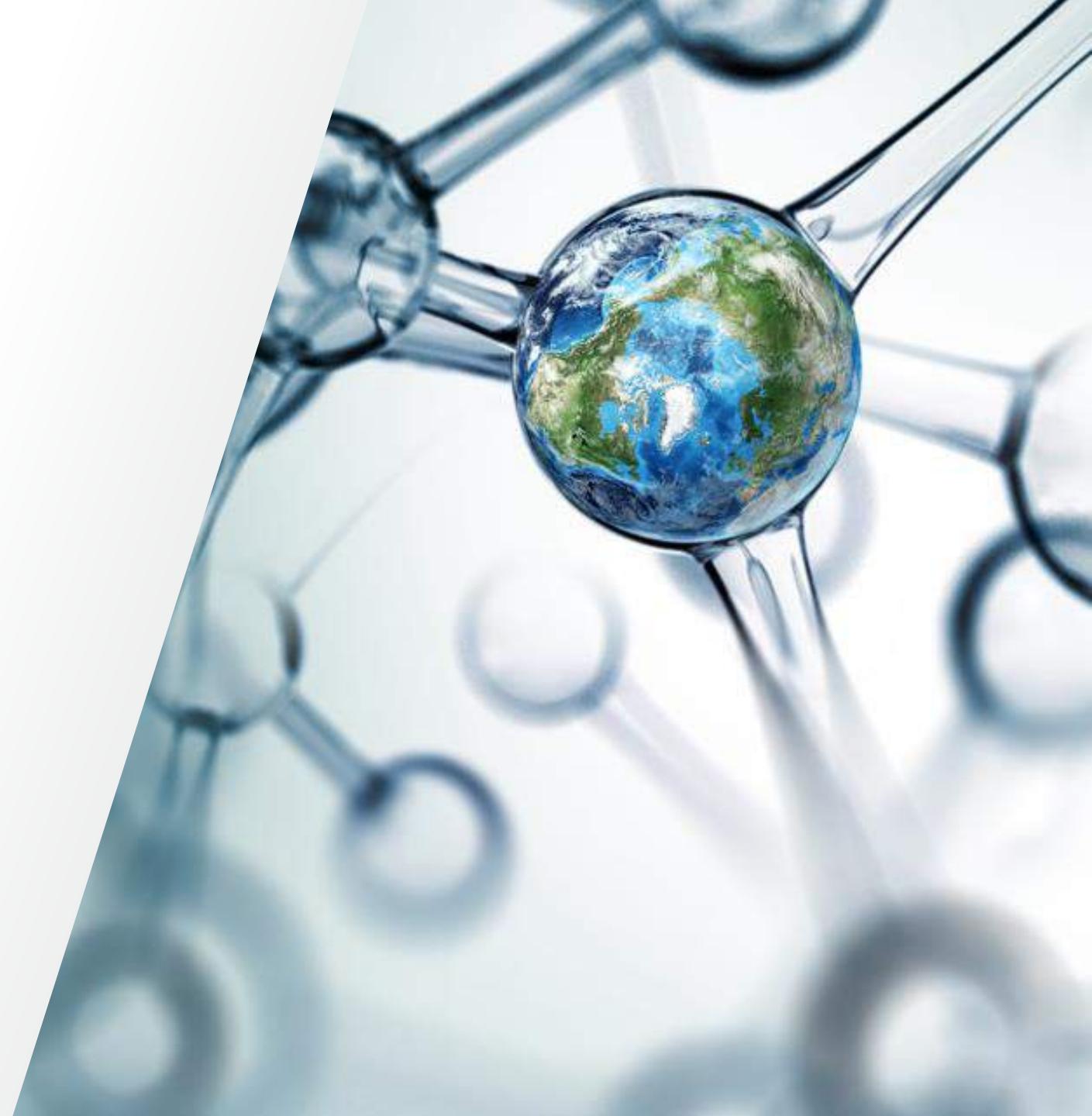


# Best Practices for Pipetting Ergonomics

**Maria Hidesand**

TSS Liquid Handling Solution

 The world leader in serving science



# Definition of Ergonomics



Ergonomics is “the science of fitting the job to the worker”

*Occupational Safety and Health Administrations (OSHA), Federal and State Programs*

## How is Pipetting Linked to Safety?

An overview of pipetting ergonomics, pipetting risk factors, methods for reducing risk of injury, and recommended solutions

# What happens If Ergonomics Is Overlooked?

## Musculoskeletal Disorders (MSDs)

### MSDs are injuries to:

- Muscles
- Nerves
- Tendons
- Ligaments
- Joints
- Cartilage
- Spinal discs



# What Happens If Ergonomics Is Overlooked?

## Pipetting risk factors

- Environment
- Repetition
- Force
- Posture



# Repetitive Strain Injuries are Painful

- Reduces ability and performance, resulting in lost time at work
- Reduces quality of life outside work
- Increases the number of worker's compensation medical claims
- Intrusive corrective action may be necessary, such as:
  - Wrist supports and splints
  - Surgery
- Pain and injury may be permanent



# Stages of Repetitive Strain Injuries

## STAGE 1

- Feel pain or discomfort while pipetting
- No reduction in productivity
- Reversible with rest

## STAGE 2

- Symptoms start early
- Feel pain in your thumb or wrist while pipetting
- Reduction in productivity
- Symptoms persist after work

## STAGE 3

- Pain even during rest
- Unable to perform light duties
- Pain may be permanent

# Pipetting Risk Factors

## Pipetting is a forceful activity

- Tip attachment
- Tip ejection
- Multiple arm/hand movements
- Reaching/stretching with thumb
- Plunger operation
- Gripping the pipette

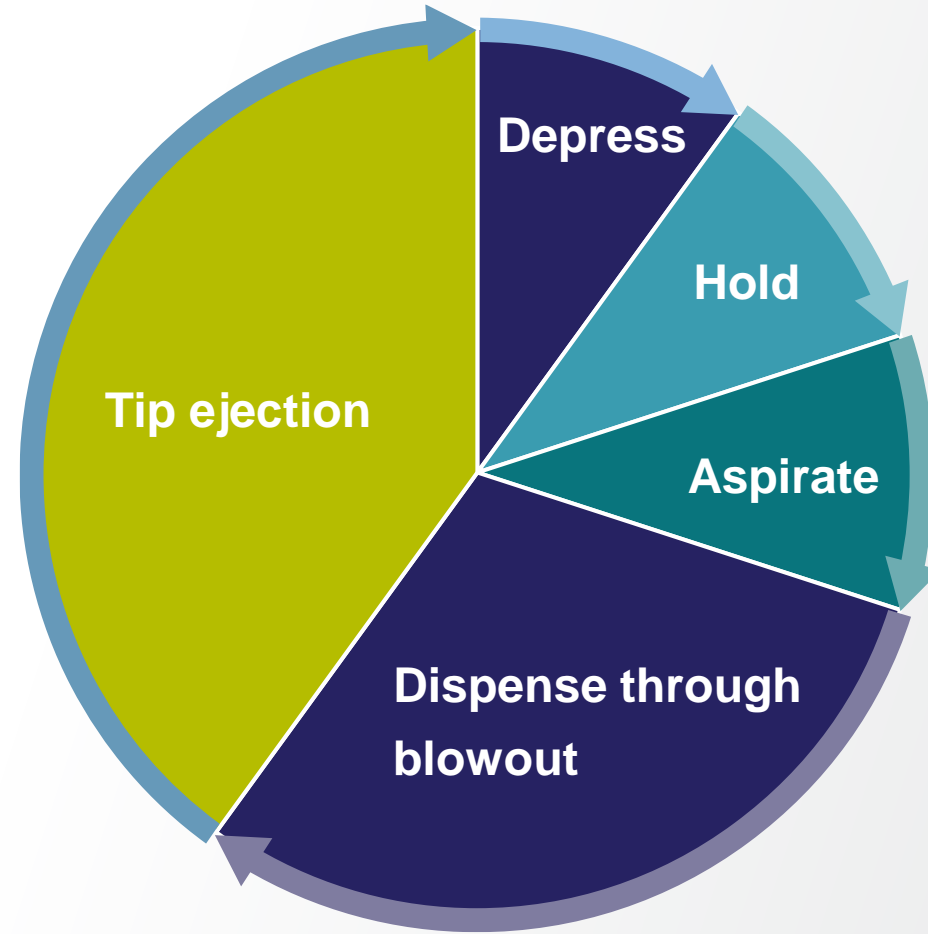
## Pipetting is a repetitive activity

- More than 500 hours per year pipetting are common
- Pipetting forces are measured in kg of force (1kg force = 9.8N)



# Reviewing the Pipetting Cycle

Air displacement pipetting  
action forces on the thumb



# You are at Risk

If you:

## Pipette over 80 minutes per day

- Pipetting 300 hours per year is linked to injury
- Hand and shoulder disorders are common among laboratory technicians using modern plunger-operated pipettes

Source: Björkstén et al. (1994) *Applied Ergonomics* 25: 88-94

## Use traditional heavily sprung manual pipettes

- Require excessive forces to operate



# One size does not fit all

Worker's compensation claims from ergonomic injuries represent an estimated **\$20 billion a year in lost-time** compensation costs alone.

Total costs are estimated to be \$120 billion annually when lost productivity and other indirect costs are considered.<sup>1</sup>

An estimated **9.5 million working days were lost** in 2014/15 through work-related musculoskeletal disorders that were caused or made worse by work.<sup>2</sup>

Work-related musculoskeletal disorders...are the most dominant, most expensive, and most preventable workplace injuries in the country.



# Repetitive Strain Injuries are Preventable



Repetitive Strain Injuries (RSIs)  
are preventable through the use of:

- Ergonomic practices
- Ergonomic tools

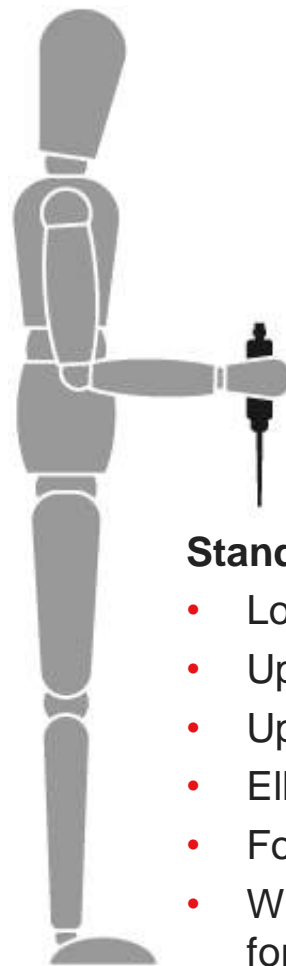
What does the Center for Disease Control and Prevention (CDC) recommend for pipetting ergonomics?

# CDC Recommendation for Posture



## Seated posture:

- Lower back supported by chair
- Upper back and neck upright
- Upper arm vertical
- Wrist in the same plane as the forearm



## Standing posture:

- Lower back and trunk upright
- Upper back and neck upright
- Upper arm vertical
- Elbow bent at 90°
- Forearm parallel to the floor
- Wrist in the same plane as the forearm



## Wrist posture:

- Forearm parallel to the floor
- Wrist in the same plane as the forearm

# CDC Recommendation for Environment

- 1 Take micro-breaks of 3 to 5 minutes for every 20 to 30 minutes of pipetting
- 2 Adjust the workstation so work can be done with arms close to the body
- 3 Use shorter pipettes
- 4 Use pipettes that fit comfortably in the user's hand
- 5 Keep samples and instruments within easy reach
- 6 Use low-profile waste receptacles for used tips
- 7 Use anti-fatigue matting when it's necessary to stand for long periods of time
- 8 Use an adjustable stool or chair when sitting



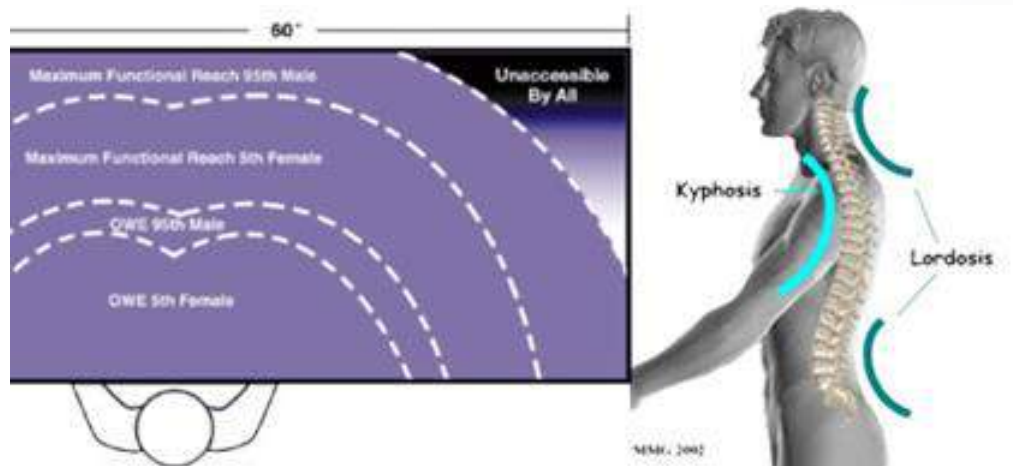
# CDC recommendation for environment

## Work surface<sup>1</sup>

The primary work surface must have sufficient space to handle all equipment.

Work surface top should be at least as large as a standard office desk, 30" deep by 60" wide

Should take into account the maximum reach of both male and female workers. This prevents hunching of the shoulders and repetitive stretching which increases muscle fatigue and rotates the spinal column out of the ideal double "S" curve.



# CDC recommendation for environment



## Lighting

- Bright lights should be kept out of the worker's field of vision. Monitors and screens should be tilted when possible to avoid glare from overhead sources.  
Overhead lighting must be flicker free

## Air Flow

- Maintaining fresh air in the work place as well as keeping dust in the area to the minimum will improve worker productivity.

## Temperature

- Ideal settings are from 68-72°F/  
20-22°C with a 30-50 percent relative humidity





# CDC Recommendations for Improved Efficiency

1

Minimize repetitive tasks

2

Use index finger trigger mechanisms

3

For tasks such as mixing or aliquoting, use an electronic pipette with mixing functions

4

Use an electronic multichannel pipette for large microplate reagent additions



# CDC Recommendations for Reducing Force

1

Clean and service pipettes on a regular basis

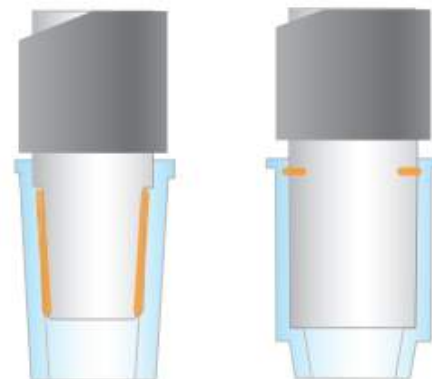
2

Use racked pipette tips that fit correctly and are easy to eject

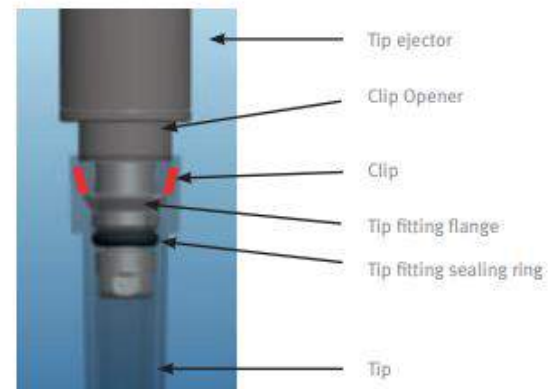
3

Use minimal force when applying pipette tips

Friction Sealing System Diagram shows the sealing area highlighted in orange.



ClipTip System Diagram shows how the clips lock the tip firmly in place.

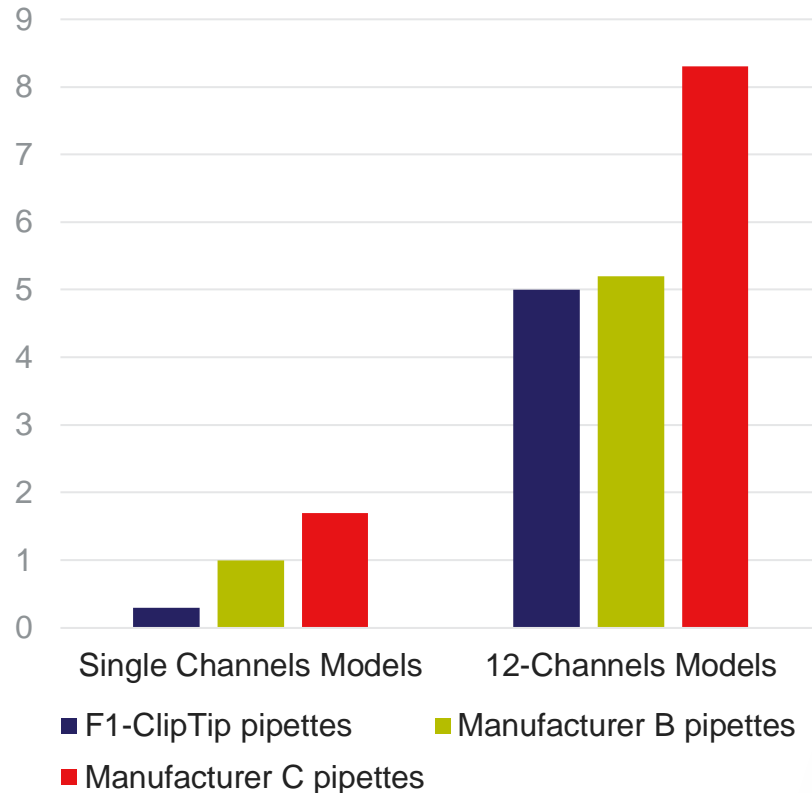


## Thermo Scientific Technology

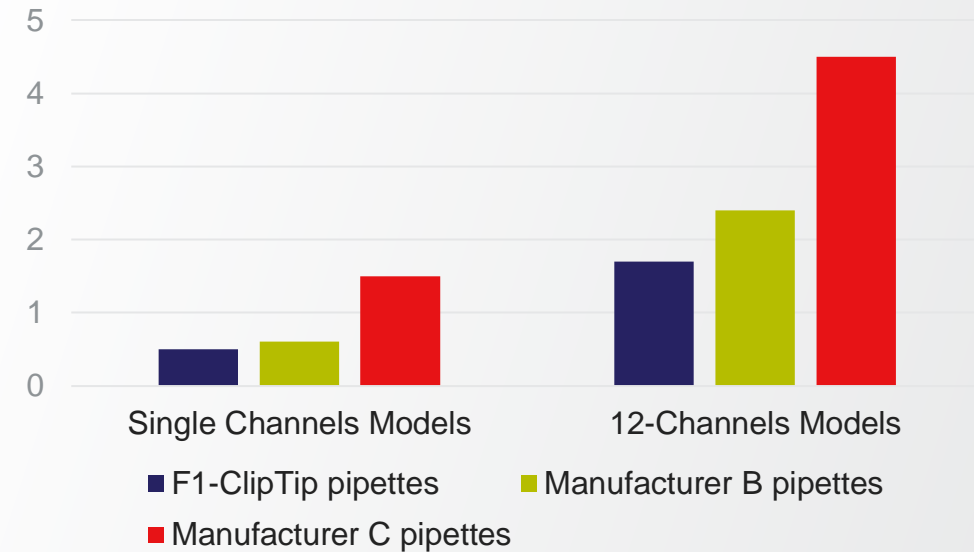
Thermo Scientific™ F1-ClipTip™ and E1-ClipTip™ Technology

# F1-ClipTip and E1-ClipTip Technology

## Attachment forces



## Ejection forces



- **Up to 75%** lower attachment forces compared to friction based systems
- No more banging and rocking to load tips
- Reduced the risk of RSIs

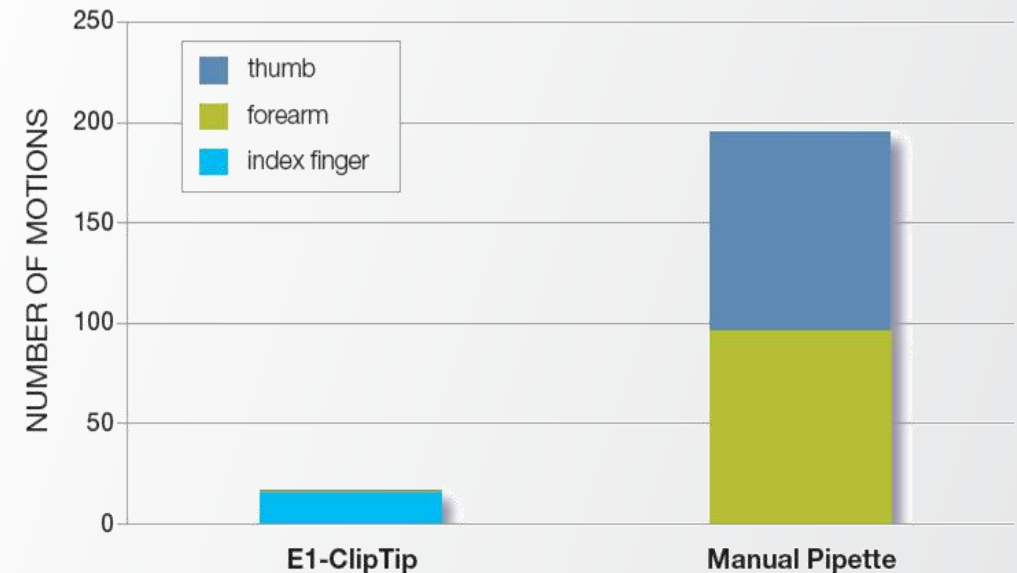
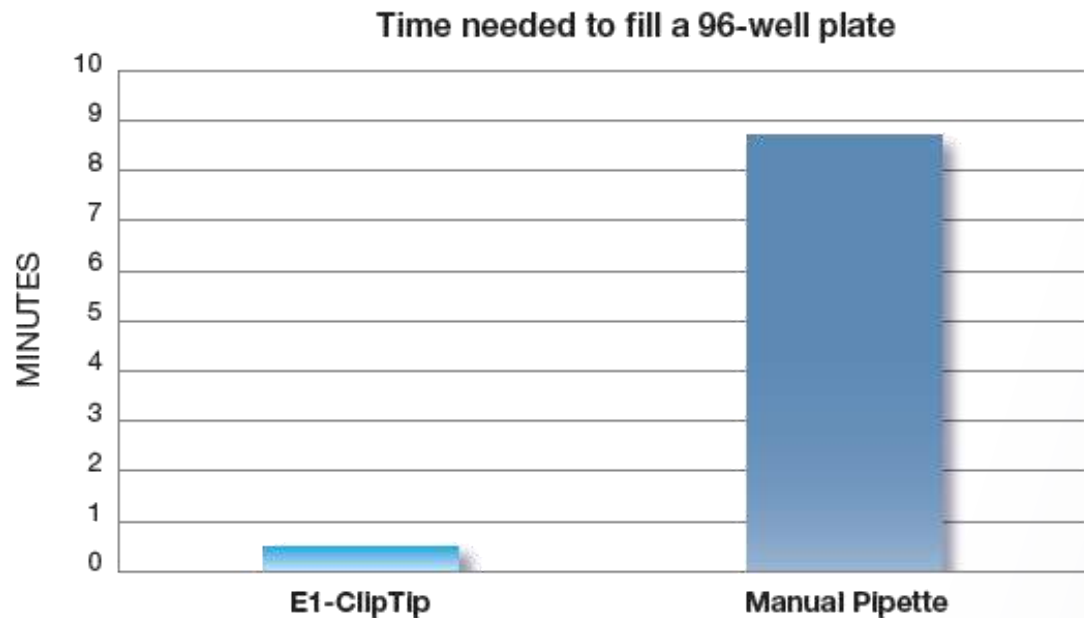
Source: Thermo Scientific ClipTip Technology – Part 3 Reduce the Risk of Repetitive Strain Injury (RSI)

# E1-ClipTip Technology

Transfer multiple samples between different lab formats at once:

- Test tubes to 96/384-well microplates
- 96-well microplate/test tubes to agarose gel
- 48/96-well microplate to 384-well microplate

**Over 90%** time savings and fewer repetitions compared to single channel manual pipettes. The reduction in repetitions can lessen the risk of pipetting mistakes and RSI<sup>1</sup>



Source:1. Thermo Scientific Smart Note 2016 -: Is there an easier and more efficient way to transfer liquids between various labware formats, than using traditional handheld pipettes?

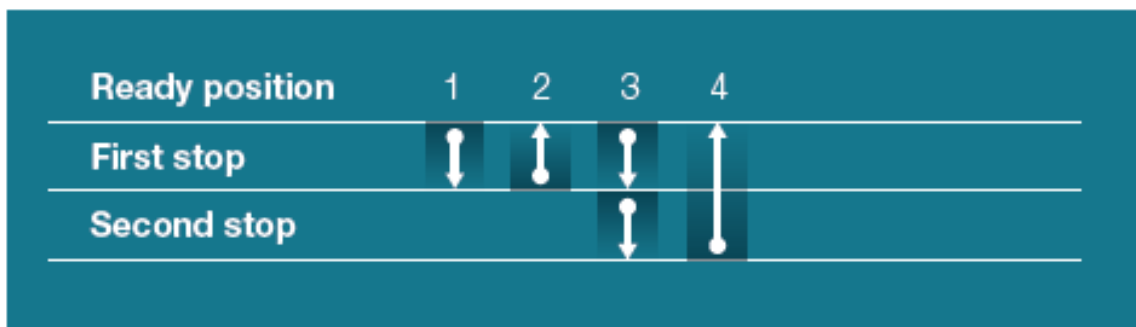
# Good Laboratory Pipetting Guide

## Pipetting education and advice

- Selecting the best pipette and tip
- Proper pipetting techniques
- Ergonomics
- Maintenance and service

### For standard pipetting use the Forward Technique:

Recommended for aqueous solutions, such as buffers, diluted acids, or alkalis, this technique is commonly used when pipetting and mixing a sample or reagent into another liquid.



thermo scientific

## One fluid movement – pipetting for a lifetime

An overview of pipetting techniques,  
ergonomics, maintenance and  
optimal pipette and tip selection



# References

- Centers for Disease Control - [cdc.gov/](https://www.cdc.gov/)
- National Institute of Health - [nih.gov/od/ors/ds/ergonomics/labergo.html](https://www.nih.gov/od/ors/ds/ergonomics/labergo.html)
- National Institute of Environmental Health Sciences – Guide to Laboratory Ergonomics  
[niehs.nih.gov/odhsb/ergoguid/chapi.htm](https://niehs.nih.gov/odhsb/ergoguid/chapi.htm)
- Chemical Health and Safety – Laboratory ergonomics The wake-up call: A CASE STUDY (Immunex)
- Smart Pipetting: Using Ergonomics to Prevent Injury; Joan Erickson and Bob Woodard

# Thank you

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