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Application Note

October 06, 2021

Keywords or phrases:
CCR10-C, Automated Weight Determination, Precision, Uncertainty, Throughput, Calibration, Mass Dissemination, Weight Comparison, ASTM E617, OIML R111

High Precision Automated Weight Determination of the Finest Weights: Direct Comparison of the Output of the CCR10-Compact Table-Top Robot vs Manual Processing on MCM Mass Comparators

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Abstract

Reliability, precision, and productivity are the major benefits when it comes to weight calibration and dissemination processes. To meet the requirements of the National Metrology Institutes, private calibration laboratories, and weight manufacturers, there are many factors which need to be considered, both from the operator´s perspective and from the instrument side. This article focuses on the typical calibration workflows (mass dissemination and weight comparison) executed with an operator on a manual mass comparator and executed by an automated robotic system. The aim of this study was to compare the two options to execute these workflows and highlight the advantages and

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disadvantages of both methods (manual vs automated). Weights at fine ranges from 0.05 mg up to 10 g were tested and handled. Preparation time, the handling process, and execution of the measurements were considered, and manual versus automated workflows were compared. The results show that automated weight handling not only enhances throughput but significantly reduces the error rates which typically derive from manual sample processing, such as dropping the weight or mixing up weights especially in case of high workload. An additional advantage of the automated handling is that there is no need of a skilled person to operate the automated system. Further, our results indicated a very short return on investment (ROI) of 1 to 2 years, depending on the type of application.

Introduction

Reducing uncertainty, increasing throughput, freeing resources, and saving costs are the major objectives during the execution of weight calibration and dissemination. The aim of this study was to showcase the advantages of the CCR10-Compact Table-Top Robotic Systems from Sartorius versus manual mass comparators. Weights from 0.05 mg to 10 g were used for testing and handling. Preparation time, handling process, and measurement process were considered, with the focus on the actual contribution time of a trained personnel.

The following parameters were tested and compared using manual mass comparators vs the Sartorius CCR10-Compact Table-Top Systems:

- Time needed for an operator to execute 5X ABA cycles for mass dissemination of E1 class weights
- Time needed for an operator to execute 3X ABA cycles for direct weight comparison of E2 and F1 class weights
- Average number of weights handled per time (day | week | month)
- Return on investment (ROI)

Methods

ABA cycles were performed according to OIML R111-1, where “A” represents weighing the reference weight and “B” represents weighing the test weight. For E1 class weights, 5X ABA cycles (Figure 1) were executed; and for E2 and F1 class weights, 3X ABA cycles were executed (Figure 2 and Figure 3, respectively). The ROI values were calculated using 18 Euros per hour average cost of a technician working 7 hours per day (excluding breaks) and 5 working days a week (Figure 6). For mass dissemination of E1 weights, CCR10.7-C, MCM6.7 and MCM36 were considered. For weight comparison of E2 weights, CCR10.7-C and MCM6.7 and MCM36 were compared. For weight comparison of F1 weights, CCR10.6-C and MCE10.6S-2S00-M were taken into consideration.

Results

Figure 1

Time Needed for an Operator to Execute 5X ABA Cycles for Mass Dissemination of E1 Class Weight

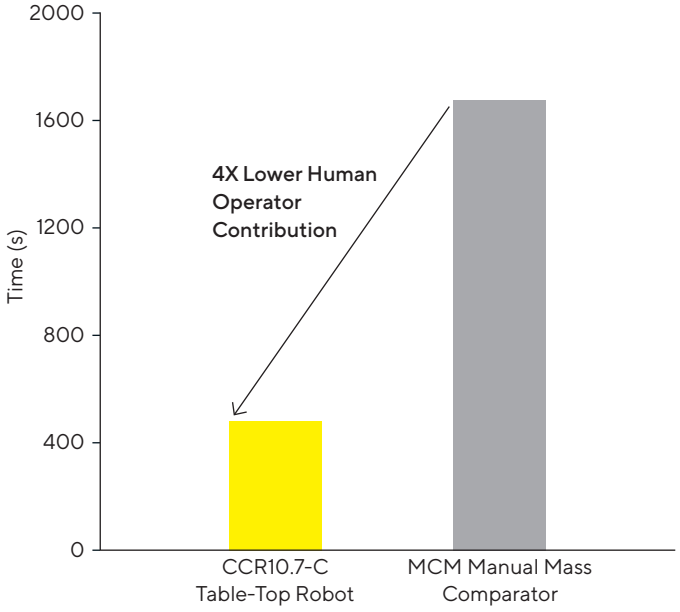


Figure 2

Time Needed for an Operator to Execute 3X ABA Cycles for Direct Weight Comparison of E2 Class Weights

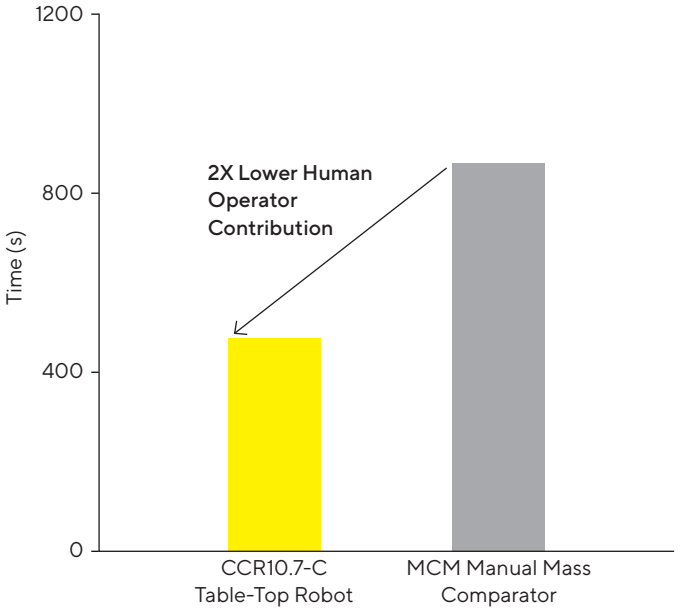


Figure 3

Time Needed for an Operator to Execute 3X ABA Cycles for Direct Weight Comparison of F1 Class Weights

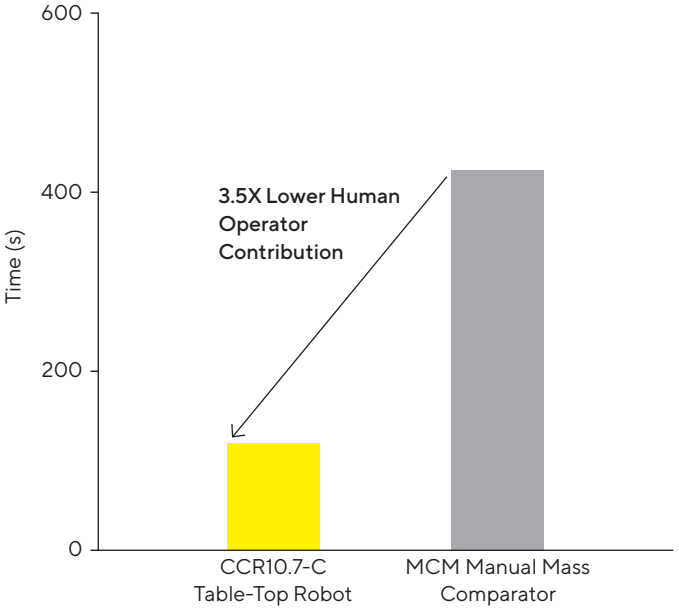


Figure 4

Average Number of E1 Weights Handled Per Week

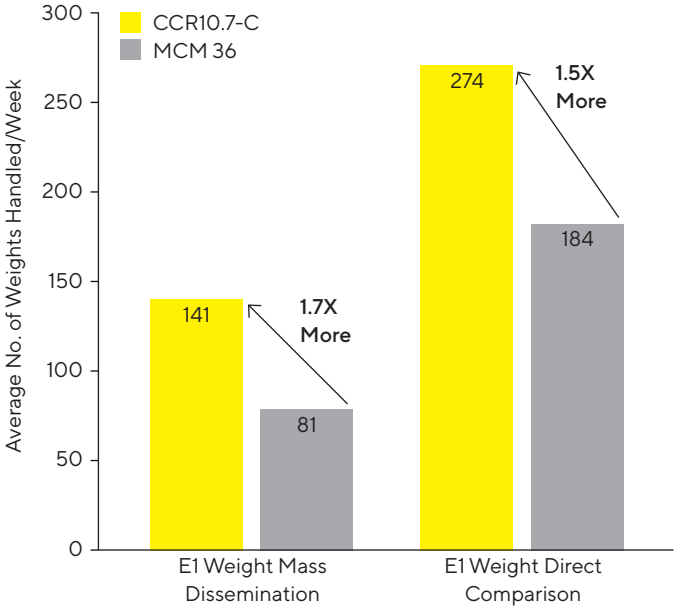


Figure 5
Average Number of E2 and F1 Weights Handled Per Week

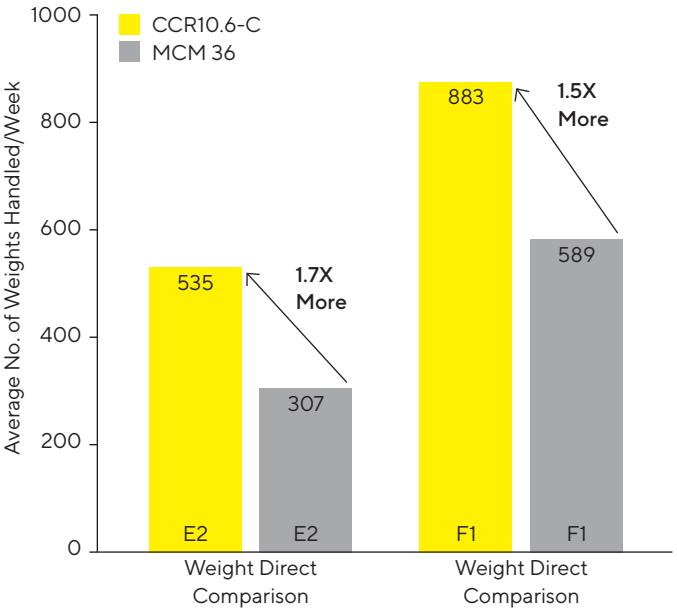
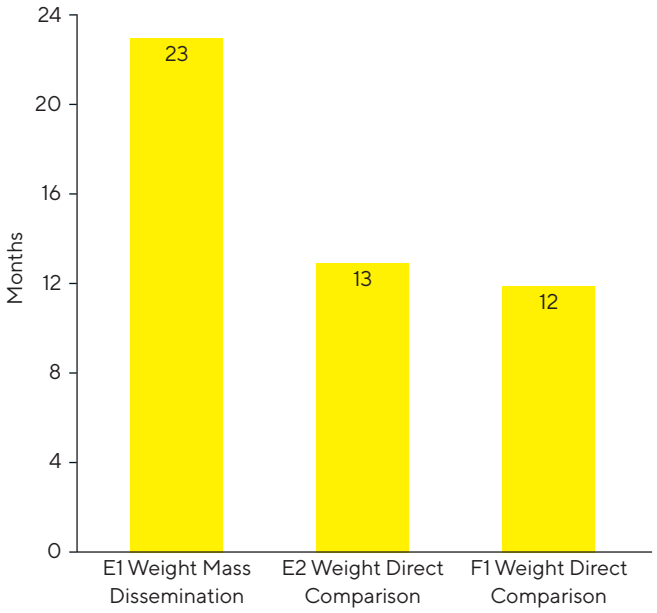


Figure 6
Return on Investment



In addition to the data presented above, it is worth mentioning that the following two aspects are to be considered according to the feedback from laboratory technicians performing these workflows on a daily basis:

1. Easier and safer weight handling with the CCR10-Compact Robotic Systems, especially handling wire- or leaf-shaped weights.

2. No more 'mix up' of the weights. Daily users find the weight sorting plate (YAW10CCR-C) especially useful. The design of this accessory allows error-free and straightforward processing of the weights despite the large capacity of the robotic systems (up to 120 weights/load).

Executive Summary

Our results have proven that where larger amount of weights need to be calibrated, a CCR10-Compact Robotic System is a better choice and a good investment compared to investing in manual mass comparators for the following main reasons:

1. Two to four times less operator's contribution for mass dissemination or direct weight comparison measurements of E1 to F class weights
2. Not only the operator's involvement can be significantly reduced, but the robotic systems can handle 1.5 to 1.7 times more weights per given time
3. There are 12 to 24 months of the return on investment, depending on the model and the application required

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Version 1 | 10 | 2021