

Force Platform Validation Report

Version: 1.0 Date: May 2026 Prepared by: Cronox Sports

Status: Preliminary internal validation — pending publication of external university study

1. Introduction and Purpose

This document aims to describe the internal validation process carried out on the CRONOX force platforms, in order to provide clients and users with confidence in the reliability and accuracy of the measurements obtained during use in sports performance and functional assessment contexts.

This internal validation has been designed as a provisional supporting document while awaiting the publication of results from an independent validation study currently underway, conducted in collaboration with UNIVERSIDAD ALFONSO X EL SABIO, MADRID. That study, broader in methodological scope, will in due course provide formal scientific evidence on the validity and reliability of the system. Until then, the tests recorded in this report provide an empirical basis for concluding that the platforms offer consistent behaviour concordant with reference instruments recognised in the field of sport and applied research.

2. Materials and Methods

2.1 Description of the Evaluated System

The force platforms evaluated are the CRONOX FORCE ONE, with a sampling frequency of 940Hz, a measurement range of 0–20,000 N, and a resolution of ± 2 N. The analysis software used was CRONOX FORCE APP for iOS, version 3.1.

2.2 Reference Instruments Used

One reference instruments widely used in sport and research were employed for system validation:

Hawkin Dynamics Force Platforms: a high-precision reference system, widely validated in the scientific literature, used for comparison of kinetic variables in vertical jump (CMJ) and maximum isometric pull test (IMTP).

3. Comparative Validation Against Hawkin Dynamics Platforms

3.1 Evaluation Protocol

To compare the response of the CRONOX platforms against a high-level reference system, a battery of tests was carried out simultaneously on both systems. Subjects

performed the tests on the CRONOX platforms, which were placed on top of the Hawkin Dynamics platforms, ensuring complete temporal and spatial coincidence of measurements.

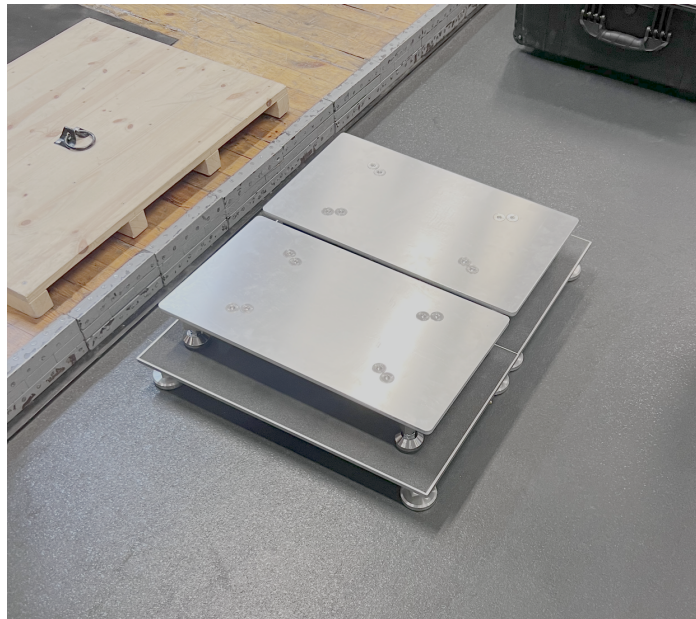


Fig.1 Experiment setup placing the Cronox plates over the Hawkin plates.

The tests selected were the countermovement jump (CMJ) and the isometric mid-thigh pull test (IMTP), as they are two of the most widely used protocols in neuromuscular performance assessment and present very different force profiles, enabling evaluation of system behaviour under both explosive dynamic efforts and sustained high-intensity isometric contractions.

3.2 Countermovement Jump (CMJ)

The CMJ is a vertical jump test involving an eccentric loading phase followed by an explosive concentric propulsion. The main variables analysed were peak force, flight time, time to take-off, and gross impulse.

Each subject performed 3 valid repetitions following the standard protocol: standing start, hands on hips, landing on the platform. Data from both systems were recorded simultaneously and agreement between the resulting force-time curves was analysed.

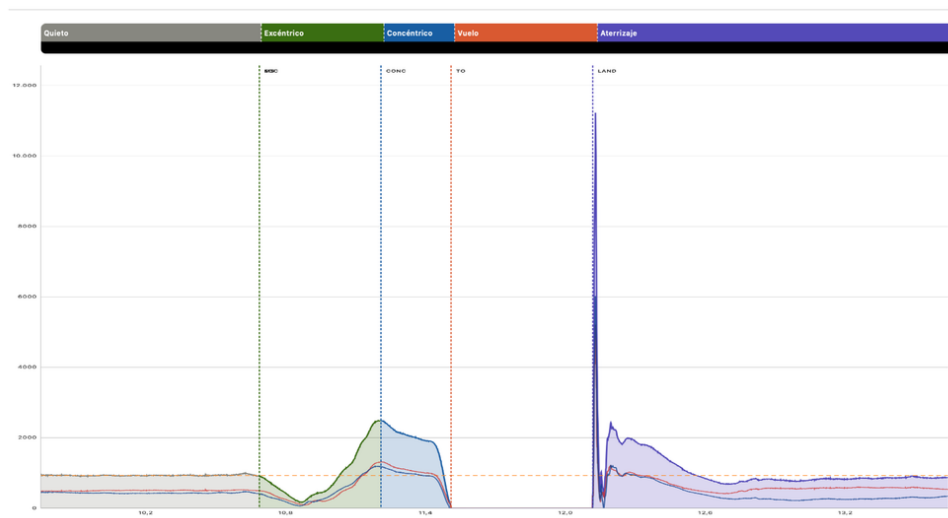
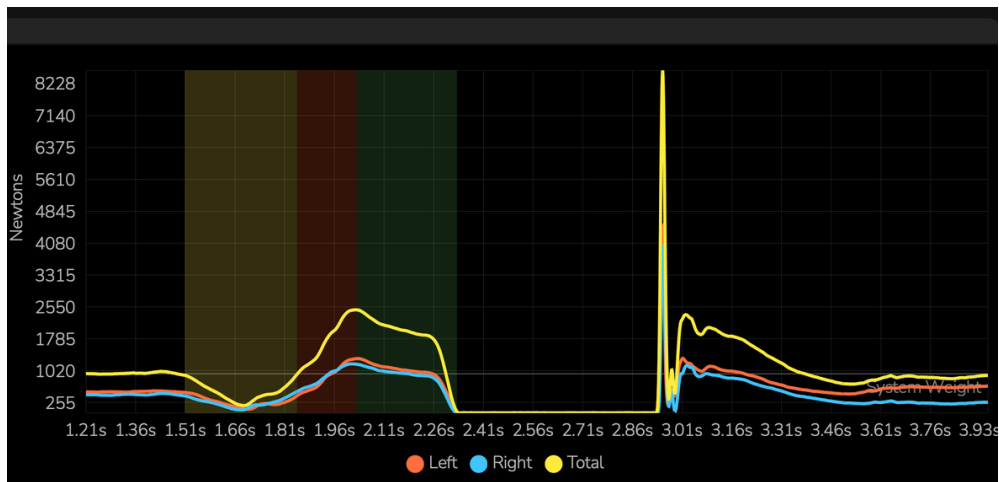


Fig 2. Visual comparative for the $F(t)$ curve between Hawkin Dynamics force plates (above) and Cronox Force Plates (below) for a CMJ.

	Hawkin Dynamics	Cronox Force Plates
Flight time	603 ms	607 ms
Time to take off	822 ms	821 ms
Total impulse	1036.67 N·s	1035.71 N·s
Jump Height (w/ impulse)	0.381 m	0.386 m
Peak Force	2477	2486 N
Force @ min. displacement	2478 N	2483 N

Concrete example from a basketball player. At first glance, the graphs and results are virtually identical.



Información

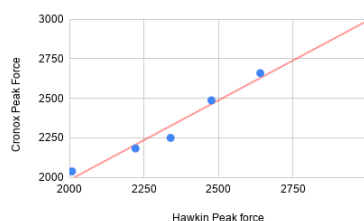
Cronox Sports is aware that the sample represented (n=5) is very small. This document is therefore purely empirical, pending the external validation study by the aforementioned university.

Analysing 5 samples from 3 different subjects, the following was obtained:

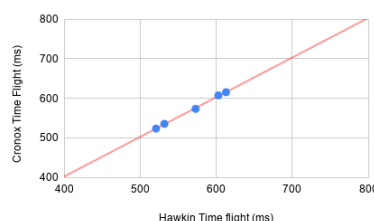
Concordance Table by Variable

Variable	Cronox (mean)	Hawkin (mean)	RMSE	ICC(2,1)
Peak Force (N)	2345,8	2337,8	44,8 N	0,982
Flight Time (ms)	568,4	570,6	2,6 ms	0,998
Total Impulse (N·s)	944,8	944,6	38,9 N·s	0,973

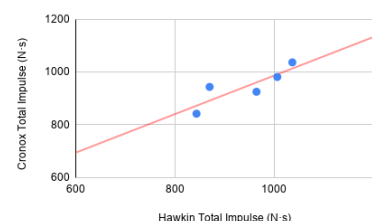
Peak Force (N)



Time flight (ms)



Total Impulse (N·s)



The results showed a high level of agreement between both systems for the three variables analysed. Peak force yielded an ICC of 0.982 with an RMSE of 44.8 N, flight time an ICC of 0.998 with an RMSE of 2.6 ms, and total impulse an ICC of 0.973 with an RMSE of 38.9 N·s. The observed differences fell within the variability margins accepted in the literature for this type of instrumental comparison, although the lower concordance index for total impulse is attributed to the limited sample size of this preliminary validation (n = 5), whose interpretation will be confirmed by the ongoing external validation study.

3.3 Maximum Isometric Strength Test (IMTP)

The IMTP is an isometric maximum strength assessment protocol in which the subject exerts a maximal pull against a fixed bar in a standardised position of semi-flexed knee

and hip. Variables analysed included peak force and analysis of the $F(t)$ curve. Three subjects performed one or two maximal contractions. The CRONOX system recorded data simultaneously with the Hawkin Dynamics platforms throughout the protocol.

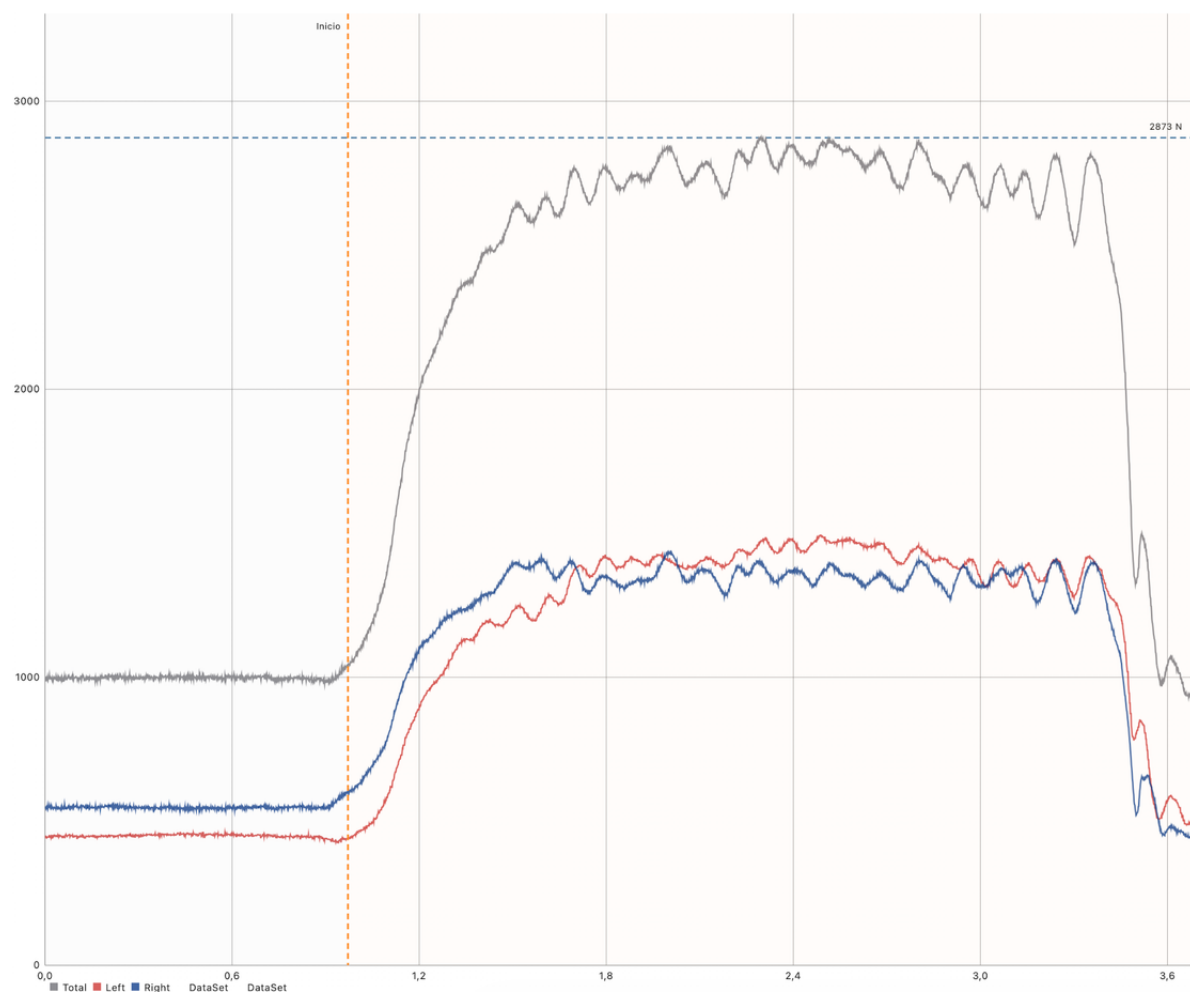
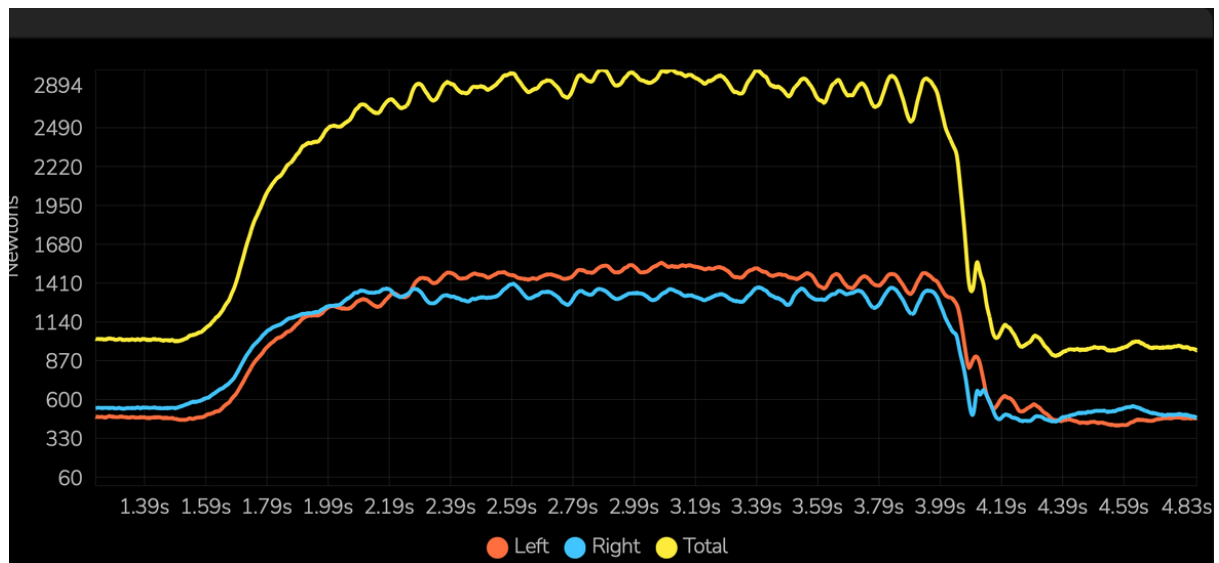
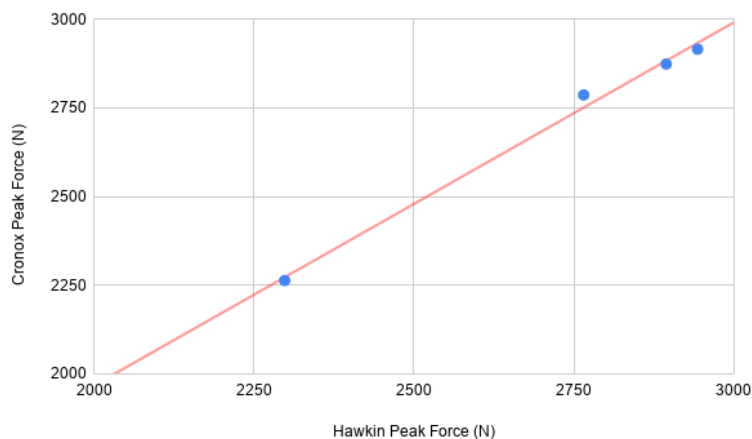


Fig 3. Visual comparative for the $F(t)$ curve between Hawkin Dynamics force plates (above) and Cronox Force Plates (below) for a isometric effort IMTP.



At first glance, both results are virtually identical — both in the force-time curve and in the maximum peak force values.

Comparison of the isometric peak force recorded during the IMTP showed a close correspondence between both systems. The agreement values obtained ($ICC = 0.995$; $RMSE = 26.9$ N) confirm that the CRONOX system faithfully reproduces the maximum isometric force recorded by the Hawkin Dynamics reference system, with absolute differences below 35 N in all analysed cases.

Since this validation is based on a limited sample size ($n = 4$), these results should be interpreted as a preliminary approximation, whose statistical robustness will be supported by the ongoing external validation study.

4. Conclusions

The internal validation tests described in this document allow us to conclude that the Cronox force platforms provide reliable measurements concordant with recognised reference systems in the following respects:

- Agreement with Hawkin Dynamics platforms: in both the CMJ and IMTP force profiles, the Cronox system reproduces the force-time curves recorded by the reference system with high fidelity, with errors within the margins accepted in the literature.
- Linearity and accuracy under static load: the incremental load test demonstrates that the system responds in a linear and precise manner to known weights across the full evaluated load range.

Taken together, these results support the use of Cronox platforms in sports performance assessment, training, and longitudinal athlete monitoring contexts, pending publication of the formal validation study currently underway with UNIVERSIDAD ALFONSO X EL SABIO, MADRID.