Table of Contents

Aircraft Weighing Guide

14465 23d Avenue North
Minneapolis MN 55447

Telephone (612) 476-2531

SAFETY SUMMARY

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DO NOT SUBSTITUTE PARTS OR MODIFY SCALE

Because of the danger of introducing hazards, do not substitute parts or perform any unauthorized modifications of the scale.

WARRANTY

INTERCOMP CORPORATION (hereafter called "the company") warrants the AC100 CPU (and JW load cells) which this document accompanies to be free of defects in materials and workmanship, and to operate according to design specifications for a period of one (1) year after receipt by the original purchaser. After authorized return to the company at the purchaser's expense, the company shall evaluate any returned equipment under warranty claim, and shall make such repairs or replacements as may be judged necessary, in as expeditious a manner as possible.

IN THE EVENT that the company determines the claim to be made as a result of improper use, abuse, modification, shipping damage, or other factors beyond the reasonable control of the company, the company will advise the purchaser of the estimated repair costs. The company makes no warranty other than that contained in this statement. No agent other than an executive officer of Intercomp Corporation is empowered to modify in any manner this statement of warranty.

COMPLIANCE WITH FCC RULES

Please note that this equipment generates, uses, and can radiate radio frequency energy. If this equipment is not installed and used in accordance with the support manual, you are warned that it may cause interference to radio communications. This unit has been tested and has been found to comply with the limits for a Class A computing device pursuant to subpart J of part 15 of FCC Rules. These rules are designed to provide reasonable protection against interference when equipment is operated in a commercial environment. However, if this unit is operated in a residential area, it is likely to cause interference and under these circumstances the user will be required to take whatever measures are necessary to eliminate the interference at their own expense.

Introduction

This section is intended to provide a basic familiarity with Intercomp weighing systems and the weighing process. Later sections of this manual provide detailed descriptions of how to operate each component and more details on weight and balance control.

NOTE: We will mention some details of the aircraft as it comes up throughout the text, but this is for demonstration only. It is essential to remember that you **MUST** seek and follow the specific requirements of the aircraft manufacturer.

In order to understand the operation of a scale, it is necessary to have a basic knowledge of the elements of any aircraft weighing system. There are three basic elements you should know in weight and balance control.

Lets consider each of these in turn.

1. The relationship between mass and weight (What is weight) Weight is related to mass. The earth's mass attracts any objects mass, producing a downward force we call weight.. This force varies slightly depending on your location and altitude. This downward force can be measured and related to the weight. Remember, a scale is a force measurement instrument; it does not measure mass directly.

2. Gross, net and tare values. (What are you weighing) The next element of weighing is the definition of just what are you weighing. A scale detects anything on it's surface. You may need to use a fixture to hold what you are weighing on the scale. The scale weights this fixture just as if it is part of the of object you wish to weigh. An example: you wish to weight some liquid. You might use a container to hold this liquid. A scale would show the combined weight of the liquid and container. This relationship is so common that special words describe each part of the weight.

> **Gross:** The combined weight of an object being weighed and any container holding it.
> **Net:** The weight of an object only. This is the weight used in all calculations.
> **Tare:** Any container or fixture weighed with out the object to be weighed.

3. Arms, moments, center of gravity (Where is the weight). The purpose of weighing an aircraft is to determine the amount and location of the aircraft's mass. The location of the scales and weight read from the scales are combined with simple mathematical formulas to determine where the plane would balance if suspended at a single point. This point is known as the **CENTER of GRAVITY or CG**. The manufacturer designates the correct CG for the aircraft, referenced to the datum (See below). Changes to the aircraft structure, equipment, fuel supply, and loading affect the CG.

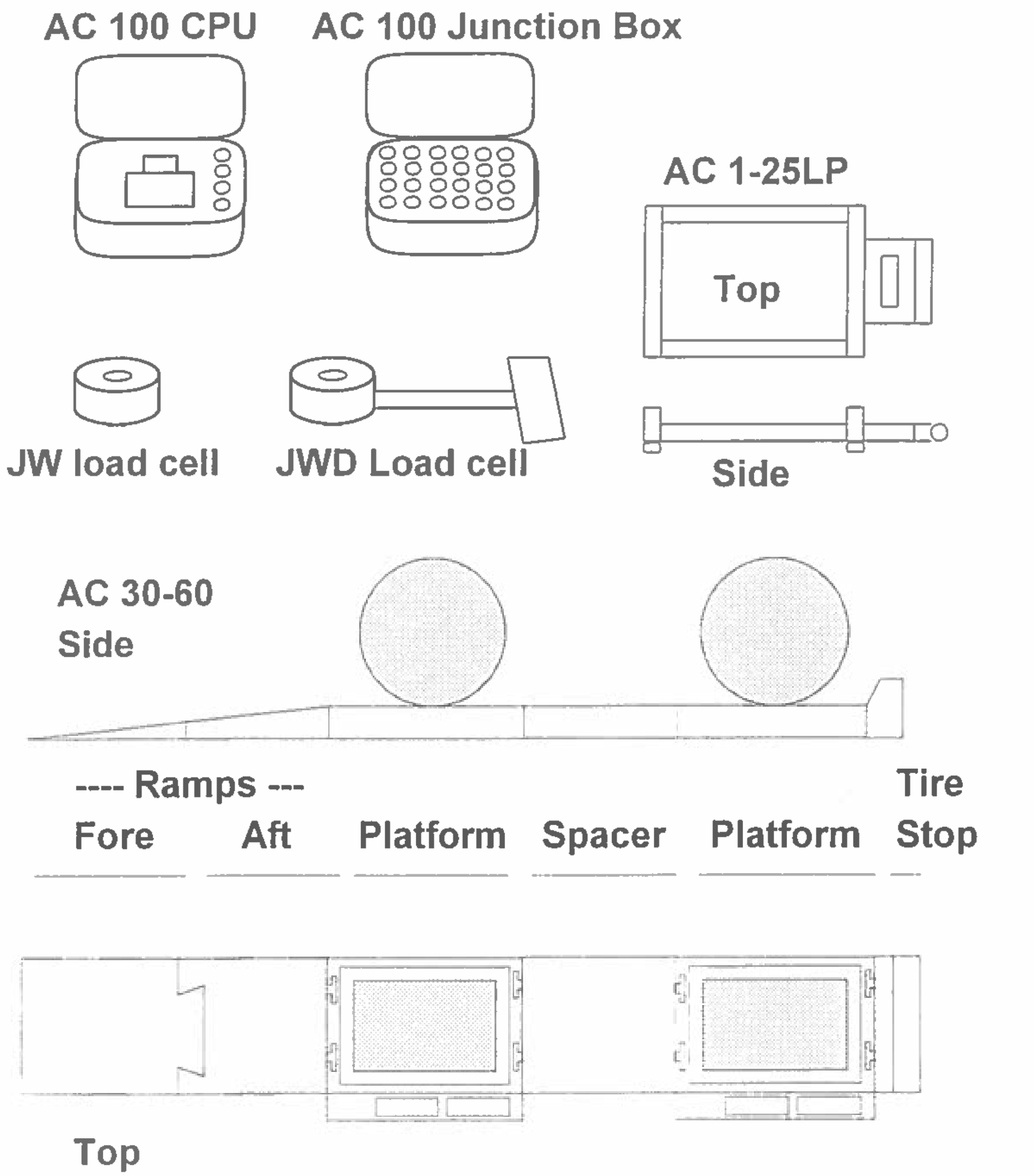
It is necessary to have a standard reference point for all measurements concerning the aircraft. Each aircraft manufacturer therefore designates some point on or near a specific type of aircraft as the standard reference point, which is called the **DATUM**. The datum is often a point some distance in front of the aircraft, although it may also be located on the aircraft. It is used for the zero reference point for all longitudinal (front to rear) arm measurements on the aircraft. Specifications for locating the datum must be permanently with the aircraft, and are often found in the cockpit on a datum plate or included in the aircraft records. Manufacturers usually use the longitudinal centerline of the aircraft as the datum for lateral (side to side) arm measurements. If a different lateral datum is specified, its location is included in the datum record.

The distance from the datum point to the scale is called an **ARM**, measured in inches or centimeters.

The Weight from the scale is multiplied by the arm to give us a **MOMENT ARM**. The preferred unit of measure for moment is in*lb (or cm*kg).

The moments are combined and divided by the total weight to determine the center of gravity.
Each aircraft has an aircraft record book which contains a listing of the CG location. This weight record listing must be updated for any permanent changes made to the aircraft, such as adding electronic equipment or different navigation lights.

Scale system Components



The JWD, AC 30-60 and AC 1-25LP may be used in the standalone mode. All of these devices may be connected to the AC 100 CPU for central control and enhanced feature set. If more then 5 devices are to be connected to the AC 100 CPU at one time, the AC 100 Junction box will allow more sensing devices to be connected. Up to 42 weighing elements of any type may be connected to the AC 100 CPU in any combination.

Weighing Aircraft

Before You Weigh

Aircraft must be weighed before we can determine the center of gravity. The only way to find the weights is to use accurate, calibrated scales. Also, the weighing site should be prepared and the aircraft must be brought to a standard configuration.

Before weighing certain factors must be prepared. These mostly fall in the categories of plane and site preparation.

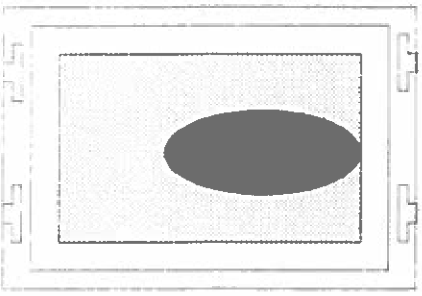
The floors should be leveled to 1/4 inch per foot (1.2°). It is possible to compensate for greater slopes mathematically but a level floor is best.

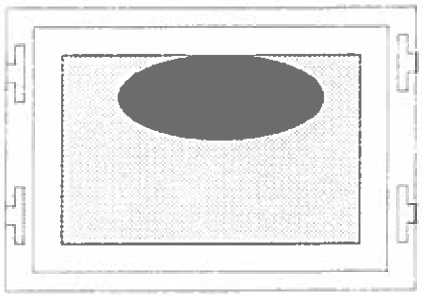
The hanger must be free of drafts or stray wind currents. Any air currents across the wings or tail will be sensed as changes in weight. Close hanger doors (if you have any). Turn off all blowers and air conditioning while weighing.

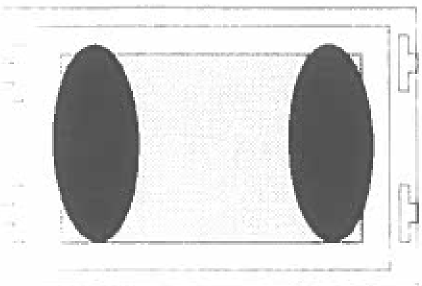
The plane must be prepared for weighing. We assume that a standardized check list is used for this task. This list is available from the aircraft manufacturer. Some items on this list would be: The aircraft should be washed and dried, tires inflated, struts serviced, engines serviced, plane de-fueled, all interior stations cleaned and brought to standard conditions. All the aircraft contents must be inventoried. A weight without an accurate inventory is of no value. In addition, flap position, horizontal stabilizer, seat position, etc. are all set according to manufacturers recommendations.

It is convenient to charge the scales the day before the weight job. At this time insure that the scales are within the specified calibration interval.

Place the scales. You may use the track of the tire as the plane is brought into the hanger to position the scale. Arrange the scale so all the tires will be on the active surface of all the scales at the same time. An easy method is to chalk around the tires in the desired weighing location, then place the scales on the chalk marks.







Anywhere inside traction pad

Balanced in frame

Tire placement with platforms

Weighing

Allow the scales to acclimate to the temperature in the hanger before use; Intercomp scales are stable within a few minutes.

Zero each pad, and verify a displayed zero weight. Load the scales. This varies according to the type of scales used. Please check manufacturers recommendations for any special weighing or leveling fixtures.

Load with Platforms:

Release the aircraft brakes. Push the plane onto the scales. Used chocks or towbar to control the aircraft. Read and record all weights. Tow the aircraft off the pads. Verify that all scales return to zero. Where possible, exchange pads between positions. Tow the aircraft on the pads. Record the weights. Remove the aircraft from the pads. Verify that the scale returns to zero.

Load with Top of jack scales:

Position the jacks under the jacking points. Level Raise the aircraft and level the aircraft per the manufacturer's recommendations. Read and record all weights. lower the aircraft. Verify that all scales return to zero. Where possible, exchange cells between positions. jack and level the plane again. Record the weights. lower the aircraft. Verify that the scale returns to zero.

Compare the weights obtained from the first and second weighings. The weights should agree within 0.25%. Repeat the weighing with scale rotation if there is not agreement. Check to see if a particular pad is weighing too much or too little. (A high or low reading moves with the cell). When you have agreement, average the two closest readings.

NOTE: While it is not strictly necessary to do two or more weighing during a weigh job with scale rotations between positions, the benefit of catching potential human or machine errors outweighs the cost in time. Intercomp recommends this as the best practice, regardless of the brand or type of scale used.

After Weighing

This is where you would normally calculate any scale factor corrections, such as latitude or altitude corrections, Intercomp equipment calculates this automatically.

Calculate MAC if your CG is specified this way.

Compare your readings with your calculated values. They should agree closely. Some possible reasons for discrepancy: Weighing error (residual fuel, residual water, equipment, etc.); Check for operator error in recording values; Check calculations for errors; checks chart for errors; check scales for overdue calibration.

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Model AC30-60

Platform Weighing System

Operations/Calibration Manual

Covering Serial numbers from 270257

Intercomp Co.
14465 23rd Avenue North
Minneapolis, MN 55447

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NOTICE

 The information contained in this publication is derived in part from proprietary and patent data of the Intercomp corporation. This information has been prepared for the express purpose of assisting operating and maintenance personnel in the efficient use of the instrument described herein. Publication of this information does not convey any rights to use or reproduce it or to use it for any purpose other than in connection with the installation, operation, and maintenance of the equipment described herein. While every precaution has been taken in the preparation of this manual, Intercomp Corporation assumes no responsibility for damages resulting from the use of the information contained herein. All instructions and diagrams have been checked for accuracy and ease of application; however, success and safety in working with tools depend largely upon the individual accuracy, skill, and caution. For this reason Intercomp Company is not able to guarantee the result of any procedure contained herein. Nor can they assume responsibility for any damage to property or injury to persons occasioned from the procedures. Persons engaging the procedures do so entirely at their own risk.

WARRANTY

INTERCOMP CORPORATION (hereafter called "the company") warrants the AC30-60 Platform Weighing System and Accessories which this document accompanies to be free of defects in materials and workmanship, and to operate according to design specifications for a period of one (1) year after receipt by the original purchaser. After authorized return to the company at the purchaser's expense, the company shall evaluate any returned equipment under warranty claim, and shall make such repairs or replacements as may be judged necessary, in as expeditious a manner as possible.

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General Information

The Intercomp Model AC30-60 Aircraft Weighing System provides the capability to weigh medium to heavy capacity aircraft. The weight display is selectable to either pounds or kilograms. Each pad provides latitude and altitude correction to maximize weighing accuracy. Large (1.0 in/2.54 cm) displays with automatic back lighting provides superior viewing under all conditions. Operation and specifications comply with all applicable sections of NIST Handbook 44.

Scope of manual

This operations manual describes the Intercomp Model AC30-60 platform scales specifications, detailed calibration and operating procedures.

This manual is separated into several sections, each containing information on a different aspect of the scale platform. The specifications outline the design parameters for the scale. The detailed operation section outlines the correct use of the scale for most applications. The theory section includes a system description and theory of operation that explains how the scale works. The Procedures section shows correct assembly, disassembly, and repair techniques. The calibration section explains how to set the platform's adjustments.

This manual is not designed to be a substitute for proper training in the installation, operation, maintenance or service of the AC 30-60 electronic scale. It is to be used as a guide for training service personnel and as a reference source for training previously received.

For U.S. military applications, the weighing system conforms to equipment specified in T.O. 1-1B-50, 5-1 and 5-3. All weighing procedures specified in 5-6 should be strictly followed per the T.O. In these instances, refer to this manual for platform operation instructions only.

Caution: Your AC30-60 scale is covered by a one year warranty and should be referred to the factory for maintenance within the warranty period. Attempts to make any extensive repairs within the warranty period may invalidate the warranty. If repairs are needed after the warranty period, only qualified technicians should attempt such repairs.

Features

- Independent weight readout on each Platform.
- Operation and specifications comply with all applicable sections of NIST Handbook 44.
- Accuracy of ±0.1% of applied load or ±1 display count, whichever is greater.
- Pound or kilogram selectable readout.
- Capability to apply altitude and latitude correction factors automatically.
- Auto-zero maintenance automatically corrects zero-weight display shifts.
- 5 digit LCD (1.0 in/2.54 cm)displays, automatic backlighting provides viewing under all condition.
- +12 VDC, with adapter for 120 VAC 60 Hz power sources.
- RFI/EMI protection.
- Automatic shut-off to conserve battery life.
- Low battery detection with automatic shutoff to protect batteries.
- Built-in self-diagnostics to check:
  - memory
  - display
  - power supply.
- Weigh pads manufactured from high strength aluminum alloys.

Options

- AC 100 Central Processing Unit.
- 220 VAC 50 HZ power adapter.
- Carrying cases for platform scales.
- Storage / Transportation / Charging Cart.

AC30-60 Aircraft Weighing System

Specifications

Controls

General	Zero, Lbs/Kg, On, Off.
Latitude Correction	Ability to apply correction values.
Display	5 digit liquid crystal display (LCD), with automatic red LED back lighting.
Indicators	On-screen Lb/Kg, Charging Lamp.

Electrical

Power source required	12-20 VAC or DC, 120 VAC, optional 240 VAC.
Charging Voltage	12 volts to 20 volts AC or DC.
Batteries	6-D (4 Amp-hour) size Rechargeable Nickel-Cadmium cells.
Charging Current	235 mA.
Charging Time	16 hours if the batteries are discharged.
Battery endurance	45 hours of continuous use.
Auto Shut-off	After 120 minutes without use.
Filtering	6 Pole, 10 Hertz low pass.
Auto-Zero	Satisfies all HB-44 requirements.

Performance

Capacity	60000 by 10 lb (30000 by 5 kg)
Accuracy	+/- 0.1% of reading or ±1 display count, whichever is greater.
Speed	2 seconds to typical reading (static).
Calibration interval	Twelve months.

Environmental

Humidity	10 to 95% Non-Condensing.
Temperature	
Operating	-10 C to +40 C. +14 F to +104 F.
Storage	-40 C to +75 C. -40 F to +170 F.

Physical

Dimensions

Overall / **Footprint**

33.5" X 33.5" X 4" (85 cm X 85 cm X 10.2 cm)

Platform / **Active Weighing Surface**

24" X 30" (61 cm X 76 cm)

Weight 150 lb (68 kg)

Furnished Items

Quantity	Description
3	Platform Scale
3	Power Cord
3	Entry Ramp
3	End Stop
1	Bridge
1	Trailer
1	Accessory Kit

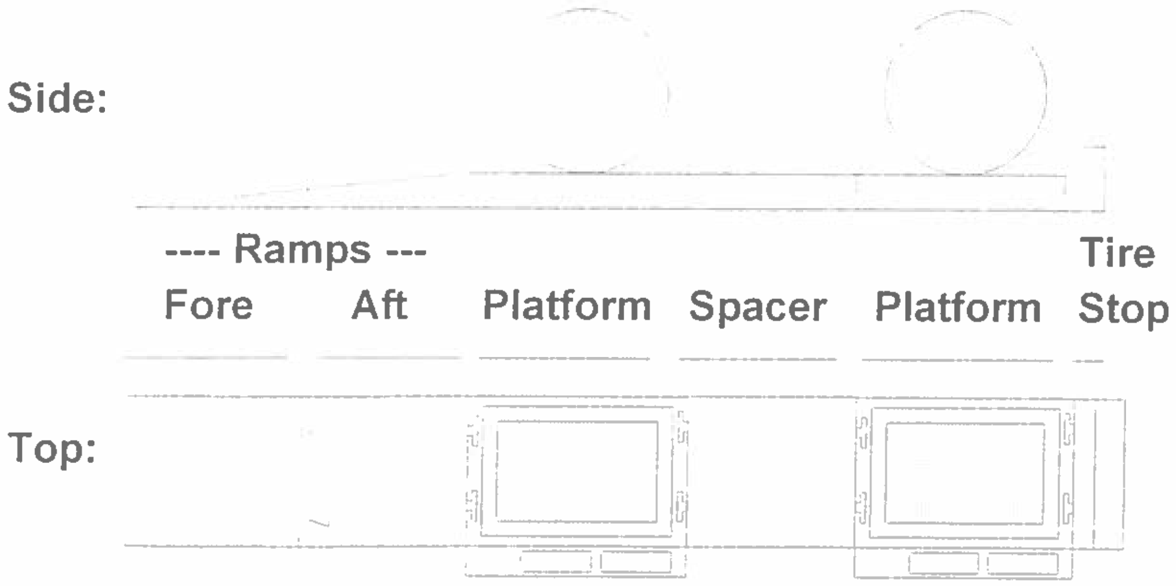
Tools and Test Equipment.

See "Tools Required" in the calibration and maintenance Sections for a list of the tools and equipment required to test and maintain the platform scales.

Shipping and Handling Precautions.

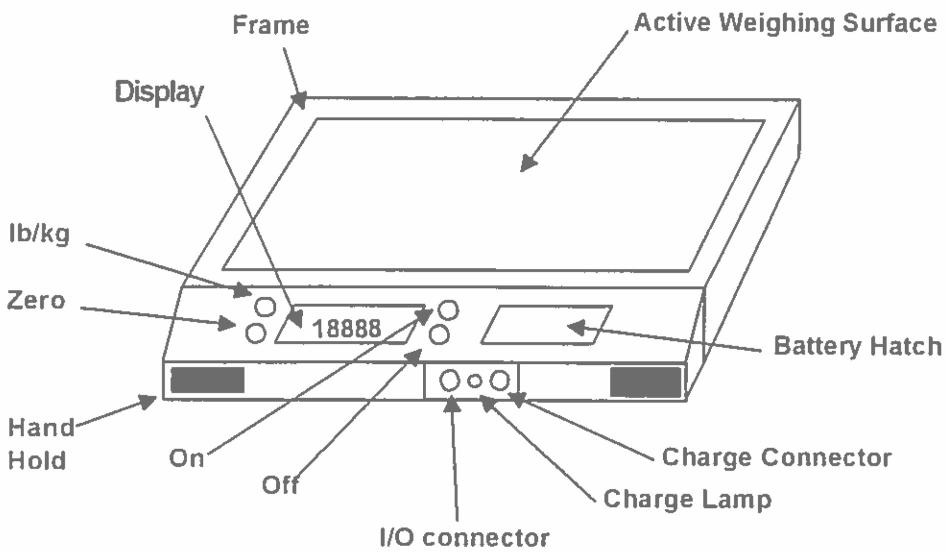
See the "Transport Cart" manual for instructions on loading and transport.

Component Identification



Control Panel Switches and Indicators

The control panel for the weighing platform is in the front section of the pad, along with the electronics of the system. The control panel has a liquid crystal display (LCD) screen and several control switches. Please examine this diagram to familiarize yourself with the control and connector locations.



Display Description

The display is a Liquid Crystal Display unit, providing one line of 5 digits. The screen shows the weights read from the pad, displayable in pounds or kilograms. Information displayed includes segments which identify the units of measure (LB/KG). The display contains an automatic backlight for use in low-light conditions.

Control Switches

ON

Applies power to the weighing system electronics. When power is first applied, the weighing system performs a self-test of the pad and the internal electronics. When the tests have completed successfully, the system begins weighing. If a problem is detected, the screen displays an error message.

OFF

Turns off the power to the weighing system electronics. A built-in battery backup retains the latitude, altitude and zero information. This information is available the next time the weighing system is turned on. The weighing system retains the setup information in a special memory device (non-volatile memory) that is not affected by power loss or battery condition.

LB/KG

Toggles the weighing system between pound (English) and kilogram (SI metric) units of measure. When you press this switch, the system switches to the nearest comparable value in the selected system.

ZERO

Sets the weighing system to read zero pounds or kilograms. If pressed while a pad holds weight, that weight becomes the zero condition for the pad. This can be useful to cancel the weight of any weighing fixtures, such as tail cones or wheel chocks. When the weight is removed, a negative weight displays until the system is re-zeroed. This switch is used any time the scale shows a non-zero value with no weight on the pads. Please note that this system contains a feature called Auto Zero Tracking (AZT), which corrects for slight zero changes during normal operation. An example of a zero change could be a buildup of dirt on the pads.

Latitude / Altitude Correction

It should be noted that effect of gravity is not the same at all points on the surface of the Earth. Although these variations are small, they can cause observable errors in the weights determined by a scale system as sensitive as this one. The AC30-60 Aircraft Weighing System has the following means to enter corrections for local variations in gravity.

ZERO & LB/KG

Pressing both of these switches at the same time allows you to inspect and change the assumed latitude and altitude settings. The first value displayed is the latitude in degrees. Each time you press the **ZERO** switch the value will change by 5° of latitude. Pressing the **LB/KG** switch causes the altitude to be displayed. This value will change 1000 ft (304.8 m) each time you press the **ZERO** switch. Pressing the **LB/KG** switch again will return you to normal weighing.

Detailed Operations

NOTE: All AC30-60 platform scales can be linked to the optional AC100 CPU. All operations mentioned in this section can be performed via the AC100 CPU. Please refer to the AC100 CPU operations manual for complete operation instructions.

NOTE: All AC30-60 platform scales can be connected to the AC100 CPU. The AC100 CPU can in turn be interfaced to a laptop or desktop computer. As an option, Intercomp provides "AC Weigh" software. Refer to the separate "AC100" and "AC Weigh software operations" manuals for complete operation instructions.

Note: Please refer to the "Transport Cart" manual for instructions on unloading the cart.

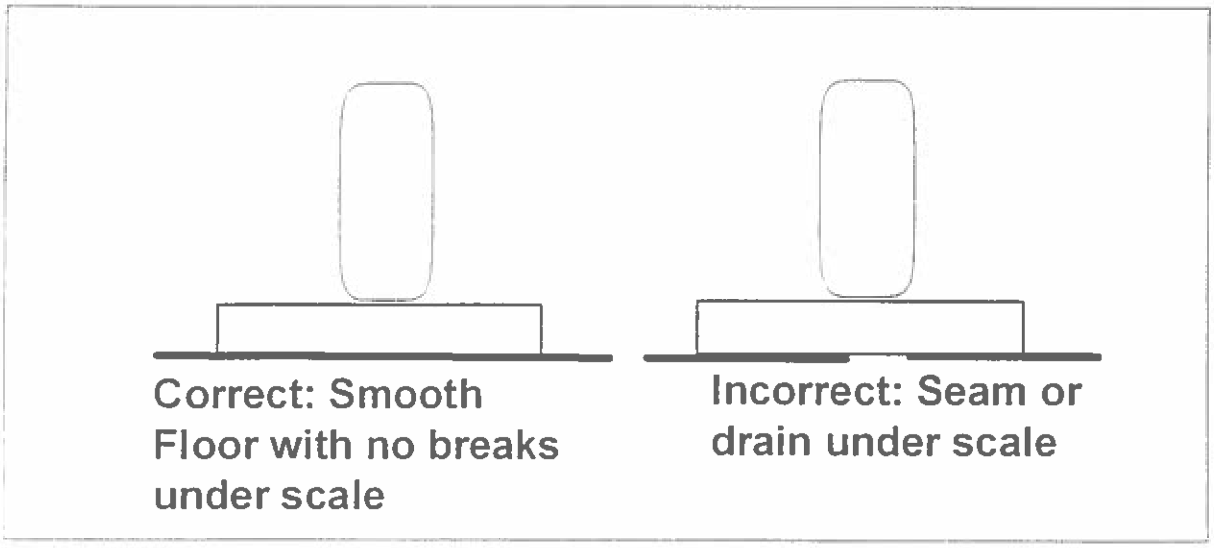
This section explains the details of operating the AC30-60 Aircraft Weighing system.

1) Allow the scales to acclimate to the temperature in the hanger before use. Check for obvious damage to the control panel and display unit. Verify that the scales are within the calibration interval.

2) Select a power source. The weighing system can obtain power from any of these sources:

> **1)** When AC power is available, plug the charger pack into the jack located in the lower right corner of the control panel. This allows full-time weighing system use.
>
> **2)** Any 12 to 20 volt power source may be used in place of the charging pack. An example would be a vehicle battery. An optional cable is required to make this connection. Please note that each pad requires 0.5 Amp charging current.
>
> **3)** The weighing system can operate using an internal rechargeable battery pack, for up to forty-five (45) hours when fully charged. Constant display backlight operation reduces this time by about fifteen hours. With the scale connected to an external 12 volt power source the pack recharges. It is best to charge the scales the day before the weight job.

3) Place the Pads. The AC30-60 Aircraft Weighing System is a very accurate weighing system that is simple to set up and use. However, the accuracy depends on proper pad placement.



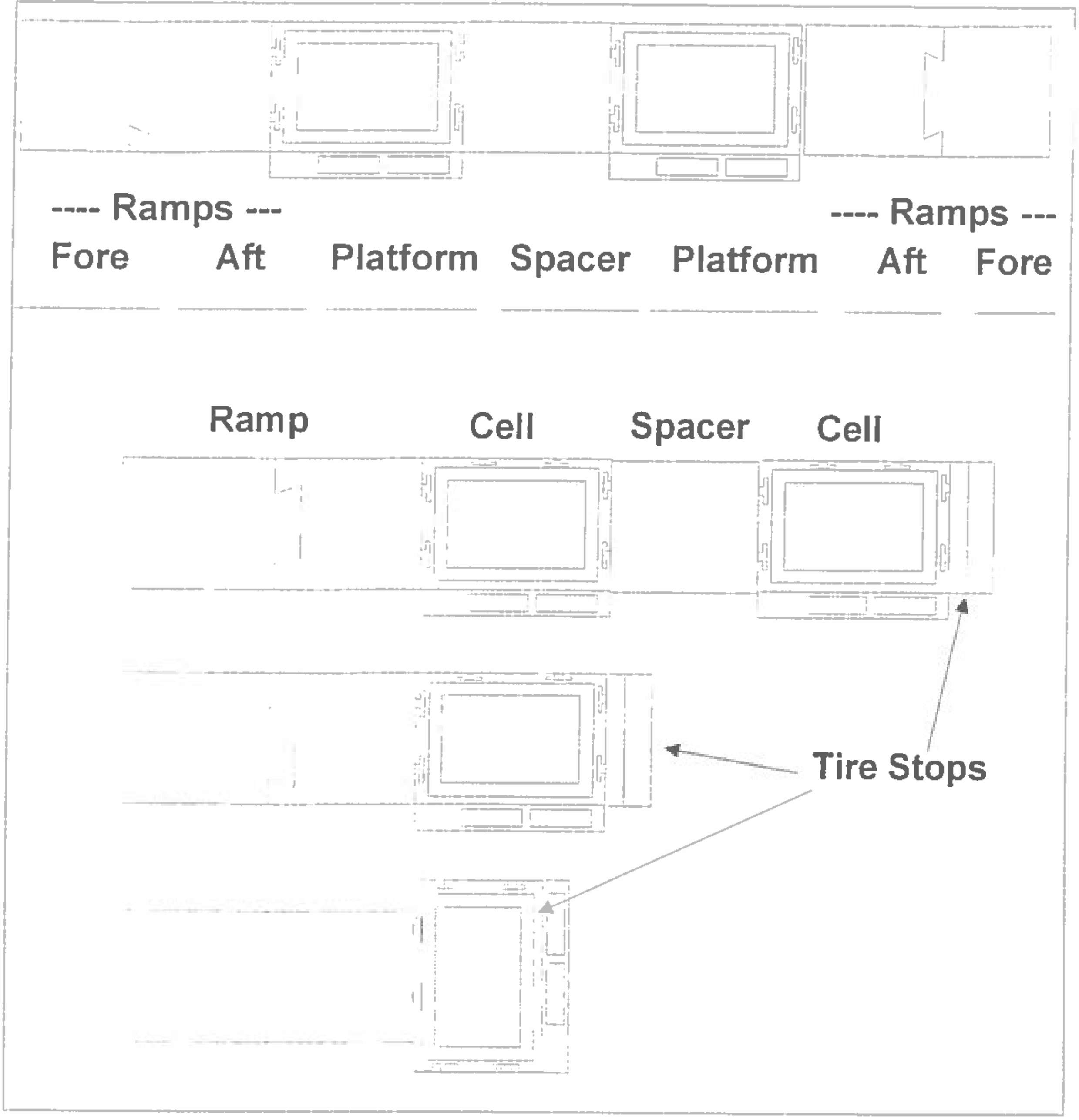
Pad Placement Detail

Make sure the pads are properly centered for the wheel base of the aircraft. You may use the track of the tire as the plane is brought into the hanger to position the scale.

Note: These scales may be used on slopes up to 3° without manual leveling. The built in inclinometer system corrects the weight reading within this slope.

Arrange the scale so all the tires will be on the active surface of all the scales at the same time. An easy method is to chalk around the tires in the desired weighing location, then place the scales on the chalk marks.

Attach ramps and spacers and tire stops as required.

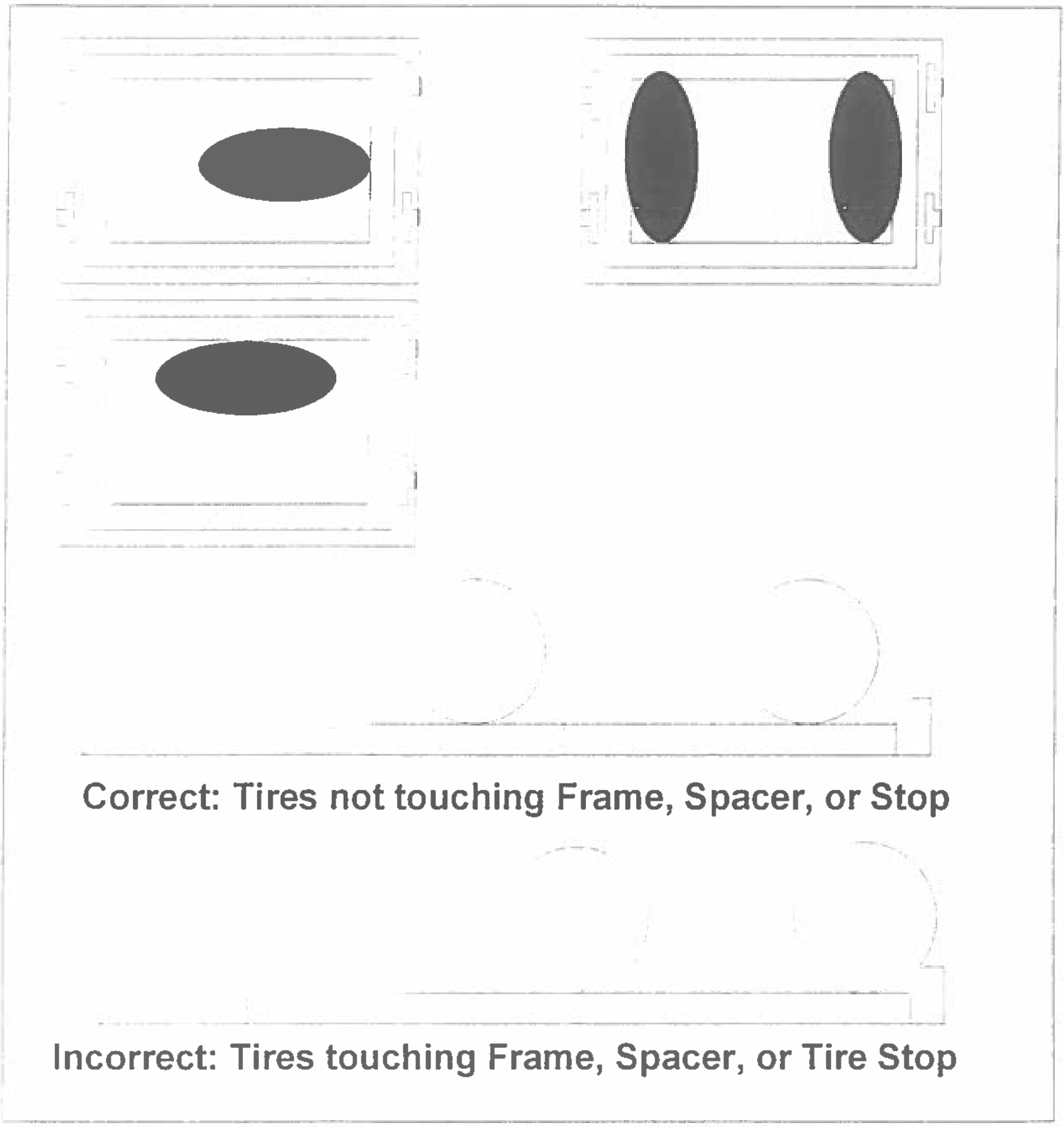


Common Platform Configurations

4) Turn the scales on. Allow 5 minutes for warmup. You may use this time to verify that altitude and latitude values are correct for each scale.

5) Zero each pad and verify a displayed zero weight.

6) Tow the aircraft onto the pads. Align all wheels as nearly centered as possible upon each of the pads during weighing.



Allowable Tire Placement

Warning: The vehicle motion **must** be controlled while on the scales. Any one of three methods may be used:

- **1)** Small chocks. The weight of the chocks may be zeroed on the pads. The chock must not contact the frame of the scale during weighing.
- **2)** Tow bar & tug. One half (½) of the weight of the towbar must be considered as a tare weight.
- **3)** Brakes.

7) Read and record the weight from each pad.

8) Remove the aircraft from the pads.

9) Read and record the zero return value from each pad.

10) Repeat steps **6** through **9** as needed.

11) Turn off scales. Disassemble and stow the system.

Latitude and Altitude Correction

Overview

The force of attraction of the earth to any object varies with latitude and altitude. In general, an object weighs the most at sea level at the poles, and the least at the equator and to a much lessor effect, higher altitudes. This effect is small, but it must be considered to achieve the scales rated accuracy of 0.1%. Note that this adjustment is only performed when moving the scales to a new location or when the scales are calibrated. You may inspect these values at any time. When the proper altitude and latitude values are set the AC30-60 will adjust the displayed weight to show what the object being weighed would weigh if it were placed at sea level, 45 degrees latitude.

Detailed operation

To inspect or change the latitude and altitude settings, press both the **LB/KG** and **ZERO** switches at the same time. The scale will show you a screen that looks like this:

00045

The value displayed is the latitude in degrees. Each time you press the **ZERO** switch the value will change by 5° of latitude. You should make sure that this value is the same as the latitude that the scale will be used at, to the nearest 5° of latitude. When you are finished with the Latitude screen, press the **LB/KG** switch. The scale will show you this screen:

01000

This is the altitude display. This value will change 1000 ft (304.8 m) each time you press the **ZERO** switch. You should make sure that this value is the same as the altitude that the scale will be used at, to the nearest 1000 ft of altitude.

Press the **LB/KG** switch again will return you to normal weighing.

This table shows the latitude and altitude correction values used:

deg\ft	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000
0	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032	1.0033	1.0034
5	1.0026	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032	1.0033
10	1.0025	1.0026	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032
15	1.0023	1.0024	1.0025	1.0026	1.0027	1.0028	1.0029	1.0030
20	1.0021	1.0022	1.0023	1.0024	1.0025	1.0026	1.0026	1.0027
25	1.0017	1.0018	1.0019	1.0020	1.0021	1.0022	1.0023	1.0024
30	1.0014	1.0015	1.0016	1.0017	1.0017	1.0018	1.0019	1.0020
35	1.0009	1.0010	1.0011	1.0012	1.0013	1.0014	1.0015	1.0016
40	1.0005	1.0006	1.0007	1.0008	1.0009	1.0010	1.0011	1.0012
45	1.0000	1.0001	1.0002	1.0003	1.0004	1.0005	1.0006	1.0007
50	0.9996	0.9997	0.9998	0.9999	1.0000	1.0001	1.0002	1.0003
55	0.9991	0.9992	0.9993	0.9994	0.9995	0.9996	0.9997	0.9998
60	0.9987	0.9988	0.9989	0.9990	0.9991	0.9992	0.9993	0.9994
65	0.9983	0.9984	0.9985	0.9986	0.9987	0.9988	0.9989	0.9990
70	0.9980	0.9981	0.9982	0.9983	0.9984	0.9985	0.9986	0.9987
75	0.9978	0.9979	0.9979	0.9980	0.9981	0.9982	0.9983	0.9984
80	0.9976	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981	0.9982
85	0.9974	0.9975	0.9976	0.9977	0.9978	0.9979	0.9980	0.9981
90	0.9974	0.9975	0.9976	0.9977	0.9978	0.9979	0.9980	0.9981

Maintenance

Complete list of required tools and materials

In addition to the usual workbench and good lighting, the following list of tools and materials are necessary to set up a complete AC 30-60 service station.

- Calibration force generator; press or deadweights. This calibration source must cover the range of 6000 to 60000 lb with an accuracy of 0.025% or better.
- Inclinometer, 0° to 10° x 0.1°.
- 8" x 8" x 1.75" aluminum loading block.
- 8" x 8" x 0.5" rubber loading pad.
- 12" x 12" x 1.75" aluminum loading block.
- 12" x 12" x 0.5" rubber loading pad.
- Torque wrench covering 125 ft-lbs.
- 15/16" socket for torque wrench.
- 15/16" combination wrench.
- 3/8" Allen wrench.
- #2 Phillips screwdriver for bezel and board mounting screws.
- Right angle #2 Phillips screwdriver for Angle sensor mounting screws.
- Torx T30 bit and driver.
- Small slotted blade screwdriver for trim pots.
- Locktite 242 removable Threadlocker (BLUE).
- Torque-seal potentiometer shaft sealer.
- Dow-Corning 3145 electronic grade RTV Adhesive/Sealant.
- Static dissipation work station.
- Small soldering iron and 0.031" rosin core solder. "No Clean" is not acceptable.
- A load cell simulator is not required, but it can save time when troubleshooting.

Spare parts list

These common parts can prevent "nuisance" downtime:

Batteries.
Charging power supply.

To set up a "well stocked" service depot, the following additional parts are useful:

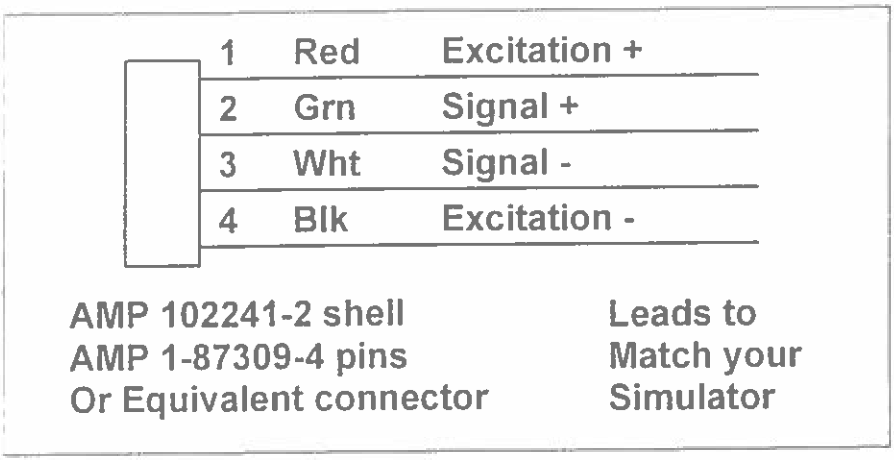
Control Panels.
Summing circuit boards.
Angle sensor circuit boards.
Load Cells.
Charging harness.
Serial I/O harness.

Use of a load cell simulator

During checkout it may be awkward to apply 60000 pounds to develop internal signals. A load cell simulator may be attached to the load cell connector on the control panel to simulate these same signals.

Caution: Using a simulator is NOT suitable for calibration for this scale; a simulator is only to be used for diagnostic purposes.

A setting of 1.3 mV/V gives about the same signal as a 60000 Lbs load. The simulator may be connected to the four pin load cell connector with the following cable:

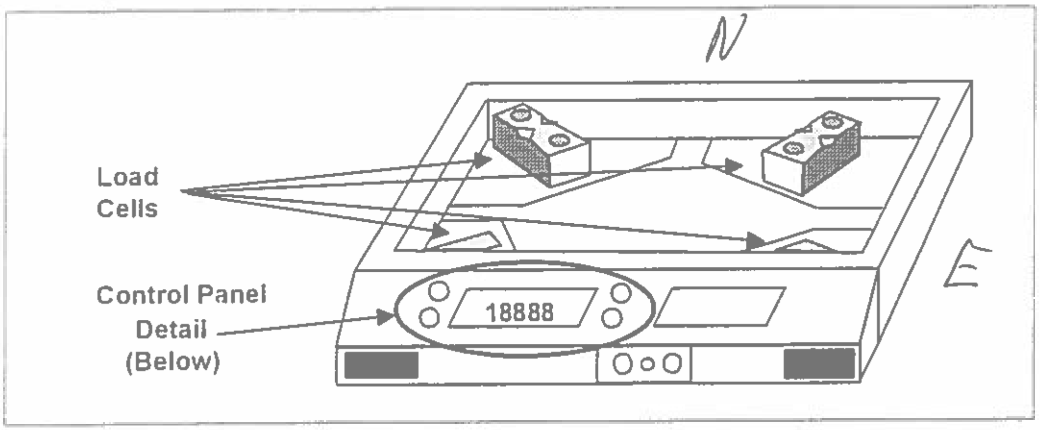


Simulator connection cable schematic

Theory of operation

Load sensor:

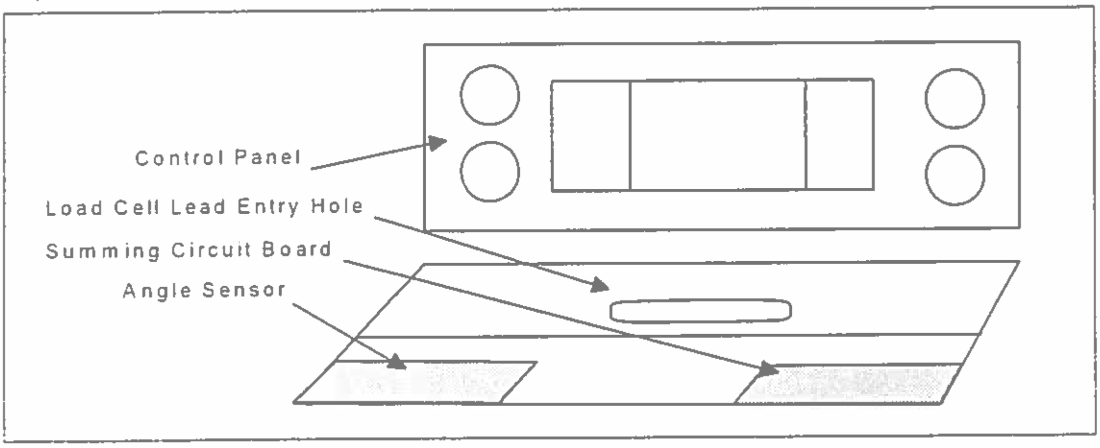
The load to be measured is applied to the platform top. This force is coupled to the load cells through a set of links and saddle blocks. If the load is centered, each load cell receives one quarter of the applied load. The load cells produce an output signal proportional to the applied load. This signal ranges from about 0 millivolts for no load to about six millivolts for a full load of 15000 pounds (6800 kilograms) at the load cell. The load cells contains circuitry to compensate for changes in temperature in the weighing environment. There are no field serviceable components inside a load cell; a cell must be replaced if found defective.



Top removed to reveal load cells

Summing Circuit board:

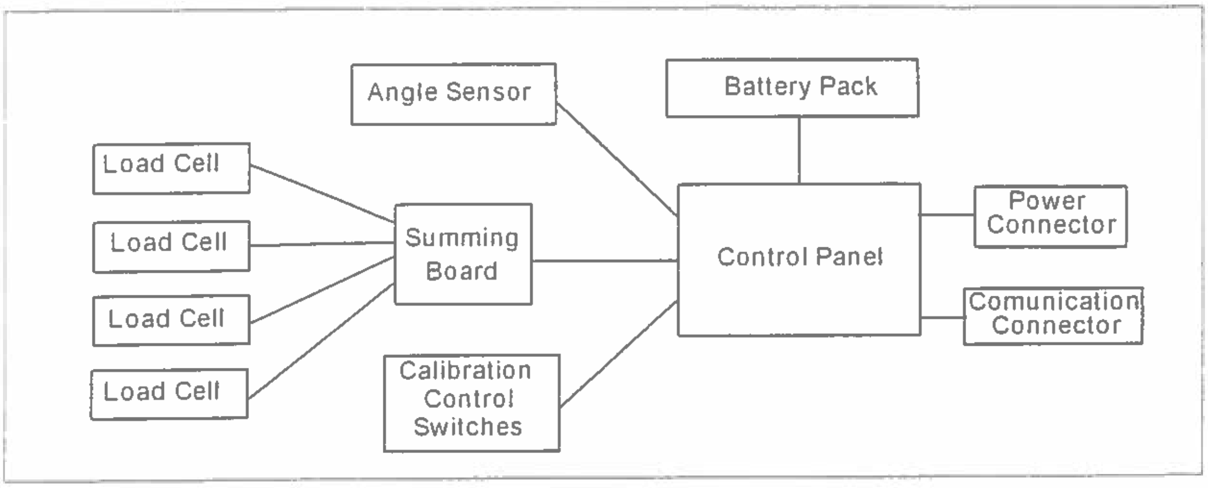
This circuit board is located in the same housing as the control panel. The signals from the individual load cells are combined in the summing circuit board. The summing circuit board also functions to adjust the output from each individual cell so that the outputs are equal. This adjustment is accomplished by varying the excitation voltage sent to each load cell. The output from the summing board is routed to the control panel.



Detail: Control Panel removed to reveal Angle Sensor and Summing Board

Angle sensor Circuit board:

An angle sensor printed circuit board is located in the same housing as the control panel. The angle sensor develops a signal proportional to the angle of the surface the scale is located on. This signal ranges from about zero millivolts to about 20 millivolts, with a level surface represented by a signal of about 12 millivolts. This signal is read by the control panel approximately once a minute. This angle information is used to correct the reading when the scale is used on non-level weighing surfaces.



Schematic system diagram

Control Panel:

This control panel performs several functions:

Weight determination:

Four sources of information are read by the control panel. These sources of information are as follows:

1) The load cell signal. This information is read several times a second.
2) The angle sensor described above. This information is read during every internal recalibration cycle. The duration of the internal recalibration varies with the filter selection entered during calibration, but is on the order of once a minute.
3) The control panel contains a precision reference network that is used to correct any drift in span or zero. This information is read once each internal recalibration cycle.
4) The latitude and altitude information entered by the user. This information is typically entered or verified once during every weighing.

The control panel combines this information and apples a calibration factor that is calculated during the calibration procedure. The result is converted to the selected units and graduations and displayed.

User interface:

A light sensor is mounted next to the display, this sensor automatically turns on a display backlight in response to the ambient lighting conditions. The control panel also contains the control switches. These switches can be used to turn the scale on or off, zero the scale, select pound or kilogram weight displays, and to enter the local altitude and latitude conditions.

Power control:

The control panel conditions the input power received through the PWR connector to charge a string of rechargeable batteries. The input is designed to accept any voltage between 12 and 20 volts AC. A DC source may be used. When the battery voltage is too low a "LB" message is flashed on the display.

Data communications:

The control panel can communicate with an external computer using RS-485 signals routed through the COM connector. This data is formatted in a compressed format designed to reduce communications time. All of the scale functions may be controlled through this port.

Troubleshooting

Caution: Changing any circuit board or load cell will affect the calibration. The calibration should be checked after any repairs.

Symptoms

Error messages displayed can be a helpful diagnostic tool. The following table describes some possible causes and solutions.

<table>
<tr><th>Message</th><th>Meaning</th></tr>
<tr><td>'EEPE'</td><td>Calibration information lost or corrupted</td></tr>
<tr><td colspan="2">Calibration information is held in a special permanent memory area. A checksum code is generated and written to this memory during the calibration process. Each time the power is turned on this code is regenerated and compared to the stored value. If a change is found this error message is displayed. Recalibration may clear the error display, but if the problem persists the control panel will have to be replaced.</td></tr>
<tr><td>'OL'</td><td>Overload or calibration information lost or bad load cell</td></tr>
<tr><td colspan="2">The control panel has detected a weight reading that is larger than expected. This may be caused by the application of too much weight to the platform. If this display is seen when there is no weight on the platform, then the most likely causes are a defective load cell or defective control panel. To isolate the problem, measure the signal across pins two and three on the load cell connector on the control panel. This should be between zero and one milli-volt. If found to be higher or lower, then the load cell system must be checked. See procedure elsewhere in this manual. If the signal is within this range then the calibration data may be lost. Attempt to recalibrate the scale. If this does not clear the problem, then replace the control panel.</td></tr>
<tr><td>'OE'</td><td>Overload or calibration information lost or bad load cell</td></tr>
<tr><td colspan="2">The control panel has detected a weight reading that is smaller than expected. This may be caused by the application of too much weight to the platform, causing a permanent change in the load cells. If this display is seen when there is no weight on the platform then the most likely causes are a defective load cell or defective control panel. To isolate the problem measure the signal across pins two and three on the load cell connector on the control panel. This should be between zero and one milli-volt. If found to be higher or lower then the load cell system must be checked. See procedure elsewhere in this manual. If the signal is within this range, then the calibration data may be lost. Attempt to recalibrate the scale. If this does not clear the problem, then replace the control panel.</td></tr>
<tr><td>'OLE'</td><td>Math limit exceeded on divisions</td></tr>
<tr><td colspan="2">During the programming of the scale parameters it is possible to change the division or capacity of the scale. If an incorrect combination of division and capacity is selected, this message will be displayed. Correct this error by recalibrating the scale with the correct division and capacity settings.</td></tr>
<tr><td>'OL' Flashing</td><td>Defective angle sensor circuit</td></tr>
<tr><td colspan="2">The scale performs internal self calibration on a periodic basis. This frequency is determined by the programmed filter selection but is on the order of once a minute. At this time the scale reads the internal calibration. zero reference circuits and the angle sensor circuit board. These values are combined to determine a calibration correction factor. If any of these values are out of tolerance, then a brief 'OL' message is displayed during this recalibration cycle. The source of this error can be tested by looking at the signals on pins two and three, and six and seven of the angle sensor printed circuit board. If the difference between either of the signals falls outside the range of 0 to 24 millivolts the angle sensor board needs to be replaced. If this board is OK , then the control panel needs to be replaced.</td></tr>
</table>

'DISE'	Number can't be displayed (such as -99999)
The most common cause of this error is pressing the zero key with a full load on the scale. When the load is removed, the full number with a minus sign will not fit on the display. Pressing the zero key again will clear this display.	
'L8'	Low battery voltage
This message indicates that the control panel has measured the battery voltage and found it to be too low. The most likely cause is that the batteries need to be charged. If the charge indicator fails to light up when the charger is plugged in, then the charger or cable may be defective. If the batteries have been charged for the recommended time and fail to run for the specified duration, then the batteries may need to be changed. If a new set of batteries fail to correct the situation, then the control panel may need to be replaced. Also check the battery holder and wiring.	

The following table describes some symptoms with possible causes and solutions.

Symptom	No power up, nothing on display
If any power reaches the control panel, the display driver turns on some random segments. Since we are not seeing this we will assume that no power is reaching the scale circuitry. Some possible causes: Defective wiring harness: Inspect for damaged wiring. Defective battery pack: Measure battery voltage, charge or repair as needed. Defective on switch: Bridge switch to see if unit turns on. Defective circuitry: Replace control panel. The power supply may be delivering power, but it might be eaten up with a circuit board or defective cable. Unplug the load cell and angle sensor interconnect cables. If the scale turns on at this point, one of these systems is the culprit. Turn the power back off and try each in turn. If it is the angle sensor, replace the printed circuit board. If it is the load cell cable look for a crushed cable or summing circuit.	
Symptom	Power up to random display
We know that some power is reaching the display driver circuit, but the control panel is not working correctly. Test for low battery voltage. Inspect for visible damage. If this fails replace the control panel.	
Symptom	Scale shuts off
If the scale turns off IMMEDIATELY after you take your finger off the off button, you may have very low batteries. If this is not the cause replace the control panel.	
Symptom	"Locks up"
The scale may be mis-programmed. This can be corrected by restoring the correct control parameters. If the filter settings are very long with an active load the display will not be updated. This may be interpreted as a lock up. Finally, the scale performs a self calibrated routine about once a minute. The scale will "hesitate" for a few seconds during the calibration routine. This is normal behavior.	
Symptom	No backlight
Cover the light sensor window. If the light does not turn on, replace the control panel. Please note that the light is not visible in bright sunlight.	
Symptom	Slow operation
This may be caused by a programmed change in the filter setting. There is a tradeoff between speed and stability of the display reading. This can be tuned by changing the settings "Samples" and "Display Update Rate"	
Symptom	Low battery indicator won't turn off
It is possible that the output from the batteries is really low. Look at the cells and charger circuit for these problems. If the battery voltage is correct then you will need to replace the control panel.	

Symptom	Jumpy/drifty weights
This can usually be traced to contamination on circuit boards or a bad load cell. This can also be caused by a rapid change in temperature. The scales need at least one hour acclimation time for each 10 degrees Fahrenheit of temperature change.	
Symptom	**No response to one or more keys**
The switch may be defective. The control panel may be defective. The zero key does not function while the scale is in motion, this is not a defect. Also, the scale may be programmed to ignore the zero key if there is more than a certain amount of weight on the platform.	
Symptom	**"Bad" weights**
First, check weighing technique. Are there air currents around the vehicle being weighed? Are the operators using dummy blocks on the unweighed wheels? (**NOT** a recommended technique) Are the scales being used on level ground? Is the scale set on the wrong units settings? Are the scales being used by a new operator? If on a calibration press, are you using weight distribution blocks and rubber pads? Is the reference scale correct? Assuming all this, is the scale spanned correctly? If the weight is exactly 3/4 of what you would expect, one of the cells leads may not be providing signal. This would probably be in the load cell or summing circuit. The interconnecting wiring or cables may be pinched, cut or crushed. There may be mechanical interference around the weighing platform. Remove the platform and inspect the load cell mounting and links.	
Symptom	**Batteries won't charge**
Check for bad batteries. The charger circuit could be out. Look for the charging lamp to come on next to the charging connector. Check for bad connections or a defective charging cable. Look at the power source, whether it's a plug-in transformer, transport cart, or automotive ignition.	

Diagnostic tests and voltage measurements

Charger voltage:

Scale off during the entire test. Remove the batteries. Plug in a charger circuit. Read the positive battery lead. 8.6V or more. Unplug the charger and install cells. Read the positive battery lead and see 5.4V to 8.6V. depending on batteries state of charge. Plug the charger back in. Measure the current flowing through the batteries. This current should be greater than 100 ma and less then 500 ma. Alternately, just measure the voltage at the positive battery lead, it should rise after you plug in the charger.

Lamp:

Cover the light sensor. All four lamps light up. Please note that it is difficult to see the lights in sunlight.

Keys:

Press ON, the scale should turn on. Press **kg-lb**, the scale should change units of measure. Apply 50 lb to 250 lb to the scale. After you get a stable display, press the **ZERO** key. The scale should go to a zero indication. Press the **OFF** key. The scale should turn off.

Low battery indicator: Connect a variable supply to the input connector and remove the batteries. Connect the meter to the positive battery lead. Set the supply to 12V and turn the scale on. Reduce the input voltage until the low battery just turns on. This should be between 6.5 and 7.0 Volts.

Power down shutoff:

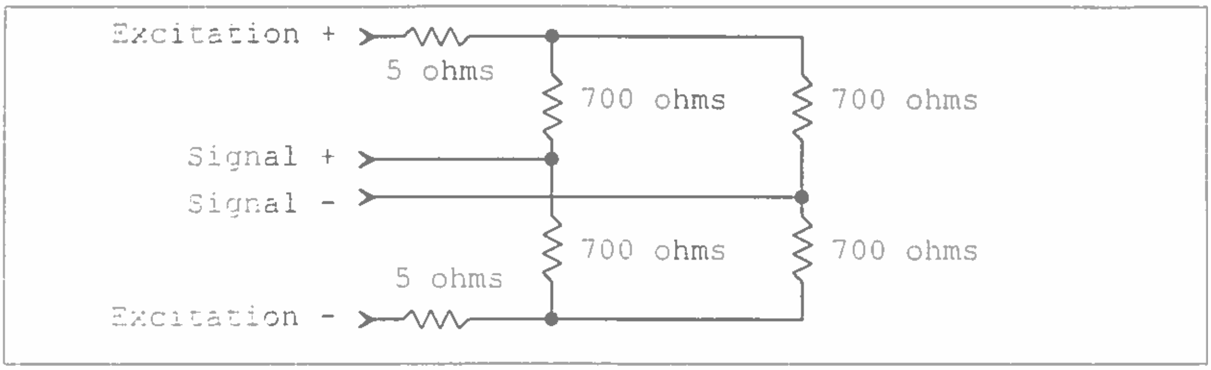
Continue the above test, reducing the power supply until the scale turns off. The voltage at shutoff should be between 6.0 and 6.5 Volts.

Load Cells:

Each AC 30-60 scale has four load cells. These load cells are the transducers that convert mechanical energy (weight) to electrical energy.

Each load cell has 4 strain gages (700 ohms apiece) and two temperature compensation resistors. The four strain gages are wired together to form a Whetstone bridge.

The schematic is:



The color coding of the wires are:

Red - + Excitation (5 Volts in our case)
Green - + Signal
White - - Signal
Black - - Excitation (ground)

The 5 ohm resistors in series with the Excitation leads are for temperature compensation. They are balco resistors that change resistance with temperature to maintain a constant signal voltage. These resistors are specially manufactured for our load cell material and strain gage types.

Check load cell zero output value:

The signal at the main circuit board with the signal leads soldered in place should be approximately 0.1 millivolts with no load applied to the cell. Larger values would indicate a defective load cell, wiring, or circuit board. The load cell must be tested separately to determine the source of the zero shift.

Check zero output from the load cell:

You can use a five volt power supply to provide the excitation voltage for this measurement. Connect plus five volts to the red lead and ground to the black lead.

Alternately, you can use a scale to provide the excitation voltage to use the with only the two excitation leads soldered in place (Black and Red). turn the scale on to apply excitation voltage.

The zero signal output (With excitation voltage applied) should measure approximately -1.00 to 1.00 millivolts between the plus and minus signal leads (Green and White). Larger values would indicate a defective load cell. This is most likely the result of an overload of the scale during use.

Check load cell resistance values:

With the load cells disconnected from the summing board the resistance readings should be as follows:

Blk - Red	= 710 Ohms
Blk - Grn	= 565 Ohms
Blk - Wht	= 565 Ohms
Wht - Grn	= 700 Ohms

It is normal for **all** of the readings to be higher or lower than the values given above by several percent. If there is several Ohm **difference** between the Blk-Grn and Blk-Wht measurements the cell is defective. This test is most useful to detect a catastrophic failure of the cell or lead; the sort of things you are looking for here are an open or a short.

Procedures Section

Please read through each procedure before attempting to perform it. Make sure that you have all of the required special tools and materials. If you have any question please contact our service department.

You may contact Intercomp using any of the following methods:

Toll free:	800-328-3336
Voice	612-476-2531
Fax	612-476-2613
E-Mail	service@intercompco.com
Web page	www.intercompco.com

Procedure: Remove and Replace Control Panel

Caution: The following procedure must only be performed at a static controlled workstation. The control panel is subject to damage by electrostatic discharge.

Caution: Avoid directly touching any exposed circuitry. Use cotton gloves or similar protection. Oils from the fingers will cause unacceptable performance in high humidity conditions. This degradation may not be obvious at the time of contamination. If the circuitry becomes contaminated it must be cleaned using isopropanol alcohol or an equivalent cleaner.

Tools required

- #2 Phillips screwdriver.
- Static dissipation station.

Disassembly

1) Remove all 10 bezel screws.
2) Detach the control panel assembly and set aside. It may be necessary to gently "wiggle" the panel to draw the panel through the access hole.
3) Unplug the harness connectors. Most of the connectors are keyed by size, the two exceptions being COM1 - COM2 and the power connector and load cell connector. Please note that the load cell connector plugs into the connector labeled "LC1" and the data cable harness is plugged onto the connector closest to R34. Please take the time to familiarize yourself with these locations before you unplug the cables.
4) Unplug the connector to the calibration switches.
5) Place the control panel in a static controlled carrier.

Assembly

6) Plug the harness connectors into the control panel.
7) Plug in the calibration switches connector .
8) Place control panel into the housing. Be careful not to pinch the wires between the housing and the printed circuit board.
9) Align the control panel on the housing.
10) Install 10 bezel screws.
11) Check and adjust calibration as needed (see calibration section).
12) This concludes the remove and replace control panel procedure.

Procedure: Remove and Replace Summing Circuit Board

Caution: The following procedure must only be performed at a static controlled workstation. The control panel is subject to damage by electrostatic discharge.

Caution: Avoid directly touching any exposed circuitry. Use cotton gloves or similar protection. Oils from the fingers will cause unacceptable performance in high humidity conditions. This degradation may not be obvious at the time of contamination. If the circuitry becomes contaminated it must be cleaned using isopropanol alcohol or an equivalent cleaner.

Tools required
- #2 Phillips screwdriver.
- Static dissipation station.
- Soldering iron and RMA core solder.

Disassembly

1) Remove all 10 bezel screws.
2) Detach the control panel assembly and set aside. It may be necessary to gently "wiggle" the panel to draw the panel through the mounting hole. Do **NOT** unplug any cables or connectors on the control panel.
3) Locate the summing board.
4) Remove screws retaining the circuit board.
5) Remove any tie wraps restraining load cell cables
6) Gently work the summing board out of the housing
7) Unplug the load cell connector from summing circuit board.
8) Record wire positions and orientation.
9) Unsolder all load cell leads. Use care to avoid fraying the individual wire bundles as you unsolder the load cell lead leads.

Assembly

9) Position load cell wire in summing printed circuit board. Solder wires.
10) Remove any traces of flux.
11) Position the summing circuit board in the housing.
12) Perform check and adjust corners procedure located in the calibration section.
13) Replace the circuit board retaining screws.
14) Secure load cell leads to prevent lead movement during normal handling.

Caution: Failure to secure the load cell leads will cause the wires to break off during shipping.

15) Place control panel into the housing. Be careful not to pinch the wires between the housing and the printed circuit board.
16) Align the control panel on the housing.
17) Install 10 bezel screws.
18) Check and adjust calibration as needed (see calibration section).
19) This concludes the remove and replace summing board procedure.

Procedure: Remove and Replace Angle Sensor

Caution: The following procedure must only be performed at a static controlled workstation. The control panel and angle sensor are subject to damage by electrostatic discharge.

Caution: Avoid directly touching any exposed circuitry. Use cotton gloves or similar protection. Oils from the fingers will cause unacceptable performance in high humidity conditions. This degradation may not be obvious at the time of contamination. If the circuitry becomes contaminated it must be cleaned using isopropanol alcohol or an equivalent cleaner.

Tools required

- #2 Phillips screwdriver.
- Right angle #2 Phillips screwdriver.
- Static dissipation station.

Disassembly

1) Remove all 10 bezel screws.
2) Detach the control panel assembly and set aside. It may be necessary to gently "wiggle" the panel to draw the panel through the mounting hole. Do **NOT** unplug any cables or connectors on the control panel.
3) Locate the angle sensor.
4) Unplug the interconnection cable connector from the angle sensor circuit board.
5) Gently work the angle sensor circuit board out of the housing
6) Place the angle sensor in a static controlled carrier.

Assembly

7) Position the angle sensor circuit board in the housing.
8) Replace the mounting screws.
9) Place the angle sensor circuit board into the housing. Be careful not to pinch the wires between the housing and the printed circuit board.
10) Align control panel on the housing.
11) Install 10 bezel screws.
12) Check and adjust calibration as needed (see calibration section).
13) This concludes the remove and replace angle sensor procedure.

Procedure: Remove and Replace Load Cell

Caution: The following procedure must only be performed at a static controlled workstation. The control panel is subject to damage by electrostatic discharge.

Caution: Avoid directly touching any exposed circuitry. Use cotton gloves or similar protection. Oils from the fingers will cause unacceptable performance in high humidity conditions. This degradation may not be obvious at the time of contamination. If the circuitry becomes contaminated it must be cleaned using isopropanol alcohol or an equivalent cleaner.

Warning: The scale weights 150 pounds and the top weighs 80 pounds. This procedure calls for frequent manipulation of the scale and platform. Use proper lifting and handling techniques to avoid injury.

Tools required

- Calibration force generator; press or deadweights. This calibration source must cover the range of 6000 to 60000 lb with an accuracy of 0.025% or better.
- 1.5" x 1.75" x 12" aluminum loading block.
- 8" x 8" x 1.75" aluminum loading block.
- 8" x 8" x 0.5" rubber loading pad.
- 12" x 12" x 1.75" aluminum loading block.
- 12" x 12" x 0.5" rubber loading pad.
- Static dissipation station.
- #2 Phillips screwdriver for bezel.
- Torque wrench covering 125 ft-lbs.
- 15/16" socket for torque wrench.
- 15/16" combination wrench.
- 3/8" Allen wrench.
- Small slotted blade screwdriver.
- Locktite 242 removable Threadlocker (BLUE).
- Torque-seal potentiometer shaft sealer.
- Dow-Corning 3145 electronic grade RTV Adhesive/Sealant.
- Soldering iron and solder.

Disassembly

1) Remove platform top. This best accomplished by standing the scale on its back on the floor. Rest your chest on the front of the scale. Have an assistant steady the scale while you reach through the opening in the bottom of the scale and grasp the bottom of the platform. There is a natural handhold formed by the platform stiffening members. Lift the platform and then swing the platform clear of the frame. Set the platform on the floor next to the scale.
2) Move the platform away from the upright scale to clear the work area.
3) Using the 15/16" wrench remove and 3/8" Allen wrench loosen the bolts on the cell to be replaced.
4) Move the scale to a convenient work surface.
5) Remove all 10 bezel screws.
6) Detach the control panel assembly and set aside. It may be necessary to gently "wiggle" the panel to draw the panel through the mounting hole. Do **NOT** unplug any cables or connectors on the control panel.
7) Locate the summing board.
8) Remove screws retaining the circuit board.
9) Remove any tie wraps restraining load cell cables
10) Gently work the summing board out of the housing
11) Unplug the load cell connector from summing circuit board.
12) Record wire position, orientation and color code of cell(s) to be removed.
13) Unsolder the load cell leads from the summing board.

14) Finish removing the nuts from the load cell bolts and lift the load cell free of the bolts.
15) Clean all the old RTV from load cell lead feed-through hole.

Assembly

16) Set new load cell in place.
17) Route the lead in the same path as the cell you are replacing.
18) Thread load cell lead through the hole in case.
19) Apply RTV liberally where load cell lead enters case. Work RTV compound inside feed-through hole.
20) Slide the centering sleeve (provided with the replacement loadcell) over the bolts inside the load cell. Replace the two nuts holding the load cell. Use removable locktite (BLUE) and torque the nuts to 125 ft-lbs.
21) Position load cell wire in summing printed circuit board. Solder the wires trim the leads.
22) Remove any traces of flux.
23) Position the summing circuit board in the housing.
24) Replace platform. This is best accomplished by standing the scale on its back on the floor. Have an assistant steady the scale while you grasp the edge of the platform and set the platform back into the frame. Tip the rest of the platform into the frame until is in the correct position. Tip the scale forward until it is resting on the floor. The weight of the platform will finish pulling it into the correct position.
25) Move the scale to a convenient work surface.
26) Perform check and adjust corners procedure located in the calibration section.
27) Replace the circuit board retaining screws.
28) Secure load cell leads to prevent lead movement during normal handling.

Caution: Failure to secure the load cell leads will cause the wires to break off during shipping.

29) Place control panel into the housing. Be careful not to pinch the wires between the housing and the printed circuit board.
30) Align the control panel on the housing.
31) Install 10 bezel screws.
32) Check and adjust calibration as needed (see calibration section).
33) This concludes the remove and replace load cell procedure.

Calibration Procedures

Note: The AC30-60 scale is calibrated by the factory prior to shipment.

Note: If the AC30-60 is calibrated using dead weights the correct altitude and latitude parameters must be set. If the scale is calibrated using a force calibration press the altitude parameters should be set to 0 feet and the latitude set to 45 degrees.

Note: The electronics contained within the AC30-60 are mathematically capable of performing 50,000 divisions for graduations under by 0.5; and 500,000 divisions for graduations above by 0.5. The number of divisions is just the capacity (or graduation break point) divided by the graduation. This limitation applies only to the capacity and graduation break points. If this limit is exceeded an 'OLE' error message will be displayed. As an example, the scale could not be set for 10,000 lb by 0.1 lb

Caution: At several points in the following procedures you will be asked to use loading blocks. The tip of a test press may exert 60000 pounds of force. While AC 30-60 scales are designed to accept this force, they may not tolerate this on a single point. **You must use a block to distribute the force over the load surface.** In general, the force should be applied over much the same pattern as a tire. We recommend a 12" x 12" x 1.75" block of aluminum on top of a 12" x 12" x 0.5" piece of rubber.

Procedure: Calibration Verification

Tools required:

- Calibration force generator; press or deadweights. This calibration source must cover the range of 6000 to 60000 lb with an accuracy of 0.025% or better.
- Tire simulator consisting of: 12" x 12" x 1.75" aluminum block on a 12" x 12" x 0.5" rubber block.
- #2 Phillips screwdriver.
- Inclinometer, 0° to 10° x 0.1°.
- Static dissipation station.

1) Bring the scales to the calibration site. If there is more than 5°F difference in temperature between the scale temperature and the calibration site allow that scales to reach room temperature.
2) Place scale on calibration fixture. Turn scale on. Wait 5 minutes for warmup.
3) Apply the following test forces:

Test force	Lower limit	Upper Limit
0 lb	-	-
6000 lb	5,990	6,010
12000 lb	11,990	12,010
18000 lb	17,980	18,020
24000 lb	23,980	24,020
30000 lb	29,970	30,030
36000 lb	35,960	36,040
42000 lb	41,960	42,040
48000 lb	47,950	48,050
54000 lb	53,950	54,050
60000 lb	59,940	60,060
0 lb	-	-

4) Verify that each display value is within the limits shown.
5) If any value is out of acceptable limits proceed to the adjust calibration procedure.
6) This concludes the verify calibration procedure.

Procedure: Adjust Calibration

Caution: The following procedure must only be performed at a static controlled workstation. The control panel is subject to damage by electrostatic discharge.

Note: At times it will be necessary to enter up to a five digit number. When this is necessary the current number will be displayed with the right most digit flashing. The flashing digit may be incremented by pressing the **ZERO** key. To move one digit to the left press the **LB/KG** key. When you have finished entering a number press the internal **CAL** switch.

1) Remove all 10 battery hatch screws.
2) Turn scale ON.
3) Wait three minutes for scale to warm up. Use this time to preload the scale to capacity three times.
4) Zero the scale.

Note: The first part of the calibration procedure involves the verification of several parameters. It is not necessary to change the numbers; you may accept the current settings to "get past" this section.

5) To access the calibration mode, the calibration enable switch, located on the left, inside of the battery compartment, must be flipped to the enable position. To initiate the calibration menu press and release the internal **CAL** switch. The display will show a 'EE-01', if it does not the calibration enable switch is incorrectly placed to allow calibration. Flip the switch and try again.

The scale shows 'EE-01'. Press the **CAL** switch located inside the control panel front.

6) Enter the cell number. The cell number is normally set to 1; if the scale is to be hooked up to a AC-100 CPU each scale must be numbered with a unique number. Valid cell numbers are 1 to 32. This number should be displayed on the outside of the scale so the operator can determine the cell number by inspection.

The AC30-60 has the ability to have multiple graduation values set. The next three entries (EE-02, EE-03, and EE-04) are the pound weight values at which the graduations increase. As an example:

EE-09 = 9 (Initial graduation equals by 0.1 lb)
HH-00 = 10000 (Capacity equals 10,000 lb)

EE-02 = 1000 72600
EE-03 = 2000 72600
EE-04 = 5000 72600

The scale would then display the following:

up to 1000 lb	by 0.1 lb;	up to 453.55 kg	by 0.05 kg
1000+ to 2000 lb	by 0.2 lb;	453.55+ to 907.0 kg	by 0.1 kg
2000+ to 5000 lb	by 0.5 lb;	907.0+ to 2268.0 kg	by 0.2 kg
5000+ lb	by 1.0 lb;	2268.0+ kg	by 0.5 kg

When weight calibration is done, the graduation break points will be set to 110% of the capacity if they are not being used (i.e. they are all the same).

7) The scale shows 'EE-02'. Press the **CAL** switch.
8) Enter the first graduation break point.
9) The scale shows 'EE-03'. Press the **CAL** switch.
10) Enter the second graduation break point.
11) The scale shows 'EE-04'. Press the **CAL** switch.

12) Enter the third and final graduation break point.
13) The scale shows 'EE-05'. Press the **CAL** switch.
14) Enter the number of samples from the A/D that are averaged. 4
15) The scale shows 'EE-06'. Press the **CAL** switch.
16) Enter the number of cycles between screen updates. 4
17) The scale shows 'EE-07'. Press the **CAL** switch.
18) Enter the AZT (automatic zero tracking) size from the table below. If the displayed weight is less than the number of grads shown for a given amount of time the weight will be zeroed off.

Number	Value
0	Off
1	0.6 grad
2	1.0 grad
3	3.0 grad

Recom. ⇒ (2); Set by Fact. (3)
6 Lbs.
1.0 Lbs
30 Lbs.

19) The scale shows 'EE-08'. Press the **CAL** switch.
20) Enter the zero range from the table below. The zero range is the percentage of capacity where the zero button is allowed to work. This setting is used to prevent accidental zeroing of the scale while a load is applied.

Fact Set → (0)

Number	Amount
0	100% (Off)
1	1%
2	2%
3	5%

21) The scale shows 'EE-09'. Press the **CAL** switch.
22) Select the units the scale will turn 'on' in.

Number	Unit
0	Pounds
1	Kilograms

23) The scale shows 'EE-10'. Press the **CAL** switch.

24) Enter the initial graduation size from the table below.

Fid Set →

Number	lb	kg
0	100	50
1	50	20
2	20	10
3	10	5
4	5	2
5	2	1
6	1	0.5
7	0.5	0.2
8	0.2	0.1
9	0.1	0.05
10	0.05	0.02
11	0.02	0.01

This is the start of the angle sensor calibration.

25) The scale shows 'PP-00'. Press the **CAL** switch.
26) Enter the desired function from table. Angle sensor calibration must be performed if the force calibration is to be adjusted or the angle sensor is replaced.

Function #	Description
0	Disable Inclinometer
1	Enable Inclinometer
2	Disabled but do a complete calibration
3	Enable and do a complete calibration
4	Disabled but calibrate the zeroes
5	Enabled and calibrate the zeroes

27) If you entered 0 or 1 for PP-00 the scale will proceed to normal weight calibration (HH-00), else it will show 'PP-01'. Press the **CAL** switch with the N-S axis level.
28) The scale shows 'PP-02'. Press the **CAL** switch with the E-W axis level.
29) If you entered 4 or 5 for PP-00 the scale will proceed to normal weight calibration (HH-00), else it will show 'PP-03'. Press the **CAL** switch with the N end of the N-S axis elevated at 10.0 +/- 0.1 degrees.
30) The scale shows 'PP-04'. Press the **CAL** switch with the E end of the E-W axis elevated at 10.0 +/- 0.1 degrees.
31) The scale proceeds to force calibration section (HH-00).
How Heavy.

At this point (HH-00), any changes made are saved in memory and the scale can be turned off without proceeding into force calibration adjustment. The changes made are used along with the previous calibration.

To adjust the calibration; no weight and three load weights need to be applied. This multiple point calibration allows the unit to weigh more accurately by removing undesirable characteristics of load cells. The scale will now ask you for the four weight readings in the order: no load, load one, load two, and load three.

32) The scale shows 'HH-00'. Press the **CAL** switch.
33) Enter the capacity of the scale. 60 000 lbs / 20 000
34) The scale shows 'LL-00'. With no weight applied to the scale press the **CAL** switch.
35) The scale shows 'HH-01'. Press the **CAL** switch. 12500
36) Enter the value (in lb) of the first load to be applied. We suggest 10000 pounds.
37) The scale shows 'LL-01'. With the first load applied to the scale press the **CAL** switch.
38) The scale shows 'HH-02'. Press the **CAL** switch.
39) Enter the value (in lb) of the second load to be applied. We suggest 25000 pounds.
40) The scale shows 'LL-02'. With the second load applied to the scale press the **CAL** switch.
41) The scale shows 'HH-03'. Press the **CAL** switch.
42) Enter the value (in lb) of the third load to be applied. We suggest 45000 pounds.
43) The scale shows 'LL-03'. With the third load applied to the scale press the **CAL** switch.
44) Return the calibration enable switch to its original position to prevent accidental entry into the calibration menu.
45) Replace the battery hatch cover.
46) Replace the battery hatch screws.
47) Perform the verify calibration procedure.
48) This concludes the adjust calibration procedure.

Procedure: Test and Adjust Corners

The corners as well as calibration are set at the factory at time of shipment. It may be necessary to make adjustments to the corner settings after replacing a load cell or the summing printed circuit board.

There are four load cells within the AC30-60; one in each corner. The cables from each of the cells enters through the back of the control box. They are numbered as shown in Fig 1.

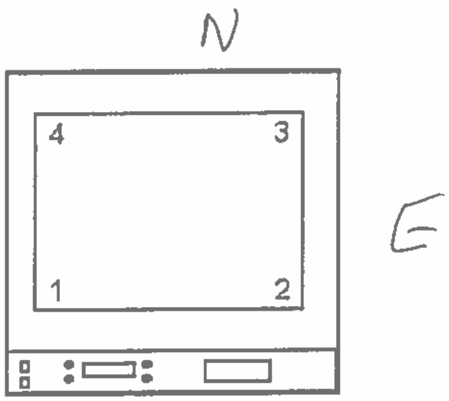


Fig 1.

The load cells are attached to the summing board as indicated in Fig 2. The trimpots are associated with their respective load cells as indicated in the figure.

Note: The dead load output of the cells can be adjusted using jumpers on the indicated header. To adjust the deadload a jumper must be placed on one of raise or lower positions, than another jumper must be placed on a position to select which resistor value is to be used. The lower value resistors will influence the dead load more. This adjustment is not used in normal service. Contact the factory if you need the details on the use of this adjustment.

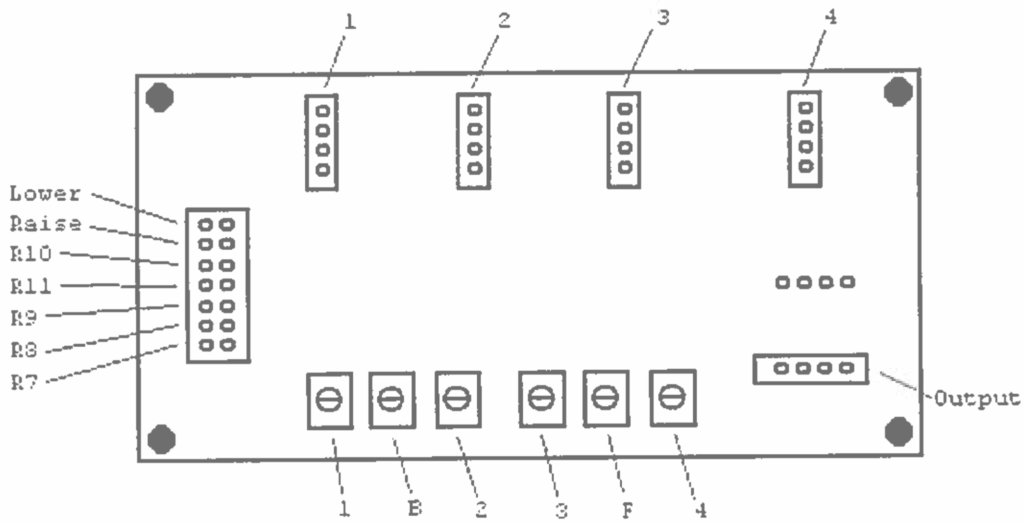


Fig 2.

Caution: Avoid directly touching any exposed circuitry. Use cotton gloves or similar protection. Oils from the fingers will cause unacceptable performance in high humidity conditions. This degradation may not be obvious at the time of contamination. If the circuitry becomes contaminated it must be cleaned using isopropanol alcohol or an equivalent cleaner.

Caution: The following procedure must be performed at a static controlled workstation. The main printed circuit board is subject to damage by electrostatic discharge.

Tools required

- Sixty thousand pound calibration press.
- 1.5" x 1.75" x 12" aluminum loading block.
- Static dissipation station.
- #2 Phillips screwdriver for bezel and board mounts.
- Small slotted blade screwdriver.
- Torque-seal potentiometer shaft sealer.

Note: If you are just checking the corners to see if adjustment is necessary you may proceed directly to step six. If you find that adjustment is required you may perform steps one through five to gain access to the adjustment potentiometers.

1) Remove all 10 bezel screws.
2) Detach the control panel assembly and set aside. It may be necessary to gently "wiggle" the panel to draw the panel through the mounting hole. Do **NOT** unplug any cables or connectors on the control panel.
3) Locate the summing board.
4) Remove screws retaining the circuit board.
5) Gently rotate the summing board until the potentiometers are accessible. Do not set the board on any conductive surface, including the scale. You may have to remove any tie wraps restraining the load cell cables
6) Turn scale ON.
7) Wait three minutes for the scale to warm up
8) Zero the scale.
9) Apply a 5000 Lb load to each load cell using the 8" x 8" loading block. Record the displayed weight.
10) Select the load cell that is furthest from the rest. Apply the 5000 lb load to that load cell.
11) Adjust the displayed weight value close to the rest of the recorded weight readings. Gently tap the potentiometer to seat the wiper after each adjustment.
12) Repeat steps 9 through 11 until there is no more the 1 division (10 pounds) difference between the load cells.
13) Apply Torx-seal to lock the potentiometer shafts.
14) Return summing board to its correct location in the housing.
15) Replace the circuit board retaining screws.
16) Secure load cell leads to prevent lead movement during normal handling.

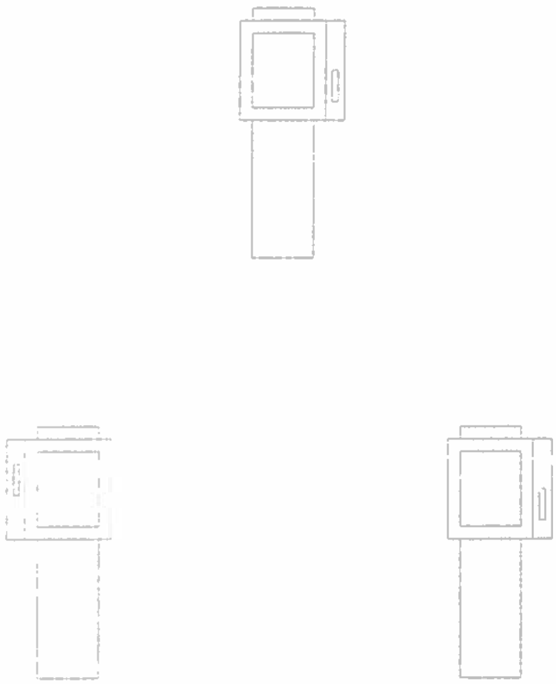
Caution: Failure to secure the load cell leads will cause the wires to break off during shipping.

17) Place control panel into the housing. Be careful not to pinch the wires between the housing and the printed circuit board.
18) Align the control panel on the housing.
19) Install 10 bezel screws.
20) Check and adjust calibration as needed (see calibration section).
21) This concludes the check and adjust corners procedure.

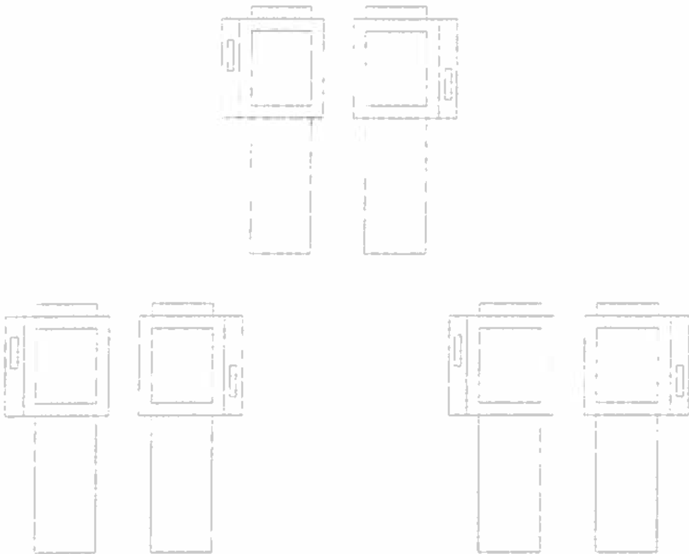
Error Messages

Message	Meaning
'EEPE'	Calibration information lost or corrupted
'OL'	Zero out of range
'L8'	Low battery voltage
'OE'	Overload or A/D out of range
'DISE'	Number can't be displayed (such as -99999)
'OLE'	Math limit exceeded on divisions

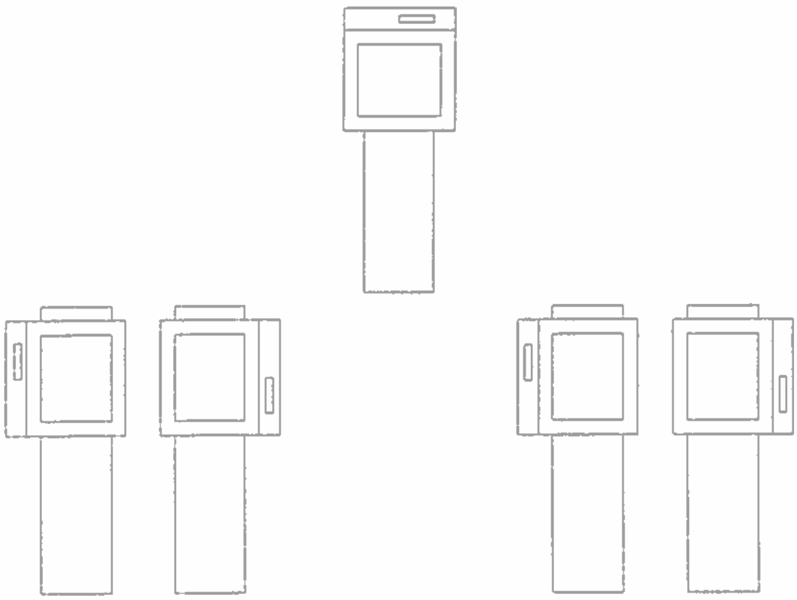
Some Common Platform Layouts



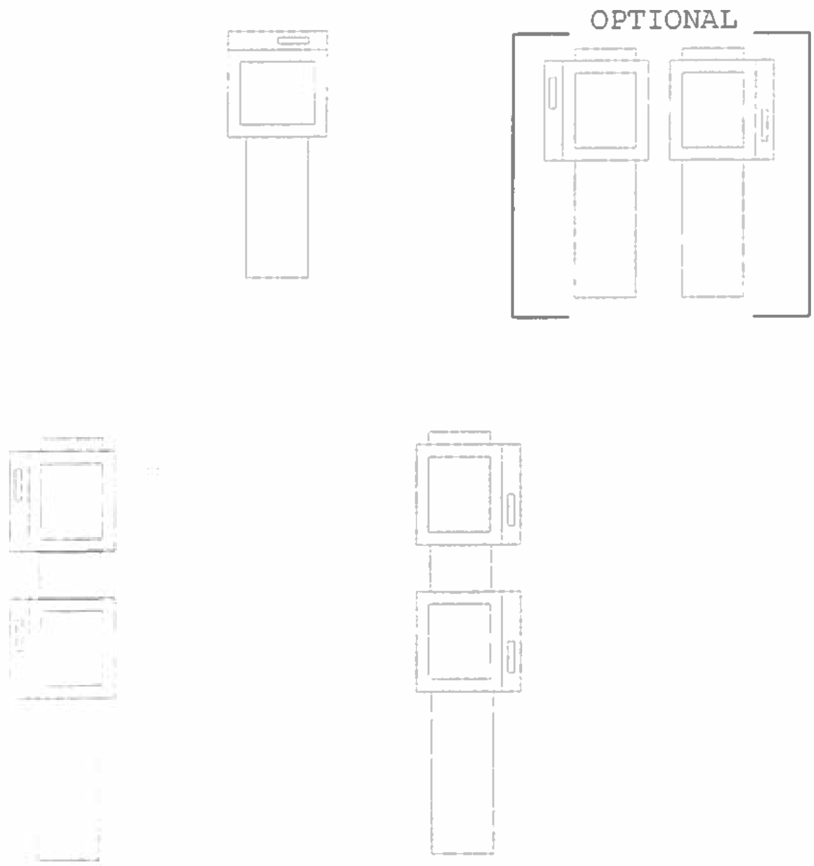
BUSINESS, CORPORATE
AND MILITARY JET



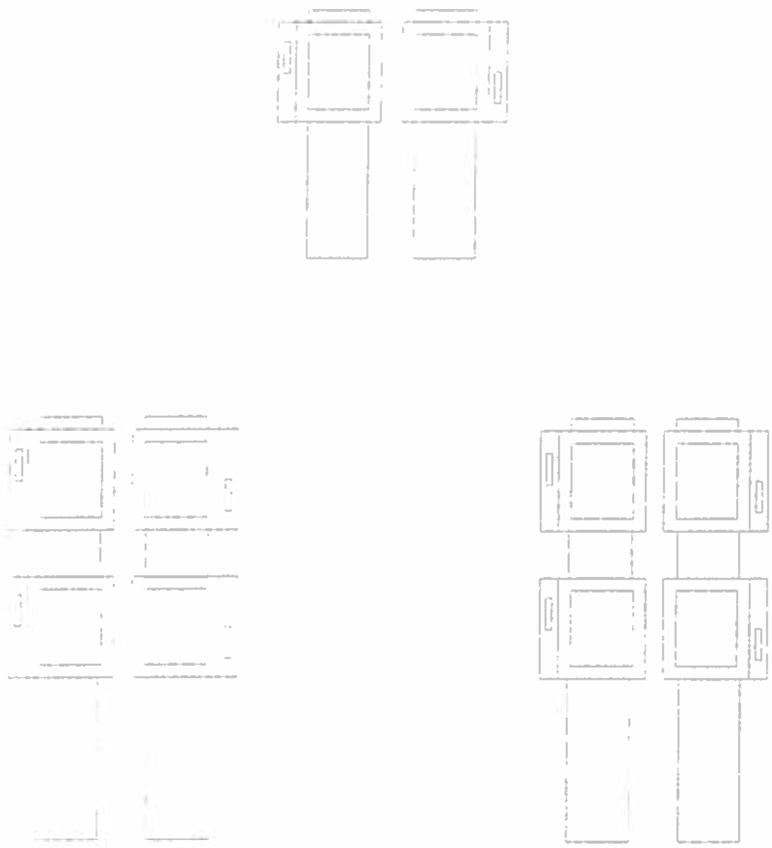
DC-9, MD-80', MD-90'S
B737,B727, A320, AND OTHER



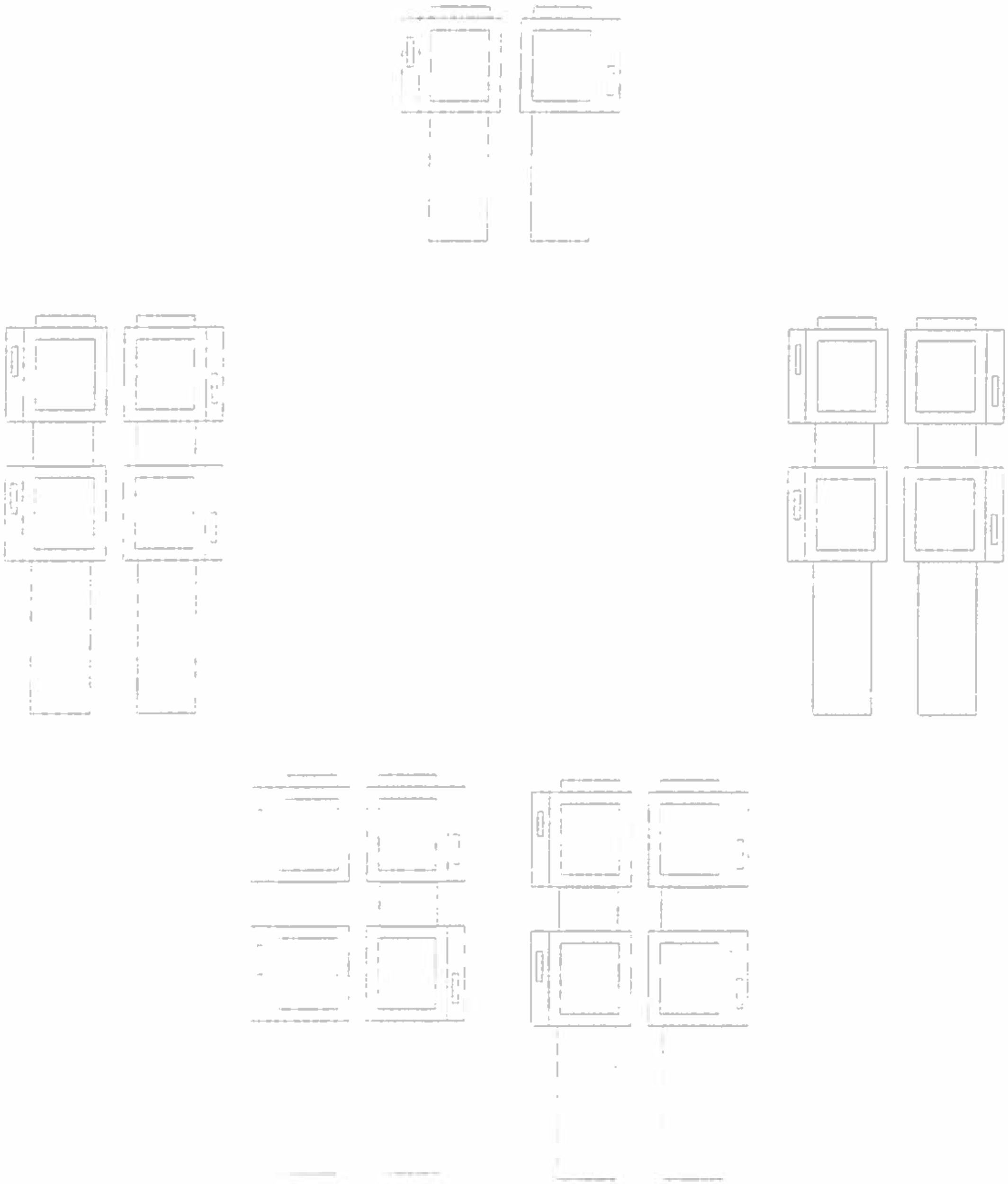
DC-9, MD-80'S, MD-90'S
B737,B727, A320, AND OTHER
-OPTION USING FIVE SCALES



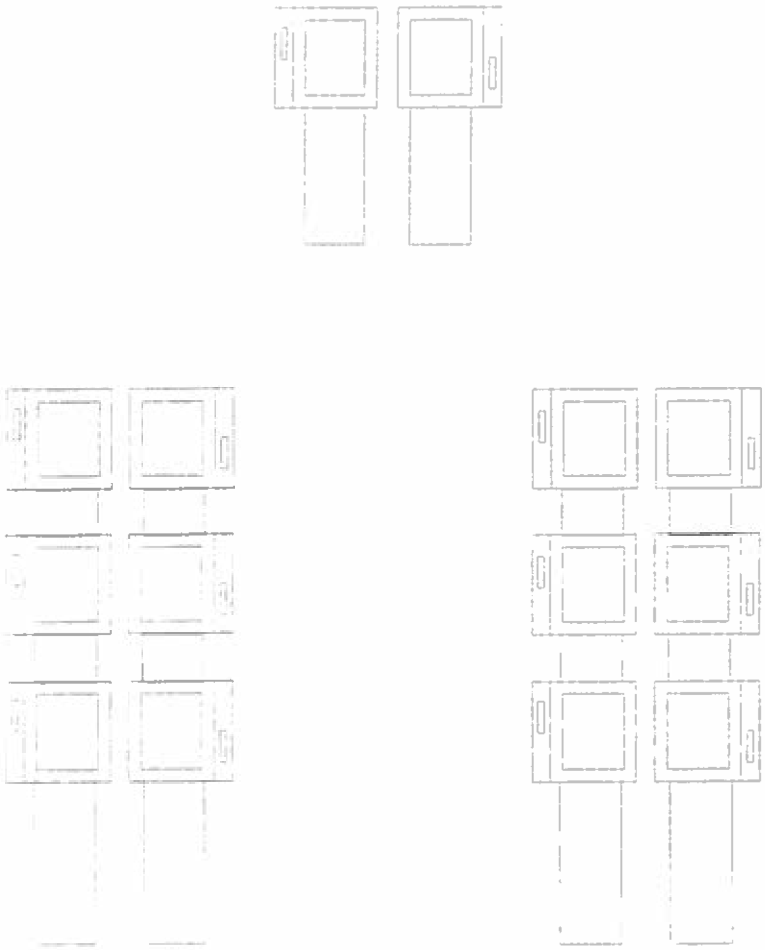
C-130, CN-235, AND OTHER



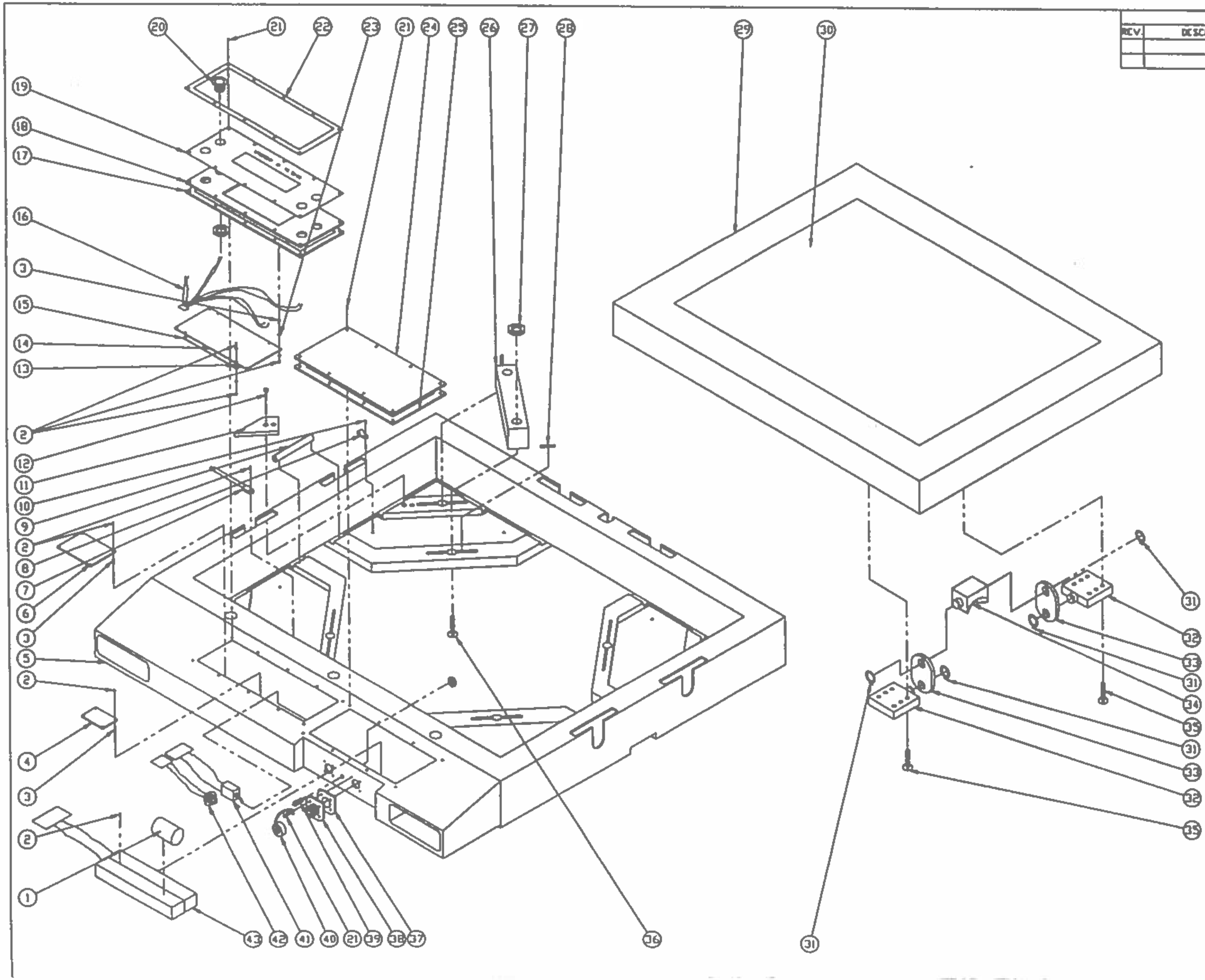
DC-8, DC-10, MD-11, D707, B757,
B767, L1011, A300, A330, A340, B1B



B747 - ALL SERIES



B777



REVISIONS

REV.	DESCRIPTION	ECO NO.	DRAWN	CHECKED	DATE

QTY REQ'D	FIND NO.	PART NO.	ITEM
1	43	000232	BATTERY HARNESS
1	42	000238	CALIBRATION SWITCH
1	41	000237	CALIBRATION ENABLE
2	40	220129	CONNECTOR - CAP
1	39	240002	LED ASSEMBLY W/ NUT
2	38	220130	CONNECTOR
2	37	300027	CONNECTOR GASKET
8	36	600037	.625-11 SCREW
48	35	600020	.25-20 SCREW
4	34	302131	LOADCELL PIN
8	33	300367	CONNECTING LINK
8	32	302130	LOWER PIN
16	31	601042	RETAINING RING
1	30	302025	PLATFORM ANTI-SKID
1	29	302132	PLATFORM
16	28	604013	.625 DOWEL PIN
8	27	601054	JAM NUT, 5/8-11UNC
4	26	603053	LOADCELL
1	25	302024	BATTERY COVER GASKET
1	24	300479	BATTERY COVER
24	23	601014	NYLON WASHER
1	22	300012	BEZEL FRAME
26	21	600010	6-32 SCREW
4	20	230142	SWITCH W/ NUT
1	19	230135	KEYPAD OVERLAY
1	18	302171	KEYPAD SUPPORT
1	17	300009	KEYPAD SUPPORT GASKET
1	16	000239	KEYPAD HARNESS
1	15	000096	A/D BOARD ASSEMBLY
1	14	000093	DISPLAY BOARD ASSEMBLY
4	13	601018	6-32 F/F STANDOFF
8	12	600019	.25-20 SCREW
4	11	302150	TIP-UP SUPPORT BLOCKS
6	10	600007	6-32 SCREW
2	9	302026	LOADCELL CABLE PROTECTOR
6	8	890040	CABLE CLAMP
4	7	890047	TIE-DOWN W/ SCREW HOLE
1	6	000103	ANGLE SENSOR BOARD
1	5	000042	BASE ASSEMBLY
1	4	000235	SUMMING BOARD
12	3	601024	6-32 M/F STANDOFF
20	2	600008	6-32 SCREW
6	1	330014	BATTERY

PARTS LIST

INTERCOMP CO.

SCALE 1:4 — DATE 3-5-96 — DRAWN BY R. EVENSON

SCALE ASSEMBLY 60K — D SIZE

SEE PARTS LIST — 000008

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Transport Cart

14465 23d Avenue North
Minneapolis MN 55447

Telephone (612) 476-2531

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Intercomp assumes no liability for the customer's failure to comply with these requirements.

Do not substitute or modify

Because of the danger of introducing hazards, do not substitute parts or perform any unauthorized modifications of the equipment.

Warranty

INTERCOMP CORPORATION (hereafter called "the company") warrants the transport cart which this document accompanies to be free of defects in materials and workmanship, and to operate according to design specifications for a period of one (1) year after receipt by the original purchaser. After authorized return to the company at the purchaser's expense, the company shall evaluate any returned equipment under warranty claim, and shall make such repairs or replacements as may be judged necessary, in as expeditious a manner as possible.

IN THE EVENT that the company determines the claim to be made as a result of improper use, abuse, modification, shipping damage, or other factors beyond the reasonable control of the company, the company will advise the purchaser of the estimated repair costs. The company makes no warranty other than that contained in this statement. No agent other than an executive officer of Intercomp Corporation is empowered to modify in any manner this statement of warranty.

Introduction

General Information

The TC-010 transport cart is designed to house and charge up to 10 AC 30-60 weighing scales. The transport cart is designed to be towed using a standard tug.

Scope of manual

This manual provide details on loading the cart and using and maintaining the built in charging system.

Features

- A tow bar with pintle ring allow the cart to be pulled by a standard tug.
- A standard pintle hook allows the cart to be connected in series with other carts.
- Hard plastic wheels with front castors allow easy towing
- The transport provides storage bays for:
  - Up to 10 weighing platforms.
  - Up to five 2 stage ramps.
  - Up to five inter-scale spacers.
  - Up to five tire stops.
  - One AC 100 control box, junction box, and associated cables.
- Restraint rods secure the contents of the cart during movement.
- Lock hasp holes in the restraint rods allow enhanced security.
- An integrated charging system allows all platforms to be charged during storage.
- The integrated charging system may be configured for 105 to 120 or 205 to 240 VAC input.
- The charging system is usable with 50 or 60 Hz input without adjustment.
- A bright red LED display confirms correct connection of input power.
- Detachable side curtains protect against blowing dust and mist.
- Top speed is 10 MPH loaded, and 5 MPH unloaded.

Options

The TC-010 may be configured with different combinations of storage bays.

Specifications

Controls

General On/off switch for the charging circuitry.
Indicator Red LED power indicator.

Electrical

Power source required 105 to 240 VAC
Operating current AC current draw is less than 1 Amp at 110 VAC or 0.5 Amp at 220 VAC.
Charging time The integrated charger allows the scales to be fully charged in 10 hours.

Environmental

The cart is designed to be stored in a semi-protected location.

Humidity 10% to 95% Non-Condensing
Temperature +14F (-10C) to +104F (+40C)

Physical

Weight

3500 lb (15875 kg) loaded
1200 lb (545 kg) unloaded

Dimensions

127" (323 cm) long x 58" (147 cm) high x 40" (102 cm) wide

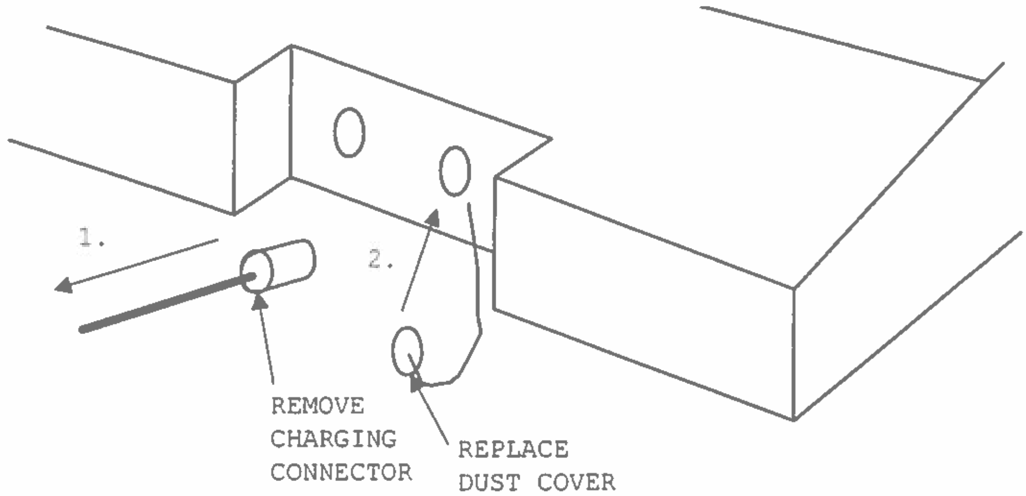
User Information

Unloading platforms

NOTE: A platform scale weights approximately 150 lb (70 kg) . Proper lifting and handling procedures must be followed to avoid injury to the operator or damage to the scales.

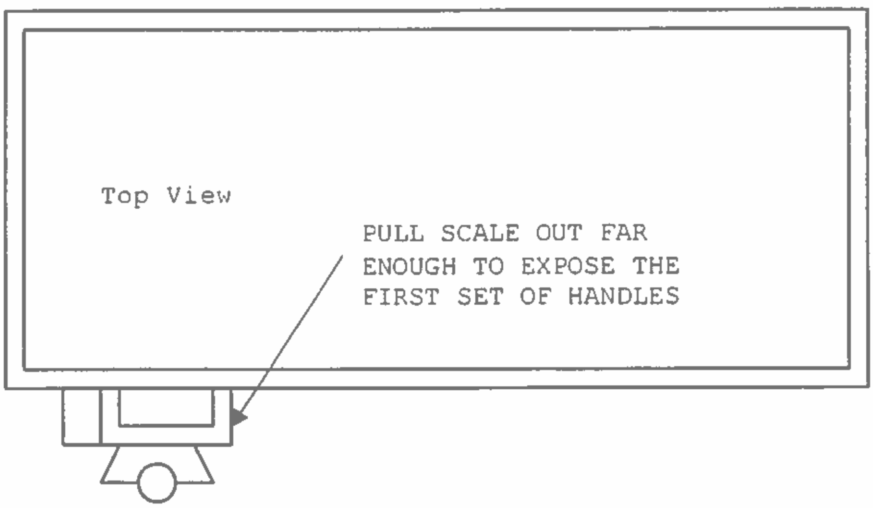
1) Tow the cart close to the location where the scales will be used. It is useful to unload the scales close to each wheel group where they will be used. This saves labor lost to carrying the scales.

2) Open the charging access doors and visually inspect that the charging jacks are removed and the dust covers are installed before attempting to remove any scales. Perform this check on both ends of the cart.

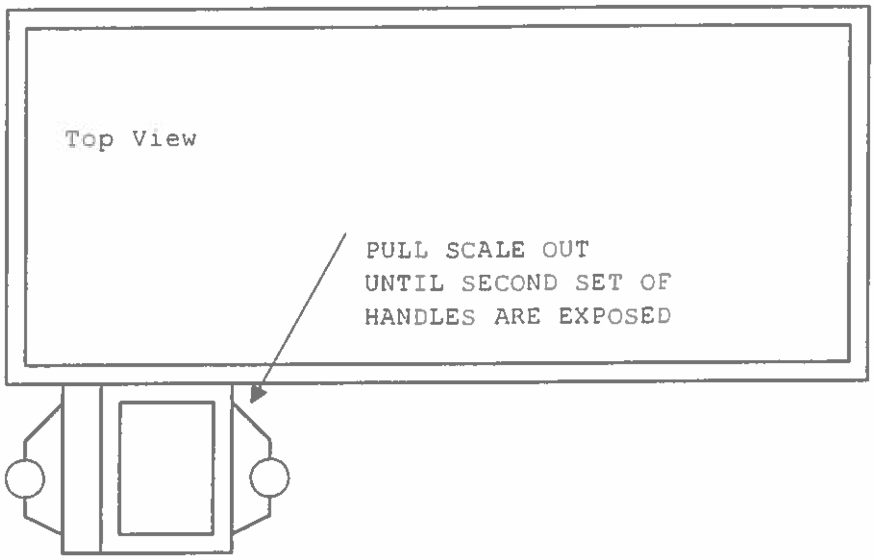


4) Unsnap the canvas covers and remove the retainer rods. The retainer rods are removed by pulling upwards until free of the cart body.

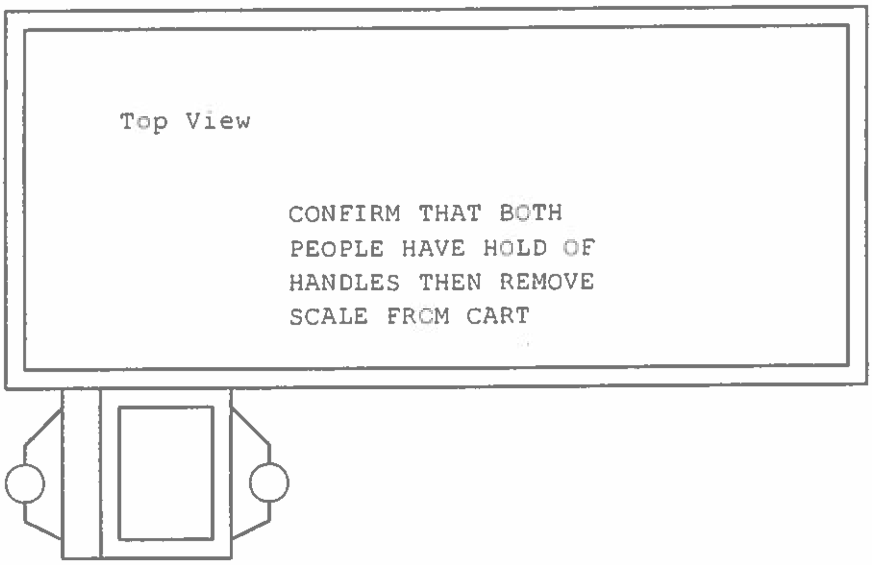
3) Draw a scale out far enough to grab the first set of scale handles.



4) While supporting the scale as it is drawn from the cart pull out the scale until the second set of handles are exposed.



5) Grasp all handles. The operators should exchange signals such as "I have it" before attempting to carry away the scale. Carry the scale to the weighing location.



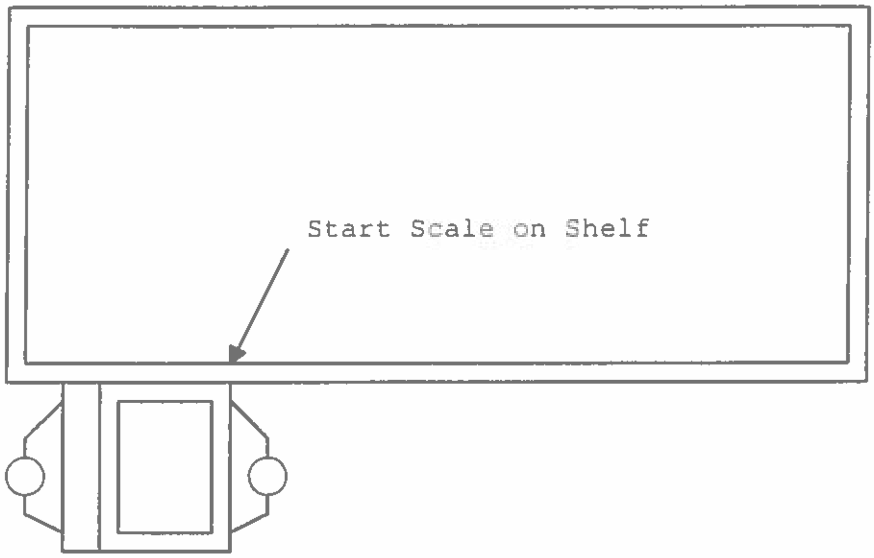
6) Repeat steps **3** through **5** until all scales are placed.

Loading

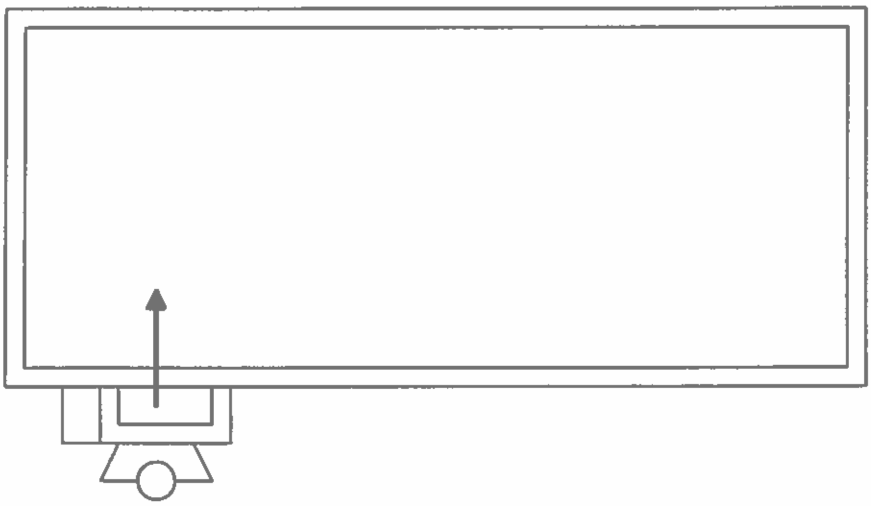
1) Carry the scale to the transport cart. Use proper lifting practices; I.E. Lift with your legs - not your back.

2) Place the edge of the scale on the storage shelf.

3) Exchange verbal signals such as "It is in" to insure that the scale is started on shelf.



4) Release the handles closest to the cart and slide the scale in past the center line.

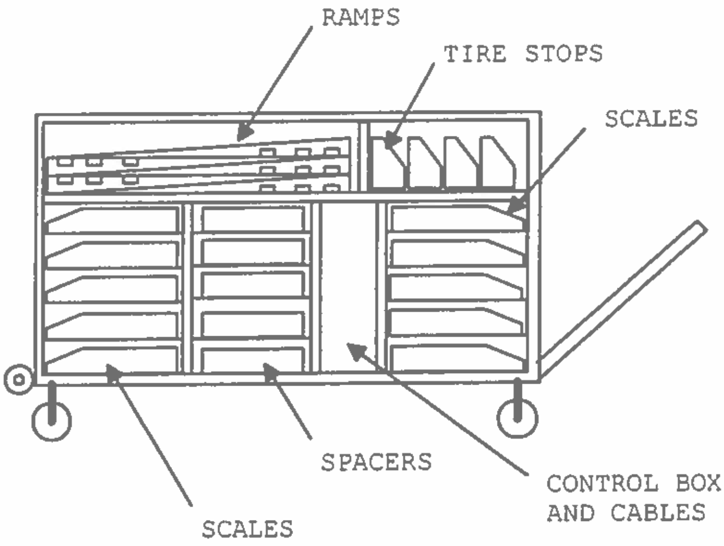


5) Release the remaining handles and slide the scale completely into the cart.

6) Repeat steps **1** through **5** as required.

7) Use the loading diagram found on the following page to replace ramps, spacers, tire stops, and other accessories.

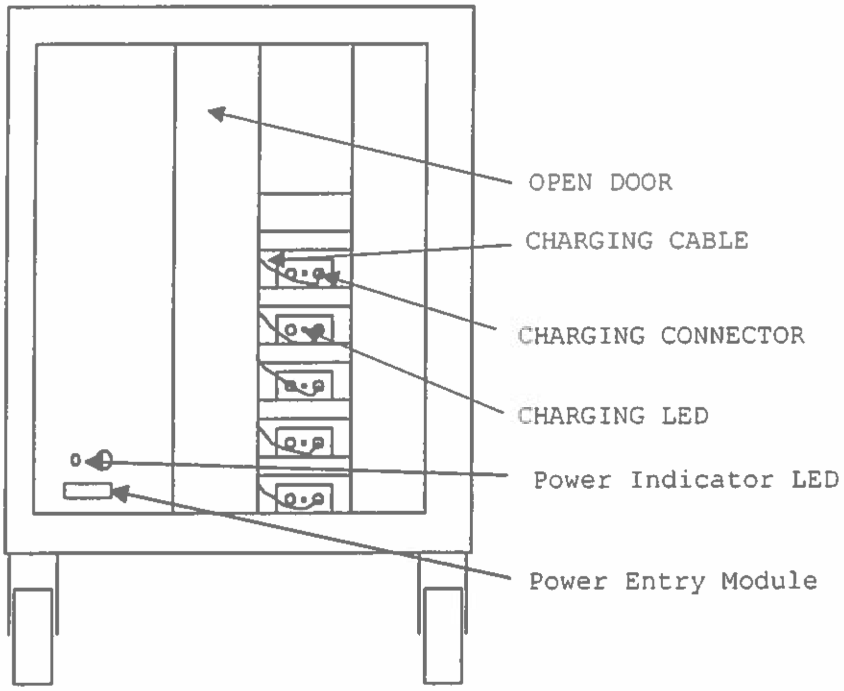
Loading Diagram



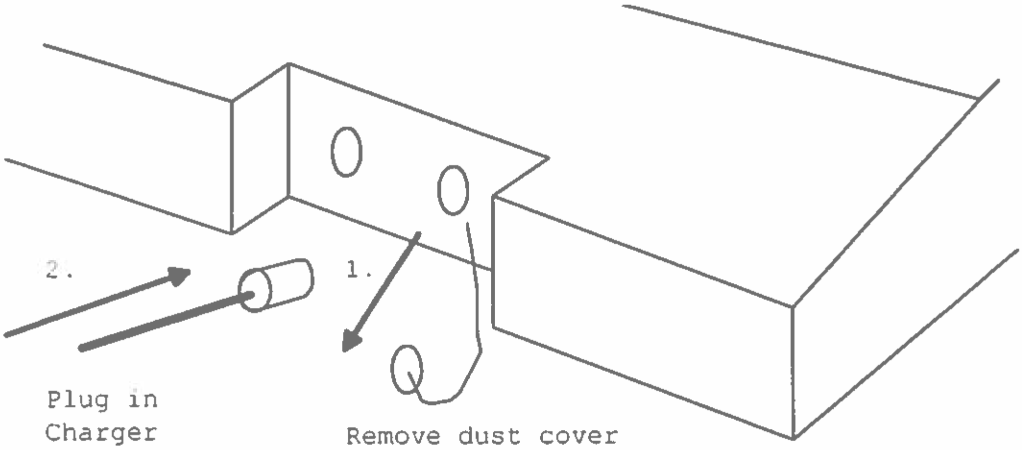
Charging

Connecting chargers to scales.

1) Open doors on each end of the cart.



2) Remove dust covers on all scales and plug in charging connector.



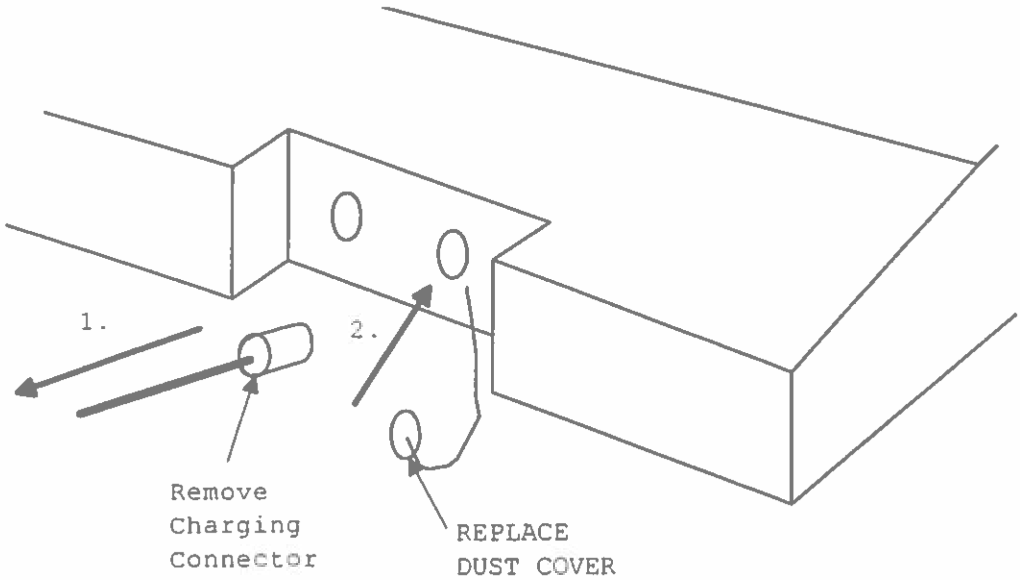
3) Attach the AC power cable into the IEC standard connector next to the power switch. Plug the cable into a suitable source of AC power.

4) Place the power switch in the "1" or on position. This applies power to the charging circuitry. The red LED power indicator shows that power is applied to the input connector. Each individual scale has its own charge indicator LED to show that its charging cable is connected correctly.

5) Allow the scales to charge for 10 or more hours.

Disconnecting chargers

1) Place the power switch in the '0' or off position. Remove and store the AC power cable.



2) Disconnect charging cables and replace dust covers on all scales.

Service

Theory of Operation

AC power enters through a **power entry module**. This module contains a power switch, fuse, and voltage selection card. The primary taps of a **power transformer** are also connected to the module. The output of the transformer passes through a low voltage fuse. The voltage at this point is a nominal 12 volts AC. From this point the power is routed to a **terminal block assembly**. All individual **charging cables** and the **power indicator lamp** are supplied from these terminal blocks. The leads to the LED power input lamp contains a **current limiting resistor**. Each individual scale takes the 12 VAC and converts this into the correct amount of charge current. Each scale may draw up to 0.4 Amps.

Please note that all of the charging jacks must be wired with the same polarity to avoid shorting out in the scales grounding systems. This becomes important if you are replacing a charging connector.

The high voltage fuse protects the line cord and power transformer input winding. The low voltage fuse protects the transform output winding and scales.

Trouble-shooting

Due to the simplicity of the charging circuitry trouble shooting is very simple.

Symptom	Possible Cause(s)
The power input lamp will not light up. All scales' charge indicator will not light up.	Bad AC power source. High or low voltage fuse bad. Incorrectly configured voltage selector. Defective ON/Off switch. Defective Power Transformer. Defective wiring harness. Defective power input lamp.
One or more scale's charge indicator will not light up.	Defective wiring harness. Defective charging connector. Defective scale
The charger keeps blowing fuses.	Shorted or pinched charging cable or connector. Defective wiring harness. Defective transformer. Defective scale. Unplug all scales and try again.
The power input lamp is very bright or very dim.	Incorrectly configured voltage selector.
Broken charger jack on scale.	Scale removed from cart while plugged in.

Procedures

Testing and Changing fuses:

AC Line fuse. The AC line fuse is found in the power entry module.

1) Unplug the AC power cord.

2) Open cover, using small blade screwdriver or similar tool.

3) Remove fuse from holder assembly.

4) Test fuse with continuity tester. Replace fuse if fuse is open (No continuity).

5) Place fuse back in cover / fuse block assembly.

6) Replace cover, and verify that indicator pin shows the desired voltage.

Low voltage fuse. The low voltage fuse is found in the holder next to the power indicator red LED lamp.

1) Unscrew the fuse holder cap.

2) Remove fuse from holder assembly.

3) Test fuse with continuity tester. Replace fuse if fuse is open (No continuity).

4) Place fuse back in cover / fuse holder assembly.

5) Replace cover.

Voltage Selection

To change the selected input voltage:

1) Open AC power entry module cover, using small blade screwdriver or similar tool; set aside cover / fuse block assembly.

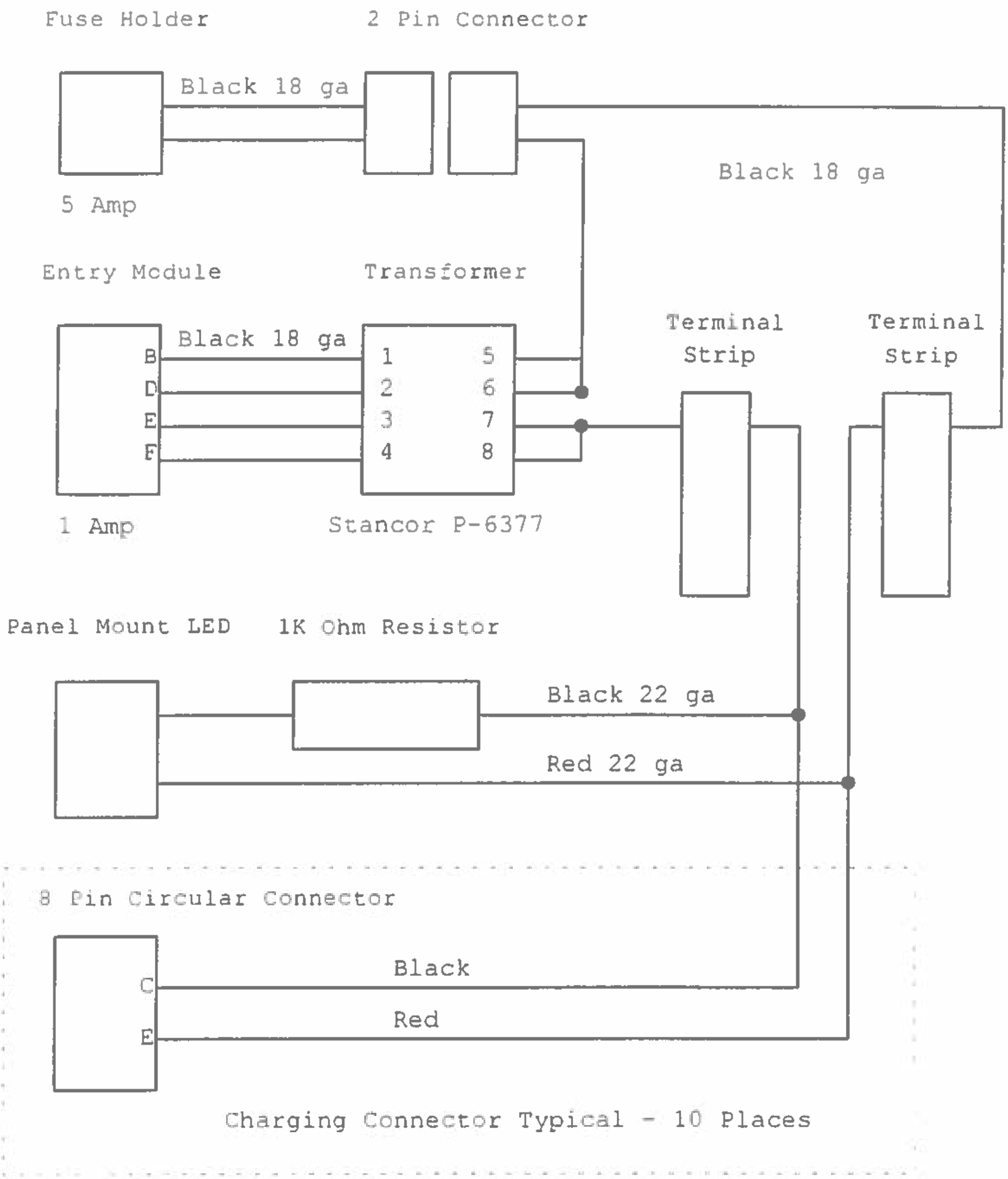
2) Pull voltage selector card straight out of housing.

3) Using indicator pin to point up when desired voltage is readable (note that when indicator pin is fixed, successive voltages are selected by rotating the card 90° clockwise). Allowable voltage selections are 110 and 220 VAC.

4) Insert voltage selector card into housing, printed side of card facing IEC connector, and edge containing desired voltage first.

5) Replace cover, and verify that indicator pin shows the desired voltage.

Schematic Diagram



AC-CSA Calibration System

14465 23rd Avenue North
Minneapolis MN 55447

Telephone (612) 476-2531

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Intercomp assumes no liability for the customer's failure to comply with these requirements.

Do not substitute or modify

Because of the danger of introducing hazards, do not substitute parts or perform any unauthorized modifications of the equipment.

Warranty

INTERCOMP CORPORATION (hereafter called "the company") warrants the AC-CSA which this document accompanies to be free of defects in materials and workmanship, and to operate according to design specifications for a period of one (1) year after receipt by the original purchaser. After authorized return to the company at the purchaser's expense, the company shall evaluate any returned equipment under warranty claim, and shall make such repairs or replacements as may be judged necessary, in as expeditious a manner as possible.

IN THE EVENT that the company determines the claim to be made as a result of improper use, abuse, modification, shipping damage, or other factors beyond the reasonable control of the company, the company will advise the purchaser of the estimated repair costs. The company makes no warranty other than that contained in this statement. No agent other than an executive officer of Intercomp Corporation is empowered to modify in any manner this statement of warranty.

FCC Rules

Please note that this equipment generates, uses, and can radiate radio frequency energy. If this equipment is not installed and used in accordance with the support manual, you are warned that it may cause interference to radio communications. This unit has been tested and has been found to comply with the limits for a Class A computing device pursuant to subpart J of part 15 of FCC Rules. These rules are designed to provide reasonable protection against interference when equipment is operated in a commercial environment. However, if this unit is operated in a residential area, it is likely to cause interference and under these circumstances the user will be required to take whatever measures are necessary to eliminate the interference at their own expense.

Quick Start

Setup

1) Place the press in the location where it will be used.

- Be sure to allow room to move scales between the transport cart and the calibration press. The calibration press should be placed on a smooth and solid floor.
- The temperature should be regulated to a range between +68°f (20°C) to 80°f (26.6°C). If the scale will be stored in an area where the temperature varies more than ±5°f (3°C) from the calibration site, time must be allowed for the scales to acclimate before attempting a calibration procedure. This time can be determined by actual measurement of the scale temperature.
- While not strictly necessary, it is wise to leave an access area to the sides and back of the press. This will allow a second person to participate in positioning a platform scale during certain operations.

2) Adjust the leveling feet to bring the table surface level to an angle of 0.1% or less.
3) Thread the load cell to the bottom of the hydraulic ram. Seat the load cell with a rapid turn in the last quarter turn of its travel. There should be NO play in the load cell mounting threads.
4) Attach the indicator mounting frame to the top of the calibration press.
5) Place the indicator into the mounting frame and the indicator secure with mounting clips provided.
6) Route the load cell lead to the back of the indicator and attach the connector to the indicator.
7) Plug the AC power cable to the indicator.
8) The press is now ready for use.

Verification of Calibration Press Function

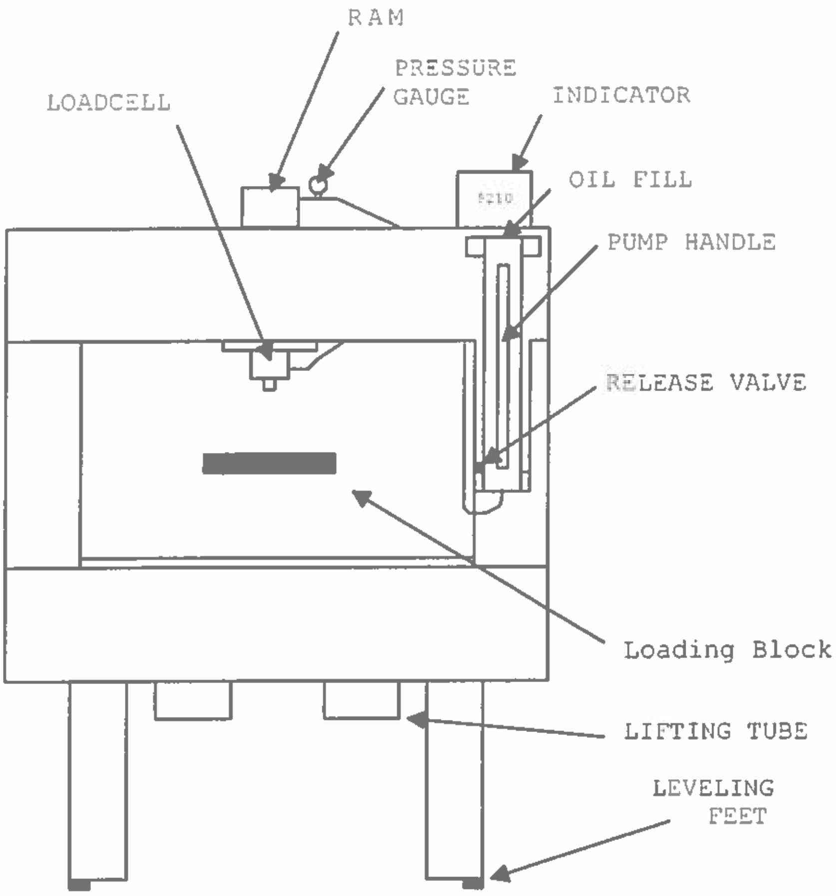
> **Note:** The tip of the load cell must not contact the scale surface directly. Always use the force spreading block provided. Always wear safety glasses when operating the calibration press.

1) Plug the indicator into a suitable source of power.
2) Wait for the indicator to finish its warm-up testing.
3) Place a scale platform under the ram (centered) and place a spreading block on top of the scale.
4) Turn the scale on. Allow it to perform its self test. This should take less than one minute.
5) Press the zero button on the platform scale.
6) Press the "ZERO" function (Not numeric zero) switch on the calibration press.
7) Close the release valve on the pump.
8) Make sure you are wearing your eye protection.
9) Operate the pump handle to apply a force to the scale.
   Do not exceed the nameplate rating for the scale or the calibration press.
10) Release the force on the scale by operating the pressure release valve.

Introduction

General Information

The AC-CSA calibration system is designed to test and calibrate medium to high capacity platform weighing scales. A removable indicator and load cell provides the force measurement function. The calibration force is generated by a standard hand pump and power cylinder.



Features

- Sturdy steel frame.
- Large calibration area allows scale corner testing.
- Precision load cell and Indicator.
- High capacity two speed hand pump.
- Uses standard hydraulic jack oil.

Scope of manual

This manual provides details on installing, using, and servicing the calibration system. Please refer to separate manuals to learn the details of calibrating each type of weighing scale.

Specifications

Performance

Accuracy:	0.025% or better (Depends on calibration source uncertainty)
Capacity:	0-60000 pounds by 1 pound force

Electrical

Power Source:	110 Volts AC, 50 or 60 Hertz. (220 available on special order)
Power Consumption:	15 Watts

Environmental

Operating temperature:	+68°f (20°C) to 80°f (26.6°C)
Storage temperature:	+14°f (-10°C) to 104°f (+40°C)

Physical

Overall size:	66" (168 cm) wide x 46" (117 cm) deep x 70" (175 cm) high
Active weighing area size:	56" (142 cm) wide x 46" (117 cm) deep
Weight:	1500 lb. (680 kg)

Options

Other capacities and graduations are available.

User Information

Controls

On the control panel

There are no separate ON/OFF controls on the control panel. The unit is ON whenever it is plugged in. Allow several hours ON to achieve maximum stability.

The ZERO key accepts whatever load is applied to the load cell as a zero indication.

Indicator	**Function**
G	Gross Weight Illuminated whenever the readout is displaying measured GROSS weight.
	Standstill Illuminated when no change in force is detected.
→0←	Center of Zero Illuminated whenever force is ± ¼ lb of zero graduation.

Other controls and indicators are covered in a separate ITG 3030 user manual. None of these controls are necessary for calibration using the AS-CSA calibration press.

On the hydraulic pump

> **Note:** The tip of the load cell must not contact the scale surface directly. Always use the force spreading block provided.

Pressure release Close this valve firmly before stroking pump to apply a test load to the unit under test. Open this valve to release the applied load. A spring in the hydraulic ram retracts the piston. It is not necessary to allow the ram to fully retract between tests.

Pump Handle Stroke this handle to apply load to the device under test.

Some operators find that an elevated surface allows more effective operation of the pump. This is a matter of individual choice. In either case, practice should allow rapid and repeatable delivery of any force within the capabilities of the press.

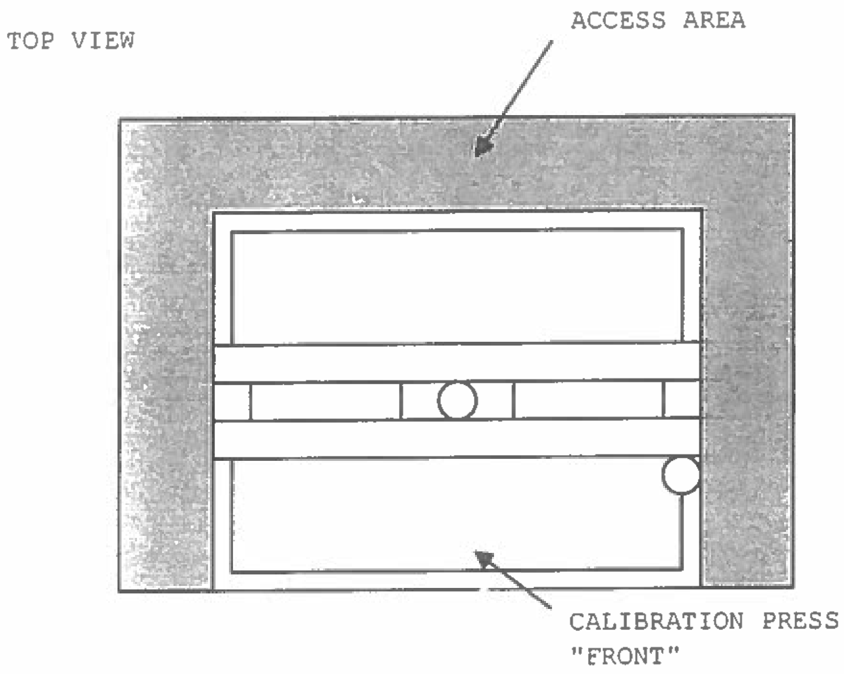
Some drift in applied load is to be expected when trying to control a load to one part per several thousand. This drift is a combination of seal deformation and internal leakage. It may be necessary to "feather" the pump handle to achieve stable readings during calibration.

This pump is of the "two stage" design. This allows rapid movement under no load conditions combined with a reasonable handle force under full load conditions. A light "tap" is useful in achieving control at the higher force values.

Setup

1) Place the press in the location where it will be used.

- Be sure to allow room to move scales between the transport cart and the calibration press. The calibration press should be placed on a solid and smooth floor.
- The temperature should be regulated to a range between +68°f (20°C) to 80°f (26.6°C). If the scale will be stored in an area where the temperature varies more than ±5°f (3°C) from the calibration site, time must be allowed for the scales to acclimate before attempting a calibration procedure.
- While not strictly necessary, it is wise to leave an access area to the sides and back of the press. This will allow a second person to participate in positioning a platform scale during certain operations.



2) Adjust the leveling feet to bring the table surface level to an angle of 0.1% or less.

3) Thread the load cell to the bottom of the hydraulic ram. Seat the load cell with a rapid turn in the last quarter turn of its travel. There should be NO play in the load cell mounting threads

4) Attach the indicator mounting frame to the top of the calibration press.

5) Place the indicator into the mounting frame and secure the indicator with mounting clips provided.

6) Route the load cell lead to the back of the indicator and attach the connector on the indicator.

7) Plug the AC power cable into the indicator.

8) The press is now ready for use.

Service

Trouble-shooting

Ram or Pump Leakage Some slight seepage around the ram and pump is normal. Also, some drift in applied load is to be expected when trying to control a load to one parts per several thousand. This drift is a combination of seal deformation and internal leakage. If either of these conditions should become unacceptable, the pump and ram seals can be rebuilt. Contact the factory for details.

Suspect numbers If you suspect the indicator values are not correct, the indicator and load cell can be tested and re-calibrated.

The best method for testing is by direct comparison with a known force. A reference load cell can be placed under the press load cell and force can be applied. The reference must be suitably accurate. This reference cell must rest on a force spreading block, not on the surface of the tester.

Another method is to compare the reading against several platform scales. If all of the scales agree with each other but not the indicator this would indicate that the load cell and indicator should be investigated.

Procedures

Calibration of the press Under normal conditions this calibration press requires calibration once each year. The load cell and indicator may be dismounted and sent to a calibration laboratory.

Hydraulic Oil Change Interval There is no regular scheduled change interval. The oil should be changed if it becomes contaminated with dirt or water.

Dumping Oil reservoir The oil in reservoir may be withdrawn through the fill access hole using a large syringe and dip tube. If necessary, the pump can be unbolted and inverted.

Filling oil reservoir The filler plug contains a level dip stick. The oil level should be on the crosshatched area with the ram fully retracted. Use ordinary jack oil.

Remove Load cell Unplug the indicator power and remove the load cell connection. If you attempt to remove the load cell by turning the load cell the entire ram will turn. The load cell **can** be removed by striking the load cell on the cable junction box with a rubber hammer. The cell can be unscrewed the rest of the way by hand. If the adapter should start to unscrew, re-tighten the entire assembly. Use a 3/8" X 4" spanner wrench to hold the adapter while striking the load cell.

Install load cell Thread the load cell onto the adapter until it is within ¼ turn of seating . Rotate the cell the rest of the way with a sharp "snap". The cell should seat with absolutely no free play in the threads. If any play in the threads can be detected, back the cell off and try again.

Storage / Handling

The press may be moved with a fork lift using the fork pockets.

Another method is to use a hand lift truck with blocks stacked on the forks. It you use this method you must be careful to insure the stability of the blocking so the press is not tipped or dropped.

The press should be stored in a protected location. It is not necessary to remove the load cell and indicator during extended storage. Clean painted surfaces with a damp rag. If the storage environment is damp the exposed metal surfaces should be oiled to prevent corrosion

Tools Required

Rubber Hammer	Remove the load cell for calibration.
Phillips screwdriver	Attach the indicator mounting frame.
5/8" wrench	Remove the oil reservoir plug for filling or dumping.
Syringe	Draw oil out of the reservoir for changing.
Angle Fixture(s)	Useful for setting the angle of the scale being calibrated.
Loading Blocks	Spread the force applied to the device under calibration.

Sample Data Recording Forms

The following pages contain example calibration data recording forms. You may reproduce these forms without restrictions.

AC 100 calibration form.

AC 30-60 calibration form.

AC 1-25 calibration form.

Calibration Record

Tester	
Date	
AC100 S/N	
S/N	
Cell #	
Capacity	
Graduation	

	Precal	1	2	3
0				
500				
1,000				
2,000				
3,000				
4,000				
5,000				
7,500				
10,000				
15,000				
20,000				
25,000				
30,000				
40,000				
50,000				
60,000				
70,000				
80,000				
90,000				
100,000				
0				

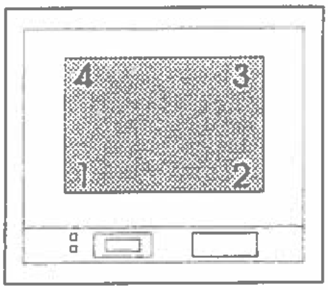
5K: 500 to 5,000; 10K: 1,000 to 10,000; 25K: 5,000 to 25,000; 50K: 5,000 to 50,000; 100K: 10,000 to 100,000.

AC30-60 Calibration sheet

Tester ______________

Date ____/____/____ AC100 S/N #______________

S/N #______________ Cell #______________



Corner 1: ______________ lb

Corner 2: ______________ lb

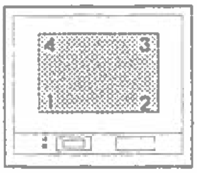
Corner 3: ______________ lb

Corner 4: ______________ lb

Cal points: ____________, ____________, ____________ lb

Calibration:

Weight Applied	As Received	Run #1	Run #2	Run #3



Set Corners:

Cell #1	Cell #2	Cell #3	Cell #4

Calibration:

Weight Applied	As Received	Run #1	Run #2	Run #3	Run #4	Run #5

Three consecutive passing runs are needed for a sucessful calibration.
Copy these three runs on the front side in columns: "Run #1-3".

Notes:

AC1-25 LP Calibration sheet

Tester ______________

Date ____/____/____ AC100 S/N #____________

S/N #____________ Cell/Platform #____________

Corner 1: ______________ lb

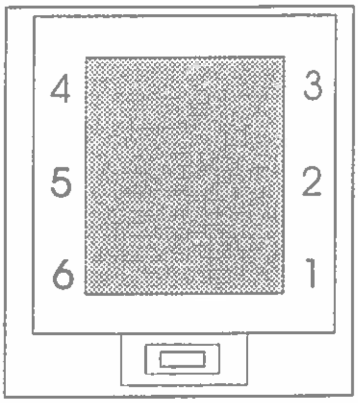
Corner 2: ______________ lb

Corner 3: ______________ lb

Corner 4: ______________ lb

Corner 5: ______________ lb

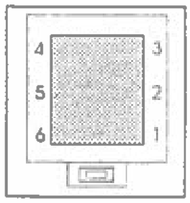
Corner 6: ______________ lb



Cal points: ____________, ____________, ____________ lb

Calibration:

Weight Applied	As Received	Run #1	Run #2	Run #3
0				



Set Corners:

Cell #1	Cell #2	Cell #3	Cell #4	Cell #5	Cell #6

Calibration:

Weight Applied	As Received	Run #1	Run #2	Run #3	Run #4	Run #5
0						

Three consecutive passing runs are needed for a sucessful calibration.
Copy these three runs on the front side in columns: "Run #1-3".

Notes:

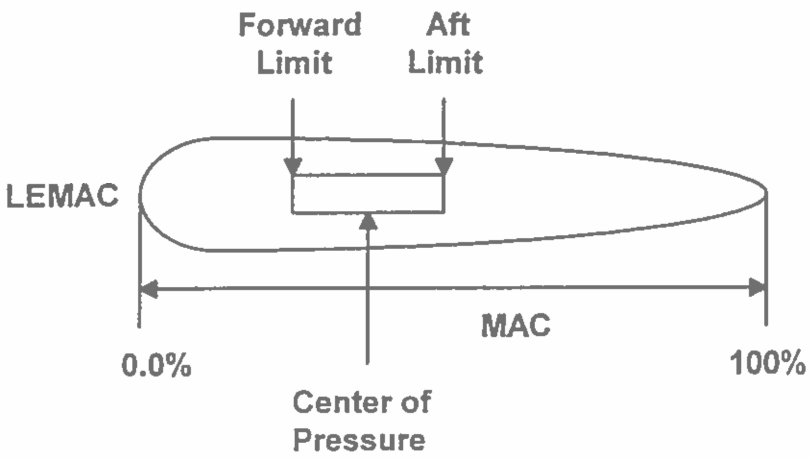
Weight and Balance Considerations

Basic Weight and Balance Theory

Weight and balance control consists of accounting for all the forces acting on an aircraft, and verifying that these forces stay within fixed limits. In a maintenance setting, we insure that all weight and balance changes are accounted for and that Service Weight Pickup is within acceptable limits.

Forces acting on an airframe

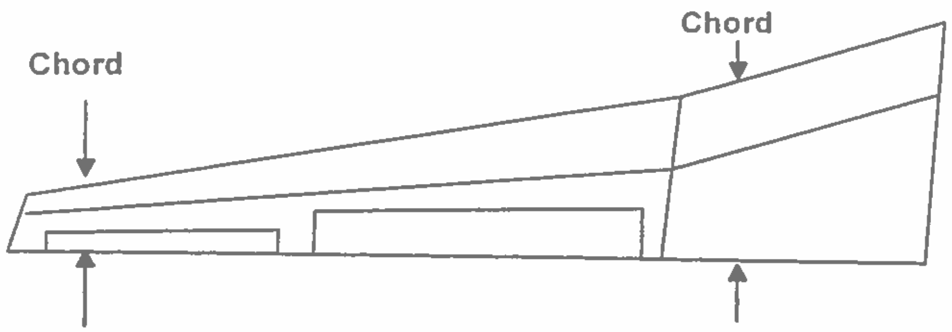
Air moving around the wing generates lift. The lift is generated over the entire wing, but you may consider the net effect as centered on the "Center Of Pressure". The horizontal stabilizer may modify this lift over a certain range. This establishes some limits on where the airplane may be loaded, called the Aft Center of Gravity Limit, and the Forward Center of Gravity Limit.



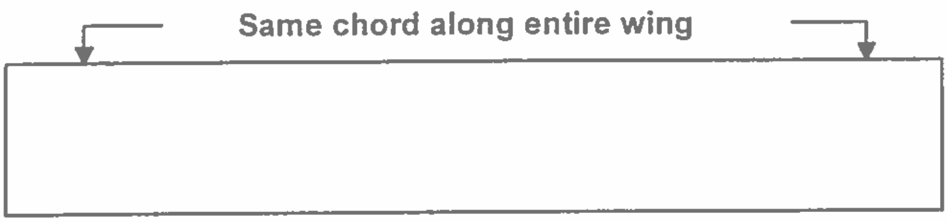
***** Note: MAC and LEMAC are only used on aircraft *****

Chord and Mean Aerodynamic Chord

The wing is the center of lift in an airplane. As such, many important parameters of an airplane are specified in terms of the wing. A unit of measure used frequently is the "Mean Aerodynamic Chord". A chord is an imaginary line from the leading edge to the trailing edge. In many aircraft this varies from one end of the wing to the other.



Where is the center of lift in a wing like this? The mean aerodynamic chord is the average chord of the entire wing. For weight and balance purposes the wing may be replaced with a wing like this:

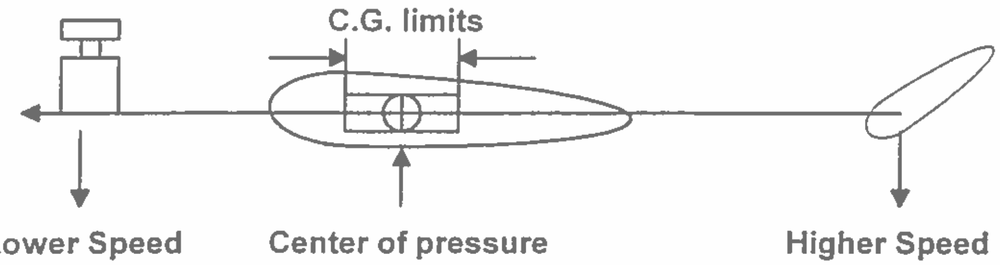


The airframe has a certain weight that may be idealized as a single replacement weight at a point known as the Center of Gravity. This equivalent weight must fall in the range set by the center of gravity limits given above.

It is the task of weight and balance control to insure that this is so!

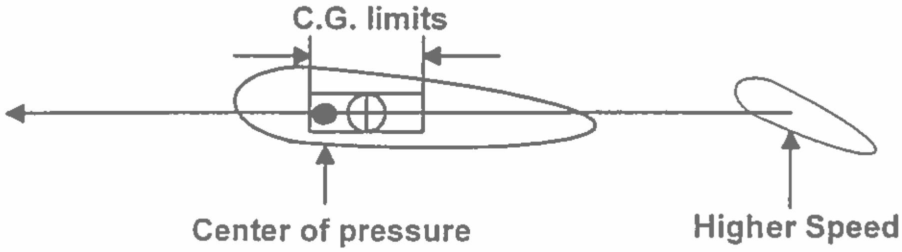
Longitudinal dynamics

The wing is combined with the mass of the airframe and the horizontal stabilizer to form stable flying machine. There are three configurations in use, lets examine each in turn.



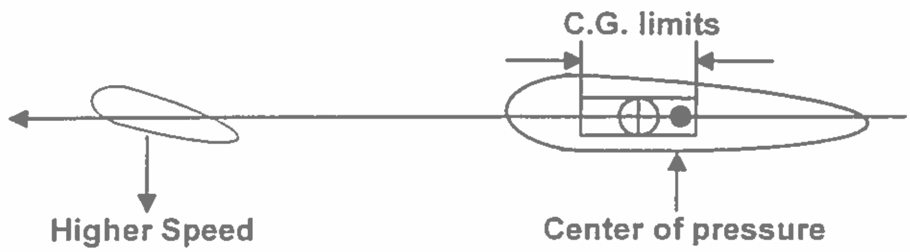
Classic Configuration

In the classic system the aircraft is weighted lightly forward of the center of pressure, and the tail is inclined slightly downward. As the aircraft moves forward the tail reacts to the airstream flowing over it. At some point, there is as much pressure pushing the tail downward as there is weight in the nose, and the system is stable. If the airplane slows down, the tail does not exert as much pressure and the nose drops. The plane picks up speed until the tail counterbalances the weight in the nose. If the plane has too much speed, the tail press down, picking up the nose and slowing the plane. The angle of the stabilizer may be changed, which changes the angle of attack of the wing, and the subsequent lift generated.



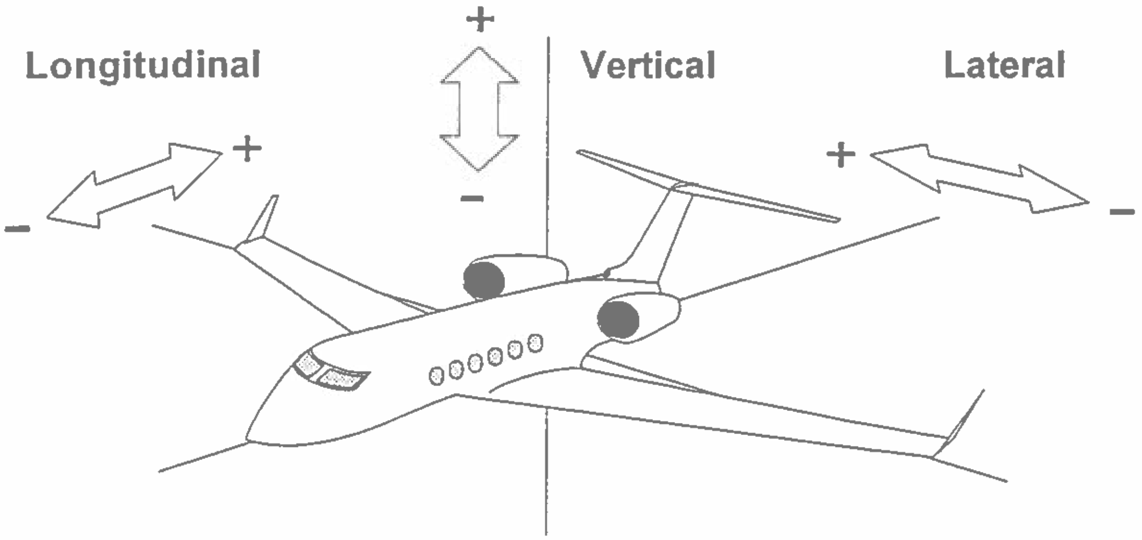
Flying Stablilzer Configuration

The second system is a variation of the classic system. Note that the classic system has the stabilizer pushing down. This reduces the potential lift of the wing. In some high performance aircraft, the horizontal stabilizer is also a lifting surface. The center of pressure is somewhere between the main wing and the stabilizer. A computer monitors the attitude of the aircraft and adjusts the stabilizer many times a second. This system depends on the computer for stability. While being more complex, you do get more lift for the same amount of wing and tail.



Canard Configuration

The third system is the canard. The horizontal stabilizer is placed forward of the wing, and again, it is a lifting surface. As the plane picks up speed, the stabilizer lifts the nose and slows the aircraft. If the nose drops the plane picks up speed and restores the nose. The stabilizer is designed to stall before the main wing, so there is a limit of how far the nose can be forced up with this system. This it desirable, as it makes the aircraft more forgiving, as its hard to stall the main wing.



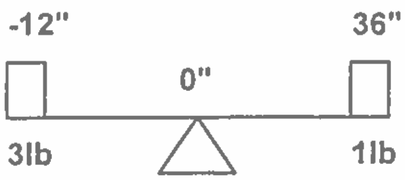
Coordinate Axis

Throughout the discussion of forces, we will use these standard conventions for up-down, left-right, and front-back.

Introduction to levers, arms and moments

The wing may be thought of as a fulcrum in a lever system. All forces must balance at the fulcrum (wing) for the airplane to be stable.

Lets review some lever systems.



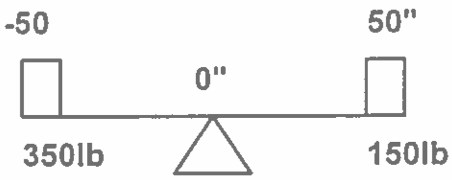
This is an example of a simple lever system. A three pound weight is placed twelve inches to the left of the fulcrum, and a one pound weight is placed 36 inches to the right of the fulcrum. Each weight is a certain distance from the fulcrum. This distance is known as the ARM. The arm is combined with the weight to create a MOMENT.

A moment is a measure of the rotational tendency of a weight about a point. A moment is derived with the weight of an item multiplied by its arm. Lets calculate the moment for both weights. The left most weight is 3 lbs times -12 inches for -36 inch-pounds. Note that distances to the left of the fulcrum are given as minus values. The moment for the right hand weight is 36 inches times 1 pound for 36 inch-pounds. This system is in equilibrium, that is the forces on both sides of the fulcrum are in balance. A more formal statement is:

Equilibrium is achieved when the sum of moments about the fulcrum equals zero.

Lets look at some properties of levers.

Please examine this lever system.



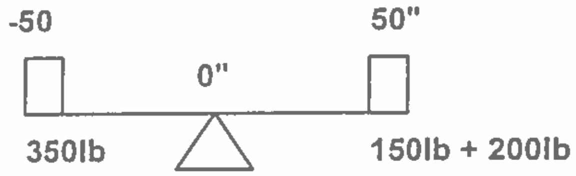
This system is not in balance. We can check this by calculating and comparing the moments.

$$350 \bullet -50'' \neq 150\text{lb} \bullet 50''$$

$$(-17500)\ \text{in-lb} \neq 7500\ \text{in-lb}$$

How can we bring this system into balance? The condition of balance may be affected by changing either the weight(s), the position of the weights, or the position of the fulcrum. Lets try each variation.

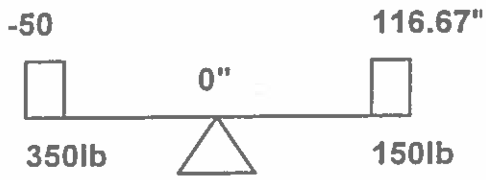
Adding weight:



$$350\ \text{lb} \cdot -50'' = (150\text{lb} + 200\ \text{lb}) \cdot 50''$$

$$(-17500)\ \text{in-lb} = 17500\ \text{in-lb}$$

Moving Weight:

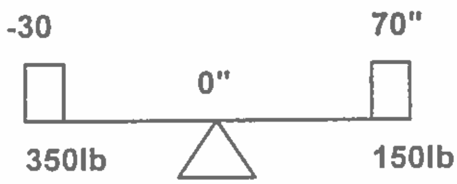


$$350\ \text{lb} \cdot 50'' = 150\ \text{lb} \cdot 116.67''$$

$$-17500\ \text{in-lb} = 17500.5\ \text{in-lb}$$

Note the slight error caused by a repeating decimal on the 116.66 . . . number. You can extend this out to as many places as you need to get the desired accuracy.

Move the beam on the fulcrum:



$$350\ \text{lb} \cdot 30'' = 150\ \text{lb} \cdot 70''$$

$$-10500\ \text{in-lb} = 10500\ \text{in-lb}$$

It is more convenient to represent the position of the weight and its value as a composite value, the MOMENT ARM, or more simply, the MOMENT. This is just the weight times its distance from a reference. Look at the examples above. In the bottom line of each example we were just comparing two moment arms. Any weight on an airframe can be described by a moment arm. Look at the "adding weight" example given above. Lets calculate the moments for each weight.

$$150 \text{ lb} \bullet 50'' = 7500 \text{ in-lb}$$

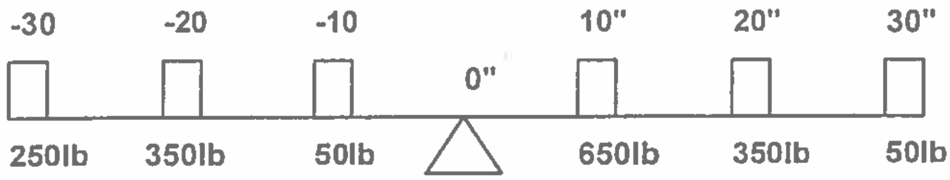
$$+\ 200 \text{ lb} \bullet 50'' = 10000 \text{ in-lb}$$

$$350 \text{ lb} \bullet 50'' = 17500 \text{ in-lb}$$

Clearly, moments can be added together.

In general, any number of moments may be added to find the total effect

Example:



$$250 \text{ lb} \bullet -30'' = -17000 \text{ in-lb} \qquad 650 \text{ lb} \bullet 10'' = 6500 \text{ in-lb}$$

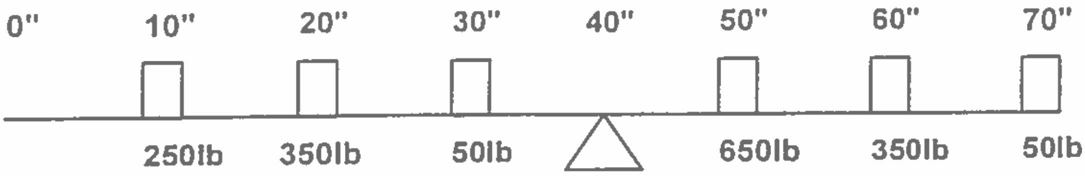
$$350 \text{ lb} \bullet -20'' = -7000 \text{ in-lb} \qquad 350 \text{ lb} \bullet 20'' = 7000 \text{ in-lb}$$

$$+\ 50 \text{ lb} \bullet -10'' = -500 \text{ in-lb} \qquad +\ 50 \text{ lb} \bullet 30'' = 1500 \text{ in-lb}$$

$$(-15000) \text{ in-lb} \quad = \quad 150000 \text{ in-lb}$$

There is no particular reason the fulcrum has to be the zero location. Any point can be selected, as long as it is used for all calculations. This provides a bonus; all signs of numbers are the same. This makes it less likely to make a simple math error.

Lets redo the above example with the reference positioned 10" to the left of the leftmost weight. In addition, we will calculate the total moment for all the weights and compare this to the fulcrum.



$$250 \text{ lb} \bullet 10" = 250 \text{ in-lb}$$
$$350 \text{ lb} \bullet 20" = 7000 \text{ in-lb}$$
$$50 \text{ lb} \bullet 30" = 1500 \text{ in-lb}$$
$$650 \text{ lb} \bullet 50" = 32500 \text{ in-lb}$$
$$350 \text{ lb} \bullet 60" = 21000 \text{ in-lb}$$
$$50 \text{ lb} \bullet 70" = 3500 \text{ in-lb}$$

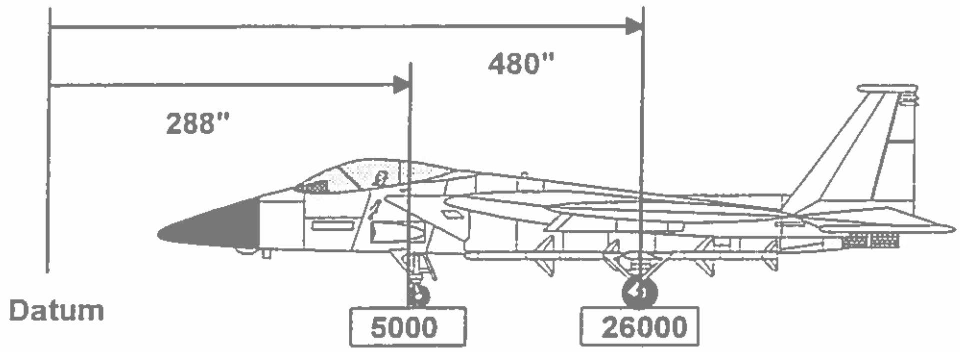
$$1700 \text{ lb} \qquad 68000 \text{ in-lb}$$

To find the center of gravity, we divide the total moment by the total weight.

$$\frac{68000 \text{ in-lb}}{1700 \text{ lb}} = 40.0" \text{ C.G.}$$

The center of gravity is at the same point as the fulcrum. The system is in equilibrium.

Here is an example of levers and moments as they apply to a real aircraft: The scales incorporate both inclinometers and altitude / latitude correction, so we can ignore these factors.



Find Total weight

$$\begin{array}{r} 5000 \\ +\ 26000 \\ \hline 31000 \end{array} \text{ Total Weight}$$

Find Total moment

480 in X 26000 lb = 12480000 in-lb
+ 288 in X 5000 lb = 144000 in-lb

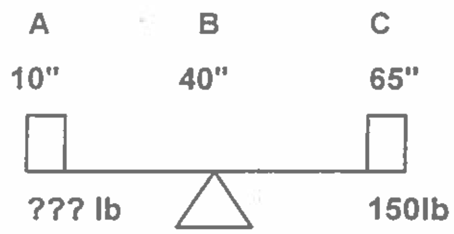
13920000 in-lb Total Moment

Find Center of gravity

$$\frac{13920000 \text{ in-lb}}{31000 \text{ lb}} = 449 \text{ in Center of Gravity}$$

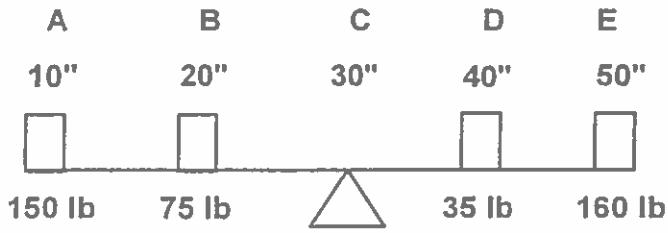
Sample Problems

Problem 1.



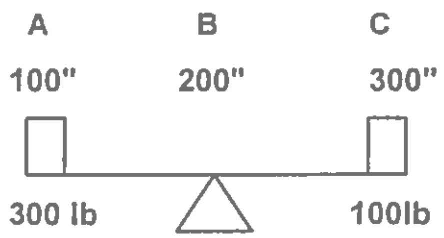
How much weight has to be added to position A to get equilibrium?

Problem 2.



a) Where is the balance point with the values given?
b) How much weight must be moved between positions A and E to get equilibrium?
c) Same thing with A and D.
d) Same thing with D and E.
e) Same thing with A and B.
f) Same thing with B and C.

Problem 3.



How does adding 100 pounds at position B affect the Center of Gravity?

In Summary:

1. Weight added forward of the CG will move the CG forward.
2. Weight added aft of the CG will move the CG aft.
3. Weight added at the existing CG will have little or no effect on the CG.
4. Weight removed forward of the CG will move the CG aft.
5. Weight removed aft of the CG will move the CG forward.
6. Weight removed at the existing CG will have little or no effect on the CG.

Put in another way: If weight is added forward of, or removed aft of, the existing CG, the CG will move forward. If the new CG is too far forward of the center of lift, a nose-heavy condition may result. Conversely, if the weight is added aft, or removed forward, of the existing CG, the CG will move aft. If too far aft of the center of lift a tail-heavy condition will result.

Fuel density and Temperature

Information on Fuel Weight and Moment tables are based on an average fuel density at fuel temperatures of 60°F. However, fuel weight increases about 0.1 lb/gal for each 25°F decrease in fuel temperature.

Any time fuel temperatures are different then shown in the chart headings a new fuel weight calculation should be made using the 0.1 lb/gal increase in fuel weight for each 25°F decrease in fuel temperature.

Example:

500 gallons of JP-4 at 32°f.

At 60°f this would be 3250 pounds.

Calculate revised weight:

$$500 \bullet (6.5 + (0.1 \bullet (60-32)/25)) =$$

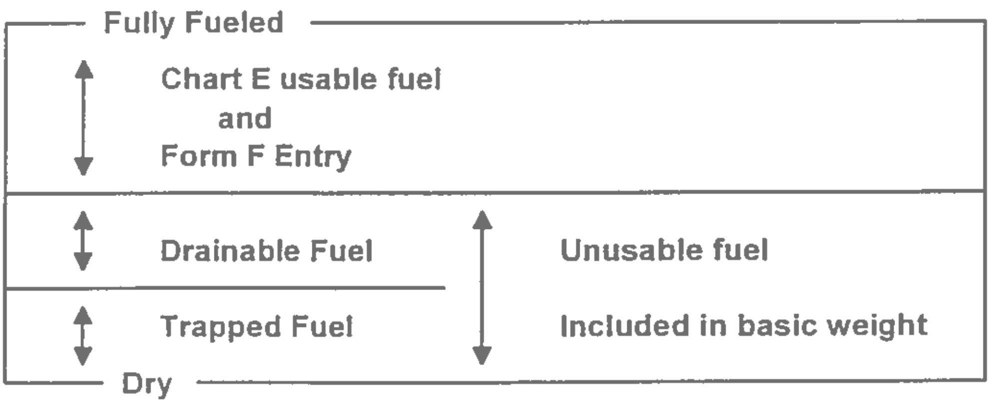
$$500 \bullet (6.5 + (0.1 \bullet 1.12) =$$

$$500 \bullet (6.5 + 0.112) =$$

$$500 \bullet 6.612 = 3306 \text{ pounds} \quad \text{(A 1.7 \% change).}$$

NOTE: The average density used in Chart E is:

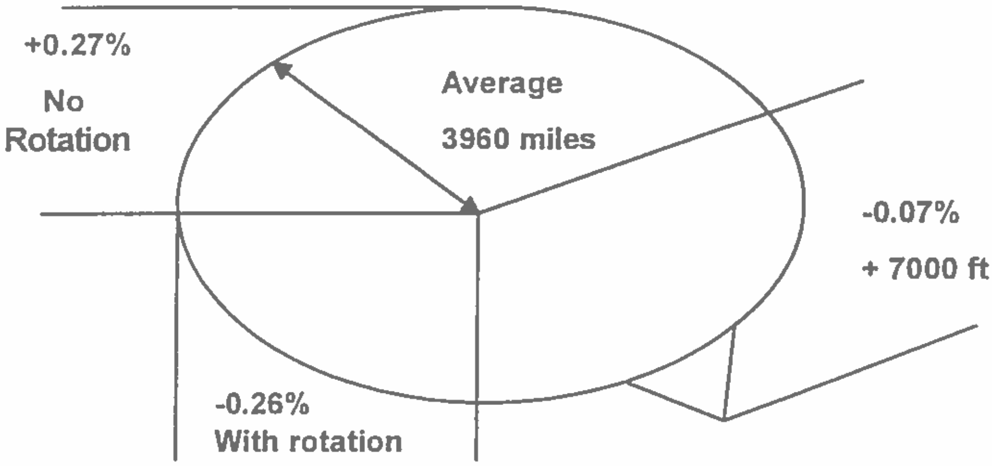
Gasoline - 6.0 pounds per gallon.
JP-4 - 6.5 pounds per gallon.
JP-5 - 6.8 pounds per gallon.
JP-8 - 6.8 pounds per gallon.



Latitude Correction

This discussion applies only if your scale is calibrated with weights at one local, and used in a different location. If a scale is calibrated with weights at a given location, all the effect mentioned below are corrected in the calibration process.

NOTE: If you use a force style calibration press, the press is the same as calibration with weights at a location of 45° latitude. Latitude correction would be required in this case.



Variations in gravity's attractions

The force of attraction of the earth to any object varies with latitude and altitude.

The formula that describes the attraction of gravity (F=G•M1•M2/R2) says that the further something is from the center of the earth, the less the earth pulls on it. The earth bulges at the equator, and is flattened at the poles. This is the result of the centrifugal force exerted by the earth's rotation.

In general, an object weighs the most at sea level at the poles, and the least at the equator and to a much lessor effect, higher altitudes. This effect is small (About 0.25% maximum), but it must be considered for accurate weighing.

Latitude Correction Table

The following table gives correction factors for different latitudes and altitudes. To use this table, multiply the scale's indicated weight by the selected table entry giving the corrected weight at standard conditions (sea level at 45° of latitude).

Lat	Altitude above sea level (FT)								Accel of Gravity
	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	
0	1.0026	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032	1.0033	32.0895
5	1.0026	1.0027	1.0028	1.0029	1.0030	1.0031	1.0032	1.0032	32.0908
10	1.0025	1.0027	1.0027	1.0028	1.0029	1.0029	1.0030	1.0031	32.0946
15	1.0023	1.0024	1.0025	1.0026	1.0027	1.0027	1.0028	1.0029	32.1009
20	1.0020	1.0021	1.0022	1.0023	1.0024	1.0025	1.0026	1.0027	32.1094
25	1.0017	1.0018	1.0019	1.0020	1.0021	1.0022	1.0022	1.0023	32.1198
30	1.0013	1.0014	1.0015	1.0016	1.0017	1.0018	1.0019	1.0020	32.1320
35	1.0009	1.0010	1.0011	1.0012	1.0013	1.0014	1.0015	1.0015	32.1454
40	1.0005	1.0006	1.0006	1.0007	1.0008	1.0009	1.0010	1.0011	32.1597
45	1.0000	1.0001	1.0002	1.0003	1.0004	1.0005	1.0005	1.0006	32.1740
50	0.9995	0.9996	0.9997	0.9998	0.9999	1.0000	1.0001	1.0002	32.1893
55	0.9991	0.9992	0.9993	0.9994	0.9995	0.9996	0.9996	0.9997	32.2036
60	0.9987	0.9988	0.9989	0.9990	0.9990	0.9991	0.9992	0.9993	32.2170
65	0.9983	0.9984	0.9985	0.9986	0.9987	0.9988	0.9988	0.9989	32.2292
70	0.9980	0.9981	0.9982	0.9982	0.9983	0.9984	0.9985	0.9986	32.2397
75	0.9977	0.9978	0.9979	0.9980	0.9981	0.9982	0.9983	0.9983	32.2482
80	0.9975	0.9976	0.9977	0.9978	0.9979	0.9980	0.9981	0.9982	32.2545
85	0.9974	0.9975	0.9976	0.9977	0.9978	0.9979	0.9979	0.9980	32.2583
90	0.9974	0.9974	0.9975	0.9976	0.9977	0.9978	0.9979	0.9980	32.2596

Example: An aircraft is weighed at a hanger at 10° latitude at an altitude of 1000 Ft. The scales were calibrated with a force style press, so the read weight must be corrected.

$$15000 \text{ lb} \cdot 1.0026 = 15003.9 \text{ lb}$$

If the scale you are using has a altitude / latitude correction feature, this table will be applied automatically. You will enter the latitude and altitude and the scale will do the correction.

Leveling Considerations

Throughout this text, and in others, you will find many references to the importance of level floors. Why is this so important? An aircraft should weigh the same no mater what the slope of the floor, right?

Yes and no. The force delivered to the scales is the same, but the weight displayed is only the amount sensed going in a direction perpendicular to the plane formed by the top of the weighpad. A scale SHOULD ignore any sideways component of the force imparted by the object being weighed. This greatly reduces any errors caused by the sideways flexing of rubber tires, or misalignment of the wheels. When a scale is not level, the force exerted by the scale is split into two components, a vertical force (weight) and a horizontal force. Any part of the force that is put into the horizontal part is not sensed as weight, thus reducing the sensed weight. The part left to be sensed as weight is just the weight times the cosine of the angle of the scale.

Example: A 10000 pound weight is placed on a scale sitting on a 3° slope.

$$10000 \text{ lb} \bullet \cos 3^\circ = 10000 \bullet 0.99863 = 9986.3 \text{ lb}$$

This gives us an error of 0.14%, more then the entire error allowed by our scales. To reduce these errors to a negligible level, the scales should be level to better then 1.2°.

Repeating the example given above with a 1.2° angle:

$$10000 \text{ lb} \bullet \cos 1.2^\circ = 10000 \bullet 0.99978 = 9997.8 \text{ lb}$$

This gives us an error of 0.02%

If you know the angle of the floor while the plane is being weighed you can apply a correction factor.

The correction factor is just:

$$\text{Corrected Weight} = \text{Weight} + \text{weight} \bullet (1- \cos \text{Angle})$$

Some scales automatically sense the angle of the floor, calculate and apply this needed correction factor.

Reference Formulas

In an aircraft the reference datum is usually some point on or in front of the nose. The aircraft is assumed to have the nose to the left, and the tail to the right in calculations. The fulcrum is the center of pressure, as defined by the manufacturer of the aircraft. This may be specified in units of MAC of the aircraft. The listed weights are things like engines, installed equipment, cargo, passengers, and fuel.

The moment to be added or subtracted from the basic moment is found by multiplying the weight of the object by its arm or distance from the reference datum. From this we derive these three formulas:

Weight (Pounds) x ARM (Inches) = Moment (Inch Pounds)

Moment (Inch Pounds) / Weight (Pounds) = ARM (Inches)

Moment (Inch Pounds) / ARM (Inches) = Weight (Pounds)

(Total moment is the sum of the aircraft's basic moment and the moment(s) of the item(s) being loaded. Total weight is the sum of the aircraft basic weight and the total weight of the load items. When total moment is divided by total weight the result is the composite CG position in inches from the longitudinal reference datum. This gives us:

To compute Center of Gravity:

$$Average\ arm\,(CG) = \frac{Total\ moment}{Total\ Weight}$$

To Compute Percent MAC

$$\%\ MAC = \frac{Longitudinal\ CG - Length\ to\ leading\ edge\ of\ MAC}{Total\ MAC\ length} \bullet 100$$

The following group of formulas are used to calculate CG location when adding, subtracting or moving weights.

Adding Weight:

$$New\ CG = \frac{Old\ moment + Added\ Moment}{Old\ Weight + Added\ Weight}$$

Removing Weight:

$$New\ CG = \frac{Old\ Moment - Removed\ Moment}{Old\ Weight - Removed\ Weight}$$

Moving Weight:

$$New\ CG = \frac{Old\ Moment \pm Moved\ Moment}{Old\ Weight}$$

CG Change:

$$CG\ Change = \frac{Change\ in\ Moment}{Total\ Weight}$$

Weight Definitions Revealed

WEIGHT EMPTY

+

Unusable fuel, Oil, Ballast, Survival kits, oxygen, any other equipment not disposed of during flight and not listed in Chart E.

-

Any Chart A items that are missing from the aircraft.

=

BASIC WEIGHT

+

Crew, crew baggage, steward equipment, emergency equipment, special mission fixed equipment, and all other non-expendable items not in basic weight.

=

OPERATING WEIGHT

+

USABLE FUEL

+

Payload items such as cargo, passengers, stores and disposable fuel tanks.

=

TAKEOFF GROSS WEIGHT

-

Load items expended in flight such as fuel, stores, ammunition, cargo and paratroops.

=

LANDING GROSS WEIGHT

Terms and Definitions

AFT CENTER OF GRAVITY - The aft-most permissible aircraft center-of-gravity location for a specific weight condition.

AIRCRAFT WEIGHING RECORD - The form used to record data obtained from actual aircraft weighing.

ALL-UP WEIGHT - See Gross Weight.

ALLOWABLE GROSS WEIGHT (AGW) - The Not To Be Exceeded Weight of a loaded aircraft. The Aircraft Flight Manuals specify allowable weights that must not be exceeded for a particular configuration or specific mission. Some examples are: Allowable takeoff weight; Allowable landing weight; Allowable jacking weight; etc.

ARM (A) - A measurement of distance, in inches, feet, etc. used in weight and balance calculations. Normally only the longitudinal arm is of practical importance. The three axial arms are:

> ***Longitudinal Arm*** - The distance parallel to the longitudinal axis between the center of gravity of a load item and the reference plane for longitudinal load arms. By convention, the longitudinal arm is negative (-) when forward, positive (+) when aft, of the designated fuselage station reference datum.
>
> ***Lateral Arm*** - The distance parallel to the lateral axis between the center of gravity of a load item and the reference plane for lateral load arms. By convention, the lateral arm is Positive (+) when port, negative (-) when starboard, of the designated buttline reference datum.
>
> ***Vertical Arm*** - The distance parallel to the vertical axis between the center of gravity of a load item and the reference plane for vertical load arms. By convention, the vertical arm is positive (+) when above and negative (-) when below the designated waterline reference datum.

AVERAGE ARM - See Balance Arm.

BALANCE - The condition of stability that exists in an aircraft when all weights and forces are acting in such a way as to prevent rotation about an axis or pivot point.

BALANCE ARM - The arm, or distance from a reference datum. The Balance Arm is the result of dividing the total moment by the total weight.

BALANCE STATION - A point measured in inches from the horizontal reference datum. Balance Station 0.0 is the reference datum.

BALLAST - Any weight installed in the aircraft for balancing the aircraft so that it remains within permissible center of gravity limits. Ballast installation may be temporary, permanent, or any combination of it.

BASIC ARM - That distance from the reference datum to the aircraft Basic Weight Center of Gravity. The basic arm is determined by dividing the aircraft basic moment by the aircraft basic weight.

BASIC CENTER OF GRAVITY POSITION - The position of the center of gravity of an aircraft at its basic weight. Normally only the longitudinal (for-aft) position is considered. Still, both the vertical (up-down) and lateral (side-side) positions may require occasional considerations.

BASIC EQUIPMENT - The non-expendable equipment common to all the configurations for which the aircraft is designed.

BASIC MOMENT - The summation of the moments of all items included in the aircraft basic weight. Normally refers to "Basic Longitudinal Moment". Occasionally a requirement exists for "basic Vertical and/or Lateral Moment". In is necessary therefore to use the proper qualifying adjective.

BASIC WEIGHT - The sum of weight empty plus the weight of items not in the useful Load Data. Examples of items contained in the basic weight are unusable fuel, trapped and unusable engine oil, ballast, survival gear/kits, and oxygen equipment. **THE AIRCRAFT'S CURRENT BASIC WEIGHT IS ALWAYS THE LAST ENTRY IN THE TOTAL BASIC AIRCRAFT HISTORICAL RECORDS (Form DD365-3) FOR THAT PARTICULAR, OR GROUP OF AIRCRAFT.**

BASIC WEIGHT CHECK LIST - A completed collection of DD365-1 forms. Commonly called Chart A. It is a partial listing of items, by the compartments, which are, or may be installed in the aircraft at the time of weighing. The primary purpose of the check list is to establish the aircraft equipment inventory at the time of the aircraft weighing.

BUTTLINES (BL) - Reference locations in the lateral (left or right) direction from aircraft lateral (side to side) reference datum or aircraft centerline. When standing at the aircraft nose, looking aft, the right hand side is negative (-). The left hand side is positive (+).

CG - The abbreviation for the Center of Gravity.

CENTER OF GRAVITY (CG) - That point about which the aircraft would balance if suspended. For field weight and balance control, the center of gravity is normally calculated only along its longitudinal axis (nose to tail), disregarding both lateral and vertical location.

CENTER OF GRAVITY LIMITS - The extremes of movement that the center of gravity can have without making the aircraft unsafe for flight. The center of gravity of the loaded aircraft must always be, and remain, within these specified limits at takeoff, during flight, and at landing.

CENTER OF GRAVITY RANGE - The distance between the above mentioned center of gravity limits. The range may vary in length from 3 or 4 inches for a small aircraft or helicopter up to 150 to 300 inches for a large aircraft.

CENTROID - The average arm or center of gravity of a compartment, fuel tank, piece of equipment, etc.

CHART A - Form DD365-1. Equipment inventory by description, weight, arm and simplified moment. See Basic Weight check list.

CHART C - Form DD365-3. The Historical Record, by aircraft serial number of the weight and/or balance changes to that aircraft.

CHART E - Detail loading information, weighing instructions, fuel tables, and miscellaneous information. See Loading Data.

CHORD - An imaginary straight line joining the leading and trailing edges of an airfoil. The average of all the wing chords on the applicable aircraft model. Also called the Mean Aerodynamic Chord Line or MACL.

COMPARTMENT - A defined section of the aircraft's load-carrying space.

COMPARTMENT ARM - The horizontal distance from a defined reference datum to a compartment centroid.

CONFIGURATION - A particular arrangement and quantity of structure, systems, internal and external stores, fuel and/or other items. It's also used to define the flaps, slats, and landing gear position.

DD365 - Record of weight and balance personal.
DD365-1 - Basic weight check list. Chart A.
DD365-2 - Aircraft weighing record. Form B.
DD365-3 - Basic weight and balance record. Chart C.
DD365-4 - weight and balance clearance. Form F.

DESIGN GROSS WEIGHT - The weight at which the aircraft is designed to fly and upon which performance calculations and manufacturers guidelines are based.

DRAINABLE FUEL - That portion of internal/external fuel that can be drained from the aircraft tanks though normal drain points after defueling.

ENGINE START - The loaded aircraft condition immediately prior to starting the engine See Ramp Weight.

EQUILIBRIUM - A condition in which all acting influences are canceled by others, resulting in a stable balanced, or unchanging system.

EXPENDABLE LOAD - Includes fuels, cargo/stores that may be air dropped, etc. These data are found in the -5 Chart E Loading Technical Manual for the particular aircraft type/model.

FLIGHT DESIGN GROSS WEIGHT - A variable condition based on the type of aircraft. Normally it is the weight of the aircraft including internal fuel, pilots/pilots and other required personnel.

FLIGHT GROSS WEIGHT - The weight of the aircraft, its contents, and external items during the flight. Its also known as flight weight and/or inflight weight.

FORM B - The Aircraft Weighing Record. Form DD365-2.

FORM F - The Weight and Balance Clearance. Form DD365-4.

FORWARD CENTER OF GRAVITY LIMIT - The most forward permissible aircraft center of gravity location for a specific weight and configuration.

FULCRUM - A pivot or support about which items can be balanced or rotated.

FUSELAGE STATION (FS) - Reference stations measured in the longitudinal direction (forward to aft) from a reference datum normally at, or well forward of the aircraft nose. See reference datum.

g FACTOR - The ratio of the force that in imposed upon the aircraft and its contents when accelerated or decelerated, in any direction, compared with its normal mass. It is expressed in relation to earth's gravitational force of 1g. For example: If an item of load that weighs 1000 pounds is subjected to an acceleration of 3 G's then a force of 3000 pounds has been imposed upon that item. The force may act in any direction.

GROSS WEIGHT (GW) (aircraft usage) - The total weight of the aircraft including its contents. The gross weight continually changes throughout ground and/or flight operations. (Called the All-Up weight in Europe)

Gross (general scale usage) - Total weight on scales; dozen dozen, total, all-inclusive, in bulk, wholesale. French: big, thick.

GUMC - Gear up moment correction.

INDEX VALUE - See moment.

JIG POINT - A hole, fitting, or other location that is the same known distance from each reference datum for all aircraft of the same model designation.

LANDING GROSS WEIGHT - The weight of the aircraft, its contents, the estimated landing fuel, and all other non-expendables when the aircraft lands. An integral part of the Form F flight information.

LATERAL AXIS - An imaginary line passing though the center of gravity, parallel to the axis of pitch and at right angles to the reference plane for lateral load arms.

LEMAC - An abbreviation for "Leading Edge of the Mean Aerodynamic Chord". Identified as a fuselage station.

LEVELING LOCATIONS - Fixtures (Leveling Lugs) or locations (attached to, or built into the aircraft structure) whose purpose is supporting a spirit level, inclinometer, or suspended plumb bob. Visual reference readings showing the horizontal and/or lateral level condition of the aircraft.

LEVER - A simple machine consisting of a rigid body pivoted on a fixed fulcrum.

LOAD ARM - See ARM.

LOADING CONTROL - The use of weight and balance forms and loading data to ensure that the aircraft weight, center of gravity, and other loading limitations are not exceeded during flight and/or ground operations.

LOADING DATA - Part of the aircraft's -5 series technical manual. Commonly called Chart E. Contain instructions for weighing the aircraft, aircraft diagrams, loading limits, general instructions affecting loading of the aircraft, and the weight, arm, and moments information necessary to perform loading control.

LOADING LIMITS - Restrictions, such as permissible center of gravity range and gross weight, beyond which aircraft loading is not permitted.

LONGITUDINAL AXIS - An imaginary line passing through the center of gravity, parallel to the axis of roll and at right angles to the reference plane for longitudinal load arms.

M - See Moment.

MEAN AERODYNAMIC CHORD (MAC) - An engineering term representing an aircraft's chord in aircraft design of constant length. Also used in the calculation of center of gravity location in terms of percent (%) MAC.

MAW - Moment, Arm, Weight.

MAXIMUM GROSS WEIGHT - See allowable Gross Weight.

MOMENT (MOM) - A measure of the rotational tendency of a weight about a point. The weight of an item multiplied by its arm.

NEGLIGIBLE CHANGE - Unless specified in the -5 T.O.'s a negligible weight is any change of ± 0.1% of the basic weight and/or moment change that moves the center of gravity ± 0.1% of the MAC.

Net - The gross weight minus the tare weight. Free of all charges, Clear of tare. Netting, netted. French: Clean, clear.

NOSE HEAVY - A condition of improper balance in which the center of gravity is forward of the established limits.

OPERATING WEIGHT (OW) - The sum of the aircraft basic weight, crew, emergency equipment, special equipment for a mission, and all other non-expendable items as applicable. The starting point for determining the mission most forward and most aft center of gravity conditions.

OVERLOADING - The addition of weight to an aircraft increases the hazards of flying because the lifting and turning forces must be increased in proportion to the increase in weight. A heavily loaded aircraft is less maneuverable, has a higher stalling speed, a lower ceiling, and requires a longer takeoff run.

PERCENT MAC - A location express as a percentage of the Mean Aerodynamic Chord.

TO COMPUTE PERCENT MAC

$$\frac{\text{Horizontal CG - Distance to Leading Edge on the MAC}}{\text{Total MAC length}} \bullet 100 = \%MAC$$

PERMISSIBLE GROSS WEIGHT - See allowable gross weight.

PERMANENT BALLAST - Ballast that must be installed in the aircraft at all times.

RAMP WEIGHT - The engine start condition less the extra fuel allowed for engine start, warmup, and taxi.

RECOMMENDED MAXIMUM GROSS WEIGHT - The maximum gross weight that an aircraft can be loaded to and still maintain the desired margins of safety established by the contracting authority.

RECOMMENDED MAXIMUM LANDING GROSS WEIGHT - The maximum weight that the aircraft can safely land at. Sometimes this weight is less than the recommended maximum gross weight.

RECORD OF WEIGHT AND BALANCE PERSONNEL - The DD365 Form used to provide a continuous record of the weight and balance personal responsible for maintaining the aircraft weight and balance handbooks.

REFERENCE DATUM (RD) - The zero reference position from which all distances are measured for balance purposes. Aircraft have three zero reference datum lines from which locations are measured:

Lateral - Buttlines (BL).
Vertical - Waterlines(WL).
Longitudinal - Fuselage Stations (FS).

The longitudinal datum is normally at or near the nose but may be the wing leading edge, rotor centerline, etc.

REPRESENTATIVE AIRCRAFT - An aircraft chosen as typical of many aircraft of the same model/designation, with similar structure, systems, and equipment configurations.

ROUNDED WEIGHT - A weight rounded to the nearest whole number, either up or down. The convention being if less the 0.5 lbs. it is rounded down, 0.5 lbs. and above, rounded up.

SCALE FACTOR CORRECTION - Modifies scale readings because of the inherent accuracy of the scales. Others may be, but are not limited to scale calibration factors, inability of the electronic load cell zero set to return to zero after unloading the cells, latitude correction, etc.

SERVICE WEIGHT PICKUP - Known and unknown weight changes due to undocumented repairs and modifications, wear, dirt, moisture, etc.

SIMPLIFIED MOMENT - Moment(s) divided by an established constant such as 10, 100, 1000, etc.

STRUCTURAL STATION - A station or location such as a bulkhead labeled for reference on an engineering drawing. Structural stations may or may not be identical with balance or fuselage stations.

TAIL HEAVY - A condition of improper balance in which the center of gravity is normally aft of the aft limit.

TAKEOFF GROSS WEIGHT (TOGW) - The aircraft gross weight at the time the aircraft becomes airborne.

TARE (aircraft weighing) - The weight of any support equipment necessary to weigh the aircraft. For example: chocks, blocks, slings, jacks, etc., whose weight is included as part of the weighed total but is not part of the aircraft weight. It can be a scale factor correction. On all aircraft the jack pads are part of the tare correction when using a load cell/jack weighing procedure.

Tare (General scale use) - the weight of the container in which goods are packed and weighed, deducted from the gross weight in order to arrive ate the net weight. Taring, Tared - ascertain the weight of a container. From Arab: Tarhah - the part that is thrown away.

Tare mechanism - A mechanism designed for determining or balancing out the weight of packaging material, containers, or other materials that are not part of the net weight determinations.

TEMPORARY BALLAST - Item(s) used to simulate, or replace any missing item. Temporary ballast may simulated a missing crew member, a piece of equipment, etc. to maintain the aircraft within specified center of gravity limits and/or simulate a specific aircraft condition or configuration.

TIME COMPLIANCE TECHNICAL ORDER (TCTO) - An addition, deletion, and/or rearrangement of equipment authorized by an approved contracting authority. A manufacturer's engineering change proposal.

TRAPPED FUEL - That fuel that remains in the aircraft after defueling the aircraft by the prescribed -5 T.O. procedure. Fuel which remains after draining that can only be removed by disconnecting fuel lines, dismantling components, etc.

UNACCOUNTABLE WEIGHT - Any change in the basic weight not referenced on the Chart C. It is also the difference between the expected scale reading(s) and the actual scale reading(s).

UNPUMPABLE FUEL - The fuel remaining in the internal fuel tanks after defueling at a specific attitude/condition.

UNUSABLE FUEL - That fuel remaining in the aircraft at fuel starvation or draining the aircraft at a specific attitude. Includes trapped fuel.

VECTOR - A quantity completely specified by a magnitude and direction.

VECTOR PLOT - A presentation prepared using precalculated graphical grids on which the arithmetic calculations have been predetermined. Normally associated with fan grid and template devices.

VERTICAL AXIS - An imaginary line passing through the center of gravity parallel to the axis of yaw and at right angles to the reference plane for vertical load arms.

WATERLINE (WL) - Location in the vertical (up and down) direction measured from a reference well below the aircraft.

WEIGHT (W) - A measurement of the heaviness of an object. The gravitational force exerted on an object equal to the product of the objects mass and the local value of the earth's gravitational acceleration. Any object used to exert a force by virtue of its gravitational attraction to the earth.

WEIGHING REACTION POINTS - Those points upon which aircraft weight is supported during a weighing operation. Examples: Jack pads, Main and nose gear, etc.

WEIGHING REFERENCE POINT - See Jig Point.

WEIGHT AND BALANCE HANDBOOK - The continuous and permanent record of the weight and balance condition of a specific aircraft.

WEIGHT EMPTY - An engineering term related primarily to aircraft design. It is the weight of the aircraft, by model designation, dry, clean and empty except fluids in closed systems such as hydraulics etc.

ZERO FUEL WEIGHT - The weight of the loaded aircraft less any usable fuel.

Transport Cart

14465 23d Avenue North
Minneapolis MN 55447

Telephone (612) 476-2531

Service

Theory of Operation

AC power enters through a **power entry module**. This module contains a power switch, fuse, and voltage selection card. The primary taps of a **power transformer** are also connected to the module. The output of the transformer passes through a low voltage fuse. The voltage at this point is a nominal 12 volts AC. From this point the power is routed to a **terminal block assembly**. All individual **charging cables** and the **power indicator lamp** are supplied from these terminal blocks. The leads to the LED power input lamp contains a **current limiting resistor**. Each individual scale takes the 12 VAC and converts this into the correct amount of charge current. Each scale may draw up to 0.4 Amps.

Please note that all of the charging jacks must be wired with the same polarity to avoid shorting out in the scales grounding systems. This becomes important if you are replacing a charging connector.

The high voltage fuse protects the line cord and power transformer input winding. The low voltage fuse protects the transform output winding and scales.

Trouble-shooting

Due to the simplicity of the charging circuitry trouble shooting is very simple.

Symptom	Possible Cause(s)
The power input lamp will not light up. All scales' charge indicator will not light up.	Bad AC power source. High or low voltage fuse bad. Incorrectly configured voltage selector. Defective ON/Off switch. Defective Power Transformer. Defective wiring harness. Defective power input lamp.
One or more scale's charge indicator will not light up.	Defective wiring harness. Defective charging connector. Defective scale
The charger keeps blowing fuses.	Shorted or pinched charging cable or connector. Defective wiring harness. Defective transformer. Defective scale. Unplug all scales and try again.
The power input lamp is very bright or very dim.	Incorrectly configured voltage selector.
Broken charger jack on scale.	Scale removed from cart while plugged in.

Schematic Diagram