EDUCATION AND PRODUCTION

An Automated Weighing System for Use in Poultry Research[1]

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ABSTRACT The conventional method of obtaining weight data in poultry research—counterweight balances and manual data recording—is labor intensive and subject to errors. A new system has been developed in which an electronic balance is connected to a data terminal with recording capability. The system accurately and rapidly obtains weight data which are then transferred directly into a computer for processing.

(Key words: data analysis, computers, electronic scales, data processing, data recording, automated weights)

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INTRODUCTION

Poultry research stations must routinely weigh thousands of birds ranging from a few grams to several kilograms. When birds are to be individually weighed, 500 g scales with counterweights are generally used to provide the accuracy required for small birds and the extended range required for large birds. There are at least five sources of error in obtaining weight data with this system: 1) incorrectly summing the scale reading and the counterweight total; 2) incorrectly calling out the weight; 3) misunderstanding the called weight by the data recorder; 4) incorrectly entering the weight on the data sheet; and 5) reading the raw data and re-entry into a calculator or computer for data processing. This system is also labor intensive and time consuming when large numbers of data are involved.

This paper describes a data acquisition system developed to obtain individual weights and insert the data into a computer without the sources of error and high labor requirements inherent with the conventional system.

WEIGHING SYSTEM DESCRIPTION AND SPECIFICATIONS[1]

The system is composed of an electronic balance and a data terminal with accessories to permit rapid weighing and simultaneous printing and storage in memory of the weights. The terminal, with the data in storage, is later used to feed the data into a computer for processing.

The electronic balance, a Mettler PK36, is a top-loading scale with dual range—0 to 30 kg and 0 to 6 kg. Readability is 1 g in the high range and .1 g in the low range. The balance uses electronic load cells, analog to digital conversion, and built-in data interface so that the weights can be handled by standard data storage and processing equipment. The balance also displays the weights in digital form on a lighted panel.

The data terminal, a Texas Instruments Model 765, is a portable instrument with 20,000 characters of nonvolatile bubble memory data storage, 30 characters-per-second thermal printer, keyboard, and built-in acoustic coupler for connecting the terminal to a remote computer *via* telephone. The memory is optionally expandable to 80,000 characters in increments of 20,000. The nonvolatile memory is capable of retaining data in storage even though the terminal is disconnected from electric power.

The data interface provided with the Mettler balance is of the passive, 20 mA, current-loop type. The Texas Instruments 765 terminal is equipped with an EIA RS-232-C serial interface. Therefore, an Expandor, Inc. Model 101-2A converter is required to connect the balance to the terminal.

Most small computers are provided with the RS-232-C serial interface; therefore, the TI 765 terminal can be connected directly to a small

[1]*Mention of a trade name, proprietary product, or specific equipment does not constitute a guarantee or warranty by the US Department of Agriculture and does not imply its approval to the exclusion of other products that may be suitable.*

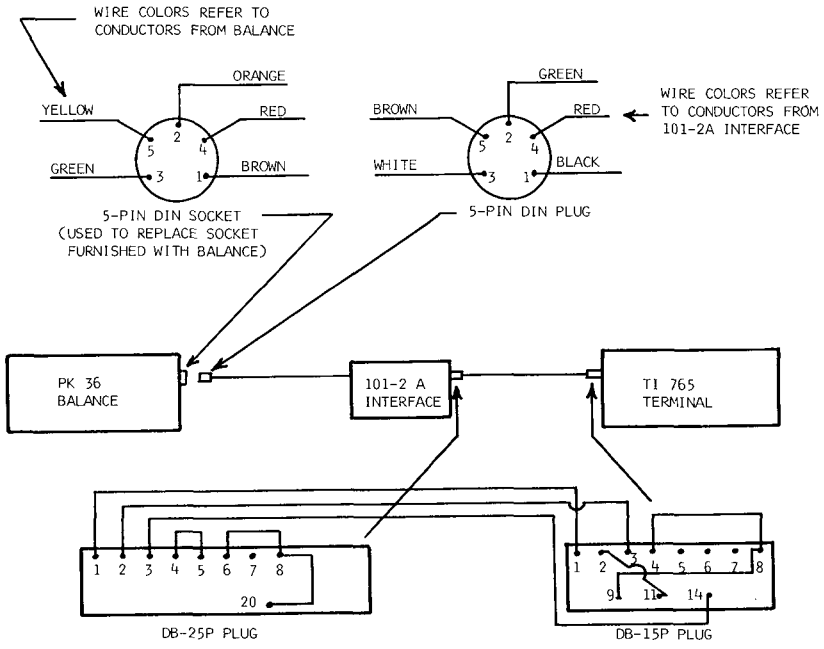

FIG. 1. Diagram for connecting balance, interface, and terminal to produce data acquisition system for weighing.

TABLE 1. *Equipment required for automated weighing and data acquisition system*

Item	Model or catalog number	Manufacturer or supplier
Electronic balance	PK 36	Mettler Instrument Corp.
5-Pin DIN Socket, Chassis Mount	274-005	Radio Shack (Tandy Corp.)
5-Pin DIN Plug	274-003	Radio Shack (Tandy Corp.)
Foot pedal	46278	Mettler Instrument Corp.
Bubble memory data terminal	765	Texas Instruments, Inc.
Current loop to RS-232-C interface	101-2A	Expandor, Inc.
25-Pin subminiature plug	DB-25P	TRW-Cinch (any electronics store)
15-Pin subminiature plug	DA-15P	TRW-Cinch
Shell for 25-pin plug	DB-19678-2	TRW-Cinch
Shell for 15-pin plug	DA-19678-1	TRW-Cinch

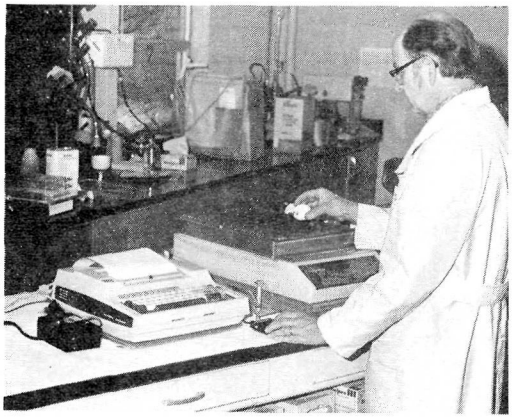

FIG. 2. Weighing and recording system in operation. Left to right, interface, data terminal, and electronic balance. At operator's left hand, pedal for recording data.

computer and the data can be transferred from the terminal memory to the computer for processing.

The foot pedal listed in Table 1 is connected to the balance, and depression causes the balance to transfer data to the data terminal. Figure 1 shows how the balance, converter, and data terminal are connected. Figure 2 shows the system in operation.

SYSTEM OPERATION AND PERFORMANCE

There are three adjustments to be made on the Mettler balance. Two of these—the stability detector and integration time adjustments—located on the back of the balance, are described in the balance instruction manual. The stability detector prevents data output from the balance until the weight reading has stabilized; the stability adjustment selects the degree of stability required before the balance is permitted to output data. The integrator averages minor fluctuations in weight data; it functions as a dampener on the balance. Selection of short integration time permits the scale to respond rapidly to weight changes; increasing integration time slows the response of the scale but decreases the possibility of recording a spurious value.

The balance can be operated with the stability detector switched off. The balance then performs as a conventional scale, with the integration time adjustment functioning as the dampener adjustment; the operator must then observe the displayed weight reading to ensure that correct values are recorded, since the balance will output data on command in this mode.

The third adjustment, located internally, controls the data transfer speed. It is adjustable from 110 to 9600 baud. This balance should be adjusted to transfer data at 300 baud to match the printing rate of the TI 765 data terminal.

To record weights with the system, the data terminal and the foot pedal are connected to the balance as indicated in Figure 1. The operator places the object to be weighed on the balance platform; depression of the foot pedal records the weight in the terminal memory and simultaneously prints the weight.

Identifier numbers may be entered as desired through the terminal keyboard. Approximately 1000 weights can be recorded with the standard 20,000-character memory available in the terminal.

After the weights are recorded, the terminal is disconnected and removed to the location required for data processing. This may either be a telephone, if the data are to be transmitted to a remote computer, or adjacent to a small computer which may be connected directly to the terminal with the RS-232-C serial interface.

As an example of the data processing rate, the weighing system as described has been used with a Radio Shack Model II computer connected through the RS-232-C interface. One person can weigh 300 eggs and obtain a complete data analysis from the computer in less than 1 hr.