Dynatest®

DYNATEST
FastFWD
TEST SYSTEMS

OWNER'S MANUAL

Version 02c

ID Number 1110013

Dynatest®
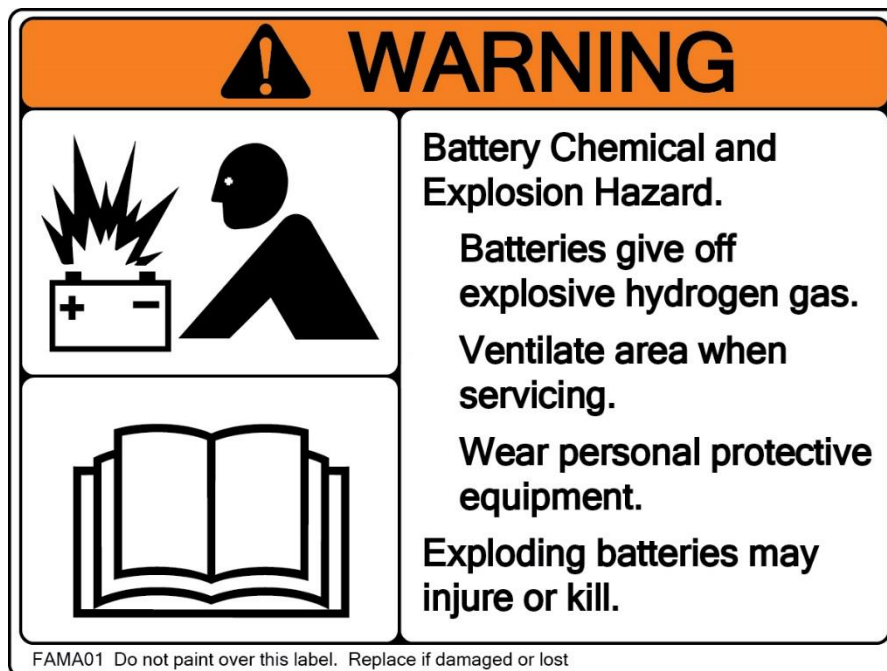
IMPORTANT SAFETY REMARKS

The FastFWD is a powerful and heavy piece of equipment that can cause extensive personal injury in cases of user error or carelessness. Please use extreme caution when testing with and performing maintenance to the machine.

A few simple rules for the operator:

- Stay clear of the moving parts of the FastFWD
- Always be aware of co-workers and surroundings while operating the machine
- Warn others to maintain a safe distance while machine is operable
- If others are present always announce what you are about to do before initiating the machine
- Never place objects near the buffer hit plate
- Never put any part of the body under the loading plate while the machine is powered
- Support the weight or subassembly during maintenance as it can move or drop unexpectedly
- Inspect batteries and always keep tools and objects away from them.

Batteries:

- Always keep tools, objects and any ignition source away from the batteries

Overview

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1. Introduction

1.1 *Intro*

A major advantage of analytically based structural design methods over more empirical methods is that the former may be used with any type of material and structure and under all climatic conditions, whereas the latter only may be used under those conditions for which the empirical relationships were developed. Most pavement research effort has therefore concentrated on developing and perfecting analytically based methods (e.g., the first six Ann Arbor Conferences).

Analytically based methods can only be used if the moduli of the pavement layers can be determined. This may be done if the test method allows for:

1. A force amplitude and duration approximating the effect of a heavy moving wheel load in order to allow for non-linear and visco-elastic stress-strain response, and

2. A very accurate deflection measurement, especially at several large distances (i.e. larger than the thickness of the pavement) from the center of the load. This is absolutely essential in order to get an accurate determination of the (non-linear) Subgrade modulus, which generally contributes some 60-80% to the total center deflection.

The Dynatest Falling Weight Deflectometers all satisfy these conditions. Most other vibrating equipment has a light load capacity, and Benkelman or other beam type equipment is inaccurate at significant distances from the load because the deflection gauge must be supported within the deflection basin itself.

The Dynatest Falling Weight Deflectometers may therefore - contrary to most other equipment - be used with analytically based structural design methods.

1.2 *History*

Based on early work in France during the sixties, the Technical University of Denmark, the Danish Road Institute, and the Dynatest Group have gradually developed and employed the Falling Weight Deflectometer (FWD) for use in Non Destructive Testing of highway and airfield pavements. In 1977, the Dynatest 7800 Registration Equipment was introduced to obtain digital load and deflection value readouts, although it was still necessary to hand place the deflection sensors away from the load. Various research projects showed that simultaneous measurements of at least six deflections (plus the load) were necessary for quick and precise deflection basin determinations. From this it became possible to evaluate the "In Situ E-moduli" or stiffness of all structural layers in an existing pavement system through the use of the Dynatest "ISSEM4" main frame Fortran computer program, and in recent years through the ELMOD PC computer program.

In 1979 Dynatest introduced the Model 8001 FWD featuring compact mechanical design with an integrated raise/lower sensor bar and remote control of all operations, including load level. Finally, the 7800 Registration Equipment was precluded in 1981 by a more compact micro-processing system called the Dynatest 8600 System Processor. In conjunction with a newer model FWD, the Dynatest 8002 FWD featured a loading range of 7 kN (1,500 lbf) to 120 kN

(27,000 lbf), and a matching Hewlett Packard HP-85 Computer. This system was able to handle seven simultaneous deflections, one load and numerous site and configuration identifiers by a single operator doing inventory work.

In 1986 the computer program for the FWD Test System, called the Field Program, was made DOS compatible and extended with many features. The DOS compatibility made it possible to use almost any IBM compatible PC as the Computer.

In 1987 Dynatest introduced a "big brother" to the FWD, the Dynatest 8081 HWD Test System, which, with a dynamic peak load capacity of up to 240 kN, was developed to simulate heavy aircraft loads. The HWD can, also be used for road evaluation at load levels down to 30 kN. The Model 8081 HWD uses almost the exact same electronics and software as the Model 8000 FWD (apart from adjustments for the higher load capacity), so that the HWD is producing data at the same high accuracy as the FWD.

In early 1989 a second-generation microprocessor control and data acquisition unit was introduced called the Dynatest 9000 System Processor, featuring nine to fifteen deflection channels. The 9000 had several new features such as a 40-character LCD display for system status monitoring.

In 1992 Dynatest introduced the Edition 25 Field Program, based on Object Oriented Programming, featuring window pull-down menus and a series of features over previous versions. Mainly providing for 9 (optionally 15) deflection channels, 0.1 micron deflection resolution, load sensing/targeting, on-line Help System, fast sampling/storage of signal time histories, user modifiable data file format, etc.

In 2001 Dynatest introduced a Microsoft Windows® version of the Field Program called FwdWin. It ofrffers all the advantages of a graphical user interface (GUI), plus real time display of many data elements. It also utilizes Microsoft Access® database format for data storage in addition to the traditional ASCII data formats.

In 2003 a third-generation control and data acquisition unit was introduced, called the Dynatest Compact15, featuring fifteen deflection channels, so that a total of 16 channels (1 load + 15 deflections) is available. Compact15 is an embedded computer unit mounted on the loading subunit and communicates with the host computer through an Ethernet connection.

The FWD/HWD, including the Compact15 System Controller and the standard PC with the FwdWin Field Program, is the most sophisticated test system which fulfils and exceeds all requirements to ASTM D-4694 and D-4695 standards.

In 2014 Dynatest took a major step in changing the FWD from using electro-hydraulics to using a purely electro-mechanical system for operation, based on robotics components. In January 2015 this new FWD model was introduced as the Model 8012 FastFWD, able to perform consecutive drops from full drop height and with full drop weight package for each 1½ second!

1.3 *8012 FastFWD, Brief Overview / Description*

A Dynatest 8012 FastFWD Test System consists of the following main components (for a more detailed description, please refer to Section 11):

1. **A FastFWD Trailer**,
   consisting of the following main elements (please also refer to the picture and exploded view in the following):

   a. A Subunit (1) with electric motor, encoder and lifting spindle, drop weight / rubber buffer package, load cell and center geophone (deflector) holder, etc.
   b. Two cabinets (2) with powering, motor control, system control and data acquisition electronics (CP15F), etc.
   c. A foldable Trailer Frame (3) with wheels / mudguards, brakes, rear lights, system buffer battery supply, spare wheel, etc.
   d. A Raise/Lower Bar (4) with typically 8 (max. 14) geophone (deflector) holders
   e. A low-noise Honda gasoline generator for charging of the system buffer battery (not needed if unit is powered from the towing vehicles 12V alternator)

8012 FastFWD Trailer (US version)
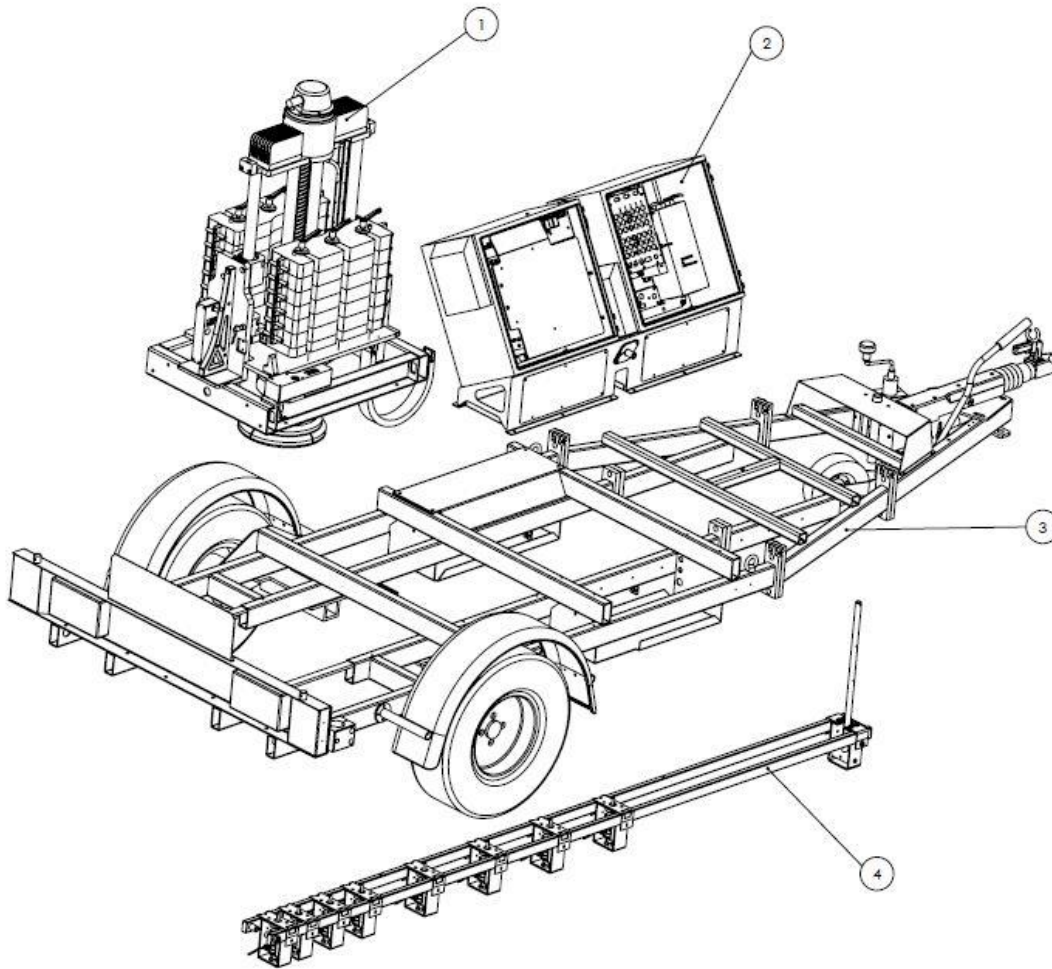
Exploded view of the 8012 FastFWD Trailer (EU version. Honda generator not shown)

2. System Components placed in the towing vehicle:

    a. A Notebook or Laptop type computer with Windows® operating system and the DDC (Dynatest Data Collection) software package

    b. A PoE (Power over Ethernet) switch

    c. A 12VDC to 110 or 220VAC Inverter for powering of a.) and b.) above

    d. A "Park Signal TX" unit for protecting against driving when the load plate is down.

There are only one or two cables running between the FastFWD Trailer and the towing vehicle:

    1. An industrial LAN cable running from a (waterproof) connector on the front of the trailer to the PoE Switch in the towing vehicle.

    2. A heavy duty 12V charging cable (up to some 100A current drain). Not needed if the trailer is equipped with a Honda gasoline generator.

1.3.1 Main Operating Principle and Features

By means of the falling weight striking a specially designed rubber spring system, the Dynatest FastFWD produces an essentially half-sine shaped, single "impact" load of 25-30 milliseconds in duration, closely approximating the effect of a moving wheel load of up to 120 kN (27,000 lbf).

- Peak load range approx. 4 to120 kN (1000 to 27,000 lbf)
- Trailer mounted: may be towed by an ordinary, adequately sized passenger automobile or van.
- Height of trailer approx. 1.55 m (61") or less in transport as well as measuring mode, low center of gravity, stable at normal highway speeds.
- Center mounted load cell, swivel suspended and integrated with the loading plate.
- Up to 15 deflection transducers in movable holders along a 2.45 m (8 ft) raise/lower bar, for precise deflection basin measurements.
- Automatic, remote controlled operation (including falling height selection in any height between 50mm and 390mm) by one person, typically the driver.
- A typical 3-drop testing sequence in one measuring point is performed in **less than 15 seconds.**
- Weather resistant.
- 10-15 VDC (100A max) or 90-240 VAC (1,300VA max.) power requirement only, heavy duty buffer battery supply provided.

1.3.2 Data Acquisition Controller

The Dynatest Compact15F System Controller is a PC based control and signal processing unit, which is networked with the host computer via Ethernet.

- A temperature controlled case that is compact and light.
- Drives electromechanical locks and reads feedback from locks and proximity sensors. Performs scanning, conditioning and further processing of the transducer signals (1 load + 15 deflections).
- Monitors status of the FWD/HWD unit to ensure correct measurements.
- 12VDC powered.
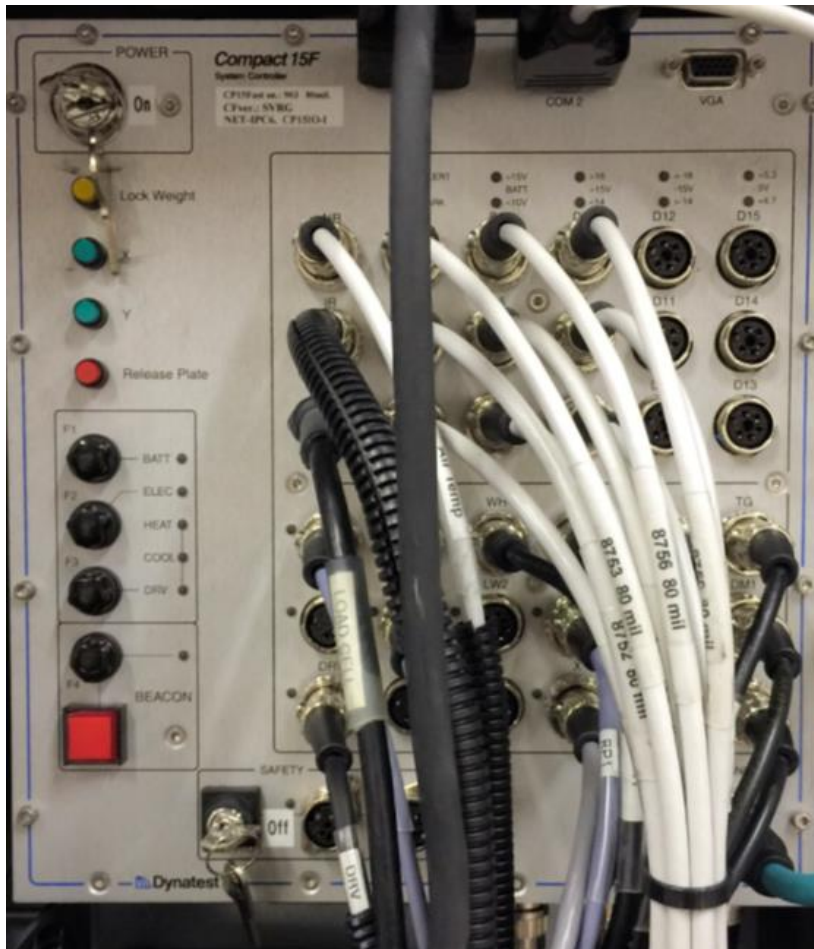
1.3.3 The Park Signal TX Box

The Park Signal TX Box, which is placed in the towing vehicle, interfaces the Park signal and relays the status to the controlling computer application.

1.3.4 The Laptop Computer

The laptop computer is used for input of control and site/test identification data as well as for displaying, storing, editing and further processing of test data.

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1.3.5 Dynatest Data Collection (DDC), the FFWD Field Program

Features

User Interface

- Flexible layout through floating, resizable windows
- Voice feedback (error and warning messages)
- Support for multiple languages

Data Files

- Test data is stored in databases for ease of processing
- Earlier Dynatest ASCII file formats still supported
- Pavement Deflection Data eXchange (PDDX by AASHTO)

Section Database

- The operator can retrieve Roadway network information in the field:

    Facility Names and Codes
    Sectioning

Quality Assessment

- Changes to primary program- and equipment-parameters are logged.

1.4 *Performance Specifications*
1.4.1 Accuracy

The deflections are measured with an absolute accuracy of better than 2% ± 2 microns, and with a typical relative accuracy of 1% ± 1 micron. The resolution of the equipment (in terms of deflection) is 0.1 micron (1 micron = 0.04 mil).

The load is measured with an accuracy of better than 2% ± 0.3 kN. The resolution of the equipment (in terms of load) is 0.03 to 0.2 kN (7 to 45 lbf), magnitude dependent.

1.4.2 Reproducibility

The reproducibility of consecutive FastFWD tests run on the same elastic materials is typically 1% in terms of the load/deflection ratio, for a given falling height, drop mass configuration and temperature.

2. Tow Vehicle Installation

2.1 Short form Vehicle Installation Guide

2.1.1 General Remarks

Normally, the delivery of a Dynatest FastFWD Test System does not include a towing vehicle.

In this section you are given all Installation Instructions (and hints) necessary to prepare a towing vehicle for a proper FastFWD System Setup.

This section does NOT describe all of the "non-permanent" connections (regarding transducers, computer power and interface cable) which are performed using quick-connect plugs - refer to subsequent sections 7, "Connecting the Electronics" and 12, "Transducers/Cables" for descriptions and cable diagrams.

The Hardware Installation Instructions are given below in a rather short form, backed up by supplementary notes where necessary (found in subsection 2.2).

Items followed by "provided" will be included in the system delivery or be shipped in advance of delivery if so agreed.

2.1.2 Vehicle Type

The towing vehicle should be of adequate size and engine power to tow the FastFWD trailer with a max permissible weight of 1,300kgs / 2,800lbs. The engine compartment should preferably allow for space for an additional alternator (see below).

2.1.3 Trailer Hitch

The vehicle should be fitted with a trailer hitch with a 50 mm (2") diameter hitch ball, the center of which should be located 480-500 mm (18-20") above ground level when LOADED with some 100kg (see also Note 2.2.1). The hitch must be rated for towing of at least 1,300kgs / 2,800lbs.

2.1.4 Trailer Lights Socket (provided)

A trailer tail lights connection socket should be mounted on the rear of the towing vehicle close to the towing hitch ball (preferably in front of and some 200 mm to any side of the ball) (see also Note 2.2.2).

2.1.5 Additional 12V Alternator

For optimum powering of the FastFWD Test System, an additional 12V belt driven alternator of at least 100 Amps output capacity should be mounted onto the vehicle engine (see Note 2.2.3). ALTERNATIVELY, if this solution is not possible or desirable, the vehicle's own existing alternator MAY be used if it has an output capacity of at least 150 Amps. A third solution is using an optional trailer mounted Power Unit (see following notes.)

2.1.6 Battery Separation Relay (provided if needed)

IF the FastFWD System is powered from the EXISTING vehicle alternator or its replacement, a special heavy duty battery separation RELAY should be installed (see Note 2.2.3).

2.1.7 Electronics Buffer Battery (provided if required)

For buffering of the alternator generated 12VDC power supply to a 12VDC to 110/220VAC Power Inverter (see 2.1.11), an existing or additional second battery should be mounted in the vehicle cabin. Preferably use a maintenance-free ("add-no-water") 12V battery of 40-60 Ah capacity (standard size in most small passenger vehicles) (see Note 2.2.3).

2.1.8 Heavy Fuse Box (provided)

A heavy fuse box should be installed for protection of the 12V power circuits (see Note 2.2.3).

2.1.9 12V Power Socket for Trailer (provided)

A heavy, 2-pin (female) power output socket for powering/charging of the FastFWD trailer electrical system should be mounted close to the towing hitch ball (like the lights output socket, but preferably to the opposite side of the ball (see Note 2.2.3).

2.1.10 Power Inverter (provided if needed)

If the Computer requires 110/220VAC powering, a 12VDC-to-110/220VAC Power Inverter should be installed (see Note 2.2.3).

2.1.11 Throttle Regulator

If the Vehicle alternator capacity is in the low end, the vehicle engine should preferably be fitted with a manual or automated throttle regulator, so that the engine idling RPM can be raised to 1000-1500, to ensure adequate 12VDC power supply from the alternator during testing. On most new vehicles, this is difficult or not possible, in which case it is important to use an alternator with an output capacity in the high end.

2.1.12 Alarm Connection Plug (provided)

A 3-pin DIN plug should be used for connection of the vehicle's PARK indicator OR hand brake (emergency brake) indicator to the ALARM socket on the Park Signal TX Box. This enables the controlling computer application to give a warning ALARM signal AND to automatically raise the loading plate, if the vehicle is set into DRIVE (or the emergency hand brake is released) during testing (see Note 2.2.4).

Alternatively, this function can be performed by feeding the trailer brake light signal directly to the CP15F (see section 15). The loss of brake light signal will then be used to trigger the warning ALARM and raise the loading plate.

2.1.13 Emergency Switch

An emergency switch (with a momentary <u>break</u> contact) may be connected in series with the above mentioned ALARM connection for immediate raising of the loading plate in an emergency situation. This switch can be dash mounted and have a large, visible push knob (see Note 2.2.4).

2.1.14 Cable Access Opening

The towing vehicle should be fitted with some kind of an opening in the rear, so that the network cable can be easily passed from the Computer to the Trailer (see Note 2.2.5).

2.1.15 Placing the Computer

The towing vehicle should be fitted with some kind of small table or the like for the Computer (see Note 2.2.6).

2.1.16 Air Conditioning

If necessary, the vehicle should be equipped with an air conditioner to keep the interior of the vehicle below 40°C (105°F) (and to keep out dust from open windows). A white roof, tinted glass and/or curtains can perhaps also be used to reduce sun heating.

2.1.17 Warning Signs / Flasher Lights

To warn the traffic during testing, warning flasher lights should be mounted on top of the towing vehicle.

Warning signs may also be mounted on the rear of the vehicle and/or the Trailer (see also Note 2.2.7).

2.2 Notes for the Vehicle Installation

2.2.1 Trailer Hitch Requirements

The Trailer Hitch should be approved for towing a trailer with a weight of up to at least 1,300 kgs (2,800 lbs.).

The Dynatest FastFWD trailer will be delivered with a coupler intended for a trailer hitch ball diameter of either 50 mm (1-31/32") OR 2" (50.8mm).

WARNING!

Make sure that the trailer hitch ball matches the coupler!

The trailer frame should be parallel to the ground surface so that the guide shaft for the drop weight will be perpendicular to the ground. The center of the trailer hitch ball should be at a height of 480-500 mm (18-20") from the road surface when loaded with some 100kg, see figure on a following page.

WARNING!

Be careful when loading the towing vehicle. Do NOT put too much cargo in the rear of the car, which will not only affect the tilt of the trailer frame but also driving stability of the vehicle.

If the vehicle is heavy loaded with cargo and/or personnel when testing, then make sure that the hitch ball is still in the correct height (480-500 mm) from the road surface with the FastFWD trailer attached.

For further guidelines please consult the Owner's Manual from the vehicle manufacturer.

THE TRAILER IS
TOWED USING AN
ORDINARY BALL
TYPE TRAILER
HITCH
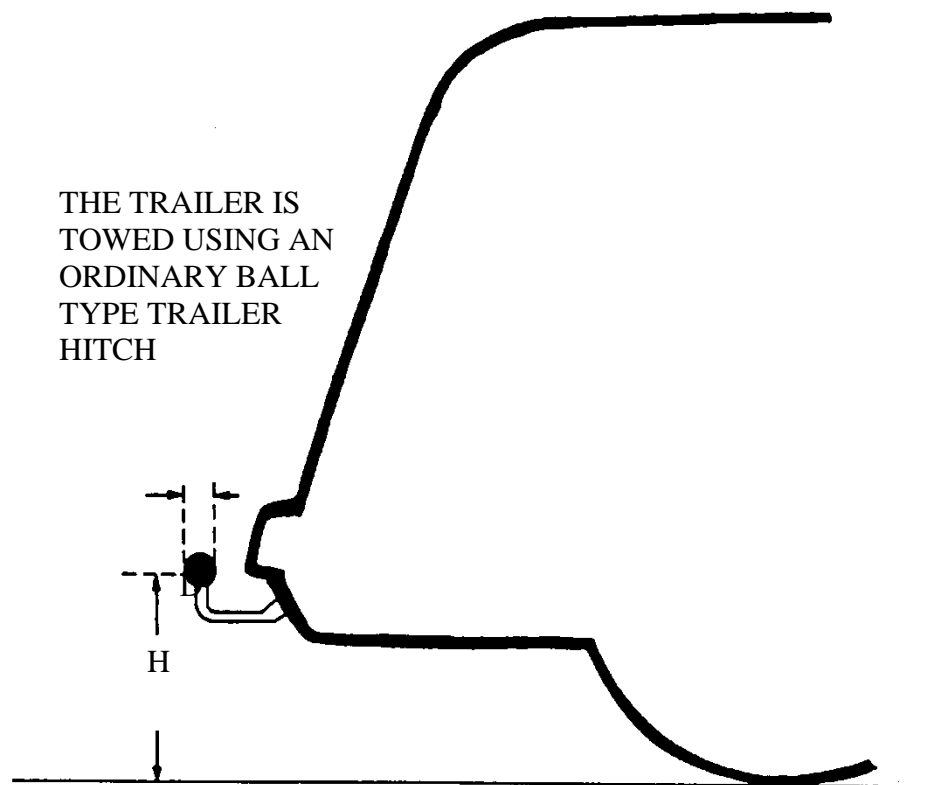
BALL DIAMETER "D":   50 MM **OR** 2 INCHES (OPTIONAL)

BALL HEIGHT "H":   480 to 500 mm (19 to 20 inches) **WITH 100 KG LOAD**

(TYPICALLY 530 TO 550 mm (21 TO 22 inches) UNLOADED)

2.2.2 Trailer Tail Lights Wiring

The FastFWD trailer is equipped with two tail light assemblies.

The trailer lights are connected to the car by means of a cable typically equipped with a 13-pin plug (European Standard, other plugs/connections are optional).

The towing vehicle should be equipped with a corresponding SOCKET (provided).

The trailer lights wiring diagram for a specific trailer can be obtained from Dynatest on request.

2.2.3 System Powering

General remarks

The entire FastFWD Test System may be powered exclusively by 12 VDC (10-15 VDC, up to 100A), normally supplied from an alternator in the towing vehicle.

A "stand-alone", trailer mounted, gasoline engine driven Power Generator Unit is provided for vehicle independent powering, see 17.1.9, "Power Unit".

The FastFWD trailer electrical system is connected to the 12V system in the towing vehicle by a "Trailer Power Cable", OR to the trailer mounted Power Unit)

The entire FastFWD Test System typically requires a total supply of up to 60Amps *average* from the 12V supply during extensive use, like e.g., three full-height drops plus one lowering/raising of the drop weight subassembly every minute.

2.2.3.1 ADDITIONAL Alternator (Recommended Solution)

As mentioned above, the FastFWD towing vehicle should preferably be equipped with an ADDITIONAL alternator of 12V, 100 Amp minimum output rating. Please take this into account when selecting the towing vehicle and make sure that the engine compartment has sufficient space for this. Perhaps ask your vehicle supplier to deliver the vehicle fitted with such an extra alternator.

The additional alternator should be connected to a second (additional) buffer battery.

IF you use this recommended, additional alternator solution, then you can skip the following paragraph.

2.2.3.2 Using or Replacing the EXISTING Vehicle Alternator (Alternative solution)

If for some reason the only possible solution is to use the vehicle's existing alternator, then this should have an output current rating of at least 150 Amps.

Many vehicles are factory fitted with 110 Amp alternators which MAY be sufficient if it can be adjusted and if the FWD is not used very extensively and the need for 12V supply for other devices (like warning flasher lights, etc.) is rather limited, but we strongly recommend to get the existing vehicle alternator upgraded or replaced to achieve the recommended 150 Amp min. current output rating.

2.2.3.3 Additional Battery with Separation Relay

If the existing alternator is used, a second additional buffer battery should be installed together with a Battery Separation Relay (provided if needed). The Battery Separation Relay serves two purposes:

First it is prevents the voltage of the second battery dropping when the vehicle engine starts and secondly the vehicle battery cannot be drained by the Test System.

Some vehicles can be delivered with such a relay plus a second battery as a factory fitted option, which is recommended.

2.2.3.4 Heavy Fuse Box

A heavy fuse box (provided) with a 100A and a 25A (or 50) fuse should be placed somewhere between the Electronics Buffer Battery and the alternator, preferably closest to the battery.

The wiring to this fuse box depends on the alternator solution.

2.2.3.5 12V Power Socket for Trailer

The provided circular 12V Power Output Socket for connection of the Trailer Power Cable should be mounted on the rear of the vehicle, close to the trailer hitch ball, but so much above or to one side of the ball that it will allow for sharp turning of the vehicle/trailer.

The socket should be connected to the alternator by two heavy wires (provided, 35 sq. mm / No 2 AWG or heavier) as follows:

- The POSITIVE terminal should be wired to the 80A fuse in the heavy fuse box
- The NEGATIVE terminal should be wired directly to the alternator GND connection (normally the alternator housing). ALTERNATIVELY, the negative socket terminal AS WELL as the alternator GND could BOTH be connected to a GOOD, SOLID CHASSIS BEAM GROUND point or the like. Connection points should then be cleaned to BARE METAL before connection. This alternative GND wiring will only work if performed carefully and will easily fail after some time if not properly corrosion protected.

2.2.3.6 Power Inverter

If a 12VDC-to-110/220VAC Power Inverter is needed for Computer supply, then it will be provided. This Inverter will produce heat and should therefore be placed so that natural air flow can cool the unit.

The 12V input terminals of the Inverter should be connected to the Heavy Fuse Box as follows using heavy wires (provided, 6 sq. mm (No 10 AWG) or heavier):

Terminal	Connect to:
Positive (red)	50A fuse
Negative (black)	Battery GND terminal

This connection should be performed very carefully, using as short of wires as possible to reduce voltage drop. LOW VOLTAGE input to the Inverter MAY CAUSE OVERHEATING/BREAKDOWN of this unit.

2.2.4 Plate-Low Alarm Connection

If the ALARM socket of the Park Signal TX Box is connected to the electrical system of the towing vehicle as described below, then the controlling computer application will produce a warning if it is attempted to drive before the FWD/HWD plate has been raised from the ground during the measurements, or if the plate lowers while driving between test points. In both cases the plate will be raised automatically.

When the towing vehicle is in PARK mode (alternatively when handbrake is pulled), then the external connection to this socket should provide 12VDC across pins 1 and 3 (polarity does not matter). When the vehicle is NOT in PARK mode (handbrake NOT pulled), the voltage must disappear. The Park LED (PK) on the computer should reflect the state of the signal (PK ON=PARK).

2.2.4.1 Emergency Switch

In the following examples, an emergency switch (indicated by an "E" in the example figures) may be included for instantaneous raising of the loading plate in an emergency situation. Such a switch should preferably have a large, red push knob and be mounted on the vehicle's dash board in a place where it is visible and easy to get to. It should have a BREAK contact connected in series with the Alarm connection as indicated in the examples. The switch needs only be activated momentarily to instantaneously initiate a complete Raise Plate cycle.

Connection Examples:

Example No 1**:**

Parallel connection in a vehicle with a PARK indicator switched to GND or 12V:

If the vehicle is equipped with a PARK indicating lamp, which is switched on when the vehicle is in PARK mode (or when handbrake is pulled), then use the provided plug and connect pin 1 to the positive side of the lamp and pin 3 to the lamp GND terminal.
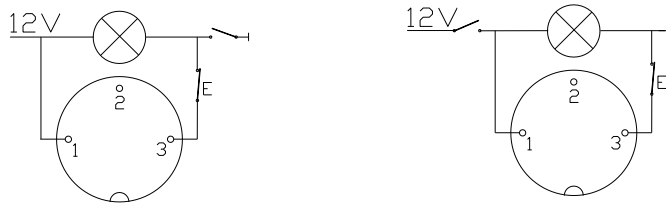
Example No 2**:**

In a vehicle WITHOUT a park indicator:

If the towing vehicle is NOT equipped with a PARK switch/indicator, so that a separate switch (e.g. a small "Micro-Switch") has to be applied, then this switch should be applied as shown in Example No. 1 above

Example No 3**:**

Using a proximity switch in a vehicle WITHOUT a park indicator:

The mechanical switch in example No 3 may be replaced by a proximity switch (optional). A suitable proximity switch may be ordered from Dynatest. A proximity switch of the same type as used for the System status sensors (described in a later section) may be used (NPN output type, active low output).

PARK SIGNAL Override Plug

Use this Plug to check out the PARK SIGNAL functioning in servicing situations. Connecting this plug to the ALARM socket asserts the "Vehicle in PARK" signal.

> ### *WARNING!*
>
> NOTE that this PARK SIGNAL Plug should NOT be used in the field, but ONLY for servicing purposes (in the workshop or laboratory).

2.2.5 Cable Access Opening

Some kind of an access should be provided somewhere in the back of the tow vehicle, through which the Ethernet cable can be passed out of the vehicle and be passed on to the trailer network. A "trap door" or some kind of plastic tubing bending from the vehicle floor down under the rear bumper, ending not too far from the trailer hitch captive ball, can be used for this. The gate/trap door opening should be 25 by 25 mm (1" by 1") (or 25 mm (1") in diameter) minimum, and if tubing is used, the tube diameter should be 25 mm (1") minimum, and sharp bends of the tubing should be avoided to ease passing of the plug. The gate should be kept closed at all times when possible to prevent engine exhaust from entering the vehicle cabin.

It is a BAD idea to pass the cable through a back door, in which it may be damaged.

2.2.6 Placing the Computer and the Park Signal TX Box

The Park Signal TX Box and the Computer may be placed anywhere inside the tow vehicle, observing a few precautions:

The Computer should be placed conveniently for the operator and the Park Signal TX Box should be placed so that the front panel LED indicators are visible from the operator's position. All units should be appropriately prevented from bumping and/or tilting during driving, e.g. using rubber straps and perhaps foam rubber underlays.

MAKE SURE that the Computer is mounted in the vehicle in such a manner that NO ventilation grids in the Computer enclosure are covered!

The maximum ambient temperature limit for the Computer is typically 40°C (105°F), if placed IN SHADE, so if the temperature in the vehicle approaches this limit, then direct sunlight should be avoided! Note also that the Computer should not be OPERATING below 5°C (40°F). Storage temperature range is -40 to +65°C (-40 to 150°F).

Electronic equipment does not like condensing moisture, as this may introduce creep currents on circuit boards. Therefore it is recommended that the Computer in cases of high air humidity and large temperature shifts from day to night is removed from the vehicle after use in the evening and stored in room temperature overnight.

2.2.7 Warning Signs / Flasher Lights

The FWD/HWD System does usually not include any warning signs and/or flasher lights.

Due to the limited height of the FWD/HWD Trailer, warning lights should be mounted on top of the towing vehicle for maximum visibility.

If so required by local regulations, warning signs could/should be mounted on the rear of the FWD/HWD Trailer. We recommend you to consult the local authorities concerning guidelines for signs selection and positioning.

Dynatest can deliver an optional, tailored rear sign assembly with two beacon or flashing lights. Please consult Dynatest for details.

3. Computer Configuration

The computer must be considered an integral part of the data collection equipment. It should not be used for any other purposes. Therefore we recommend that Dynatest supply and configure the computer for the equipment. If the customer supplies the computer, then it must be open for modifications to Computer Name, Workgroup/Domain membership, Security Setup, Network Setup, Power Options and Virus Protection.

Configuring the computer consists of

> Verifying that requirements are fulfilled

> Installing the program package

> Establishing a network connection between the computer and the Compact15F

> Running the program to setup initial parameters

Dynatest personnel normally handle this task. However, this information is supplied in the event that the end-user may need to reconfigure or replace the PC.

3.1 Requirements

The requirements listed here are mandatory to ensure a smooth running of the system:

Computer Specifications
Core i5, 2 GHz
8 GB RAM
500 Gigabyte Hard Drive
1920 x 1080 Monitor
1 GB connection
A Serial COM Port or USB-to-Serial "dongle" (for GPS)
USB Port
Windows 10 Professional, 64-bit (version 1803 or newer)
Support of DirectX9 or newer

3.2 *Install programs*

The programs are available from ftp://ftp.dynatest.com/downloads/DDC or on hard media as two packages named DDC Prerequisites n.n.n.exe and DDC n.n.n.exe, where n.n.n is the version number.

If you are upgrading, please Backup existing files and folders,
then uninstall the previous DDC (mandatory)

Prior to installation, please   **Close any running programs**

Failure to close all programs may result in failure of the installation process. This is not a serious problem, but the user will be inconvenienced by having to restart the installation process.

If this installation requests that a Dynatest program be uninstalled, then please do so (equipment information and setups are preserved) and then re-run the installation.

Locate the installation packages and then launch DDC Prerequisites n.n.n.exe first. This package contains general system modules. Launch DDC n.n.n.exe next. Just use common sense and click [Next] [OK] [Allow] etc to accept the defaults where appropriate.

The Typical installation will result in the following folder structure (Windows 64bit):

C:\Program Files (x86)\Dynatest\Elements   Control Centre and various applets

C:\Program Files (x86)\Dynatest\FwdWin   Falling Weight

C:\Program Files (x86)\Dynatest\RspWin   Road Surface Profilers

C:\Program Files (x86)\Dynatest\Survey   Manual Survey

Additional working folders are created under C:\Dynatest.

In addition to the program installation package you may have received a file specifically for your equipment and a License Code. The filename is composed of the equipment serial number and the extension MDB (e.g. 8012-080.MDB). The initial execution of DDC will copy this file to the following subfolder (typ.):

C:\Dynatest\FwdWin\MDB

Initial execution of DDC showing that FastFWD 8012-080 is available:
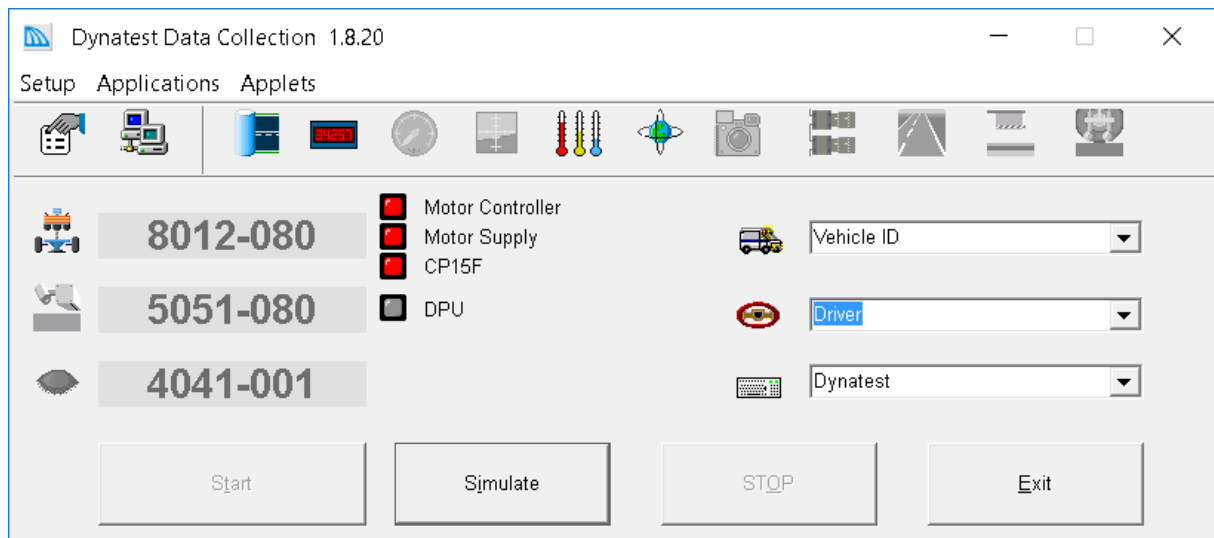
Your desktop should now have an icon for the Dynatest Data Collection suite:
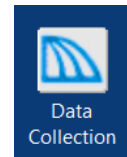
Windows Firewall may show a message saying it is blocking certain functionality of the DDC. You will have the option to remove the blocking. Please do so (see below).

Make sure both **Private** and **Public** are checked, then click **Allow Access**:
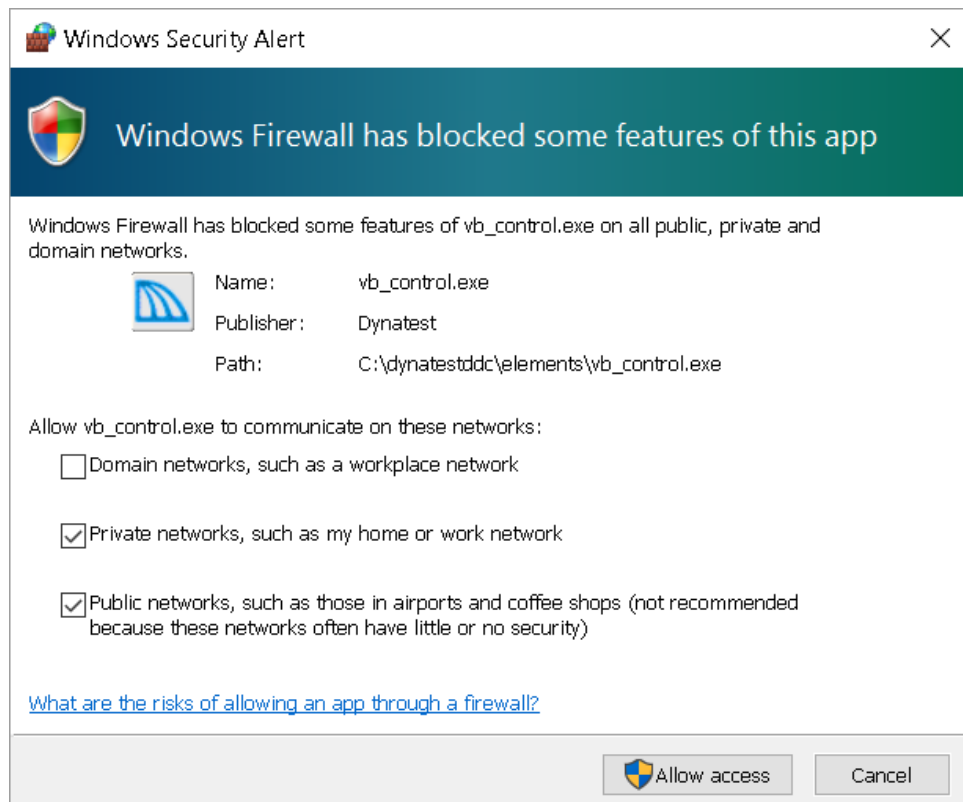
3.3 *Network Settings*

The computer communicates with the Compact15F utilizing the TCP/IP protocol. The Compact15F uses a fixed IP of 192.168.1.15. The computer must use an IP in the same range of 192.168.1.xxx. We recommend to use 192.168.1.99.

Open '**Network and Sharing Center**' and click '**Change adapter settings**', right click the Local Area Connection and then choose **Properties**:

Highlight 'Internet Protocol Version 4' and click 'Properties'

Fill in fields as shown here
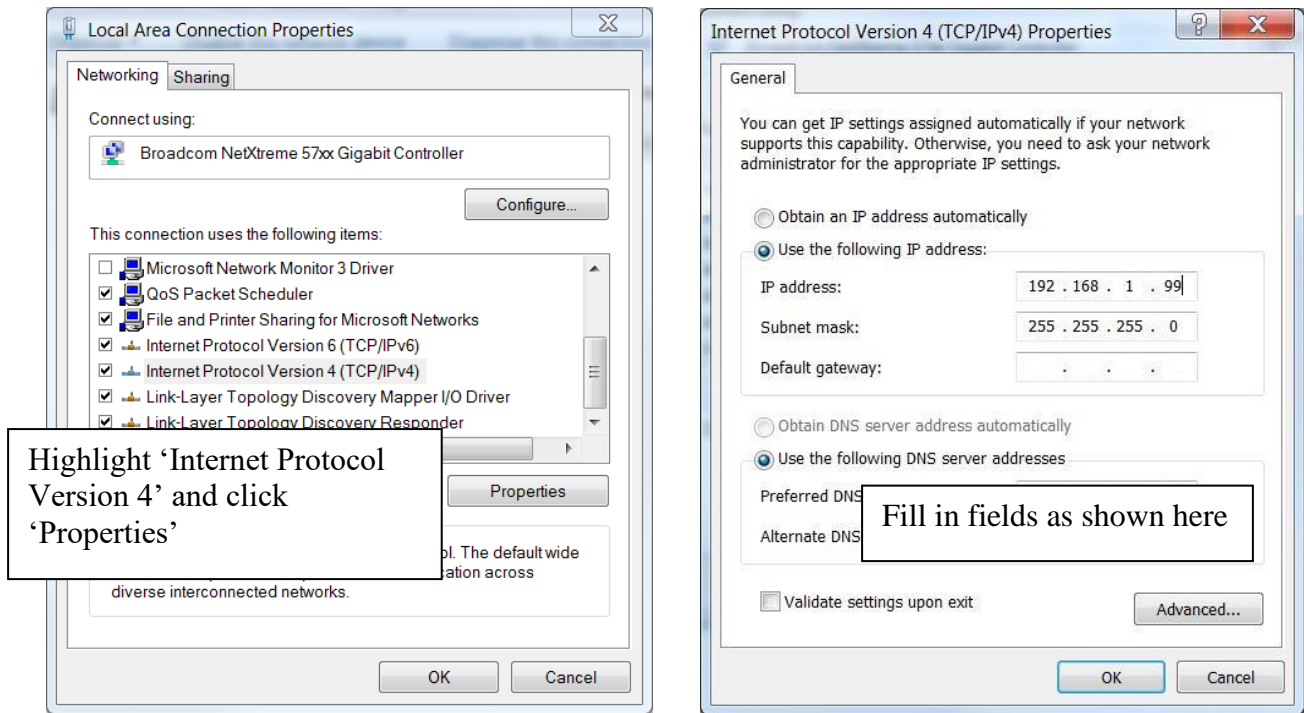
3.4 *Virus Protection*

AntiVirus software can significantly degrade the performance because it intercepts all file transfers between Compact15F and the computer. This can in some cases "Stall" the computer. To avoid this you should:

EXCLUDE the C:\Dynatest and all sub-folders from automatic protection.

EXCLUDE the following image/picture file types from automatic protection.

Extensions: *.JPG, *.BMP

3.5 *Backup*

In order to preserve your work in case the computer is damaged, you should regularly backup a number of files. Assuming that the default location was used during installation then backup all MS Access database files found in the following two folders:

C:\Dynatest\FwdWin\MDB

C:\Dynatest\Elements\MDB

In particular:

TestSetup.MDB   Test Setups

8012-075.MDB   Equipment calibrations (sample file name shown here)

Sections.MDB   Roadway Sections

3.6 *Software Upgrades*

Updates and upgrades to the Dynatest DDC program suite are periodically posted to, and may be downloaded from, the following location (simply type the address in your internet browser or click the hyperlink): ftp://ftp.dynatest.com/downloads/DDC

If programs are installed on top of (i.e. in the same folder as) a previously installed version, it will automatically detect the equipment license file 8012-123.mdb (example) from the previous installation. If DDC fails to find a license file it will run in simulator mode only.

If the existing hardware information was found and imported successfully, the FWD serial number(s) will be accessible in the introductory screen.

A License Code is required for each unit.

If the search for hardware information failed, then the serial number will be displayed as "8082-XXX" and the program is permanently in simulator mode (until hardware information is obtained and the required hardware is connected to the computer).

To the extent possible when upgrading database files the program attempts to keep the users previous settings (window positions, language support, hardware settings, test setups etc.).

3.7 *Cameras*

The software package includes two applets for camera support:

Camera   General support for Windows compatible DirectX cameras

HCamera Halcon (MvTec) based camera support (hardware triggered)

3.7.1 Camera Applet

Go to the manufacturer's software support site and look for "DirectX Drivers" or a proprietary "Capture" program. Follow installation instructions and check that the capture program can connect to the camera and show images. Shut down the capture program and check that the camera appears in the Camera Applet's "Pick Camera" list.

3.7.2 HCamera Applet

This applet is used with the Dynatest MFV (Multi Function Vehicle) and all preparations are performed by Dynatest prior to delivery.

4. Program Configuration

This section provides the necessary information for configuring the field program for first time use. Information regarding program operation is presented in Section 9 of this manual.

If the software is already configured upon delivery this configuration information will prove useful in the event that the present configuration is somehow lost.

This process should preferably take place with the electronics and any additional hardware connected, powered up, and ready.

4.1 Dynatest Data Collection (DDC)

When the "Dynatest Data Collection" is first started, this opening window appears:
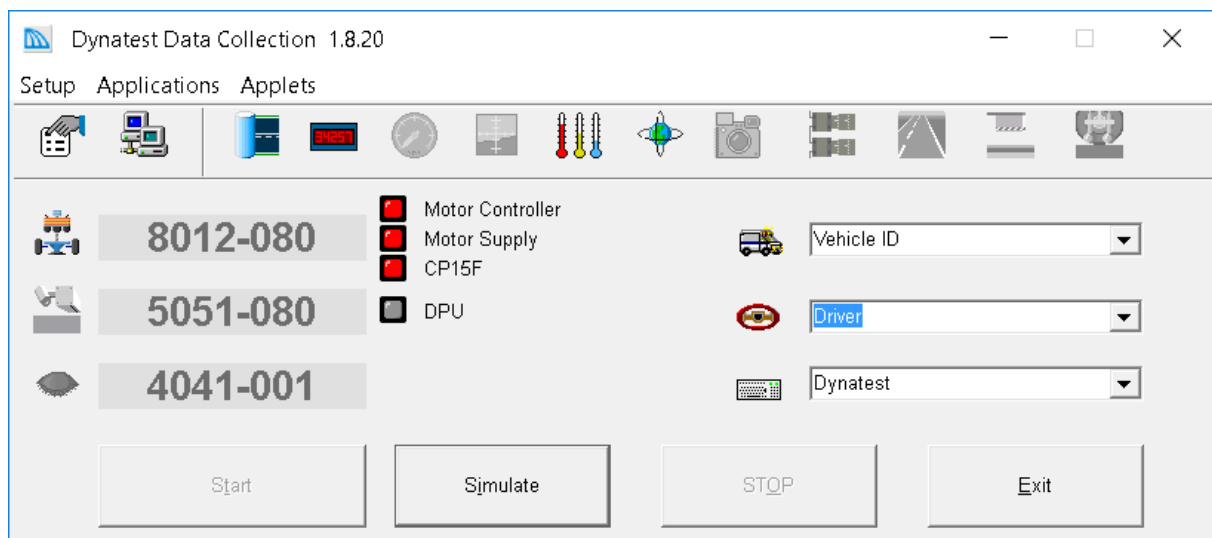
The coloured icons in this sample shows that tests will be run with Fast FWD S/N 8012-080 and the DMI, Thermometers and GPS "Applets" will be active.

The [Start] button is greyed until communication with the equipment is established.

There are various controls on this screen that affect program functionality. These controls and their functions will be discussed in the next few sections.

The first step in setting up the program is to enter vehicle identification (e.g. license plate number), the driver name and operator name or initials. This enables the field program to identify the vehicle and operators in the data files. It also enables the program to place the operator's name in any log files. These log files are written to disk whenever changes are made to test setups, equipment calibration factors, or component operating parameters.

4.1.1 Vehicle ID

Use this field to enter a "Vehicle Identification" (license plate number or other identification). The program maintains a list of several Vehicle IDs if required.

4.1.2 Driver

Use this field to enter a Driver name. The program maintains a list of several Drivers if required.

4.1.3 User

Initially there are four users each having different levels of access.

Administrator allows changes to layout and calibrations

Dynatest is for Dynatest personnel, only

Operator is for general data collection

SysOp is for the trained operator

These four accounts cannot be deleted

To create another Operator, SysOp or Administrator entry, first choose the appropriate level from the list and then type the desired name (replacing the user label). Then use e.g. TAB to leave the control.

4.1.4 Administrator

Administrative access is required for changes to calibration and operating parameters of critical components. It is important to note that this feature has nothing to do with the Windows "Administrator". Its purpose is merely to avoid accidental deletions or changes to important operating parameters. You may optionally require a password for administrators. It is recommended to choose Administrator for at least the first few runs.

The Administrator can resize and move windows and make changes to the following components:

- Load cell serial number and calibration data.
- Deflector serial numbers and calibration data.
- Air Temperature sensor serial number(s) and calibration data.
- Surface Temperature sensor serial numbers and calibration factors.

If the operator *needs* to make changes to any of the above components, he needs only pick the "Administrator" entry and optionally enter a password.

4.1.5 Options

Click the Properties icon or choose **Setup** – **Options** to show the DDC options window.
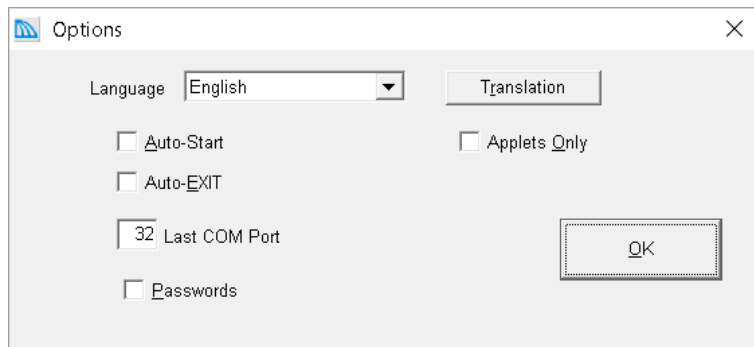
Language
All programs support English. If the chosen language is not available in a programs database then the user interface will be English.

Autostart and Auto-EXIT
Check Autostart to make DDC start all programs as soon as communication with the attached hardware is established. Check Auto-EXIT to close the opening window when the main program is terminated.

Last COM Port
Some Serial COM port drivers (Blue Tooth) can be extremely slow to determine if hardware is available or not. To avoid initial delays you may reduce this number.

Passwords
Check this to require that DDC Administrators enter a password.

Applets Only
Use this if a secondary computer needs to show some of the applets.

4.1.6 Entering the Main Program

Once everything in the introductory screen is configured, you may click the "Start" button (make sure "Administrator" is selected). The data collection screen should now appear. The Administrator can now complete the setup process.

4.2 *Applet Overview*

Applets are programs providing specific functionality to the main applications. Most applets appear in resizable floating windows. The Administrator can arrange the windows but the resulting layout is locked for the Operator. This page shows the typical appearance of each.
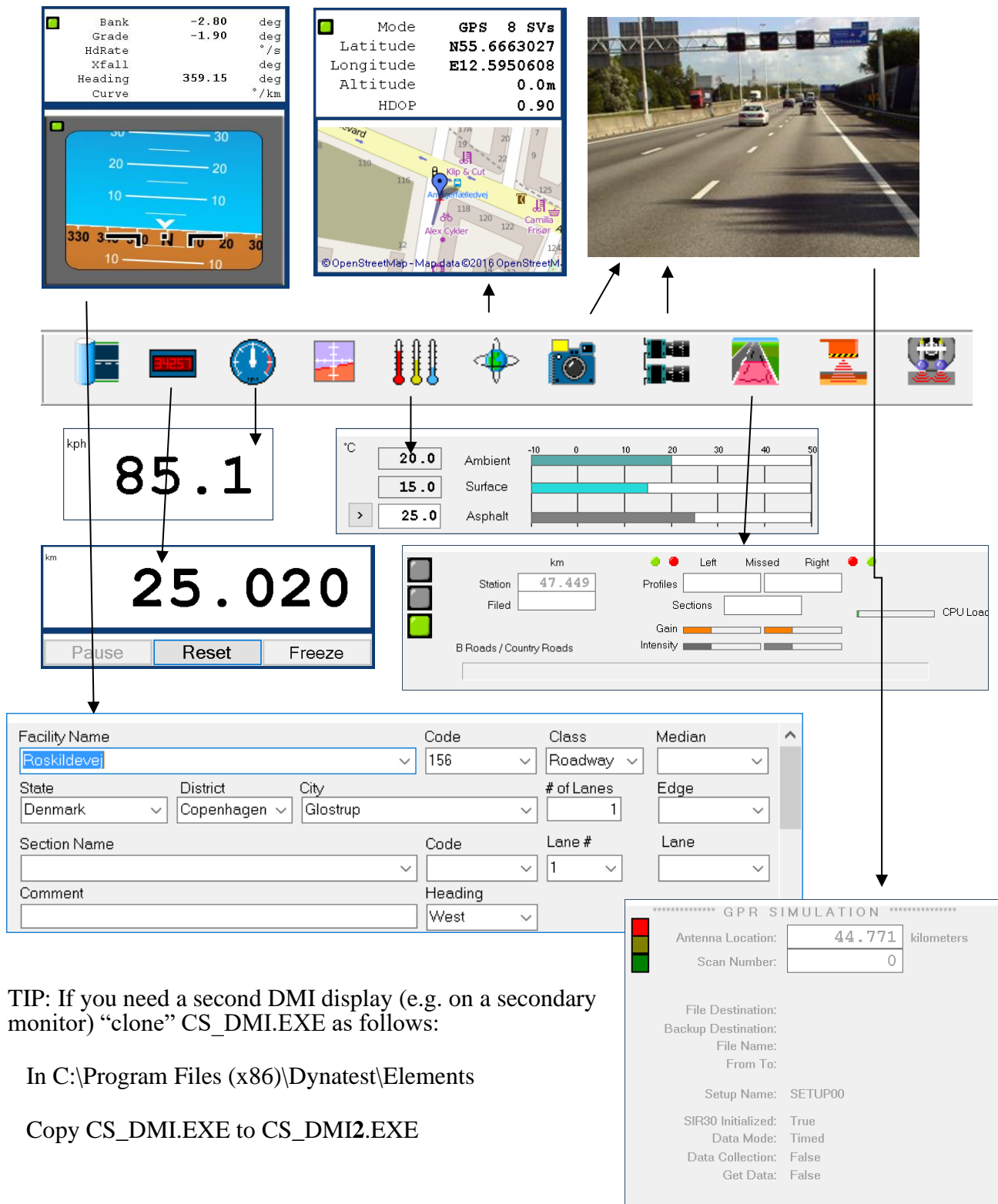
TIP: If you need a second DMI display (e.g. on a secondary monitor) "clone" CS_DMI.EXE as follows:

In C:\Program Files (x86)\Dynatest\Elements

Copy CS_DMI.EXE to CS_DMI**2**.EXE

4.3 *Completing the Setup*

This section shall address setup of the FWD/HWD hardware components. These components include the following (note that some of the components are optional and may not be present on your FWD/HWD):

- Loading Unit
- System Controller
- Load cell
- Deflectors
- Air Temperature Sensor
- Surface Temperature Sensor
- Distance Measurement (DMI)
- Global Positioning System (GPS)

In order to complete the setup, the user must be "Administrator" (see Section 4.1.4).

IMPORTANT!
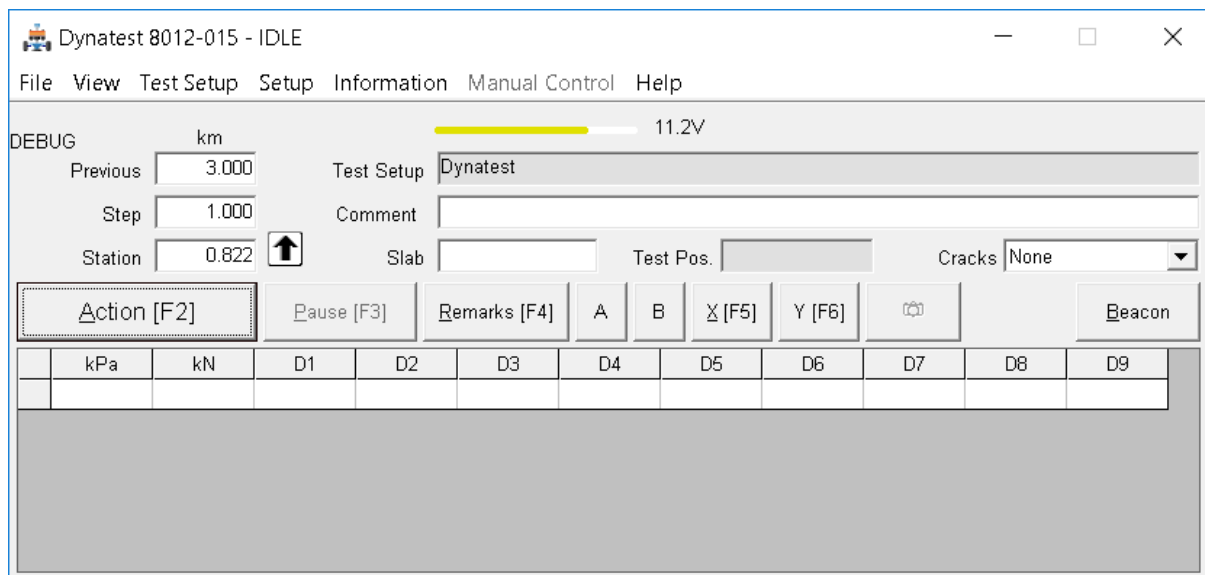
Hardware parameters (like all other parameters) are stored in a database file in order to better manage multiple setups.

Before making changes to Hardware parameters make sure that you have activated the correct equipment S/N in the introductory screen (8002-NNN).
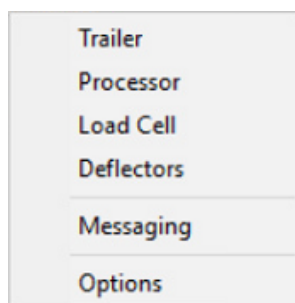
Any changes you make to the hardware setup – be it calibration or otherwise - will be stored in the equipment information file you selected in the introductory screen.

4.3.1 Entering the Data Collection Screen
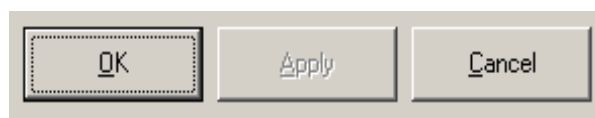
Configuration of the hardware is accomplished from a menu item at the top of the data collection screen. The data collection screen opens automatically when the user clicks the **Start** button on the introductory screen. This screen is the primary user interface for operating the FastFWD.   The data collection screen interface, in its simplest form, is shown below.

To make changes to the hardware setup, the user should click the **Setup** menu item along the top of the data collection screen. A drop down list of configurable items will appear as shown next.

Each item opens a dedicated window with options and variables and the three common function buttons:

The **OK** button saves the changes and closes the window.

The **APPLY** button saves the changes but leaves the window open.
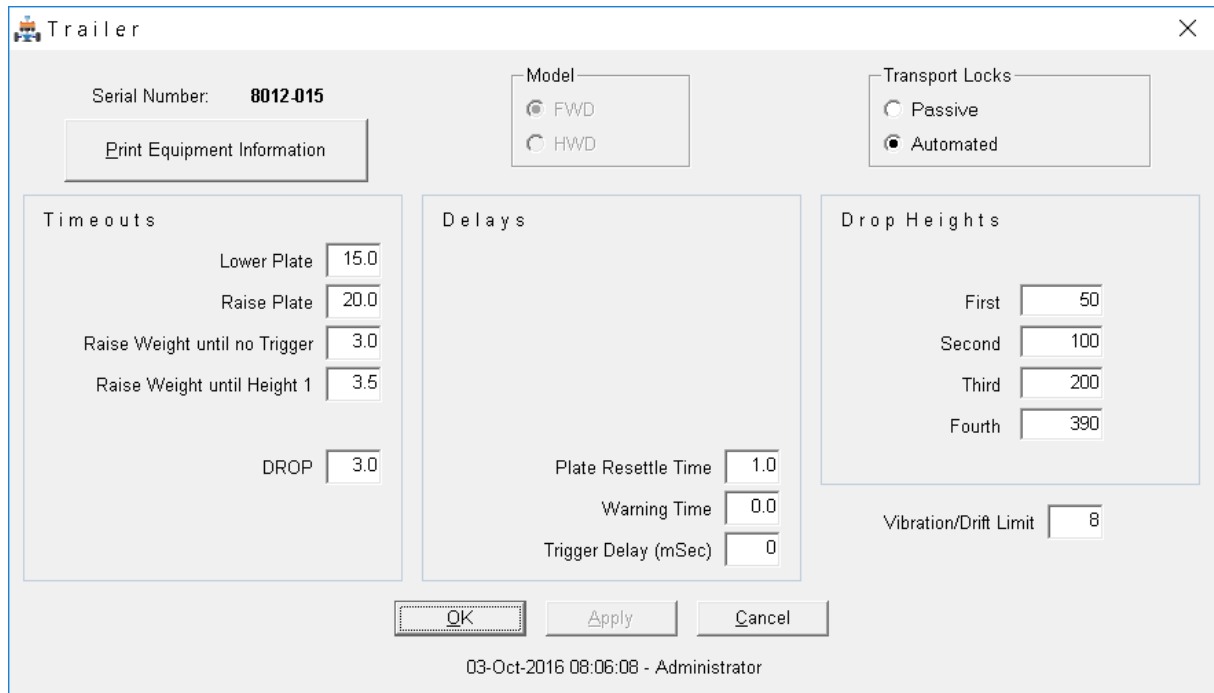
The **CANCEL** button discards changes and closes the window.

The **Apply** button is disabled (greyed out) until the user makes a change to one of the fields.

4.3.2 Loading Unit

The loading unit parameters (like all other parameters) are stored in a database in order to better manage multiple FWD/HWD setups. For example, let's suppose you have two vehicles each equipped with a computer for FWD/HWD data collection. Switching trailers between the two vehicles is then only a matter of activating the right trailer in the introductory screen.

To configure the loading unit, select <u>Setup</u>, then <u>Trailer</u> from the data collection screen. This will open the trailer setup window.

The first item to verify is the **Serial Number**. The serial number can be found on the nameplate installed on every FWD/HWD unit. If the serial number does not match your FWD/HWD, then you must restart FwdWin. At the introductory screen, click on the correct serial number, and then return to the above window. The serial number should now be correct.

Timeouts are displayed in units of seconds. These timeout values are used by the computer to monitor the status of and to control the hardware. For example, if for some reason the FWD/HWD requires more than 15 seconds to lower the plate to the pavement surface (lower plate = 15.0), an error message is generated by the program, indicating that some malfunction has occurred. To assist the operator, Tooltips are provided to show the upper and lower limits for these fields. The values shown are defaults and should not be changed unless the user has a specific reason to do so.

Delays are also displayed in units of seconds. Default values are shown. Tooltips are provided for each field to assist the user in entering proper values. Delay values cause the field program to pause for the specified number of seconds prior to performing the indicated function.

Finally, the four typical **Drop Heights** must be entered. The drop height unit is either mm or inches as specified under "Options". The values shown represent the distance the weight

travels before the impact is initiated. For information on drop heights, see Section 4.2 of this manual.

4.3.3 Compact 15F System Controller
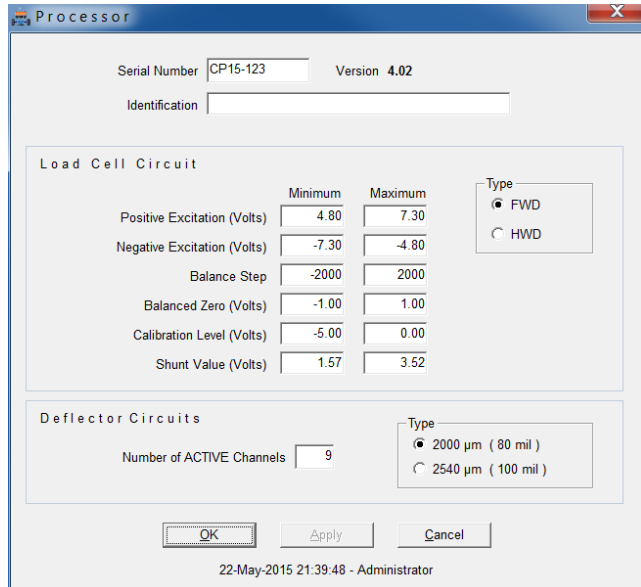
To configure the Compact15F System Controller, select **Setup** then **Processor** from the data collection screen.

The **Version** is retrieved from the Compact15F System Controller and refers to the firmware version.

The **Identification** field allows the user to enter any useful information of his choice that may be related to the System Controller setup.

The area of the screen labelled **Load Cell Circuit** contains operating voltage limits for a typical load cell. These values do not affect load cell operation. Their purpose is to establish limits beyond which the field program will issue an error message. To the right of these numbers the user can indicate whether the load cell is an FWD or HWD type.

In the **Deflector Circuits** area, the user can indicate the **Number of ACTIVE Channels**. Note that to the right the user can also specify the maximum range of the deflectors. Dynatest produce two types, 2000 and 2450 microns (80 or 100 mils). You should consult your delivery documents and specifications to verify the type of deflectors provided.

4.3.4 Load Cell

To configure the **Load Cell** parameters, select **Setup** then **Load Cell** from the data collection screen. The operator should first verify or enter the **Serial Number**. The user should also verify or specify whether the load cell is mounted on an FWD or HWD by checking the appropriate button in the **Type** box.

The **Relative Gain** and **Absolute gain** (calibration factors) are provided by Dynatest upon delivery of the equipment or delivery of a replacement load cell. The absolute gain can only be changed by the user after consulting Dynatest. The relative gain is provided to accommodate modest changes that are required as a result of a calibration of the load cell.
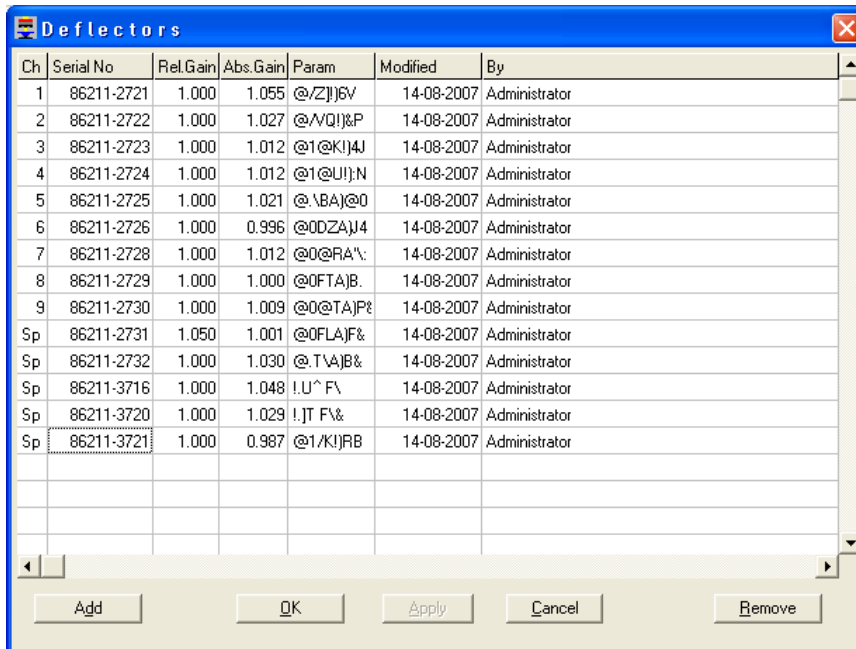
The remaining fields (Unbalanced Zero … Shunt Value) provide a real time display of load cell voltages and other parameters. These fields are not accessible by the user.

4.3.5 Deflectors

To configure the deflectors, select **Setup** then **Deflectors** from the data collection screen.

Ch	Serial No	Rel.Gain	Abs.Gain	Param	Modified	By
1	86211-2721	1.000	1.055	@/Z]I)6V	14-08-2007	Administrator
2	86211-2722	1.000	1.027	@/VQ!)&P	14-08-2007	Administrator
3	86211-2723	1.000	1.012	@1@K!)4J	14-08-2007	Administrator
4	86211-2724	1.000	1.012	@1@U!):N	14-08-2007	Administrator
5	86211-2725	1.000	1.021	@.\BA)@0	14-08-2007	Administrator
6	86211-2726	1.000	0.996	@0DZA)J4	14-08-2007	Administrator
7	86211-2728	1.000	1.012	@0@RA'\:	14-08-2007	Administrator
8	86211-2729	1.000	1.000	@0FTA)B.	14-08-2007	Administrator
9	86211-2730	1.000	1.009	@0@TA)P8	14-08-2007	Administrator
Sp	86211-2731	1.050	1.001	@0FLA)F&	14-08-2007	Administrator
Sp	86211-2732	1.000	1.030	@.T\A)B&	14-08-2007	Administrator
Sp	86211-3716	1.000	1.048	!.U^ F\	14-08-2007	Administrator
Sp	86211-3720	1.000	1.029	!.]T F\&	14-08-2007	Administrator
Sp	86211-3721	1.000	0.987	@1/K!)RB	14-08-2007	Administrator

Buttons: Add   OK   Apply   Cancel   Remove

The **Deflectors** window shown above displays information regarding the deflectors. There should be one row for each of the deflectors connected to the system as well as additional rows for any spare deflectors. This information is supplied by Dynatest for new FWD/HWD units. Changes to the values in this screen should only be performed by knowledgeable personnel.

The first column indicates the **Channel** to which each deflector is connected. The deflector situated at the center of the load plate occupies channel 1. Deflectors situated at increasing distances from the load plate occupy sequentially increasing channels, however this varies in practice, especially if one or more deflectors are located behind or beside the load plate.

The **Serial Number** of each deflector is shown in column two. Dynatest physically label each deflector with a serial number for easy identification. It is important that the operator visually inspects the deflector serial numbers and channel positions on the FWD/HWD itself to ensure that the information in the table is correct, especially after maintenance or calibration activities. Channel numbers are labelled on the CP15F front panel next to the deflector connection sockets.

The **Relative Gain** is typically updated after performing a relative or reference calibration or installing a new deflector.

The **Absolute Gain** is provided by Dynatest and should not be changed without consulting a Dynatest technician.

The **Param** column information is provided by Dynatest and should definitely not be changed without consulting a Dynatest technician.

The **Modified** and **By** columns are not editable by the user. The field program updates them automatically whenever a user makes changes in any of the other columns.

Each of the user-accessible fields can be edited by clicking in the box, then typing changes.

4.3.6 Program Options

This section provides guidance for setting up miscellaneous options including measurement units, driving conventions, file formats, messaging behavior, and screen appearance. The operator can access these options by clicking **Setup**, then **Options** from the main data collection screen.

Specifying Display and Storage Units

The operator can specify the display screen units in the upper left corner of the window and the data file units in the upper right. **This means that the computer can be configured to display test results on the screen in the metric system while storing data in English Standard units (and vice-versa).** Furthermore, as shown in the figure, it is possible to e.g. configure the DMI display to show distances in meters while storing these distances to data file in units of kilometers.

Specifying Driving Conventions
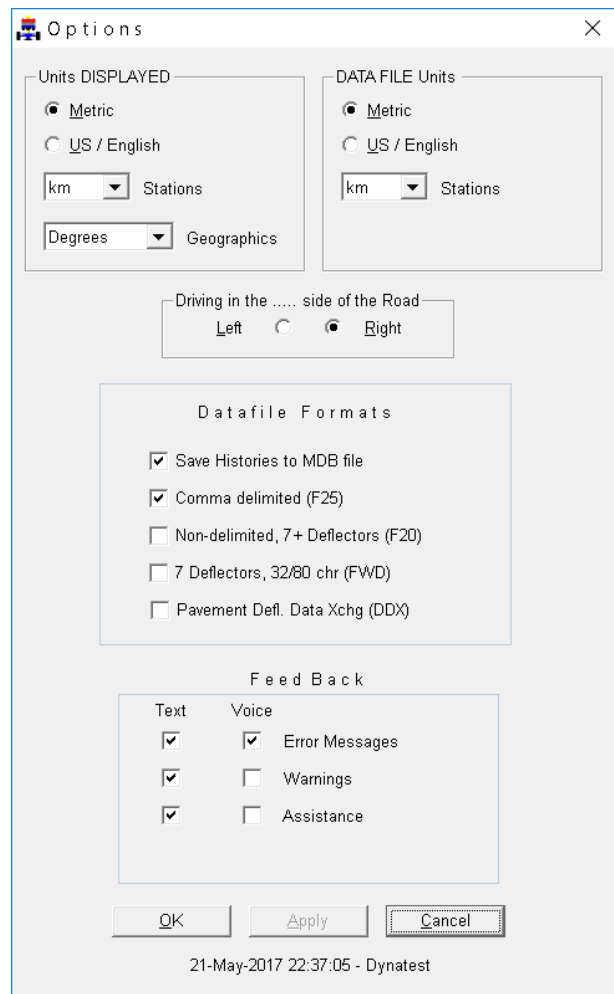
The user can also indicate which side of the road he is driving on – left or right. This affects lane designations as shown in the section **Lane Designations**. This is done by checking the **Left** or **Right** button in the **Driving in the…. side of the Road** box.

Specifying File Formats

FwdWin always stores data in Microsoft Access (MDB) format. You can chose to save load and deflection histories (recommended). The remaining formats are all text based. The first three (F25, F20, FWD) are earlier Dynatest ASCII formats. 'Pavement Deflection Data Exchange' (DDX) was developed by AASHTO in 1998.

Microsoft Access (MDB)

The Access file format is the 'working' format, meaning that during testing all results are stored in this format, only. When all test points are done and you close the file, the optional ASCII files are generated based on the contents of the Access file (see also section *10.8 Opening a Data File)*

Comma delimited (.F25)

This format is the last ASCII file formats developed by Dynatest. Those familiar with the Dynatest Edition 25 FWD/HWD Field Program may have experience with this file format. It is designed to accommodate up to 15 deflectors, is easy to import into spreadsheets and databases, can handle GPS data, among other things.

Nondelimited, 7+ (.F20)

Persons involved in the SHRP LTPP data collection program use the .F20 file format. It can accommodate up to 9 deflectors, but resembles the older .FWD file format.

7 Defl., 32/80 chr. (.FWD)

This file format is one of the oldest developed by Dynatest for PC driven FWD/HWD equipment. It is the least versatile format and will only accommodate seven deflectors. A number of back calculation programs (Modulus, Evercalc, Modcomp) were designed for this file format, only. If you intend to use one of these programs be sure to also select this file format.

Pavement Deflection Data Exchange (DDX)

This format is similar to the 'System.INI' in Windows. The file is divided into sections each having a bracketed header line, like: [Operations Information]. The data is composed of a descriptive name, an equal sign followed by the value(s), like: Operator = John Johnson. For details see www.normas.com/AASHTO/pages/PDDX.html.
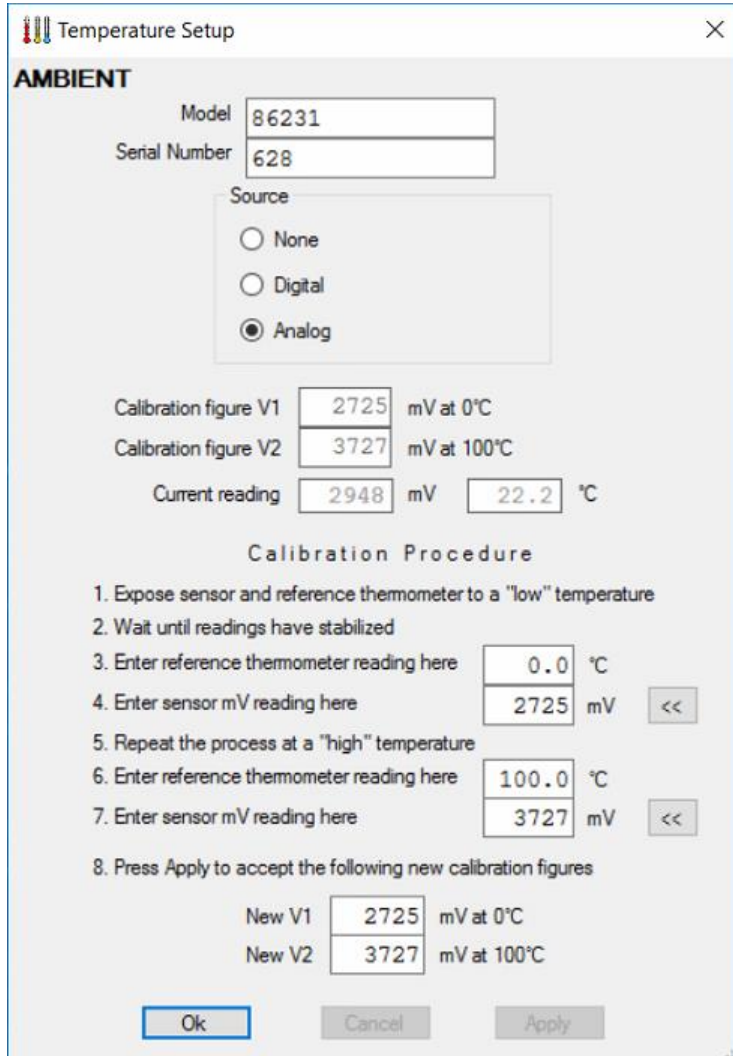
Specifying Feedback Type

The **Feedback** box allows the operator to control the way messages are issued by FwdWin. The computer (if suitably equipped) can issue audible warnings, error messages, and assistance if desired. Each type of message can be set to either **Text** (messages displayed on the computer screen) or **Voice** (audible messages played on the computer sound system).

4.3.7 Air Temperature Sensor

Dynatest provides an optional ambient temperature sensor for the FWD/HWD. If your unit is so equipped, FwdWin will monitor the output of this sensor and automatically record the information in the data file for each test point.

Right click the Temperature applet and chose "Ambient Temperature".

Verify that Model and Serial Number are correct.

If your unit is not equipped with an air temperature sensor, then you should select "None" here. Analog is for probes connected to the CP15.

The two fields, V1 and V2, are the calibration figures for the temperature sensor. Note that these values represent the predicted voltages across the sensor terminals (wires) under two temperature conditions: 0 degrees C and 100 degrees C (Note: Centigrade units are used and displayed here regardless of the units specified (Metric vs. US/English) elsewhere in the setup facility).

If a temperature sensor is connected and working properly, the current voltage and measured temperature is displayed in the **Current Reading** fields. This allows the operator to quickly assess the accuracy of the sensor and determine if a calibration is necessary.

All fields below "Current Reading" are of interest only when a calibration is performed (see *13.2 Air Temperature Sensor Calibration*).

4.3.8 Surface Temperature Sensor

Dynatest provides an optional pavement surface temperature sensor for the FWD/HWD. If your unit is so equipped, FwdWin will monitor the output of this sensor and automatically record the pavement surface temperature in the data file for each test point.

Right click the Temperature applet and chose "Surface Temperature".

Verify that Model and Serial Number are correct.

If your unit is not equipped with such sensor, then you should select "None" here. Analog is for probes connected to the CP15.
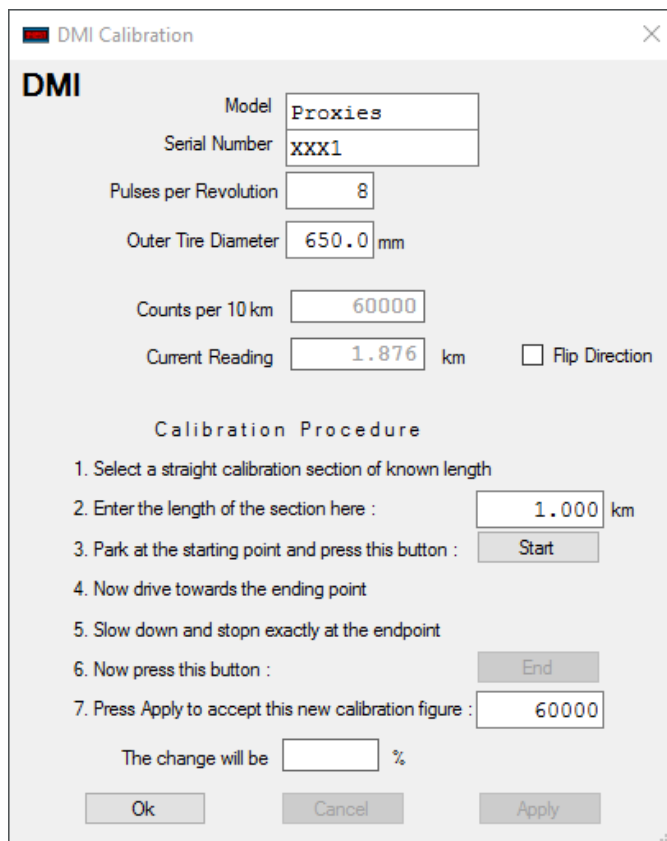
The two fields, V1 and V2, are the calibration figures for the temperature sensor. Note that these values represent the predicted voltages across the sensor terminals (wires) under two temperature conditions: 0 degrees C and 100 degrees C (Note: Centigrade units are used and displayed here regardless of the units specified (Metric vs. US/English) elsewhere in the setup facility).

If a temperature sensor is connected and working properly, the current voltage and measured temperature is displayed in the **Current Reading** fields. This allows the operator to quickly assess the accuracy of the sensor and determine if a calibration is necessary. The voltage reading is also used during the calibration process.

All fields below "Current Reading" are of interest only when a calibration is performed (see *13.3 Surface Temperature Sensor Calibration*).

4.3.9 Distance Measuring Instrument

Right click the DMI applet and choose **Calibration.** This window shows the Model, Serial Number, Pulses per Revolution (Advertised PPR), measured tire diameter, Calibration figure and a Calibration Procedure.

The calibration figure for the DMI is shown in the box labelled **Counts per 10 km**. This represents the expected total number of counts that would be accumulated over a distance of 10 km. The calibration figure is always displayed in units of **Counts per 10 km** regardless of the distance unit selected by the operator.
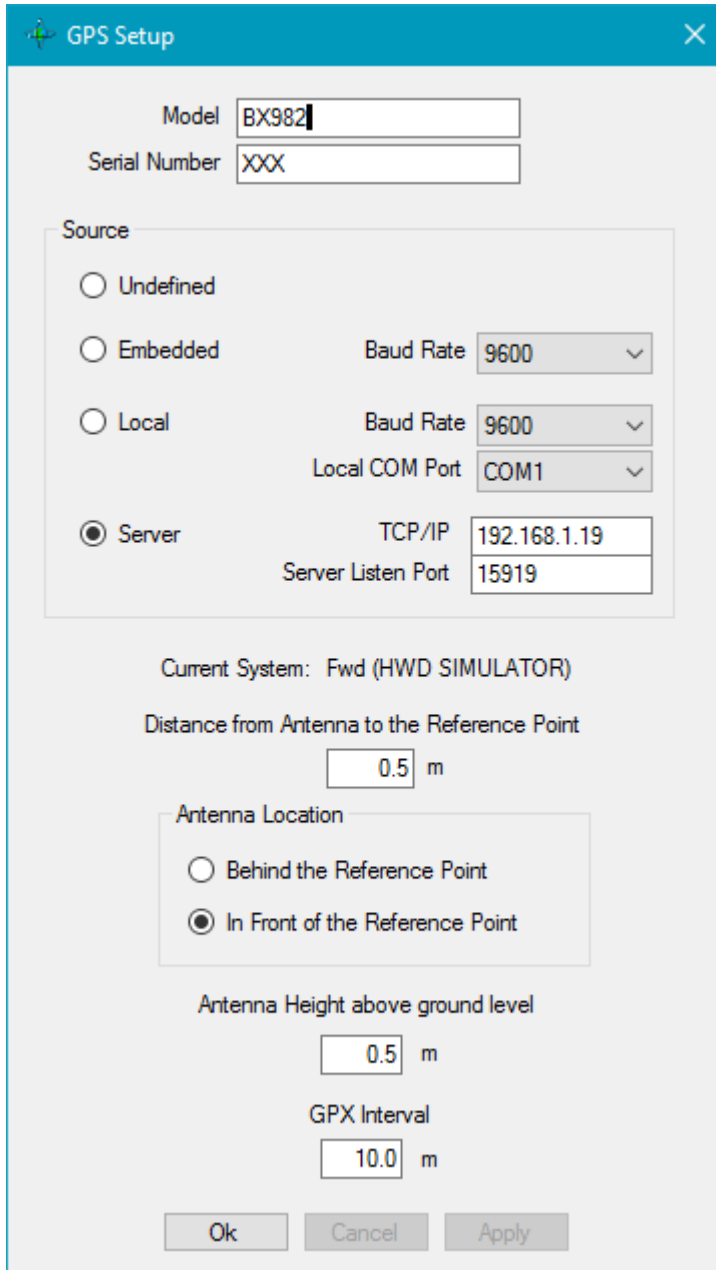
The current value of the measured distance is shown in the **Current reading** box. The value displayed here depends on the distance unit selected by the operator.

The **Flip Direction** should be toggled if the reading decreases while driving forward.

The Calibration Procedure is described in section *13.4 DMI Calibration*

4.3.10 Global Positioning System (Optional)

Right click the GPS applet and choose **Setup.** This window shows the Model, Serial Number, Source options, geometric parameters and GPX option:

GPS Setup

Model: BX982
Serial Number: XXX

Source

○ Undefined

○ Embedded   Baud Rate 9600

○ Local   Baud Rate 9600
    Local COM Port COM1

● Server   TCP/IP 192.168.1.19
    Server Listen Port 15919

Current System: Fwd (HWD SIMULATOR)

Distance from Antenna to the Reference Point
    0.5 m

Antenna Location
○ Behind the Reference Point
● In Front of the Reference Point

Antenna Height above ground level
    0.5 m

GPX Interval
    10.0 m

[Ok] [Cancel] [Apply]

Embedded means that the GPS device is connected to CP15 electronics.

Local is for a GPS connected directly to the computer.

Server is for Ethernet-enabled GPS servers (e.g. Trimble BX982 or an iPhone).

The **Reference Point** is typically the center of the Load Cell.

For preparation of maps see 14.1.1 Prefetch Maps.

5. *Preparing for Measurements*

5.1 *Checking the FastFWD Hardware*

SAFETY NOTE!
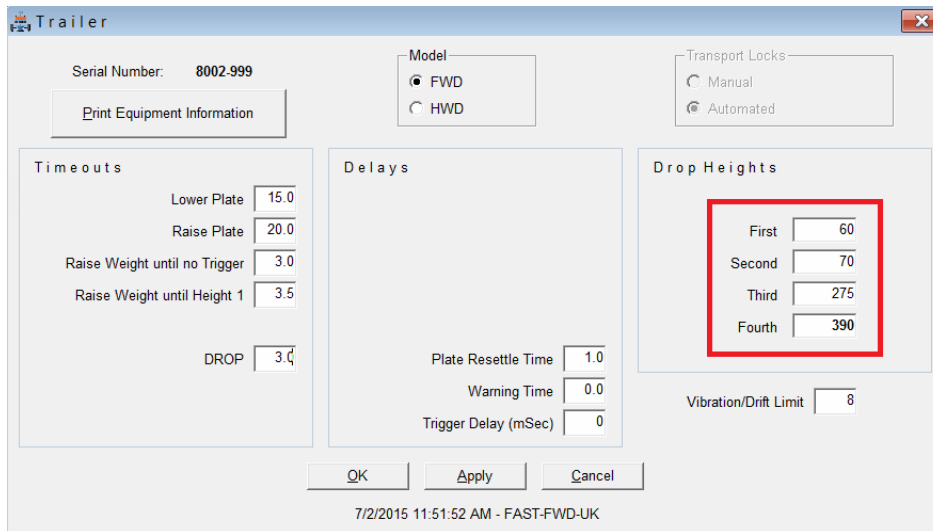
Whenever somebody is close to the moving parts of the FWD/HWD, MAKE SURE that all POWER has been switched OFF!

Prepare/check the FastFWD Hardware as follows:

1) While the drop weight subassembly is still in its top (transport) position, check that the rod of the center deflection device (deflector holder) sticks out through the bottom of the loading plate at least a distance of some 10-20 mm.

2) Check the springs, foam rubber guides and set up of all deflector holders to ensure they are functioning properly. Make sure that the spring tensions are properly adjusted such that a force on the end of a feeler can move the holder and feeler upwards until the feeler is at least some 5 mm inside the bottom of the holder body (resp. the loading plate), and that it returns easily when released again (otherwise apply a few drops of silicone oil to the top guide rod).

3) Check that the cable for the raise/lower bar is properly positioned on both guide pulleys.

4) Remove the locking pin securing the guide mechanism of the far (front) end of the raise/lower bar.

5) Using the manual functions within the FWD software, lower the load plate to the pavement surface.

6) Check that the front end of the raise/lower bar is now resting properly on the ground.

7) Raise again the load plate (subassembly) using the manual controls in the software. Check that the raise/lower bar is raised concurrently with the plate.

8)   Lock the front end of the raise/lower bar.

9) Adjust the drop heights (if desired - see "Drop Heights Adjustment" below).

![Dynatest logo]

5.2 *Drop Heights Adjustment*

The software has built in the possibility of setting 4 drop heights to any value the operator wants from 50 to 390 mm. The motor, thanks to the feedback from the encoder, is able to move the weights to any desired position. To set the heights select Setup and then Trailer:

Within the field program, a "load targeting" feature can be selected, in which case it will normally not be necessary to adjust the four heights at all, if they are chosen reasonably, such as (approx.):

h1 = 50mm (2"),   h2 = 100mm (4"),   h3 = 200mm (8"),   and   h4 = 390mm (15-1/4").

Obviously, h1 < h2 < h3 < h4. There are the following restrictions on the choice of heights:

1) h1 should NOT be LESS THAN 50mm (1-1/2") (to ensure proper triggering) and NOT GREATER THAN 100mm (4") (to prevent "raise weight time-out").

2) h4 should NOT EXCEED 390 mm (15-1/4") to ensure that the weight stops BEFORE it reaches its mechanical top position.

Before a drop height is selected, it is necessary to choose a weight setup (50, 150, 250 or 350 kg) that will achieve the desired loading. The following Table showing the approx. usable load ranges for each weight setup:

Mass of Drop Weight		**Approx.** (Peak) Load Ranges		
kg	(lbs)	kPa/300	kN	lbf
350	(770)	510-1700	36-120	8,000 -27,000
250	(550)	340-1200	24-85	5,300-19,000
150	(330)	170-640	12-45	2,600-10,000
50	(110)	60-170	4-12	1,000-2600

6. *Weight Setup*

6.1 *Changing the Drop Weight Setup*

By changing size (mass) of the FWD drop weight, any of 4 loading ranges can be selected (refer also to 5.2, "**Drop Heights Adjustment**").

There are four permitted weight setups, and each has a matching buffer setup. They are:

- 50kg (110lbs). Uses just the base weight with no additional weight blocks mounted. Two small, 70mm (2-3/4") buffers are mounted. One in each side in the centre slot.
- 150kg (330lbs). Two extra weight blocks are mounted to each side. Two large, Ø110 (4-3/8") buffers are mounted, one on each side in the centre slot. A long plastic spacers is fitted to each buffer shaft.
- 250kg (550lbs). Four extra weight blocks are mounted on each side. Four large, Ø110 (4-3/8") buffers are mounted, two on each side in the outer slots. Short plastic spacers are fitted to each buffer shaft.
- 350kg (770lbs). Six extra weight blocks are mounted on each side. Six large, Ø110 (4-3/8") buffers are mounted and no spacers are required.

In this way it is possible to ensure the force pulse is maintained at 25-30 msec for all weight setups.

Refer to 5.2, "**Drop Heights Adjustment**" for advice on selection of the drop weight mass (size), once you know which load (range) you wish to use.

To change the weight size, use the following procedure:

1) Open the Manual Control window by going to Manual Control.
2) Return the machine to transport position (if it is not already there) by clicking the "Raise Plate" button.
3) Support the weights on the upper locks by clicking the "Lock Weight" button. Wait until the operation shown in the status window is "IDLE".
4) Close DDC.
5) SWITCH OFF all power by turning the Red Main Switch key outside the big cabinet.
6) Check that the weights are securely supported by both upper locks (rear and front). See image below showing one upper lock supporting one side of the weights.
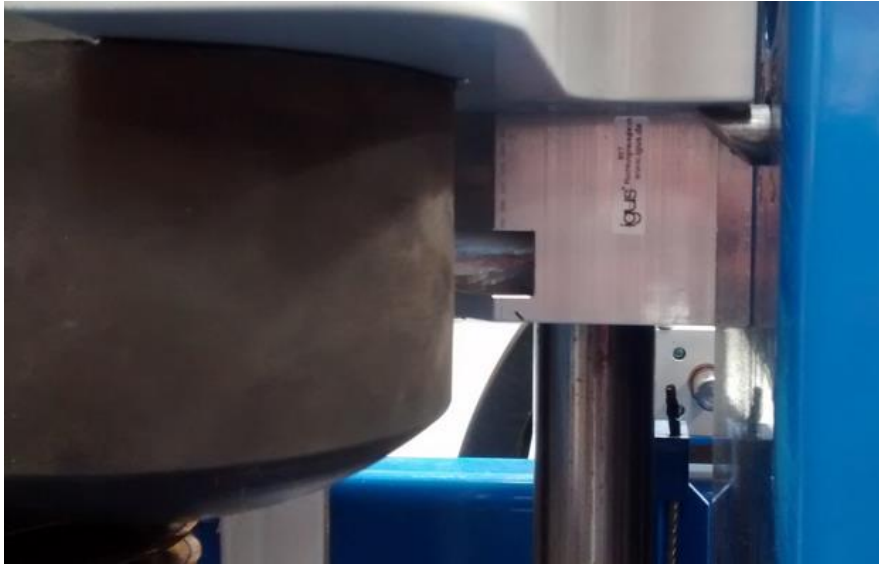
7) Unscrew the spanner handles on top of the buffer shafts and remove the buffers. Note the spanner handles can be lifted to adjust the angle of the handles.

8) Remove or add extra weights (25kg each) on each side of the base weight until the desired drop weight is achieved. See above for the allowed weights and buffer setups. The slots in the weights should always face outwards and the locating pins should always face upwards.

9) Install the correct number of buffers (with spacers as needed) to match the drop weights installed. It is very important that the circular flange at the bottom of the buffer shaft is located in the recess under the base weight. Tighten the spanner handles to clamp the extra weights.

10) Switch the machine power on.

11) Wait for CP15F startup and open DDC.

12) Once homing is completed and the weights move back to the plate retighten the spanner handles.

The machine is now ready to test. However the spanner handles should be rechecked and tightened periodically (after 5 drops, an hours testing and at the end of the day) after changing the drop weights.

7. Connecting the Electronics

7.1 Connecting the Transducers

When the FWD/HWD equipment has been installed as described in section 2, "**Tow Vehicle Installation**", then connection of the transducers should be performed as outlined in the step-by-step procedure below.

The cables from the transducers (i.e. from the Load Cell and from the Deflectors) should be connected to sockets of the Compact15F Front Panel. Please refer to the step-by-step procedure in the following.

If necessary use an anti-oxidizing silicone based spray (like that used for moisture protection of vehicle ignition systems, such as e.g. "WD40") to clean plugs and sockets and to protect them from condensing moisture and corrosion.

1. MAKE SURE that the Compact15F has been switched off before any cable is connected or disconnected.

2. Connect the 5-pin male, bayonet-lock-type DIN plug of the load cell cable (labelled FWDL) to the LC socket of the Compact15F Front Panel.

3. Place the Deflector with the S/N assigned to Deflection Channel No.1 in the center deflection holder in the hollow above the load cell, making sure that the magnet clamps well to the bottom plate of the holder (the magnet as well as the plate should be clean before the placing).

4. Connect the bayonet-lock-type DIN plug of the Channel 1 Deflector to the D1 socket of the Compact15F Front Panel.

5. Place the remaining Deflectors assigned to Deflection Channels No. 2, 3, 4, etc. in the (movable) holders on the raise/lower bar (see 7.1.2, "Note on Placing the Deflectors" below). Standard Test Setups imply that the Deflectors are placed in order of increasing distance from the loading plate with increasing Channel No.

6. Connect the plugs of the Channel 2, 3, 4, etc. deflectors to the appropriate sockets of the Compact15F Front Panel. See 7.1.3, "Important Notice!!!" below!).

7. If an (optional) Air Temperature Probe has been supplied, connect the bayonet-lock-type DIN plug of this to the AIR socket of the Compact15F Front Panel

8. If an (optional) Infrared, non-contact Temperature Sensor has been supplied, connect the bayonet-lock-type DIN plug of this to the IR socket of the Compact15F Front Panel.

7.1.1 Note on Load Cell Cable connection

Step 2 is usually factory performed and the cable for the Load Cell should be left connected, also when the equipment is not in use, and should only be disconnected in case of servicing or the like.

7.1.2 Note on Placing the Deflectors

Before placing the Deflectors, the holders should be at or at least close to the desired positions (i.e. distances from the loading center), and the loading plate and the raise/lower bar should be lowered close to, but not touching the ground. Pass a deflector to a holder from above, so that the cable passes up between the two rails of the raise/lower bar. Tie the cable along one of the bar beams using the provided cable ties. The clamping magnet of a deflector and the matching bottom plate of the inner holder should be clean before attaching the deflector. After attachment, retain the inner holder with one hand while pushing down AND from side to side the deflector to remove residual dirt and to feel if the magnet is clamping well.

Please note that a deflector MAY jump off a holder if a bump in the road is passed at high speed. Therefore tie the deflector cable(s) to the bar in such a way that IF a deflector should jump off, it will not be able to reach the road surface! (Tie while the bar is clear of the ground, so that the deflectors are in their lowest position in respect to the bar, but make sure that no cable will be strained when the bar is lowered again).

MAKE SURE that no cable(s) is/are strained at ANY level of the bar!

7.1.3 Important Notice!!!

It is VERY important that the Deflectors are properly connected, as the individual calibration data of each deflector have been programmed into the Compact15F System Controller so that a specific deflector S/N is allocated to a specific channel No., and therefore the connections MUST be performed in accordance herewith.

If you have changed round and/or exchanged any of the deflectors, then MAKE SURE that the listing in the "Deflectors" window in the Field Program is in exact accordance with the order of the actual deflector connections! See also 4.2.5, "Deflectors".

In ANY case of doubt, perform a RELATIVE DEFLECTOR CALIBRATION procedure as outlined in the supplied FwdCal30 package.

![Dynatest logo]

7.2 Vehicle Power and Computer Network Setup

7.2.1 Power

A static mains inverter (which inverts 12VDC from the vehicle battery to AC line voltage) powers the computer and an Ethernet PoE Injector Switch. When the PoE injector is switched on it powers the following:

- Optional camera(s)
- The Park Signal TX Box
- A PoE splitter located at the trailer. This will power ON the trailer circuits.
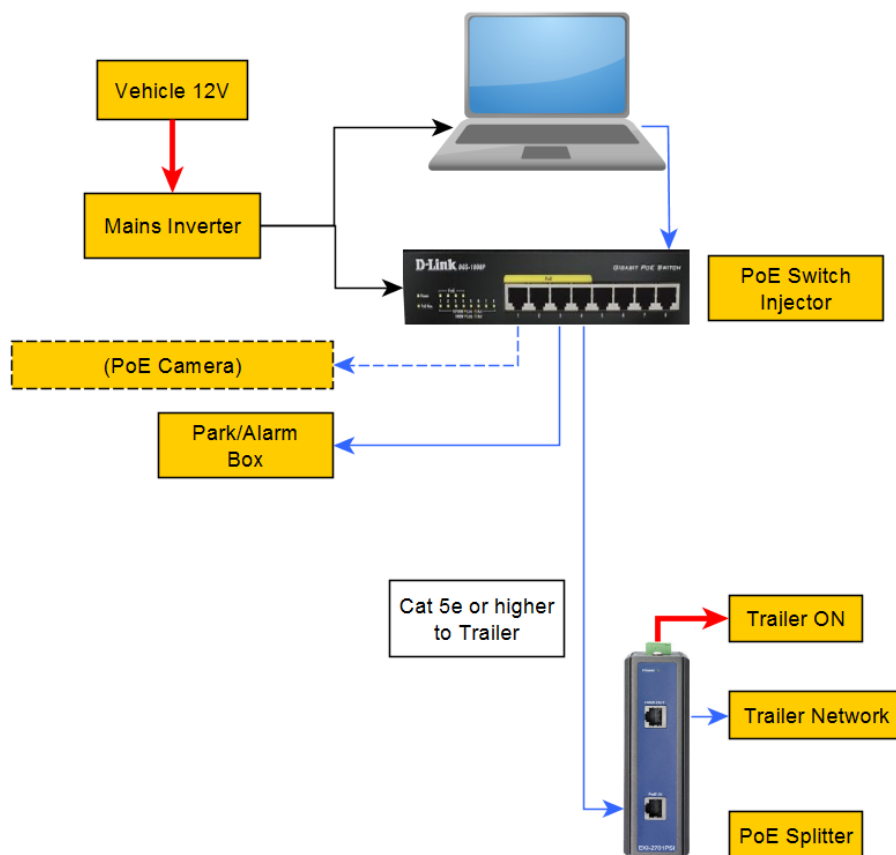
7.2.2 Ethernet

The Trailer Network consists of another Ethernet switch which connects the following:

- The Compact 15F System Controller
- The Motor Power Unit (FPS600)
- The Motor Controller
- Optional GPS receiver

8. Leaving Base

To ensure that the entire FastFWD Test System is properly prepared and set up to perform field testing, always as a minimum perform the following procedure before leaving your base:

8.1 Maintenance Checks

See also Section 15, "**Maintenance**" for more details.

8.1.1 Tire Pressure

Check tire pressure of both/all wheels and adjust if necessary (to 2.8 bar / 40 psi cold).

8.2 Connect Trailer to Tow Vehicle

8.2.1 Hook to Hitch

Hook up the FastFWD Trailer to the tow vehicle's trailer hitch ball. MAKE SURE THAT the trailer tongue hitch is properly locked to the ball. Attach the inertial brake breakaway security wire to the vehicle's towing hitch assembly. ALTERNATIVELY, (OR in addition), attach heavy safety chains from the trailer to the vehicle, if provided / required.

8.2.2 Rear Lights Connection

Connect the plug of the FastFWD rear lights cable to the appropriate socket on the rear of the towing vehicle and check the function of all lights.

8.2.3 Front Support Wheel

Raise the FastFWD front supporting wheel fully and clamp it in place (the clamp must be VERY tight). Also secure the wheel using the heavy split-pin above the clamp block.

8.2.4 Power Cable

Connect the heavy, 2-pin male plug of the trailer power cable to the matching, female power output socket on the rear of the towing vehicle.

8.2.5 Network Cable

Connect the Network Cable as explained in Section 7.2.1 "Interface connections".

Be careful NOT to get ANY DIRT into the connectors!

8.3 Functional Check

Before leaving base it is useful to perform a functional check to ensure correct operation of the complete test system. Ideally, a complete test sequence to be used in the field should be run (see Section 9 for details).

Take care not to overload a weak pavement during this test. And check that all incoming data including temperatures GPS location and so forth are as expected.

8.4 *Just Before Leaving...*

8.4.1 *Lower Locks*

Lower the loading plate onto the ground (Use "Lower plate" command in FwdWin Manual Control). Clean the lower lock bolts with a clean cloth. Then lift the plate to transport position ("Raise plate" in Manual Control). Make sure that the plate subassembly is in its topmost position and that both of the transport locks have been brought properly into their locking position under the loading plate!

8.4.2 *Raise/Lower Bar Locking Pin*

Make sure that the rod of the raise/lower bar front end guide mechanism has been locked in its top position by a locking pin.

8.4.3 *Trailer Handbrake*

IMPORTANT! Make sure that the Trailer handbrake is fully released!

8.5 *During Driving*

WARNING!

NEVER switch ON or OFF or perform Computer HARD-RESET WHILE DRIVING!! This MAY initiate uncontrolled activity!

---

9. Running the Program

9.1 Switch ON

IMPORTANT: DO NOT DRIVE while you or your co-pilot switches on the system!

You must switch on the computer and Trailer as follows:

1. Make sure everything is switched off (Check "Manual Power ON" in the controller cabinet on the trailer).
2. Turn the trailer "Main Switch" ON
3. Switch ON the inverter in the vehicle
4. Switch ON the computer and the Ethernet PoE Switch in the vehicle
5. Let the computer boot up completely
6. Wait until the Ethernet Switch shows activity on the trailer line
7. Make sure that the PARK/ALARM signal is active.
8. Wait at least one minute (watch LEDs for network activity at the RJ45 socket).
9. Start "Dynatest Data Collection"
10. Wait until the trailer serial number turns black-on-white

Now all equipment has been started up and the system is ready to launch the data collection program, FwdWin.

Windows Firewall
The first time you run "Dynatest Data Collection" the Windows Firewall may show a message saying it is blocking certain functionality of the DDC. You will have the option to remove the blocking. Please do so.

Network Timeout
If you get a "Network Timeout" error, then check the power on the Trailer, Network cables, Router/Switch and then run through the starting power up sequence.

9.2 Warnings

9.2.1 Emergencies

If you have to move away from the test site swiftly:

1) Go OUT OF PARK or RELEASE the HAND BRAKE. This will instantaneously initiate a Raise Plate operation.

2) WAIT until the Plate AND the deflectors are OFF GROUND.

3) Drive away.

The automated Raise Plate action in step 1 is dependent upon the alarm circuits being installed correctly (see Section 2.2.4) and communication being open between the operator laptop and the motor controller.

9.2.2 Stopping a Sequence

If someone approaches the equipment it may be necessary to Stop or Pause an ongoing test sequence. Pressing ESCape or any of function keys F1, F2 or F3 will pause the test, return the weight package to the base and bring up a screen with the options shown here.
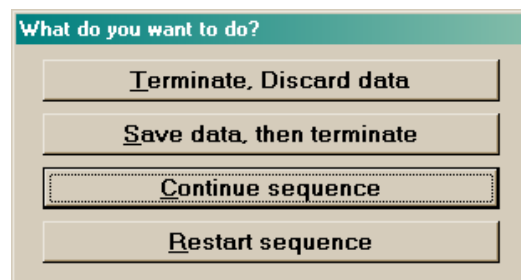
In any case, be very careful what you do next!

If you stopped because you suspect some malfunction, do NOT continue the sequence. Instead, do trouble shooting.

9.2.3 Driving

Things you should NOT do while driving:

NEVER switch the Computer OFF or ON

NEVER switch the in vehicle Ethernet PoE OFF or ON

NEVER perform Computer HARD-RESET as this may cause UNCONTROLLED ACTIVITY

9.3 Dynatest Data Collection

When the "Dynatest Data Collection" is first started, this screen appears:
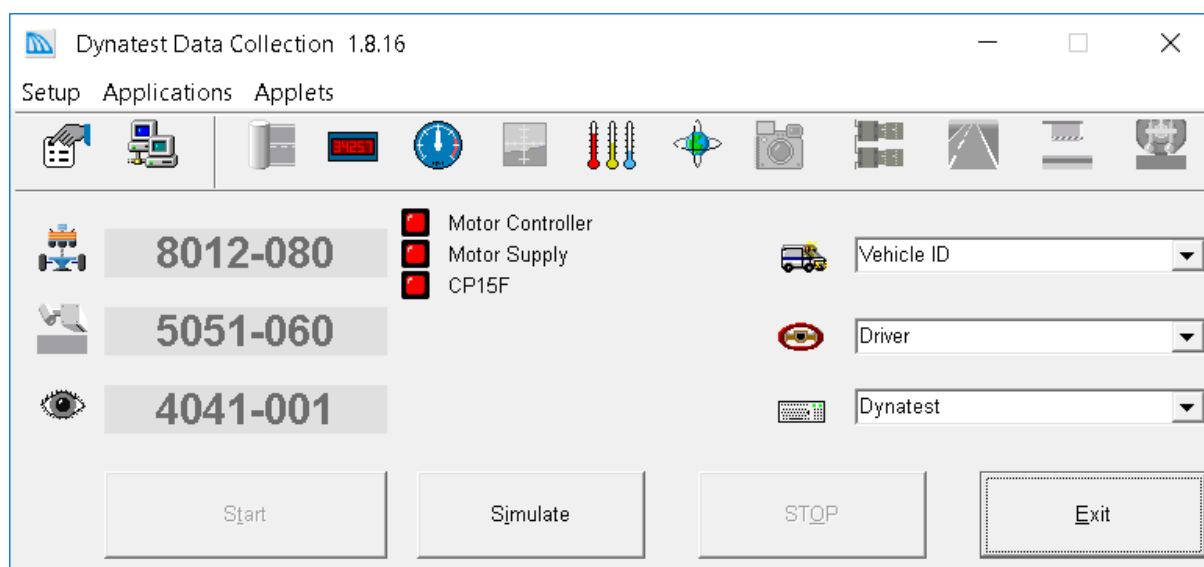
This sample shows that you will run tests with Fast FWD S/N 8012-080 and run the DMI, Thermometers and GPS "Applets".

Check Vehicle ID, Driver Name and User Name

If the FWD Serial Number stays pale, then check the power on the Trailer, Network cables, Router/Switch and then re-sequence power.

9.3.1 Applets

Applets are small programs providing specific functionality to the main applications. Most applets appear in resizable floating windows. The Administrator can arrange the windows but the resulting layout is locked for the Operator.

Click an icon to toggle between coloured and gray icons. When you press [Start] then all coloured applets are launched together with the main program, RspWin. After this the opening window "Dynatest Data Collection" minimizes, but must be left running during the mission.

The next chapters cover the FWD relevant applets, only.

The menus shown in the following appear when you right click the applet.

9.3.1.1 Network

The Network applet manages Section information. The entered information is saved in a SectionLog database for each test run. Some of the fields are also saved in the data files.

A "Facility" can be anything from roadways, runways and streets to parking lots or even railways. Often a facility is identified by both its common name and a code which links into a pavement management system.

A single facility is often composed of sections of varying construction. This "Sectioning" can be both longitudinal and transverse. The latter is appropriate for multilane roadways where traffic load varies across the construction.

![Dynatest logo]

9.3.1.2 DMI

The DMI applet displays the current DMI reading.
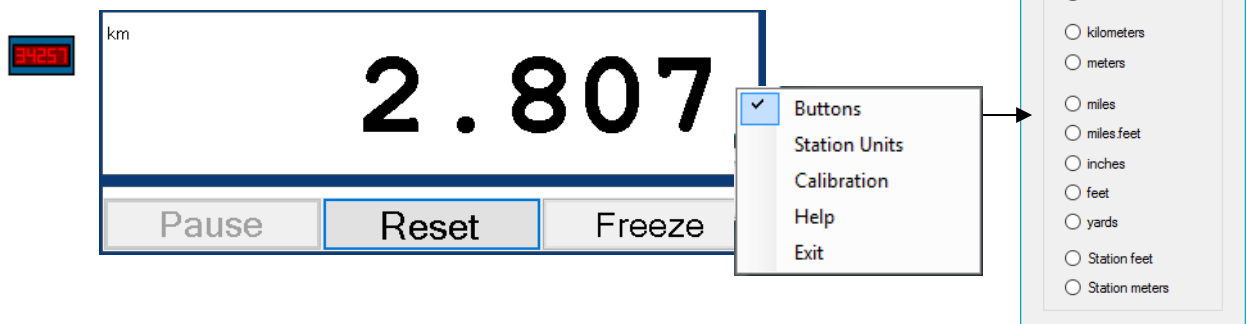
Uncheck "Buttons" to hide the Pause, Reset and Freeze buttons.

The unit can either track the unit used in FwdWin (Default) or be set to any other desired format.

9.3.1.3 Speedometer

The Speedometer applet displays the current driving speed.
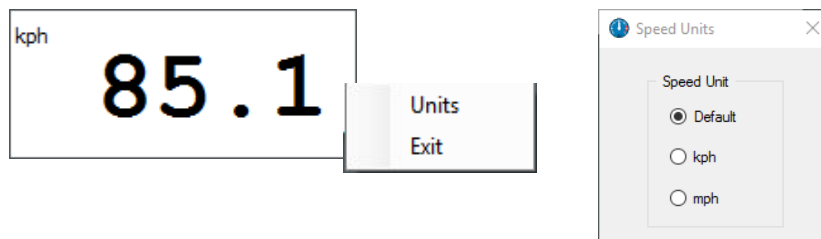
The unit can either track the unit used in FwdWin (Default) or be set to kph or mph.

9.3.1.4 Thermometers

The Thermometer applet displays three temperatures and colorizes Air and Surface temperature relative to the Asphalt temperature.
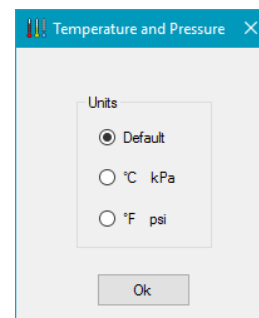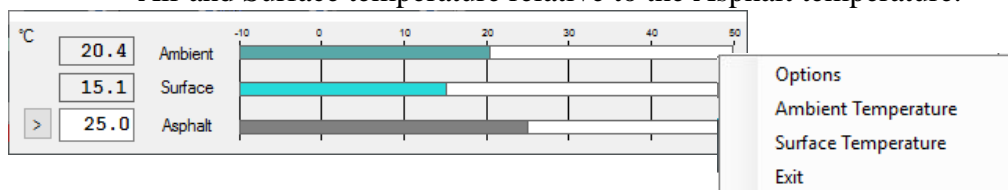
The unit can either track the unit used in FwdWin (Default) or be set to **C** or **F**.

9.3.1.5 GPS

The GPS applet displays the current geographical coordinates and position on a moving map.
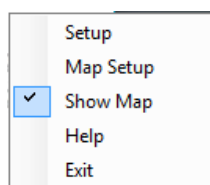
Uncheck "Show Map" to hide the map window
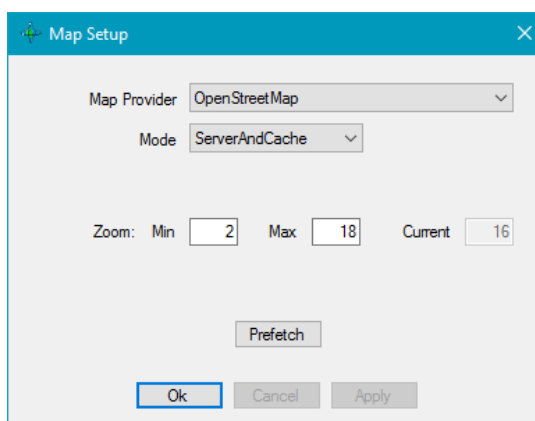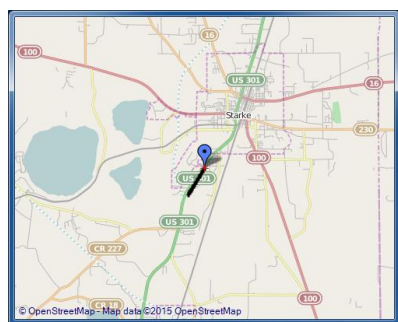
Chose the desired map provider and the maximum zoom level.

9.3.1.6 Camera

The Camera applet displays and saves images from DirectX cameras.
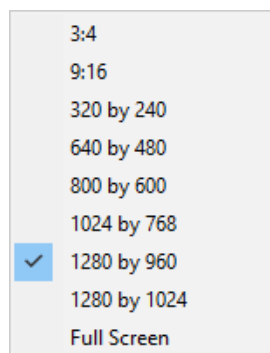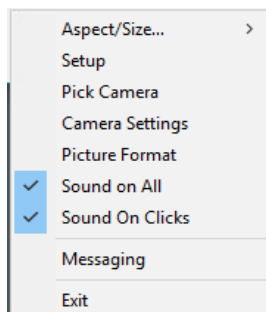
Setup:
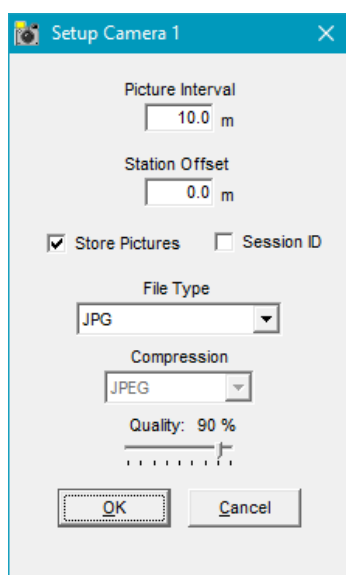
Picture Interval:
This example shows 1 image stored every 10 meters.

Station Offset:
Adjustment of your distance reading.
(Part of the image file name).

Session ID:
Ad Session ID No to image file name.
(For FWD and Survey testing only).

File Type:
BMP, JPG, TIFF or PNG.

Quality:
100% is least compressed ~bigger files.

Pick Camera
Lists available DirectShow devices
Camera Settings and **Picture Format**
These windows are supplied by the camera manufacturer
Sound
Uncheck to shut off the shutter sound

For detailed setup of specific camera models see chapter 14.2 Camera.

Unibrain
The following items must be performed for each camera after camera power-off!

Right-click on the ROW picture and select "Camera Settings" and then "Exposure"

1. For "Shutter" as well as for "Gain", check the "at" box
2. Click the "Basic" tab.
3. In the "Basic" window, adjust "Gamma" to 1 or 2 and "Sharpness" to 16 _

9.3.1.7 Ground Penetrating Radar

The GPR option enables simultaneous and automated collection of layer properties. GSSI's model SIR-30 is presently supported.

Red: Idle state
Yellow: Prepared to start
Green: Started

```
************** G P R  S I M U L A T I O N  **************

     Antenna Location:              1.908    kilometers
        Scan Number:                    0


     File Destination:
   Backup Destination:
           File Name:
           From To:

        Setup Name:     SETUP02metric

    SIR30 Initialized:   True
         Data Mode:     Timed
     Data Collection:   False
          Get Data:     False
```

Setup:

GPR Setup ✕

Model	SIR-30
Serial Number	000

Units
◉ Metric
○ English

☐ Shut down on exit   Shut down the GPR system when DDC is closed

Number of Scans: 25.00 per meter

Mark every: 1.0 meters

Number of Ticks: 873.55 per meter   Encoder pulses per meter

Longitudinal Offset: 12.0 meters   Offset from FWD loading plate to GPR antenna (negative if the antenna is behind the FWD)

GPR Setup file

SETUP02metric

```
DEFAULT
SETUP00
SETUP01metric
SETUP02metric
```

Choose one of the prepared setups
These setups are prepared in the GSSI software

Ok   Cancel   Apply

9.3.2 Simulation Mode

If the opening window cannot detect the presence of FWD hardware, you can always run the system in Simulation Mode.

Simulation mode allows the user to run FwdWin even when the equipment is not connected. In this mode artificial data is fed into the program at the appropriate times to create the appearance that an FWD/HWD is actually connected.

Simulation mode is useful for training purposes. Using simulation mode, an instructor can conduct classroom training with one or more computers and operators (no hardware is needed). The operator can also "practice" running the equipment in the office.

In simulation mode you can use **Ctrl** + **P** to toggle the PARK state.

9.3.3 Entering the Main Program

Once everything in the "Dynatest Data Collection" screen is configured, the user may click the "Start" button (choose "Administrator" first). The data collection screen should now appear with a "HOMING" warning.

9.3.4 Homing

Each time the equipment is powered up it needs to determine the position of the hit plate and the spindle. The following message will be shown.
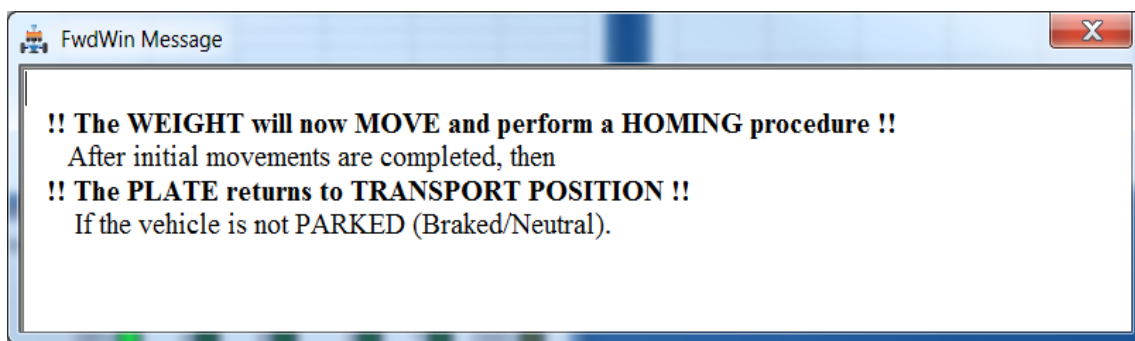
When the message is closed the weights move up slowly until the encoder reference mark is found (always less than 1 revolution, and usually 15-20 degrees). At the end of the movement the weights are lowered until they are resting on the hit plate. This position is then defined as "zero" height.

If the plate is not in transport position at the start of the homing procedure a warning message will appear before the homing message shown above. Even though the normal scenario when starting DDC is that the plate is in transport position with the weights resting on it, other situations can occur. Homing can still be performed from all starting situations and the weights will end up resting on the hit plate.
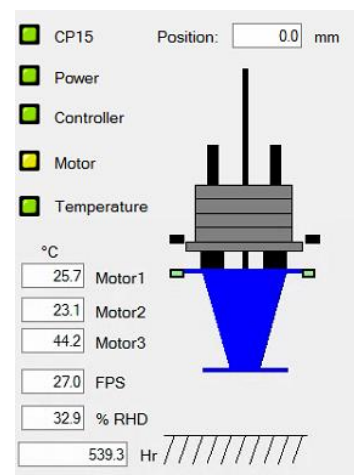
9.3.5 Machine status indicators

The status of various components of the machine is shown by the lights and data fields as seen to the right. This can be very helpful for troubleshooting.

CP15: Compact15F Connection

- Green: connected

Power: Power to the controller

- Green: there is power to the controller
- Yellow: there is no power to the controller
- Red: no connection to the controller

Controller: Connection to the controller

- Green: connected
- Red: not connected

Motor: Motor State/Status

- Green : Power is ON and Homing done
- Yellow : Power is ON but Homing not done
- Red: Motor in Error
- Grey : Power is OFF

Temperature: Status of the motor coils

- Green: <100 degrees Celsius
- Yellow: >100 degrees Celsius
- Red: >130 degrees Celsius

Motor1, **Motor2** and **Motor3** show the temperature of each of the phases of the motor. This is the raw data used to calculate the status above. If one or more coil is over 100°C then the indicator will be yellow. If any are over 130°C it will show Red.

FPS: Temperature in the FPS600.

% RHD: Humidity inside the FPS600.

Hr: Total hours that the Fast FWD has been powered on. Note this value is stored in the FPS600, so changing this unit will reset the value.

9.4 *The Data Collection Screen*

The data collection screen opens when the user clicks the "Start" button in "Dynatest Data Collection".
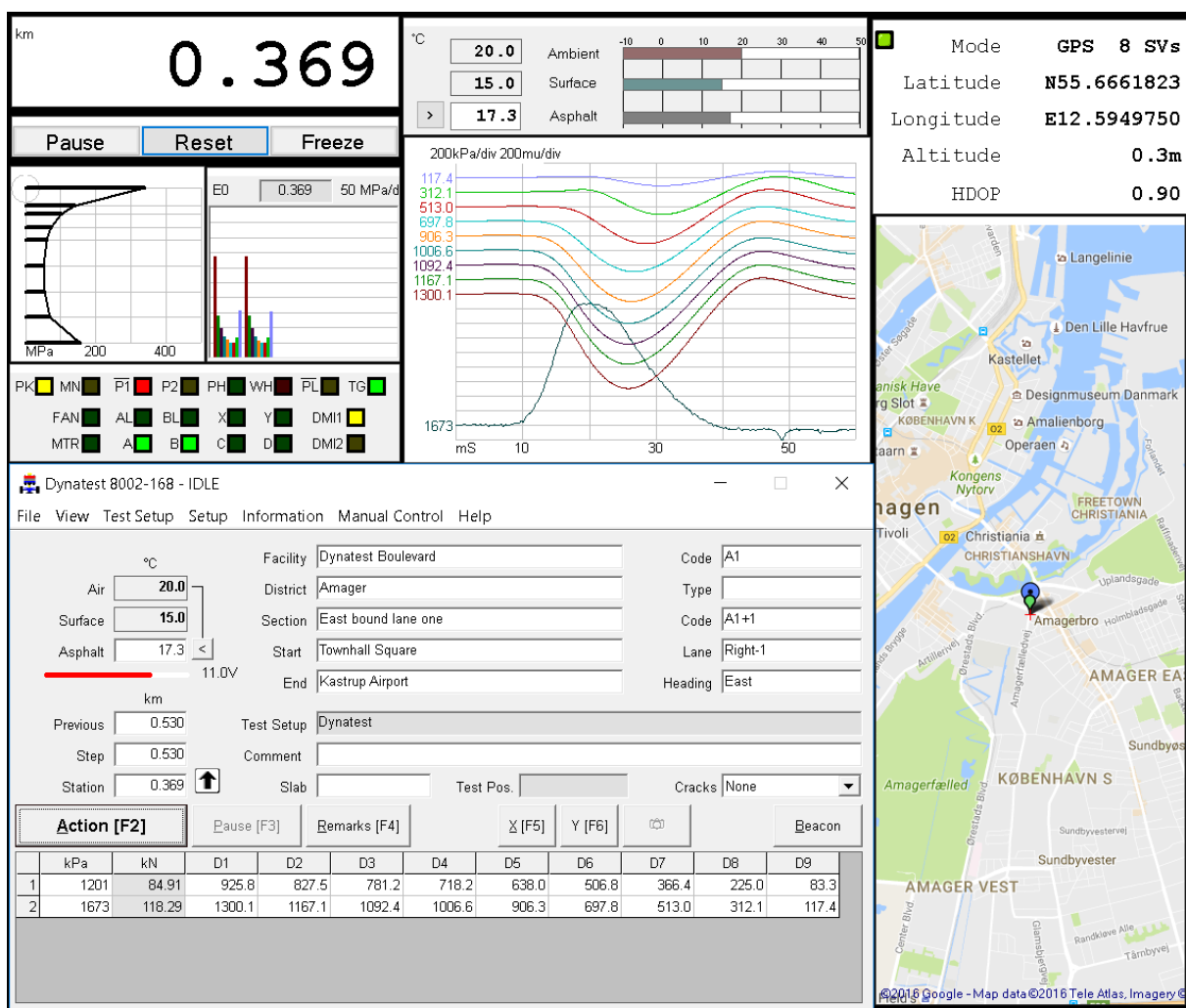
The screen consists of a Main window, sub-windows and applets. The large Main window is the primary interface or "mission control" for operating the program, i.e. all things are controlled from here. Each of the sub-windows and applets tend to mimic a real-life instrument like, for instance, a GPS navigator, Distance Measuring Instrument etc. Sub-windows and applets may be resized and moved around independently by simple drag operations using the mouse pointer. They may even be moved to a secondary monitor.

9.5 *Main Window*
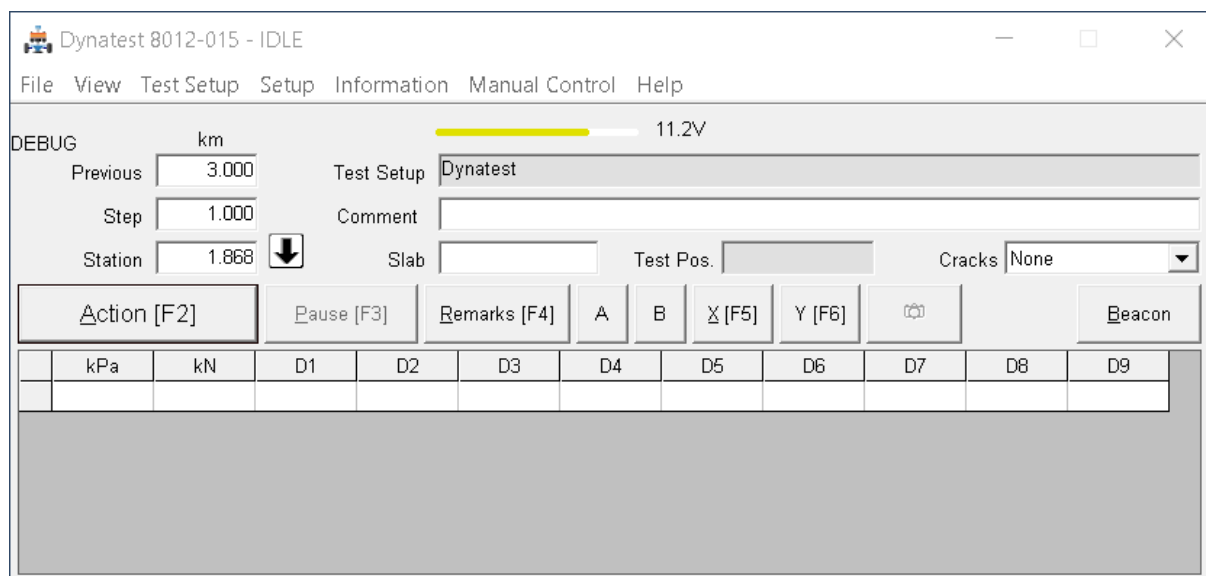
As mentioned earlier the Main window is the "mission control" for operation of the program. From this window the additional sub-windows can be toggled on and off by clicking the **View** menu item on the menu bar. Applets can be turned off from their individual menus.

Greyed text boxes cannot be edited directly. Some are filled automatically (temperatures) others may open sub-windows for data entry.

At this point, if any setup changes are required to the loading unit, the System Controller, the deflectors, etc. they should be made now through Main Menu item **Setup**. Details regarding setup changes are documented in Chapter 4.

9.5.1 *Navigating with the Keyboard*

Often, when using the program within a confined space (like in a testing vehicle), it is impossible or – at its best – inconvenient to use a mouse to operate the program. Therefore it may be a good idea for the user to brush-up the basics of navigating with the keyboard.

Actually, most of the operations you can do using a mouse (except drag-and-drop operations) can be done using the keyboard instead. The key to navigating with the keyboard is using the **TAB** (↔) key to put the focus on a *control* in the active window (controls are all the items that a window contains, like command buttons, textboxes, drop-down lists etc.).

When a control has the focus it has a *focus rectangle* around it as shown below (the **Apply** command button has the focus):
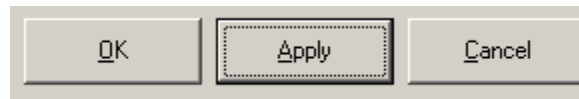
Each control in a window has been assigned a tab order, so that when the user presses the **TAB** key the focus rectangle is moved to the next control in the tab order, and when **TAB** is pressed while simultaneously holding down the Shift key the focus rectangle is moved to the previous control in the TAB order.

When a control has focus the user can manipulate it using the keyboard. Here is a quick overview of how to manipulate the most common of windows controls using the keyboard:

- Command Buttons:

To activate a command button simply press the Enter key on the keyboard.

- Drop-down lists:
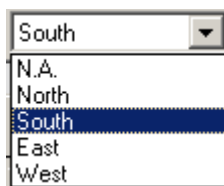
To make a drop-down list drop down or retract simply press the up- or down arrow while at the same time holding down the **Alt** key. To navigate in the drop-down list simply use the up- and down-arrows WITHOUT pressing the **Alt** key. When an item in the drop-down list is highlighted the user can select it by pressing the **Enter** key on the keyboard.

- Combo Boxes:
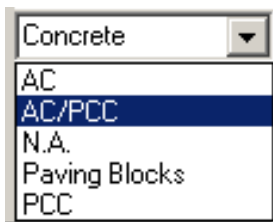
A combo box is a combination of a textbox and a drop-down list. The text portion of a drop-down list can only display items from the list, whereas a combo box allows the user to directly enter an input into the text portion as if it was a plain textbox as well.

In the combo box shown above the user has been allowed to enter the word "Concrete" into the text portion of the combo box although "Concrete" doesn't appear in the list of pavement types to choose from.

- Check Boxes:
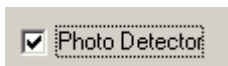
The checkmark in a checkbox can be toggled ON and OFF by pressing the **Enter** key.

The menu bar (along the top of the main window) is accessed in a rather special way. Actually there is two ways a user can access the menu bar using the keyboard:

- The user can shift the focus between the menu bar and the rest of the window by pressing the **Alt** key. When the menu bar has the focus one of the headline items is "depressed" as shown below (the **View** headline item is highlighted):
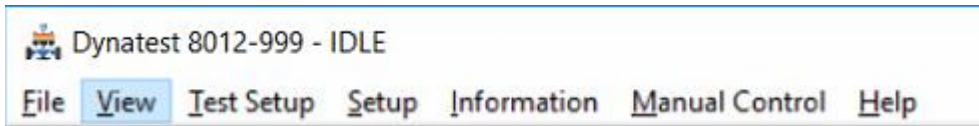
Use the left- and right arrows to highlight the desired headline item. Each headline item conceals a list that the user can drop-down by pressing the **down-arrow**. To navigate in the drop-down list simply use the up- and down-arrows. When an item in the drop-down list is highlighted the user can select it by pressing the **Enter** key.

- The user can navigate the menu bar using *short-cuts*. Each of the items in the menu bar has an underscored letter in their name. A menu item can be selected by pressing the underscored letter in combination with the **Alt** key. For instance, pressing **Alt + V** would be a direct way to select the UU**V**UU**iew** menu and make it drop-down at the same time:
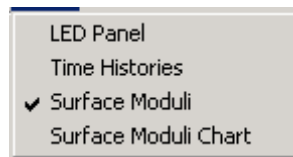
Note: Short-cuts not only apply to menu bars, but can be used for ordinary control items as well. For instance, a UU**Q**UU**K** button like the one shown elsewhere in this chapter can be focused and activated (pressed) in a single keyboard operation by pressing **Alt + O**.

![Dynatest®]

9.5.2 Special Keys

Some key combinations are allocated for various special purposes. You will use one or more of the Shift, Control and Alt keys together with a letter. Some of the functions are available for the Administrator, only.

The Help entry in the menu item Help displays the full list of special keys
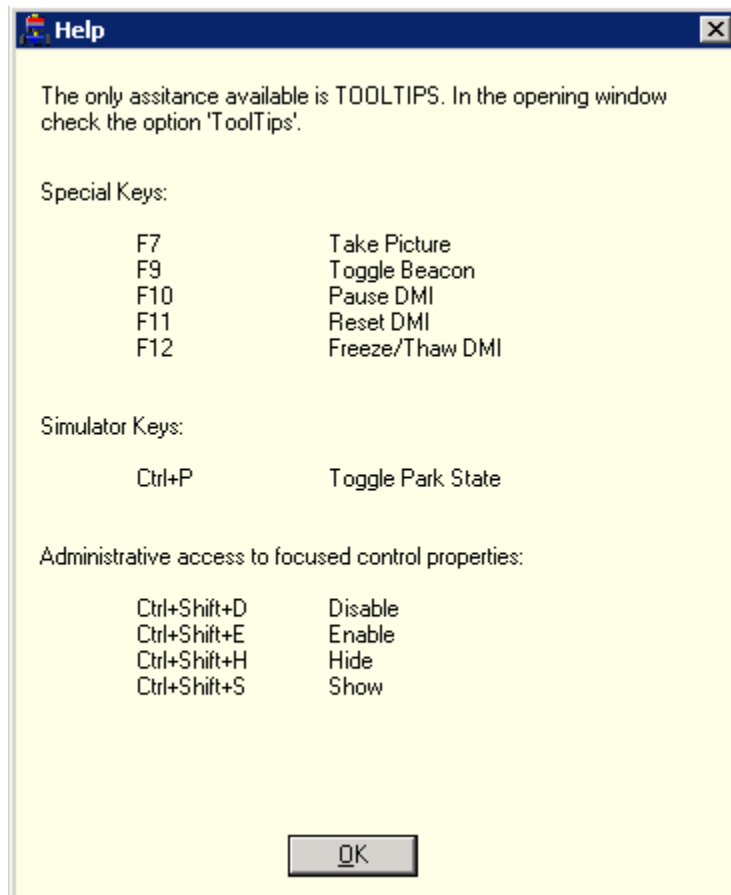
9.6 Sub-Windows

The sub-windows listed here are FWD/HWD dedicated windows. General functions are handled by the previously described applets.

- LED Panel
- Time Histories Plot
- Surface Modulus Plot
- Surface Moduli Chart
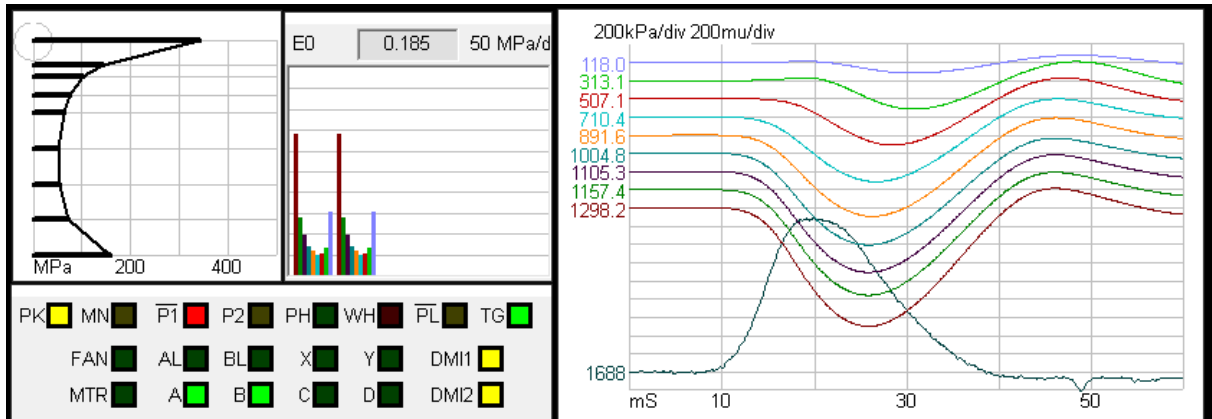
The additional display components can be toggled on and off by clicking the **View** menu item at the upper left corner of the data collection screen.

Note that the user can move the various components around using the mouse, so the operator should take care that one component does not cover another up. Also, the majority of components can be resized to some extent.

9.6.1 LED Panel

This window gives feedback for proximity and pressure sensors and also the state of the MOS output drivers

9.6.2 Time Histories

This window shows the time histories of the last drop. The peak stress and peak center deflection rules the auto scaling.

9.6.3 Surface Moduli

This window shows the Surface Moduli. Center modulus at the top and farthest measurement at the bottom.

9.6.4 Surface Moduli Chart

This window shows the development of surface moduli as you go.
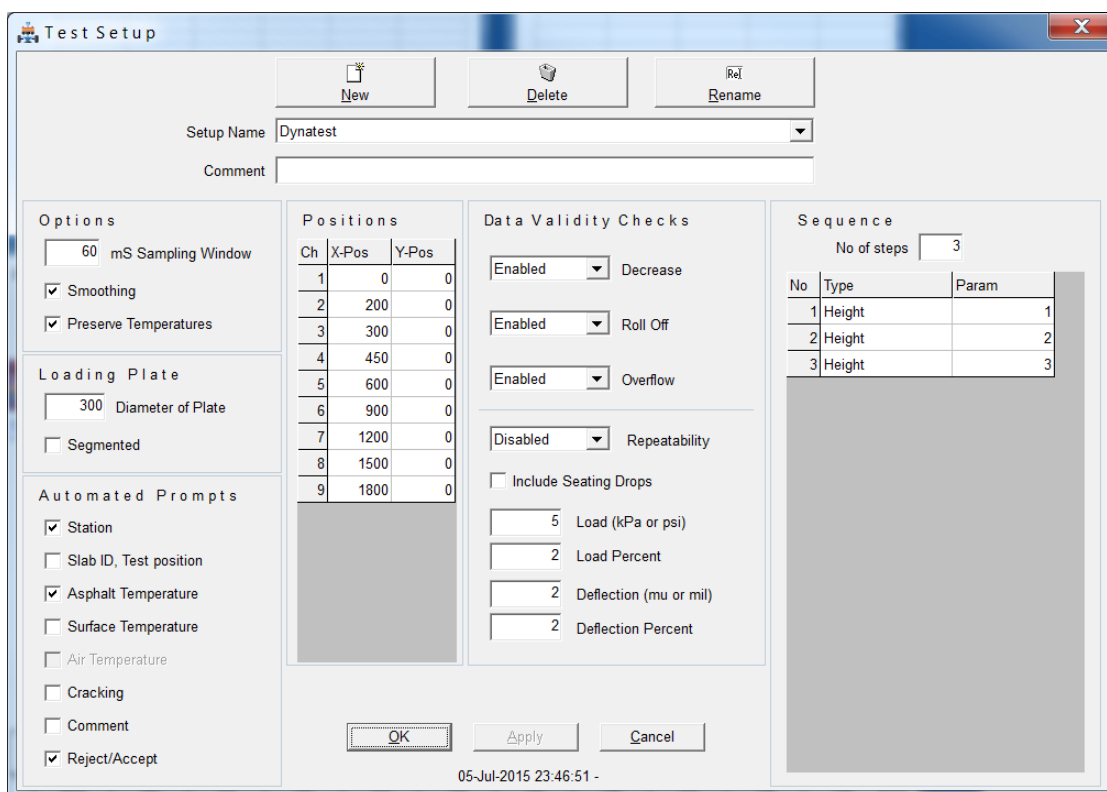
10. Performing the Measurements

10.1 Test Setups

The next step in the process is to establish a test setup that meets the procedures required by the particular project. Accessing the test setup screen can be done in several ways:

1. Click the **Test Setup** menu item at the top of the data collection screen.
2. Hold down the Alt key and then press the T key (Alt-T shortcut).
3. Click on the **Test Setup** label in the middle of the data collection screen.
4. Click in the greyed text box to the right of the Test Setup label.

Once the Test Setup window is opened the user will be presented with the following screen.

It may be useful to the operator at this point to define what a "Test Setup" is. It is a collection of software settings that tell FwdWin the type of loading plate, the positions of all deflectors and what actions to take during each test cycle. For example, you might want FwdWin to collect four drops at each test point, all from different heights. A Test Setup can be created to do this. Moreover, you might have several different sets of deflector spacing commonly used with different types of jobs. You can create a Test Setup for each job type and store them for easy retrieval next time a similar job comes up.

Note that the Test Setup screen is divided into different areas that control specific operational aspects of the FastFWD. These will be discussed in detail below.

![Dynatest logo]

New
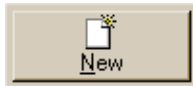
Creates a new test setup based on the present test setup, so, BEFORE you press this button you should select the Test Setup that best matches your needs from the drop down list to the right of the **Setup Name** label. The operator must specify a new name in the **Setup Name** field then click the **Apply** button. The operator can then make changes to the test setup. Once changes are complete, the operator should then click the **OK** button to save the changes.

Delete

This deletes the present Test Setup. The operator will be prompted to confirm that he/she wishes to delete the setup.

Rename
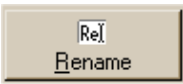
This allows the operator to rename the present Test Setup. The operator must enter a new name in the **Setup Name** field, then click **OK**.

Setup Name

Setup Name | Dynatest

This is a drop down list that contains all of the test setups that have been created by the operator. If you click on this box, a list of all setups stored in the program will appear. Clicking on one of the setups loads it into the FwdWin program. It is useful to include descriptive information in the setup name for easy identification (when you operate an FWD/HWD for a while, you'll create MANY setups).

Comment

Comment |

The operator can use this line to include additional descriptive information regarding the present test setup.

Options

Options
60 mS Sampling Window
☐ Smoothing
☑ Preserve Temperatures
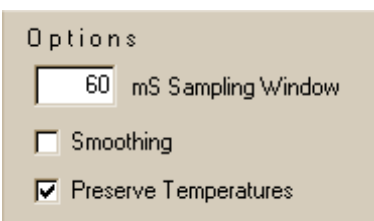
The options box contains three program controls:

Sampling Window

For each drop the system samples the load and deflection signals for a period of typically 60 milliseconds. This parameter also controls the range of the time axis on the time-history plot (see "Time History Plots" later in this chapter).
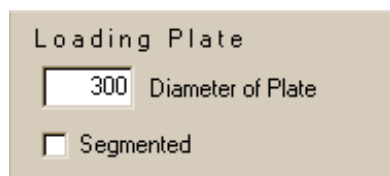
Smoothing

The Smoothing (or Smoothed Peaks Option) is a special feature, which ensures that the influence on the load and deflection peak values from possible undesired, high frequency components in the load cycle will be reduced to a minimum. Correlation trials have proved the value of this option. Nevertheless, use of this feature is left to the discretion of the operator or responsible engineer. For further information, please contact Dynatest**.**

Preserve Temperatures

Some agencies manually measure asphalt temperatures at time of test in addition to or in-lieu of the surface temperature measurements. These measurements are labour intensive, so they cannot be done at each test point. If this box is checked, FwdWin will record the last entered asphalt temperature at each successive test point until a new temperature measurement is recorded and entered into FwdWin.

Loading Plate

The FWD/HWD is provided with two sizes of load plates – a 300 mm (5.9 in.) and a 450 mm (11.8 in.) diameter plate. You must indicate which plate is presently installed on the FWD/HWD. If the plate is segmented (split) the **Segmented** box should be checked as well. A quick visual inspection of the load plate will reveal its size and whether it is segmented. A segmented plate consists of two or four sectional pieces.

Automated Prompts

Automated prompts provide an interactive way for the operator to enter or verify certain information at each test point prior to storage in the data file. Automated prompts should be used sparingly as they contribute heavily to operator fatigue and slow production.

Station

This item is mostly used when the FWD/HWD is equipped with a third party odometer that is not physically connected to the system. The operator would then read the distance from the dash and enter it into the dialog box that appears at each test point.

Slab ID, Test Position

This prompt is only used on jointed Portland Cement Concrete pavements. It is common practice to assign numbers to slabs so that they can be positively identified during the data analysis phase of the project, which almost always occurs in the office away from the test site. If this option is checked, FwdWin will prompt the operator to enter the slab number and position (corner, joint, midslab, etc.) of the load plate.

Asphalt Temperature

This option is activated on projects where the operator or technician is manually measuring (average) asphalt temperatures (e.g. at mid-depth of layer). This provides a way to record these manually measured temperatures in the data file.

Surface Temperature

Same as "Asphalt Temperature" except that the temperatures are measured at the surface as opposed to mid- or third- depths. This item is greyed (irrelevant) in the Test Setup screen when an automated surface temperature measurement system is installed.

Air Temperature

Same as "Asphalt Temperature", except that the technician or operator is measuring and recording the air temperature. This item is greyed (irrelevant) in the Test Setup screen when an automated air temperature measurement system is installed.

Cracking

Pavement surface cracking can influence the measured deflections making it difficult to analyze the deflection data. If cracking is turned on, the operator can record the severity of cracks in the vicinity of the test point. This will aid the analyst in properly processing the deflection data.

Comment

If this option is activated, the operator can enter a comment at each test point.

Reject/Accept

This option allows the operator to review, then reject or accept the measured deflections at each test point. This option is most commonly used on structures where irregular deflection basins are prevalent. This includes severely distressed pavements or structures with extensive underground utilities, pipes or culverts.

Positions

This area is used to record the positions of the deflectors. The number of deflectors shown is determined by the number of active sensors as indicated in **Setup - Processor** - **Deflector Circuits**.

Note that the deflectors are referenced by channel number. To view a list of deflectors and assigned channels, select **Setup** then **Deflectors** from the main menu.

Ch	X-Pos	Y-Pos
1	0	0
2	200	0
3	300	0
4	450	0
5	600	0
6	900	0
7	1200	0
8	1500	0
9	1800	0

Each channel is assigned an X position and a Y position. The values displayed are a function of the display units selected, in this case millimeters. Both the X and Y positions represent the distance from the deflector to the center of the load plate.

A positive X value indicates that the deflector is "in front" of the load plate. The X axis is assumed to be parallel with the travelled lane.

The Y axis is assumed to be oriented perpendicular to the travelled lane. The meaning of a positive Y value may differ depending on location. The local agency should establish the convention. (If no convention, we suggest positive towards the roadway centerline).

Data Validity Checks

Data validity checks is a quality assurance feature which alerts the operator to irregularities in the deflection data immediately during the testing cycle. There are three simple types of validity checks, Decrease, Roll off, and Overflow and the more complex Repeatability.

Each type of test can be:

Disabled: The test is not performed

Enabled: If the test fails, then the test cycle will stop and prompt the operator to decide whether to keep the data or throw it away and repeat the test.

Relaxed: If the test fails, then the results in the data grid will be flagged somehow but the test cycle continues.

Smart: If the test fails, then the program will automatically repeat the last drop to obtain data that pass the test.

Decrease

It is commonly accepted in pavement engineering that the measured pavement deflections should decrease as the distance from the center of the load and point of measurement increases. In other words, the farther a deflector is positioned from the center of a load, the smaller deflection it should measure. This is true in theory, but sometimes not in practice.

Pavement cracks, joints, and other irregularities (such as defective deflectors) result in "non-decreasing deflections" whereby some outermost sensor records a higher deflection than its neighbor who might be closer to the load impact point. This results in data that is extremely difficult or impossible to analyze.

Roll Off

At the end of the sampling interval (60 msec), the program expects the deflection time history to return to less than 90% of the peak value. Roll-off errors may occur when a deflector is lowered onto a piece of gravel or some other unstable surface, then falls off when the weights drop. A roll-off error can also occur if the pavement is experiencing excessive vibrations due to heavy traffic in an adjoining lane. Finally, a roll-off error may be caused by a defective deflector.

Overflow

Most deflectors delivered with Dynatest FWD/HWDs are capable of measuring deflections of up to 2000 microns (80 mils). Deflectors delivered with some systems are rated at 2450 microns (100 mils). If the range is exceeded, the deflectors may exceed their stated accuracy and the quality of the data may be in question. Overflows can occur on soft pavements, near joints and corners on Portland Cement Concrete, or may be caused by defective deflectors.
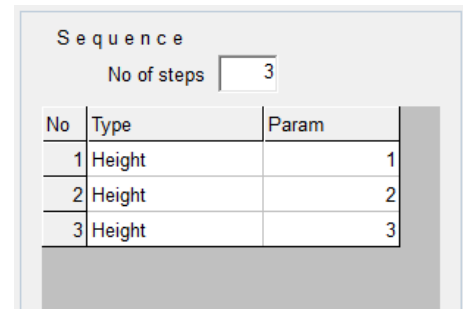
Repeatability

Some agencies (most notably the FHWA LTPP group in the USA) utilize a repeatability check as an additional quality assurance measure. Repeatability specifications require that a series of consecutive similar drops give similar results. These specifications are intended to alert the operator in the event that the testing is in some way affecting the physical properties of the pavement structure, or that the surface of the pavement is unstable. They also alert the operator to variations in loads or deflections caused by defective equipment.

The program allows the operator to specify the allowable variation in load and/or deflection, both in terms of the actual measurement units as well as in percent. Seating drops can also be included in the repeatability check. Note that the test only applies to a series of drops that are conducted from the same drop height (or the same target value).

Sequence

Prior to testing, the operator must define the sequence. A sequence is a series of programmed tasks to be performed by the FWD/HWD at each test point. The sequence box allows the operator to specify the number of steps, step types, and step parameters utilized at each test point.

Sequence		
No of steps		3

No	Type	Param
1	Height	1
2	Height	2
3	Height	3

A step can be any one of the following types:

1. No Op — No Operation (fill)
2. Pause — Waits for user action
3. Seating — A drop from a specified height, data will not be stored to disk
4. Height — A drop from a specified height
5. Loading — The drop height is adjusted to achieve a specified target load
6. Deflection — The drop height is adjusted to achieve a specified center deflection
7. Resettle — The plate is lifted of the ground and then lowered again
8. Weight Up — The weight is raised to a specified height (but not dropped)
9. Catch Dn — The catch is lowered (returning the weight to the hit plate)
10. Terminate — Leaves the plate on the ground

3, 4, 5, 6 and 8 require a "Step Parameter". A step parameter is a 'modifier' associated with the step type. For example, "Seating" and "Height" requires that the desired height (1,2,3 or 4) is chosen (see Section 5.2-"Drop Heights Adjustment").

To define a sequence, the operator first enters the number of desired steps in the **No of steps** box. The number of rows in the table expands or shrinks to accommodate the specified number of steps. The leftmost column shows the step numbers.
Next, for each step, the operator must select the action to be performed. In the example above, the operator has specified that three drops from a specified height will be performed at each test point.
The operator then assigns a step parameter for each step type. In the example above, the parameters are 1, 2 and 2. This will perform one drop at drop height 1 and two at drop height 2 at each test point.

OK

Once all of the items in the "Test Setup" screen have been modified as needed, the operator can then click the OK button to save the data and return to the data collection screen.

Apply

The Apply button serves the same function as the OK button except that the "Test Setup" window remains open. Note that the button shown here is "greyed out" indicating that the button is disabled. This button is disabled by default and is only enabled when a change is made anywhere in the "Test Setup" screen.

Cancel
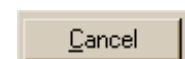
The "Cancel" button discards any changes made in the "Test Setup" and returns the user to the data collection screen.

10.2 *Test Section*

Before initiating a data collection you also need to specify the test Section information.

The Network applet provides a wealth of opportunities to incorporate section information in your data files. In addition, many attributes, such as your start location, end location, pavement type, lane, and other useful bits of information can be included as seen below:

All fields default to plain text entry mode, however there are a few features that make it easier for the operator to incorporate location and other information in the datafile.

All fields with a drop down arrow provide access to previously used information.

Districts

Most highway agencies subdivide their networks into Districts for more efficient management.
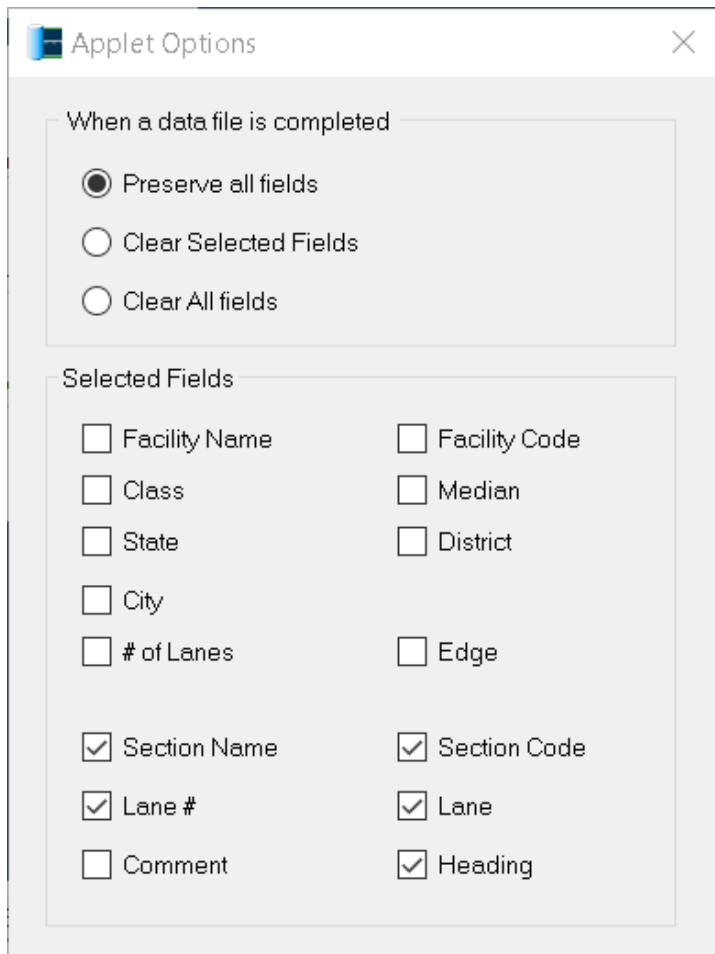
Facilities

Various attributes of the facility under test can be entered by the operator. A "Facility" can be anything from roadways, runways, streets to parking lots or even railways. Often a facility is identified by both its common name and a roadway code.

Section

A single facility is often composed of sections of varying construction. This "Sectioning" can be both longitudinal and transverse. The latter is appropriate for multilane roadways where traffic load varies across the construction.

When a data file is closed you have the following options to act upon the fields in the Network window:

10.3 *Data Files*

Once the operator has configured the test setup, and made the necessary changes or additions to the network information, it is time to test. It will now be necessary to create a file for storage of the deflection data. Prior to opening a file, a few words about file formats are necessary.

Specifying File Formats
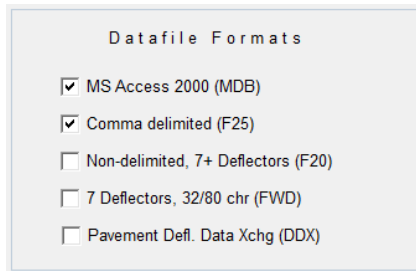
From the main menu, select **Setup** then **Options**, which reveals that FwdWin can store data in several formats. The native format is Microsoft Access 2000® (MDB), which is the most versatile and HIGHLY recommended. The remaining formats are all text based. F25, F20 and FWD are earlier Dynatest ASCII formats. 'Pavement Deflection Data Exchange' (DDX) was developed by AASHTO in 1998.

For further information see *4.3*.

Creating a Data File
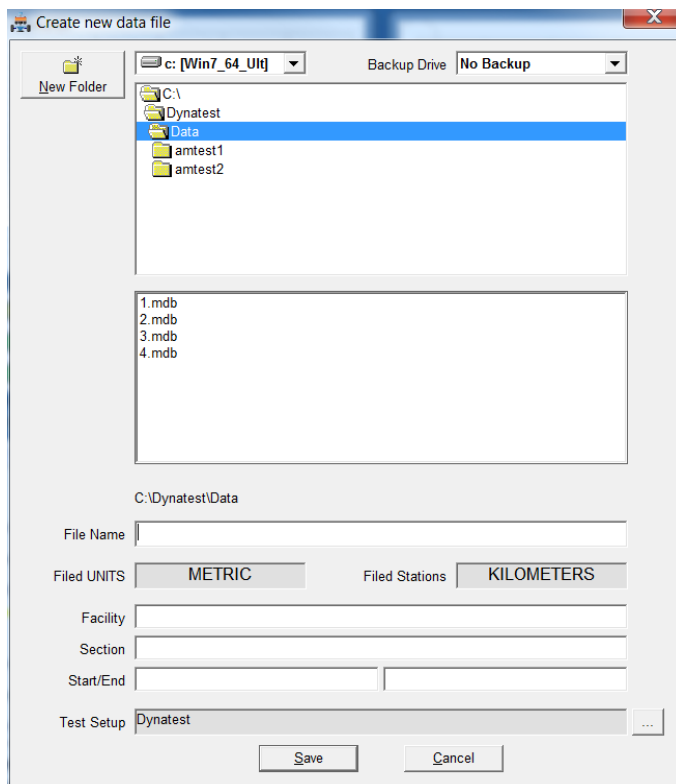
A data file is created by clicking the **File** menu item from the data collection screen, then choosing **New**. The resulting dialog box allows the operator to navigate to an existing subdirectory for file storage. It also allows the operator to create a **New Folder**.

To create a new file, the operator merely needs to type the data file name in the **File Name** field, or click an existing file to serialize filenames pertaining to the same facility.

This window also informs the user which system of units will be employed for storage of data. The user is also given a last chance to sort out the facility information and choose a suitable test setup. Buttons are provided for convenient navigation to the "Section" window and the Test Setup window.

Once the information on the screen has been entered, the operator should click the **Save** button. The program will now prepare the disk file and then return to the data collection screen.

We are now ready to test!

10.4 Running a Test

Prior to running a test, it is assumed that the following functions have been performed (in addition to driving to the site and positioning on the first test point):

- The program has been configured for the appropriate FastFWD unit
- A proper test setup has been created (or loaded).
- The location information has been entered.
- A file has been created.

The data collection screen serves as the primary control interface. At first glance, it may seem complicated, but after a short time the operator will become quite familiar and comfortable with it.
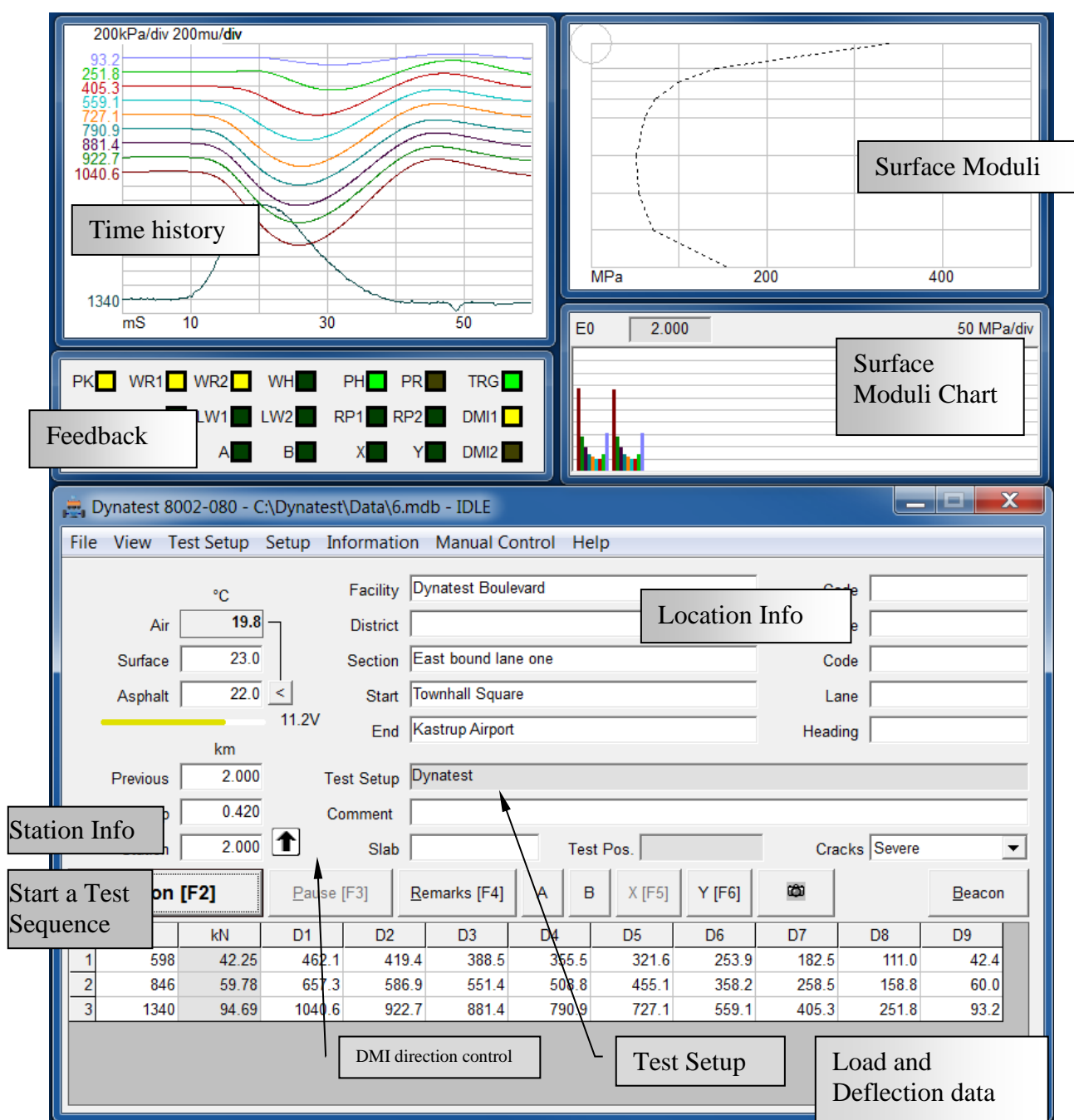
The testing process is fairly simple. When the vehicle is located in the appropriate test position, the operator merely clicks the **Action** button to start the test sequence. When the sequence completes, the computer will issue one of a variety of sounds indicating that the plate has been raised to the transport position and it is OK to move to the next test point.
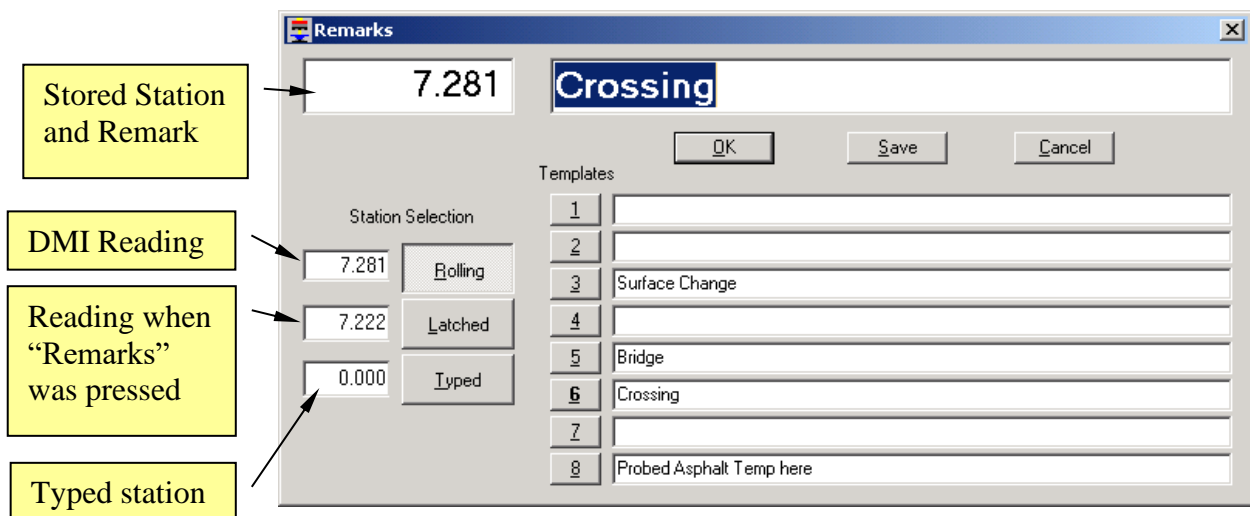
If an error or other problem occurs during the test sequence, a pop-up window will appear indicating the nature of the problem or error. If so equipped, the computer may also issue an audible version of the error message.

During the test sequence, there is generally nothing for the operator to do until it is complete. This is a good time to scan the surroundings to make sure persons stay clear of the equipment and that traffic is not posing a hazard.

After each drop, the load and deflection data are written to the data collection window. This provides a convenient method for monitoring the progress of each test sequence.

10.5 *Remarks*

It is sometimes desirable to enter additional Remarks after testing or while moving on to the next test station. Pressing the "Remarks" button (or F4 or Alt+R) opens the following window:

Rolling Use this mode if you want the rolling DMI reading to be stored with your remarks. In this example the **Remarks** button was pressed at 7.222 (ahead of the Crossing), then **6** and then **OK** (or **Save**) was pressed at 7.281 while passing the Crossing.

Latched Use this mode if you prefer to use the DMI reading at the moment you press the **Remarks** button (while passing the spot of interest).

Typed Use this mode if you want to enter the station manually.

The eight templates can be used to prepare often used remarks

10.6 *Auxiliary Outputs X and Y*

Function Keys F5 and F6 are dedicated to control two auxiliary outputs (MOS Switches) at the Compact15F front panel. Right click either button to access the options:
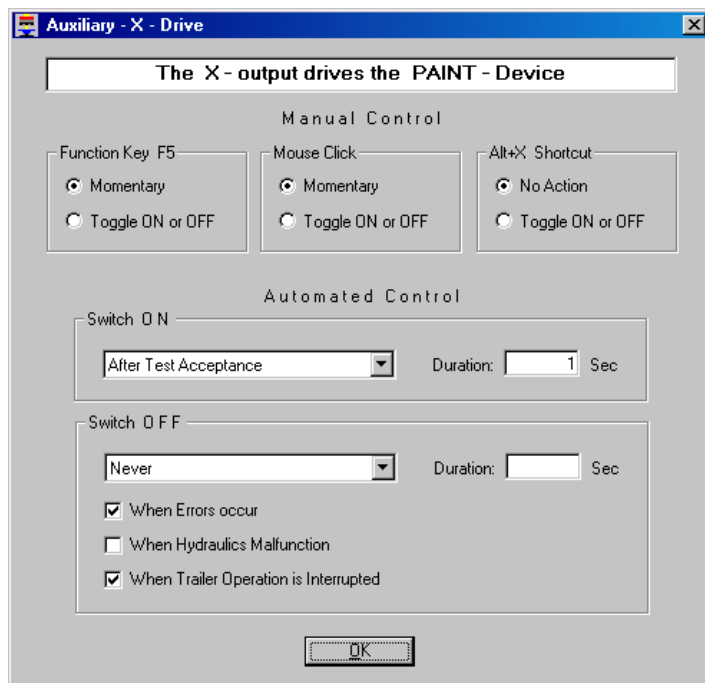
In this case output X controls a paint spray device. F5 (or the mouse) will switch ON the output momentarily, only.

In addition to manual control, the output is activated for one second "After Test Acceptance".

Further, the output is switched OFF if errors occur or if the user interrupts the System operation.

10.7 *Closing the Data File*
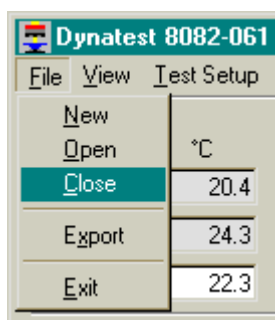
The operator can close the data file by selecting **Close** from the **File** menu item. The Microsoft Access (MDB) file closes and optional ASCII files as selected in **Setup** – **Options** are subsequently written (se also *10.9 Exporting Data*).

Closing the program (**Exit**) will automatically close the data file properly before shutting down.

10.8 *Opening a Data File*

You can use **File** – **Open** to re-open an MDB file in order to store another data collection session. Note that you cannot re-open an ASCII file, i.e. the program cannot append data to such files. Instead, additional sessions generate additional ASCII files with sequenced file names (se also *10.9 Exporting Data*).

10.9 *Exporting Data*

Use the **File** - **Export** facility to generate ASCII files based on MDB files at a later time (in the office). This option means that you can safely un-check all ASCII options in **Setup** – **Options**.

Sessions – Keep generates multiple files from multiple sessions.

Sessions – Join merges multiple sessions (from re-opened files)

Smooth - This option enables post-smoothing of stored histories. The resulting files contain smoothed peak results. If histories are not available, then this option is ignored.

The selection of formats here is independent of the chosen "real-time" **Setup** - **Options**.

Note that you may select multiple source files from the same folder.

Note that you may select multiple source files from the same folder.
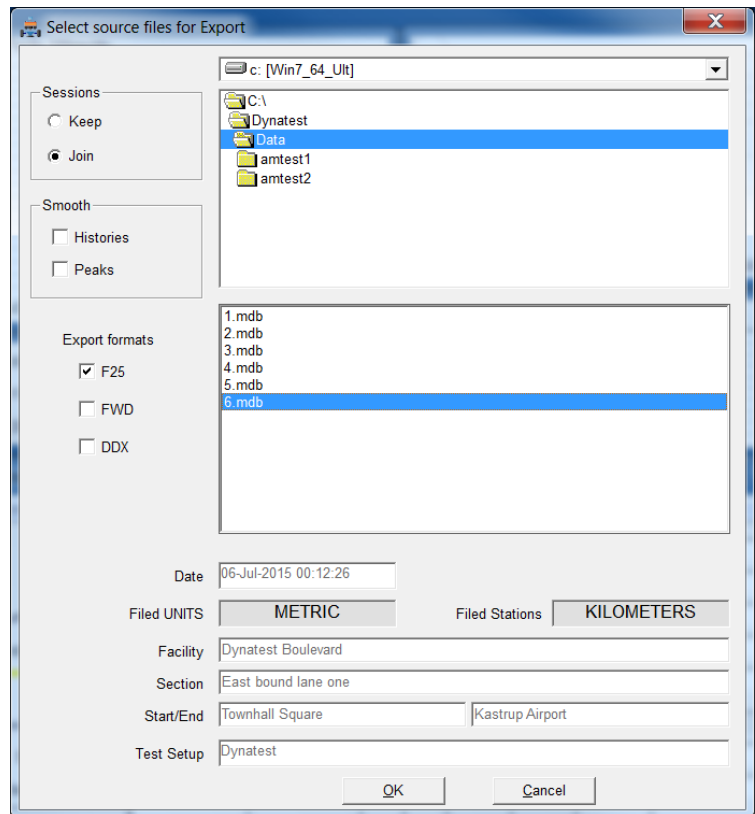
10.10 *Monitoring the System's Status*

The program provides an interface that can be used to monitor the status of the FWD/HWD systems including voltages, deflector drifts, and statistics regarding the number of tests performed. These screens are accessed from the **Information** menu item in the data collection screen. Three menu items are available in the list box: **Voltages**, **Drift/Vibration**, and **Statistics**.

Voltages

The voltage screen is shown at right. The list of voltages appearing along the left side of this window corresponds to the various deflectors. If a deflector is stationary, the voltage should be very close to zero. If the voltage is varying with time, it either means the deflector is experiencing vibration from some source, or is defective.
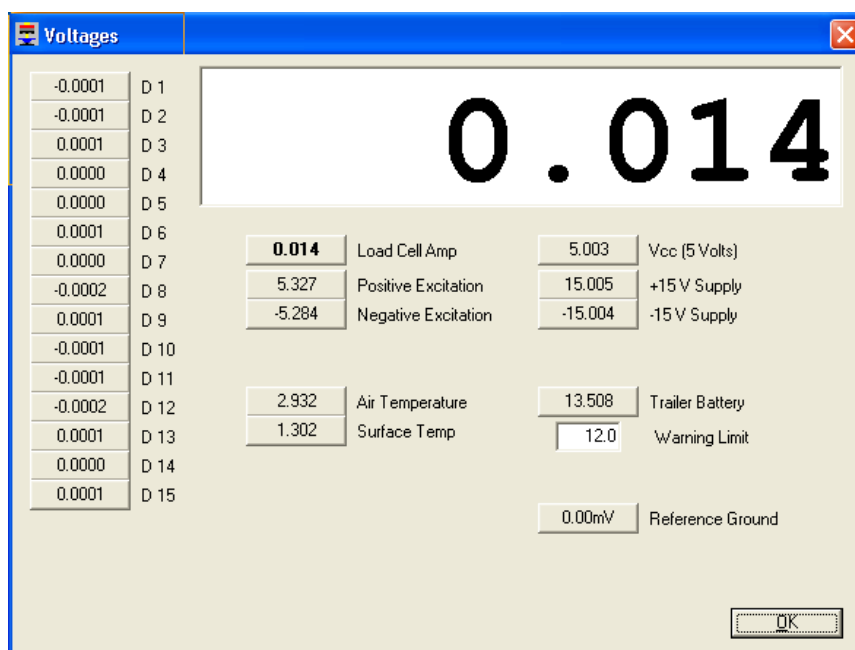
Clicking on a button on this screen causes the reading to be displayed on the large readout at the top of the screen as well as on the face of the button. This aids in troubleshooting as the reading can be seen from some distance.

Where applicable the tool tip shows the typical voltage range for the component.

The "Warning Limit" sets threshold for warning the operator of low voltage condition. Note that the Fast FWD runs a 24V power system and 12V for the CP15F is generated by a DC-DC converter. This means that the "Trailer Battery" voltage shown here should be very stable at 12V regardless of the state of the 24V batteries.

Pressing the **OK** button closes this screen and returns to the data collection window.

Drift/Vibration
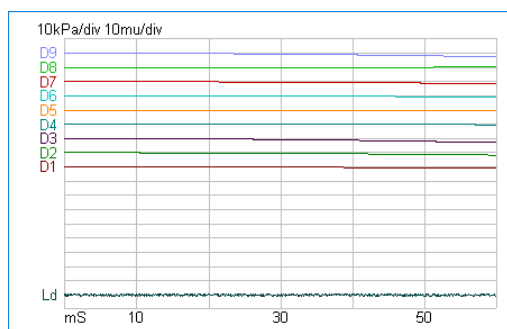
Selecting this menu item will bring up a continuously updating time-history plot of the load cell and deflector outputs. This screen is used mainly for troubleshooting suspected problems. Time in milliseconds is plotted along the X-axis while load and deflections are plotted for each device on the Y-axis. Load reading is plotted with positive in the "up" direction, while deflections are plotted as positive downward.

Prior to activating the drift screen, the operator should lower the plate and deflectors to the pavement surface. The pavement should be free of vibrations (due to traffic or other sources).

The base line for each transducer is adjacent to the respective label Ld, D1 … D15.
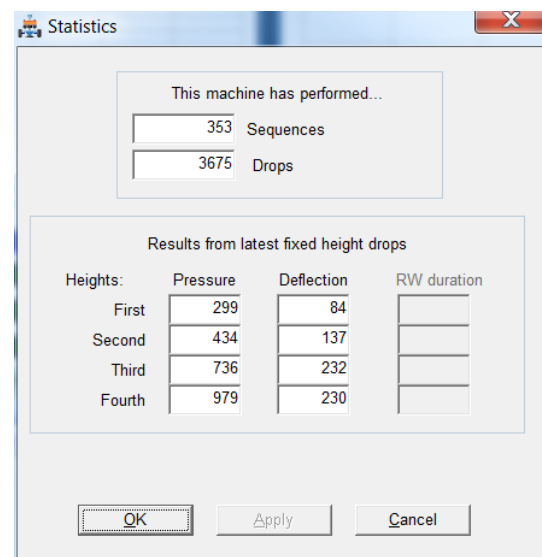
The Y axis scale for load and deflection is shown at the top of the plot. In this case, each horizontal line represents and increases of 10 kPa of pressure for the load cell. Each horizontal line represents 10 microns of deflection for the deflectors.

If the FWD/HWD is working properly, the lines should be fairly flat and coincident with the each components base line. If one or more lines are tracking away from their origins, this is indicative of a problem with the system.

Statistics

FwdWin can track certain statistics such as the number of test sequences and drops completed by a given machine. These statistics are stored in a database and are serial-number specific. In other words, if you use the same computer to run two or more FWD/HWDs, the program will keep separate statistics for each.

Note that the operator can overwrite the numbers shown in the **Sequences** and **Drops** fields. Pressing **OK** saves the changes and closes the window. Pressing **Apply** saves the changes but leaves the window open. The Apply button is "greyed-out" (disabled) until some change is made in one of the fields. The **Cancel** button discards any changes and closes the window.

The program also monitors and records the plate pressure and pavement center deflection. This information pertains only to the last drop completed at each fixed drop height. This information is useful for troubleshooting such problems as e.g.:

- Inadequate charging systems - as loading unit batteries discharge, weights are lifted progressively slower.
- Effects of cold weather on loading unit
- Problems with "Loading". If the targeting is not working as it should, check that the values of "Pressure" and "Deflection" are updated frequently.

It is a good idea for the operator to record typical values for "Pressure" and "Deflection" when the system is new or known to be in good operating condition. This will provide a baseline for later comparisons.

10.11 *Manual Control*

Occasions will arise when it will be convenient or necessary for the operator to take manual control of the loading unit systems. For example, if a testing sequence terminates abnormally and it is necessary for the operator to raise the plate prior to vehicle movement, he/she can do so from within the program.

Manual control of the FWD/HWD is accomplished through the **Manual Control** menu item near the top of the data collection screen.

The manual control screen consists of several buttons and an indication of the weight "Position" relative to the hit plate.

The subassembly window will respond visibly to the controls so that the operator knows what position the loading subassembly is in.

The drop button causes the weight to fall. The stop button will cause an immediate abort to any operation in progress and return the weight to a resting position.

The Home button moves the weights to their Home position, resting on the hit plate. It can also be useful to reset errors, if it is pressed when the weights are already resting on the base plate. This move should NOT be confused with Homing as they have different functions.

The Lock Weight button will locate the weights automatically on the upper locks and then power from the motor will be removed. It is useful for changing weights and buffer configuration. The operator must still check that the two locks (front and rear) are properly engaged before beginning any adjustment or servicing of the machine.

The button Unlock Weight does the inverse movement than Lock Weight. The weights will be unlocked and moved back to the zero position. It will do so slowly and a Homing movement will be done again because it is assumed that the weight configuration has been changed.
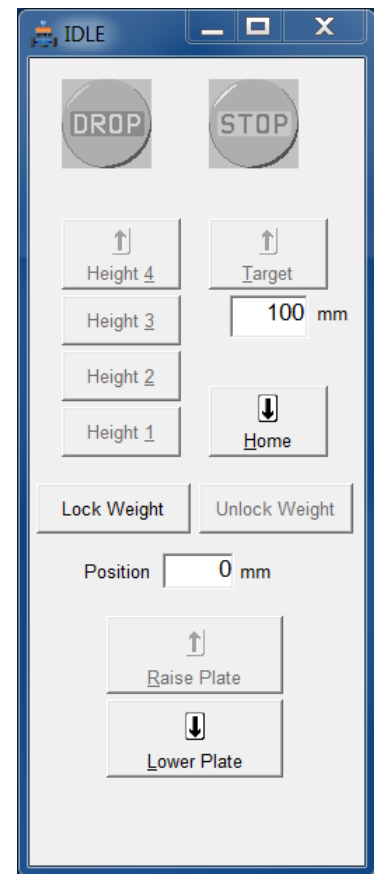
10.12 *Exit*

The operator can close the program by selecting **Exit** from the **File** menu item. Windows can now be shut down in the usual way.

IMPORTANT!!

Before driving away from the test site, the operator should:

1. Secure the loading unit. Transport locks and locking pins must be in position (see section 8.4, "**Just Before Leaving...**")

2. Raise the raise/lower bar at the front of the trailer and secure the bar with the raise/lower security pin.
3. Switch OFF the in-vehicle Ethernet PoE Switch which turns OFF the trailer.
4. Switch OFF the computer.
5. Switch OFF the Main (Red) Power Switch on the FWD trailer.

11. The Dynatest FastFWD Hardware

11.1 General Description

A Dynatest 8012 FastFWD Test System consists of the following main components:

A FastFWD Trailer, consisting of the following main elements (please also refer to the picture and exploded view in the following):

a) A Subunit (1) with electric motor, encoder and lifting spindle, drop weight / rubber buffer package, load cell and center geophone (deflector) holder, etc.
b) Two cabinets (2) with powering, motor control, system control and data acquisition electronics (CP15F), etc.
c) A foldable Trailer Frame (3) with wheels / mudguards, brakes, rear lights, system buffer battery supply, spare wheel, etc.
d) A Raise/Lower Bar (4) with typically 8 (max. 14) geophone (deflector) holders
e) A low-noise Honda gasoline generator for charging of the system buffer battery (not needed if unit is powered from the towing vehicles 12V alternator)

Exploded view of the 8012 FastFWD Trailer (EU version. Honda generator not shown)
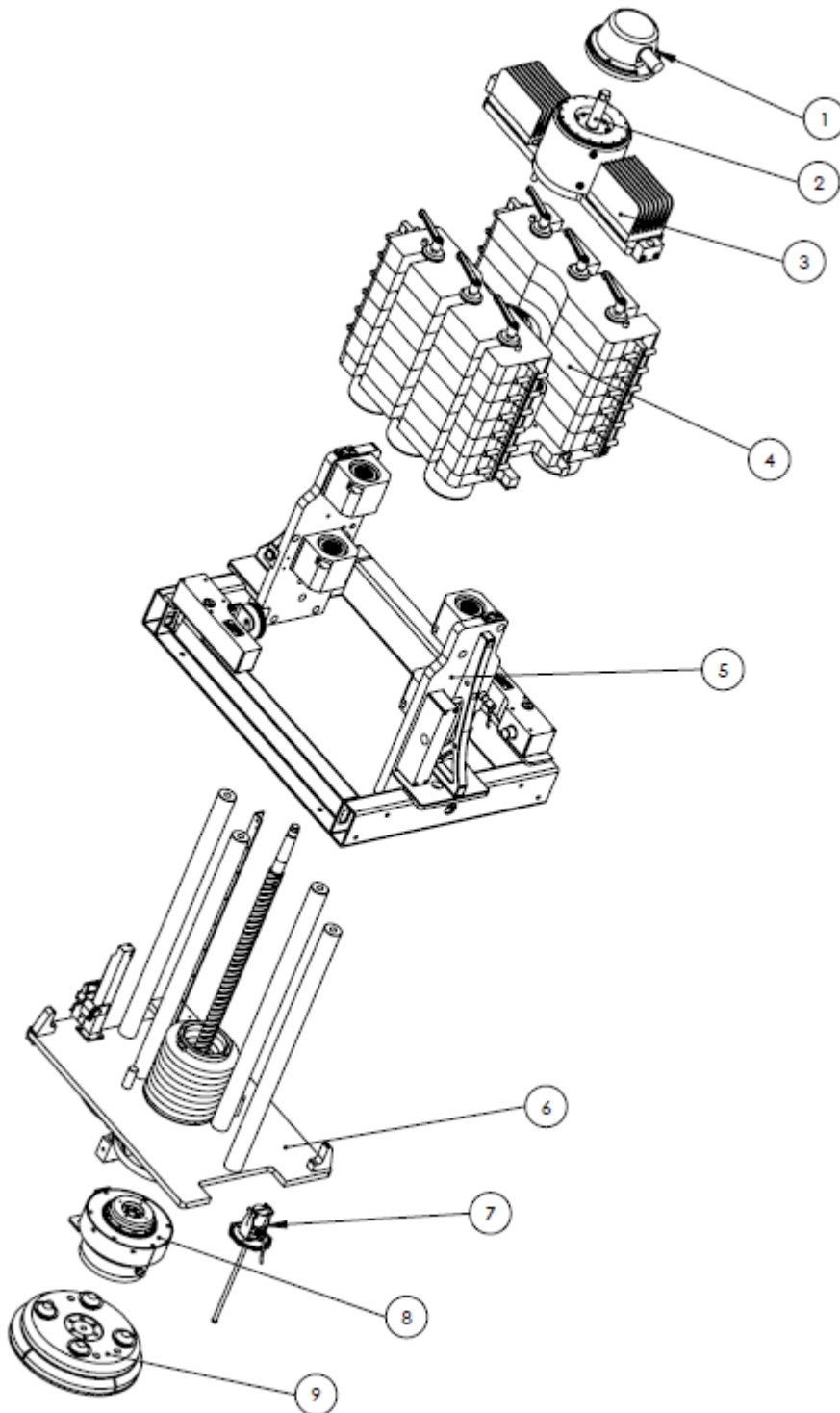
The subunit consists of an electric motor (2) with an encoder (1) driving a spindle for raising the drop weight (4) or raising/lowering the load transfer assy., consisting of the hit plate (6) connected to a load cell (8), which in turn is connected to the load plate (9).

A center deflector holder (7) is passing through a center hole in the load cell and load plate, to facilitate measurement of the pavement deflection at the loading center.

The subunit frame (5) is guiding the drop weight and the load transfer assy. And also holding the upper and lower transport locks.

The Raise/Lower Bar is connected to the load transfer assy. And thereby lowered and raised concurrently with this. This bar typically holds 8 (optionally up to 14) deflector holders, which can be located between 200 and 2400mm from the loading center. All deflector holders are spring loaded ensuring good contact between the deflector (via a free rod beneath their center) and the surface being tested.

11.1.1 Emergency lift procedure

If the Fast FWD footplate ever needs to be lifted in an emergency, where a power failure or mechanical issue means that the motor cannot safely be used to drive the weights and hit plate, then the emergency lifts can be used.

The threaded, emergency lifting rods must be installed in the brass support blocks at either end of the motor bridge. The end with the square drive must be up so a ½" internal square drive ratchet (supplied in spare parts kit) can be used to turn the rods. See illustration below.
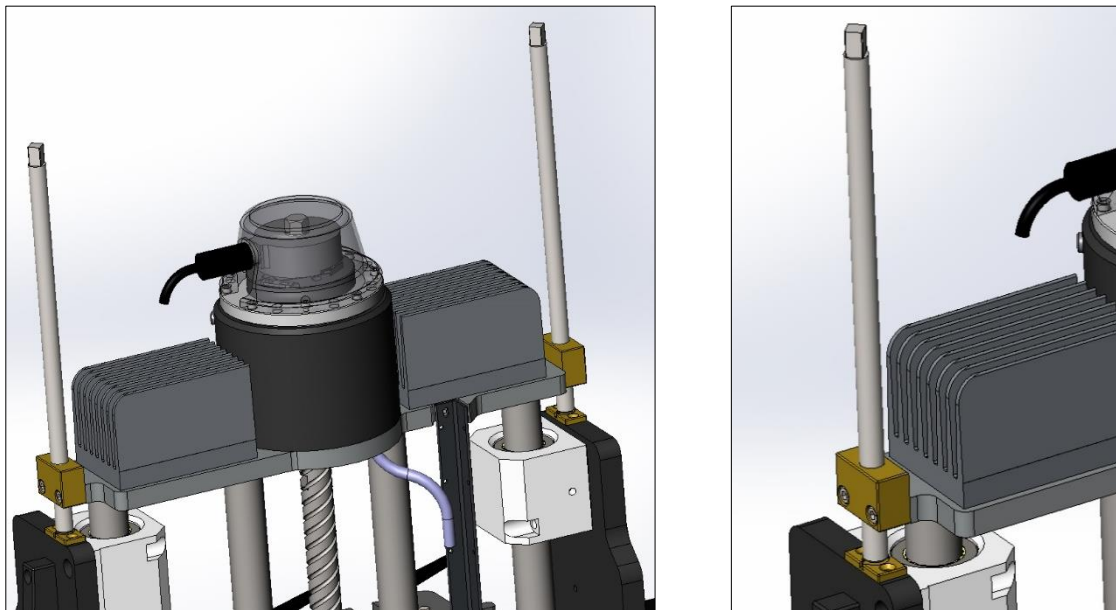
Alternate lifting at each end so the hit plate rises evenly and remains level relative to the subunit frame. Continue lifting until the hit plate is above both lower locks and the lower lock bolts have extended, ready to support the hit plate. The hit plate can then be lowered onto the locks and the emergency lift rods removed. In extreme time pressure the trailer can be moved as soon as the loading plate has lifted off the ground (allow some clearance for road bumps and suspension compression). But lift the hit plate to the normal transport position as soon as possible after moving to safety.

The emergency lifts can also be used to support the loading plate under transport in emergency situations where the lower locks have malfunctioned.
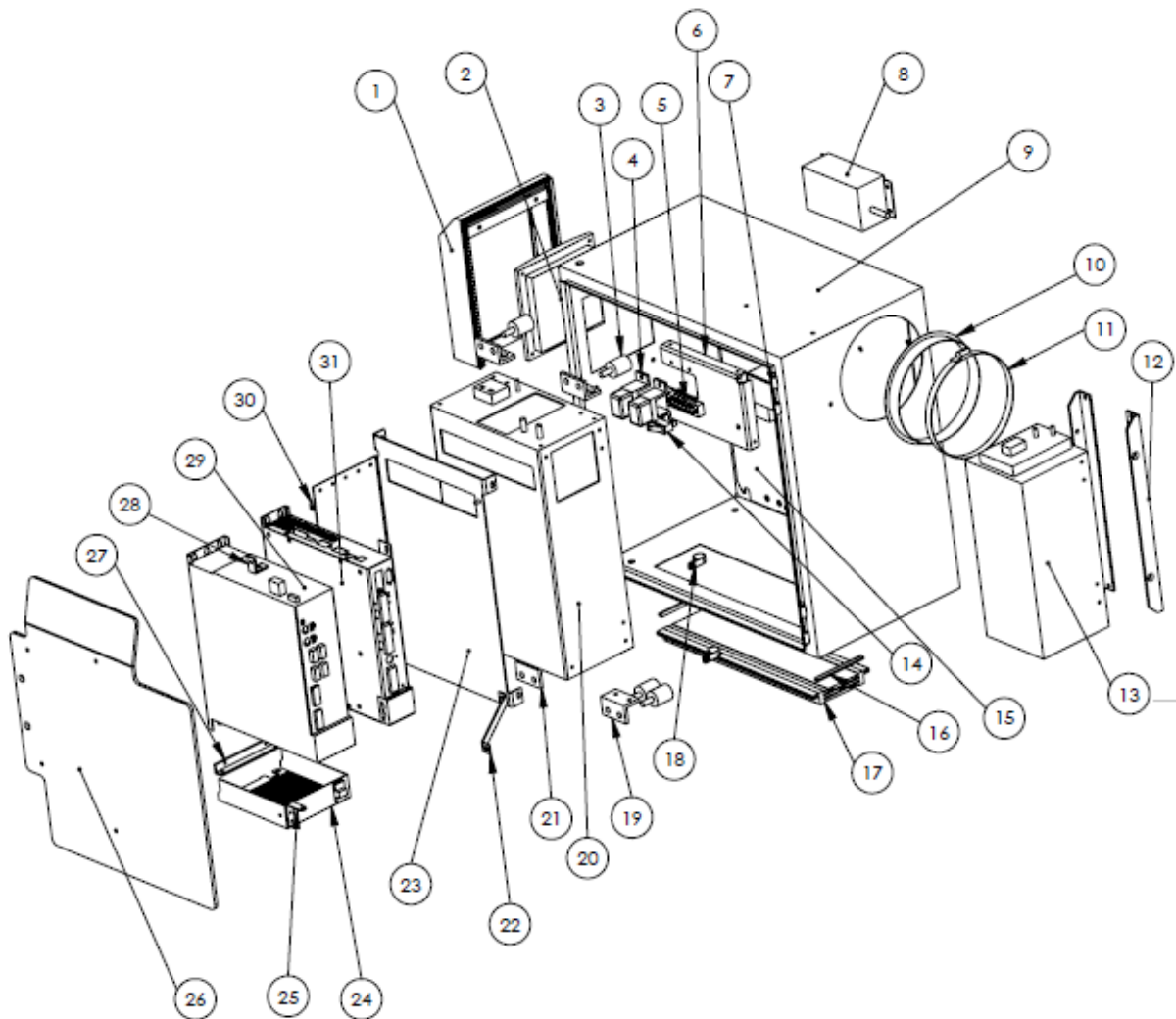
The left side electronics cabinet shown above holds the following main components:

A 24VDC to 580VDC, 2kW Power Converter (20), which provides 580VDC power for the Etel AccurET 600 Motor Controller (29) via the FPS600 Power Conditioner (31).

A 12VDC to 28VDC Converter/Charger (13), used for charging the 24V buffer battery bank (on the trailer).

A 24VDC to 12VDC Converter (8) for powering of the CP15F (see below)

The right side electronics cabinet shown below holds the following main components:

A CP15F System Controller and Data Acquisition Unit (56), see also Section 14

A Locks Driver Module (55)

A PoE (Power over Ethernet) power splitter (51)

An Ethernet Switch (52)

A 110/220VAC to 28VDC charger (50), for charging of the 24V buffer battery bank, powered by the on-board Honda gasoline generator (can also be used for powering from mains power in e.g. a workshop)

A fan (41) for ventilation of the electronics cabinets
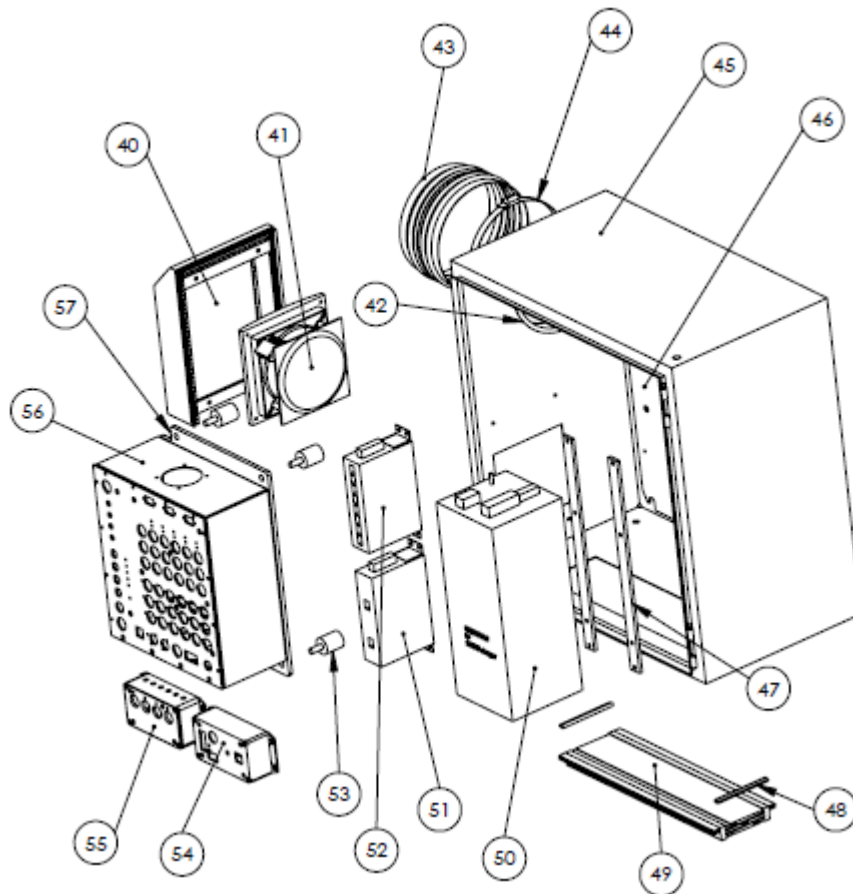
System Components placed in the towing vehicle:

a. A Notebook or Laptop type computer with Windows® operating system and the DDC (Dynatest Data Collection) software package
b. A PoE (Power over Ethernet) switch
c. A 12VDC to 110 or 220VAC Inverter for powering of a.) and b.) above
d. A "Park Signal TX" unit for protecting against driving when the load plate is down.

There is only one or two cables running between the FastFWD Trailer and the towing vehicle:

1. An industrial LAN cable running from a (water proof) connector on the front of the trailer to the PoE Switch in the towing vehicle
2. A heavy duty 12V charging cable (up to some 100A current drain). Not needed if the trailer is operated by the Honda gasoline generator.

A complete electrical block diagram for the FastFWD is shown on the following page.

The circled numbers refer to the reference numbers in the description of the electronics cabinets above.

All transducers (i.e. the load cell and the deflectors) are connected to sockets at the Compact15F Front Panel – please also see Section 14.

Block diagram showing powering of Fast FWD using Ethernet enabled FPS600.
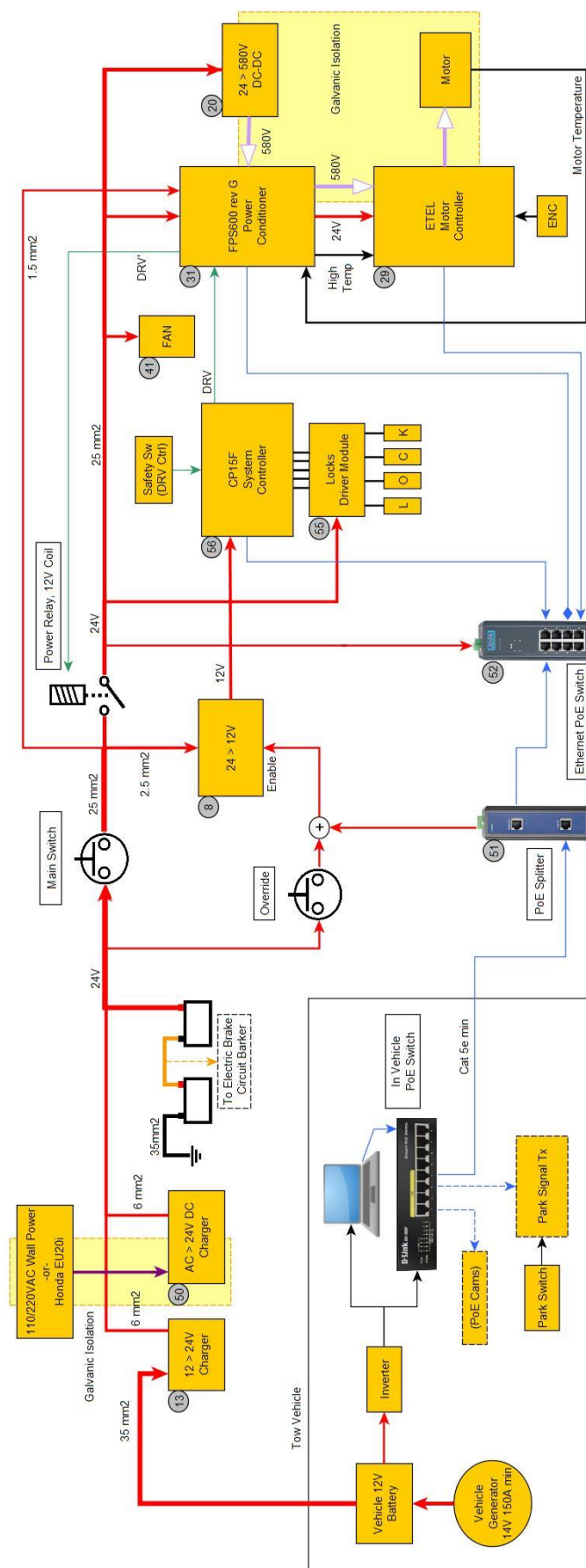
11.2 Electrical System

11.2.1 Trailer Status Switches

Three proximity switches are used for detection of the trailer "status" are connected to individual sockets of the CP15F Front Panel. On activation, the output of a proximity sensor is pulled low (by an internal, current limited NPN-transistor) to max. some 1V from the PWR GND. This causes the corresponding LED indicator, beside the socket on the CP15F, to turn ON.

PH: "Plate High" proximity switch sensor, only activated when the plate (i.e. the falling weight subassembly) is close to its highest position. Thus, **the PH LED must be ON when the plate is high. It must also be ON when the loading plate is resting on the transport locks in EITHER or BOTH side(s).**

WH: "Weight High" proximity switch sensor, activated when the weight is just above the locking pistons. Thus, **the WH LED must be ON when the weight package is resting on the upper locks.**

TG: "Trigger" proximity switch sensor, activated when the drop weight is less than 6 to 12 mm (1/4" to ½") from its lower, resting position. Thus, **the TG LED must be ON when the buffers are resting on the loading plate AND it must turn OFF when the weight has been raised more than 6 to 12 mm (1/4" to ½").**

WR: "Weight Released" micro switch sensor, activated when the weight locks (upper locks) are retracted (out of the way allowing free movement of the plate through all the drop height range. Thus, **the WR must be ON when the lock bolts are retracted (most of the time) AND it must be turn OFF when the bolts are extended (the weights are locked and resting on the upper locks).**

PR: "Plate Released" micro switch sensor, activated when the plate locks (lower locks) are retracted (out of the way) allowing free movement of the plate for lower and raise plate operations. Thus, **it must be ON when the plate is being lowered or raised and it must be OFF for all other movements.**

Test procedures for these status sensors are given in Section 17.6.1.

12. Transducers

12.1 *Load Cell 86207*

12.1.1 Key Features

- Compact Size
- Centre Bore for Centre Deflector rod
- Resistance to Extraneous Forces
- Long Term Stability and Fatigue Life
- True Linearity
- High Output

12.1.2 Description

The DYNATEST FWD LOAD CELL 86207 is a low profile shear web design strain gauge type load cell. Despite its high range of 250 kN (55 kips), it features a height of only 45 mm (1.75"). Due to the shear web design, the cell will deflect less than 30 microns (1.2 mil) at max. FastFWD peak load.

The load cell is mounted directly on top of the loading plate to minimize errors due to inertial forces from masses below the cell. This placing requires, however, that the load cell has a center-bore for the center deflector holder stem.

Despite the low profile, the high range and the low cell deflection, the 86207 load cell features a high electrical output of approx. 36 mV at max. FWD peak load and 15V excitation.

12.1.3 Specifications

Range: 250 kN (55 kips)

Nom. sensitivity: Approx. 16 µV/V/kN (73 µV/V/kip)

Excitation: 20V (DC or ACrms) max.

Sensitivity shift with temp.:   0.002%/deg. C (0.001%/deg. F) max.

Output resistance: 350 ohms (± 0.5%)

Temperature range: -30 to +80°C (-20 to 175°F)

12.1.4 Calibration

The DYNATEST FWD LOAD CELL 86207 has a nominal sensitivity of approx. 16 microvolts per volt excitation per kilo Newton of applied load (73 µV/V/kip).

The exact sensitivity has been achieved by a multi-point calibration against a special high-precision reference load cell.

As the load cell is used in connection with the Compact15F System controller, which has an automatic shunt calibration facility, the cell sensitivity achieved by the above mentioned calibration is specified as a shunt calibration value.

Shunt calibration means that a very precise resistor (0.1% tolerance) is connected in parallel with one of the four "legs" of the strain gage bridge of the load cell, thus equivalating a specific physical load applied to the cell. This specific, equivalent load is the shunt calibration value.

The advantage of using shunt calibration is that the final, registered load reading caused by the shunt calibration at any time will be equivalent to a physical load on the cell equal to the shunt calibration value, independent of the excitation voltage, input impedance, amplification etc. used in the registration equipment.

12.2 Seismic Detector 86211

12.2.1 Key Features

- High precision
- Long term calibration stability
- Very robust
- Light weight
- Weatherproof construction
- Clamping magnet for easy mounting
- Low impedance
- Requires no power

12.2.2 Description

The DYNATEST SEISMIC DETECTOR 86211 (SD, also sometimes named "deflector", "deflection sensor" or "geophone") is a very robust, high precision, light weight, seismic velocity transducer in a sealed and anodized aluminum housing. It has a natural frequency of approx. 4.5Hz and ± 2mm available movement of the seismic mass.

The SD is delivered with a cable length of 5 m. A clamping magnet at the bottom of the Deflector makes fixture to and removal from a deflector holder quick and easy.

The SD can only be used for the measurement of vertical movements with the clamping magnet downwards and the mounting surface horizontal. If the Deflector is tilted, the measuring *range* will be decreased, but the *sensitivity* will remain virtually unaffected.

12.2.3 Specifications

(SD vertical within 10 degrees, clamping magnet downwards, values typical at 25°C unless otherwise specified):

Natural frequency: approx. 4.5 Hz

Output resistance: 375 ohms

Damping coefficient: approx. 0.7 (when connected to the electronics)

Available movement
of seismic mass: 4 mm (total, i.e., +/- 2 mm from equilibrium position)

Weight: 250 g (excl. cable)

13. Calibration

13.1 *Relative Deflector Calibration*

Relative Deflector Calibration Procedure assures the highest possible degree of deflection basin accuracy and consistency (without performing a *reference* calibration). This calibration can be performed by the user. The Relative Deflector Calibration Procedure verifies the similarity of the response from each of the deflection sensors. A series of multiple drops are recorded when all the deflection sensors are mounted in a stand and exposed to the same deflection.

Reference Deflector Calibration Verification requires specialized equipment (can be performed by Dynatest) and will not be detailed here. The *Relative* Calibration Procedure, however, also reveals if the gain of a deflector is out of range. Hence this Relative Calibration Procedure is so very important. The procedure is the same for FWD, HWD and Fast FWD.

The system should be charged during testing.

The Relative Deflector Calibration consists of three steps.

Data collection	A test is performed to obtain data from the deflection sensors
Analysis	"PrEN-5 RelCal.xlsx" is used to calculate the data
Gain adjustment:	If required the relative gains are adjusted in DDC
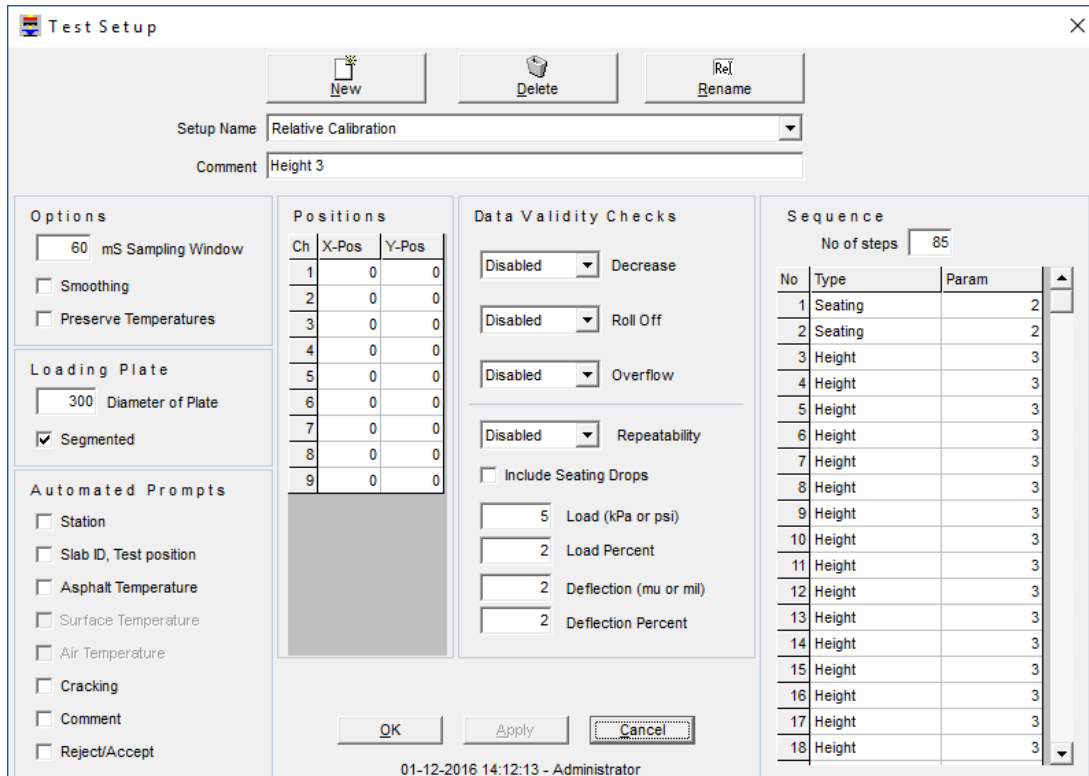
13.1.1 Data Collection

Remove the deflection sensors from the raise/lower bar and place them in the calibration column starting with deflector number one in the bottom as shown under "1. RUN" in below picture.
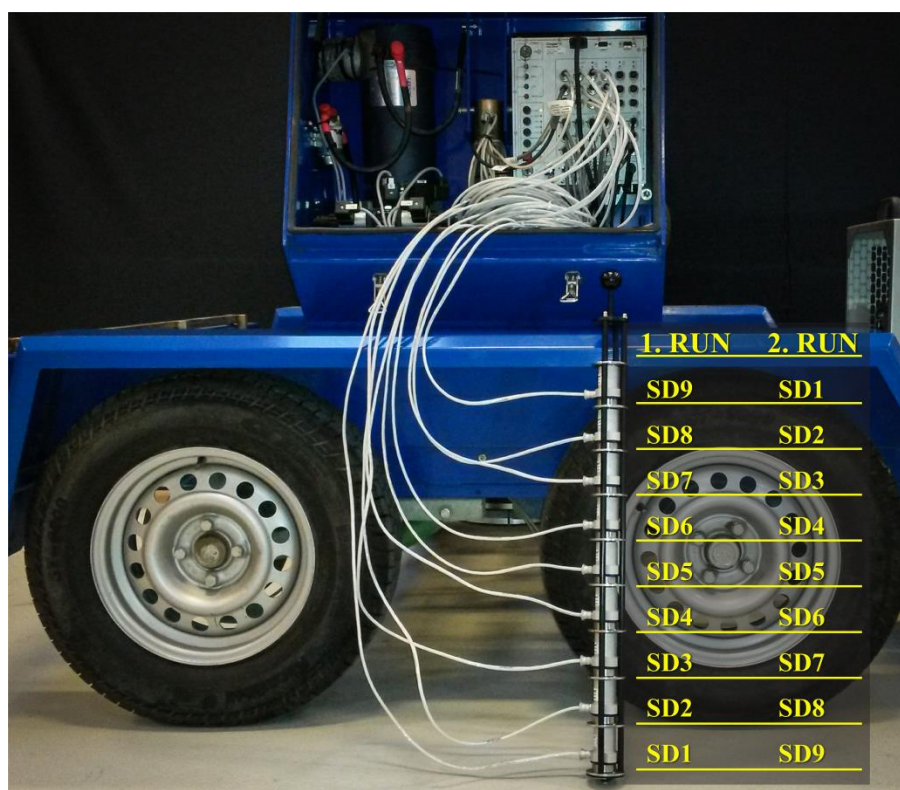
The Test-Setup for the Relative Deflector Calibration consists of 2 sets of 42 drops (2 seating and 40 recorded) separated by a pause. Thus a total of 85 steps.

The recorded deflection must be 350µm ± 100µm. Place the Calibration Column with the deflectors in a vertical position close to the load cell and press it firmly to the ground. Use the manual function in DDC to determine which drop height would be suitable to generate the requested deflection and use this Height Parameter in the Test Setup.

After preparation of Test Setup, open a new file and start the test with the calibration column placed in the same position as when drop height was selected. Again, it's vital that the column is held vertical and with a firm pressure to the surface.

After 2 seating drops and 40 recorded drops the pause will appear. The pause is used to mirror the deflectors in the calibration column. The deflectors should now be placed as described in "2. RUN" in previous page illustration. Now run the last 42 drops and close the file.

13.1.2 Analysis

Open the .mdb test file that was generated. If a security warning pops up, click "Open".

Choose "Enable content".
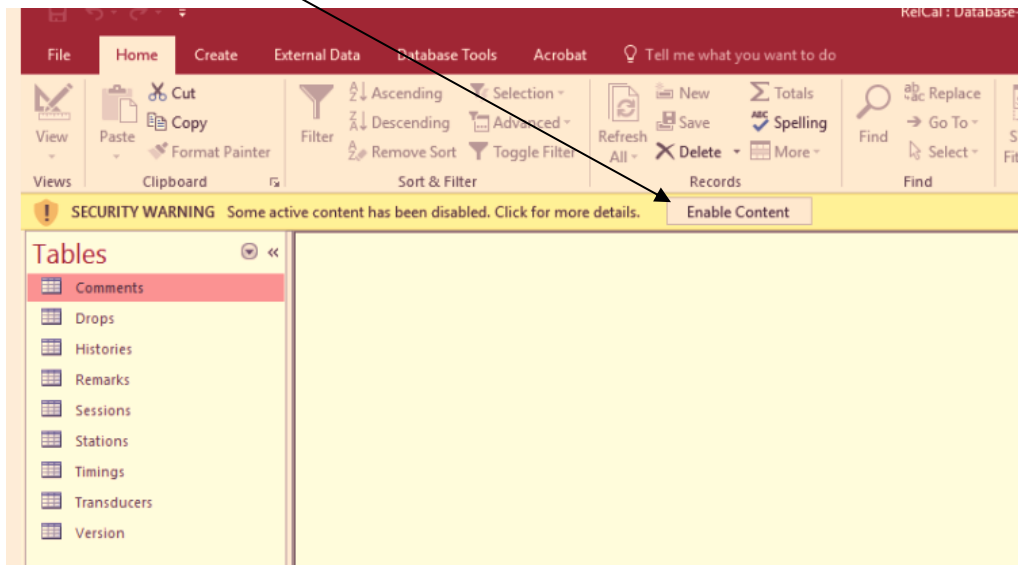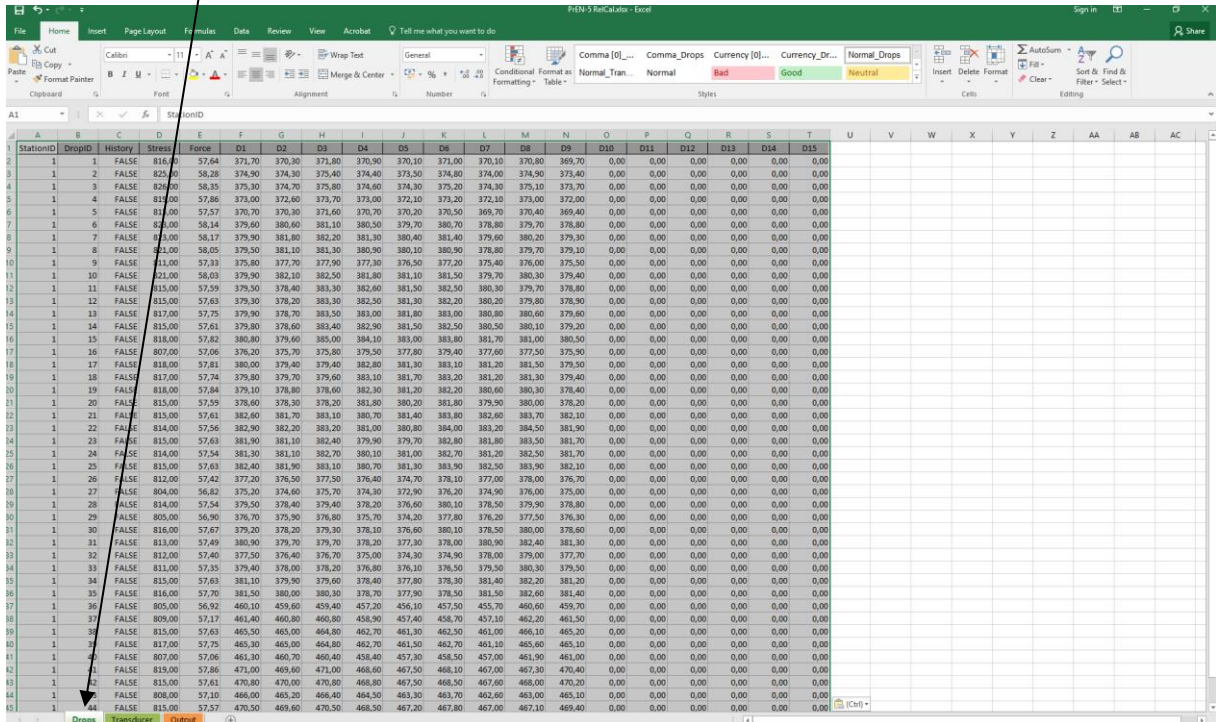
Open the "Drops" tab and copy all content.

Go to [C:\Dynatest\Data] and open "PrEN-5 RelCal.xlsx".
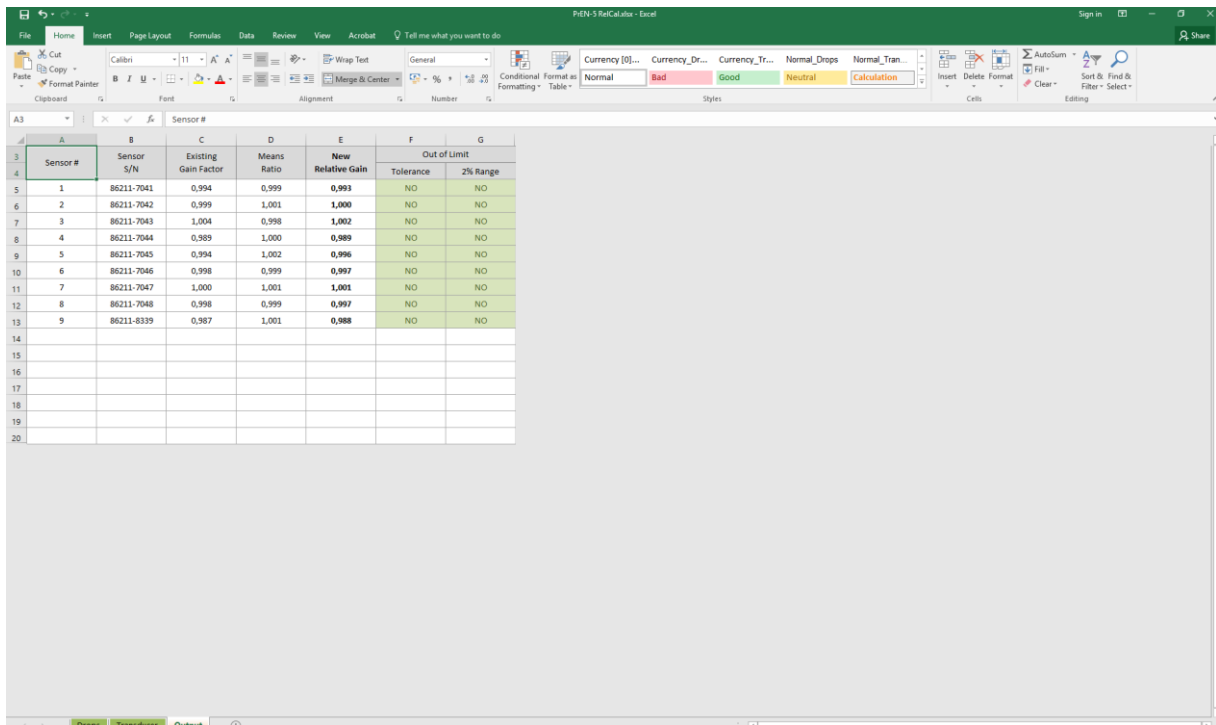
Choose the "Drops" tab and paste the copied data from the .mdb test file.

Now copy the content from the "Transducer" tab in the .mdb test file to the "Transducer" tab in the .xlsx file, in the same manner as the drops content.

Choose the "Output" tab in the .xlsx file to view the result of the relative calibration.

In the Output table, the calibration results for each individual deflection sensor is represented.

Tolerance:

A means ratio between 0.995 and 1.005 inclusive is considered equal to a ratio of 1.000, and no adjustments to the Relative gain is necessary. In this case the "Tolerance" field will be green and state "No".

If the means ratio is greater than ±0.005 the "Tolerance" field will be red and state "YES". The Relative Gain will then have to be updated in DDC (see next section "Deflector gain adjustment") and the Relative calibration should be performed again

2% Range:

The means ratio must be within the range of 0.980 and 1.020. Contact Dynatest for evaluation of the deflection sensor if it is out of the 2% range.

13.1.3 Gain Adjustment

As described in previous section a means ratio greater than ±0.005 requires an update of the relative gain for the deflection sensor.

In DDC go to [Setup] [deflectors].

Ch	Serial No	Rel.Gain	Abs.Gain	Param	Modified	By
1	86211-7041	0,993	1,040	@PLJ@FVR	02-12-2016	Dynatest
2	86211-7042	1,000	1,026	@PHZ@HJP	02-12-2016	Dynatest
3	86211-7043	1,002	1,041	@N>V@F<Z	02-12-2016	Dynatest
4	86211-7044	0,989	1,042	@PFD@H@H	02-12-2016	Dynatest
5	86211-7045	0,996	1,033	@PJZ@HLR	02-12-2016	Dynatest
6	86211-7046	0,997	1,010	@PDB@HRR	02-12-2016	Dynatest
7	86211-7047	1,001	1,012	@PRF@HFV	02-12-2016	Dynatest
8	86211-7048	0,997	1,033	@PJF@HBR	02-12-2016	Dynatest
9	86211-8339	0,988	0,993	@PL<@FFJ	02-12-2016	Dynatest

Update the values in "Rel. Gain" column to reflect the ones in the "New Relative Gain" column in the "PrEN-5 RelCal.xlsx". The Relative calibration should now be performed agin, to ensure that the new relative gain is correct, and means ratio are within tolerance.

The relative calibration is now completed.

If you want to save the result in "PrEN-5 RelCal.xlsx" remember to choose the "Save as" option and leave the original worksheet for the next relative calibration.

13.2 *Air Temperature Sensor Calibration*

Before delivery of a Dynatest Air Temperature Sensor, the best-fit calibration line for this sensor has been established from linear regression on a set of 9 values obtained from a reference calibration procedure performed by means of a high-accuracy, certified, dry-block calibrator traceable to international standards. The 9 reference temperatures are 5 to 45 °C in steps of 5 °C. A sensor is only approved if it performs to linearity specifications.

The Temperature Applet needs two calibration "numbers" (V1 and V2, i.e. sensor output values (in mV)) to calculate and display the air temperature. These values are the sensor outputs at 0 °C and 100 °C *calculated* from the above-mentioned, linear regression line (and therefore not necessarily the values which the sensor would *actually* output at these temperatures). This procedure ensures maximum possible accuracy in the most important range of 0 °C to 50 °C.

The Temperature Applet provides an automated procedure for periodic verification of the calibration numbers of the Air Temperature Sensor in TWO points, which is in most cases adequate, as the *linearity* of a sensor has been checked at the initial calibration and normally does not change significantly with time, and two points therefore will suffice to determine the (linear) calibration line.

For maximum accuracy, Dynatest render a 9-point re-calibration service.

For a user to perform the two-point calibration verification procedure, one or two stirred liquid bath(s) will be required. To monitor the (reference) temperature of the liquid, we recommend a digital reference thermometer with a traceable accuracy of ±0.4 °C or better (in the 0 °C to 50 °C range) and a resolution of 0.1 °C or less.

The temperature of the stirred liquid bath(s) must be adjustable to "low" and "high", stable reference temperatures. The low temperature should be in the range of 0 °C to 10 °C, and the high temperature should be in the range of 40 °C to 50 °C. The measuring tips of the Air Temperature Sensor and the reference temperature sensor should be in as close contact as possible at all times during the calibration.

Calibration instructions are provided on the screen. The operator need only follow these instructions to successfully perform a calibration. When each of the temperature readings stabilizes, the buttons near the right edge of the screen can be used to enter the voltage values. This reduces the possibility of typed input errors.

When the calibration is complete, the Temperature Applet calculates new calibration voltages and display them in the fields labelled **New V1** and **New V2**. The operator may then click the **Apply** button to store and use the new calibration figures. Alternatively, if the operator is not satisfied with the calibration results, he may click **Cancel** to discard the new figures and keep the old ones.

If the operator wishes to enter calibration values without performing the calibration, he may do so by clicking on the **Calibration figure V1** and **Calibration figure V2** fields and manually overtyping the existing values. In this case, the operator would then click the **OK** button to store the new values.

13.3 *Surface Temperature Sensor Calibration*

Before delivery of a non-contact Dynatest IR (Infra-Red) Surface Temperature Sensor, the best-fit calibration line for this sensor has been established from linear regression on a set of 9 values obtained from a reference calibration procedure performed by means of a high-accuracy, certified, dry-block calibrator (with a special adapter giving the desired emissivity of 0.95) traceable to international standards. The 9 reference temperatures are 5 to 45 °C in steps of 5 °C. A sensor is only approved if it performs to linearity specifications.

The Temperature Applet needs two calibration "numbers" (V1 and V2, i.e. sensor output values (in mV)) to calculate and display the air temperature. These values are the sensor outputs at 0 °C and 100 °C *calculated* from the above-mentioned, linear regression line (and therefore not necessarily the values which the sensor would *actually* output at these temperatures). This procedure ensures maximum possible accuracy in the most important range of 0 °C to 50 °C.

The Temperature Applet provides an automated procedure for periodic verification, establishing the calibration numbers of the Surface Temperature Sensor in TWO points, which is in most cases adequate, as the *linearity* of a sensor has been checked at the initial calibration and normally does not change significantly with time, and two points therefore will suffice to determine the (linear) calibration line.

Calibration of an IR sensor is NOT a simple task, so we recommend users NOT to perform this procedure themselves unless absolutely necessary. For maximum accuracy, Dynatest render a 9-point re-calibration service.

If a user decides to perform the two-point calibration verification procedure anyway, one or two stirred water bath(s) can be used. To monitor the (reference) temperature of the water, we recommend a digital reference thermometer with a traceable accuracy of ±0.4 °C or better (in the 0 °C to 50 °C range) and a resolution of 0.1 °C or less.

The temperature of the stirred water bath(s) must be adjustable to "low" and "high", stable reference temperatures. The low temperature should be in the range of 0 °C to 10 °C, and the high temperature should be in the range of 40 °C to 50 °C. The Surface Temperature Sensor and the liquid bath with the reference temperature sensor should be enclosed, so evaporation from the water will not decrease its surface temperature, and also to prevent condensing moisture on the lens of the Surface Temperature Sensor, which should be placed vertically, preferably with a distance of some 300 mm between the lens of the sensor and the surface of the water, with no objects between the lens and the water surface.

Calibration instructions are provided on the screen. The operator need only follow these instructions to successfully perform a calibration. "Low" and "high" temperature measurements are obtained as explained above. When each of the temperature readings has stabilized, the buttons near the right edge of the screen can be used to enter the voltage values. This reduces the possibility of typed input errors.

When the calibration is complete, the Temperature Applet will automatically calculate new calibration voltages and display them in the fields labelled **New V1** and **New V2**. The operator may then click the **Apply** button to store and use the new calibration figures.

Alternatively, if the operator is not satisfied with the calibration results, he may click **Cancel** to discard the new figures and keep the old ones.

If the operator wishes to enter calibration values without performing the calibration, he may do so by clicking on the **Calibration figure V1** and **Calibration figure V2** fields and manually overtyping the existing values. In this case, the operator would then click the **OK** button to store the new values.

13.4 *DMI Calibration*

Dynatest provides a simple method for calibrating the DMI. It does require however, that the user has access to a smooth straight pavement section (of say 1 km or 1 mile of length) which has been accurately measured and whose endpoints have been marked.

To initiate the DMI calibration, right click the DMI applet and select **Calibration**.

The first fields in the screen holds the encoder Model, Serial Number and Pulses per Revolution.

Enter the approximate tire diameter

"Counts per 10 km" is the calibration value currently in effect. This is the total number of counts received from the wheel encoder over 10 kilometres.

The field labelled "Current reading" is the distance travelled since the DMI was last reset.

The "Flip Direction" (phase reversal) should be toggled if the reading decreases when driving forward.

The Calibration Procedure consists of the following steps:

1. Locate a straight, smooth, accurately measured pavement section with no distresses.
2. Enter the measured length of the section.
3. Locate the starting point and stop the vehicle as close as possible, then press **Start**.
4. Accelerate gently to a constant speed, maintaining a straight trajectory over the length of the calibration section.

5. Slow down in a smooth manner and stop the vehicle as close to the end of the section as possible.
6. Click the **End** button. The program will calculate a new calibration figure and display it in the window under the **End** button.
7. If the calibration figure is within a few percent of the old figure, click the **Apply** button to accept it. Note that the box at the bottom of the window shows the percent change from last calibration.
8. Click the **Ok** button to return to close the window.
9. If the calibration figure is more than 1% different from the old figure, subsequent runs should be performed. If the calibration figure is erratic, check the system for possible problems with the tires, encoder mounting, encoder wiring, etc.
10. The calibration process can be abandoned at any time provided the **Cancel** button is pressed before the **Apply** button.

14. Setup Details

14.1 *GPS*

14.1.1 Prefetch Maps

If you don't have Internet connection during data collection, then you may prefetch map imagery when the Internet is available. This can be done by connecting your laptop to an office network and run DDC in simulation mode.

Right click the GPS applet and chose "Map Setup"
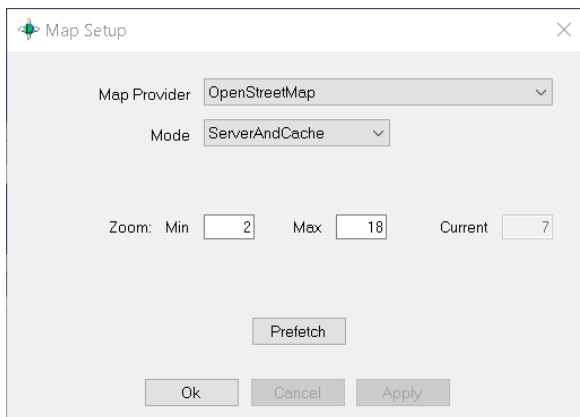
Select the desired Map Provider

ServerAndCache means that if a tile is not found in the cache, then it is fetched from the Internet

Embrace your area of interest (Denmark) and get familiar with the detail of zoom levels. This is zoom level 15 with a fair amount of detail:
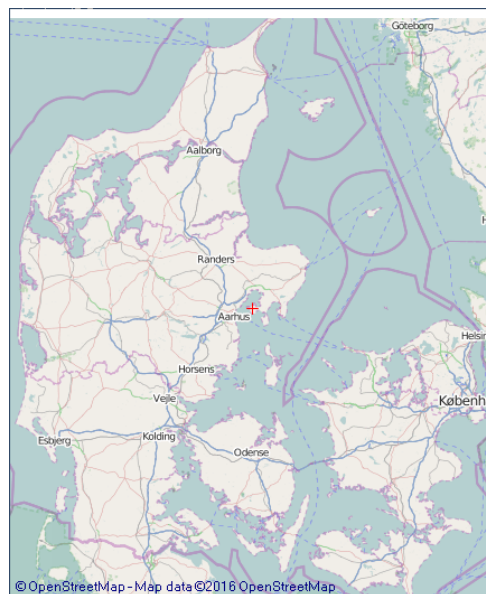
Zoom out again to level 7 to embrace all of Denmark and then set Zoom Max to 15.

Press "Prefetch" to start the process.
This may take several hours!

![Dynatest]
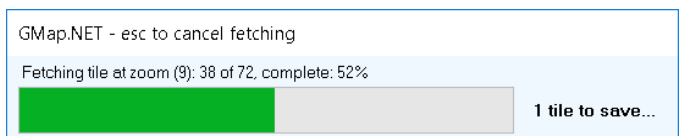
14.1.2 Trimble Ag262 Setup

We will setup the Ag262 through port B and later use the device through port A

Install Trimble's AgRemote software

Connect signal cable to port B

Connect RS232 plug to computer

Apply power

Start AgRemote and choose File – Connect, then select the right COM Port:
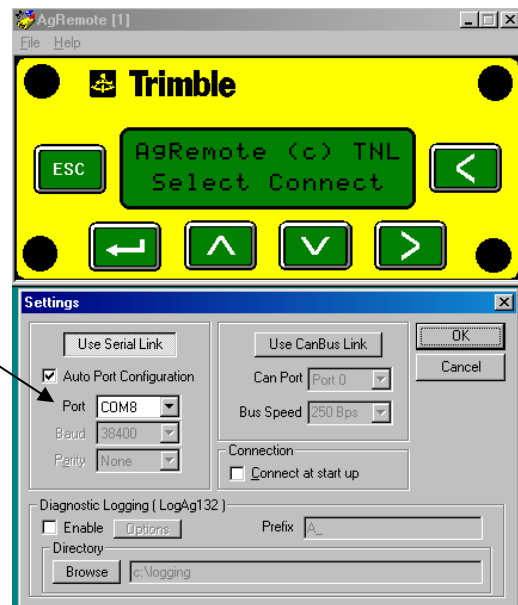
Connection is established if this comes up:
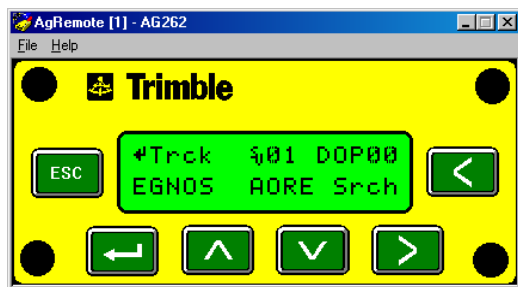
Click **>** until **Configuration** then **V** once, then **>** until **Port A Config**:

Click **V** to enter Port A configuration:
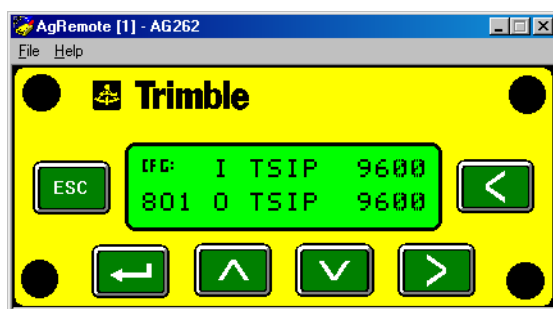
Click **>** until cursor reaches **O** in **8O1**, then click **V** once to make it **N** (no parity)
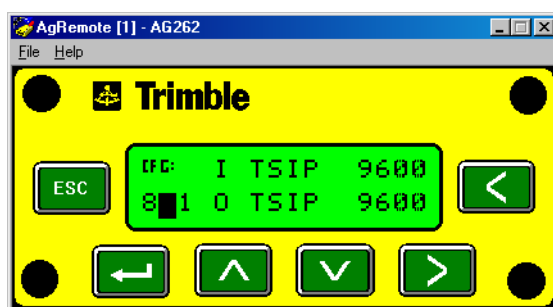
Click **>** until cursor reaches **TSIP**, then click **V** until you get **NMEA**
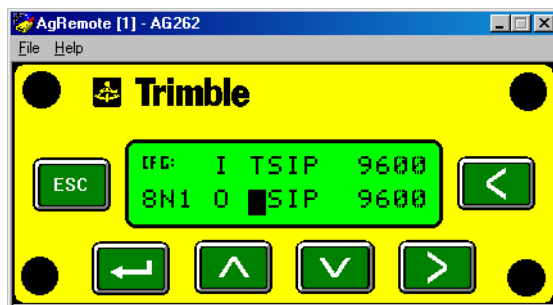
If the baud rate is not 9600, then change it

Press ← (Enter) to terminate edit mode

Click **V** to check the NMEA message settings, which should be as follows (GGA only):
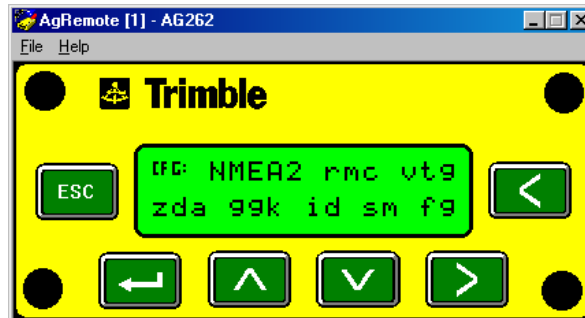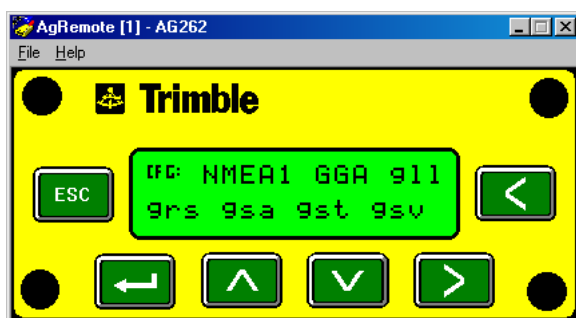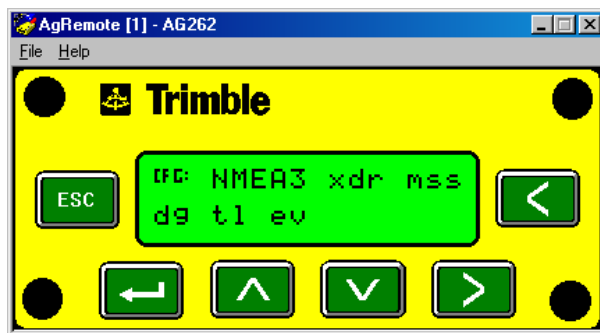
Click **V** to get to:

Then click **ESC** to return to idle display
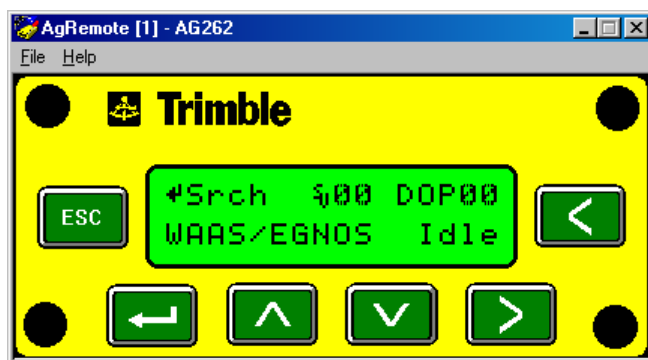
Then Choose [File] – [Disconnect] and exit the AgRemote program.

Switch off the GPS

Connect signal cable to port A

Check the GPS with DDC

![Dynatest logo]

14.1.3 Trimble BX982, Ver. 85992-<u>01</u> (Basic Version) Setup

Download WFC-BD9xx-V494.exe from this web site:

http://intech.trimble.com/support/oem_gnss/trimble_bd982

Install on a computer on the usual 192.168.1.xxx network.

Connect a Serial cross over cable to PORT4 at the BX 982

Connect an Ethernet cable to the BX 982 "Dongle"

Start WinFlash and set the COM port for your computer:
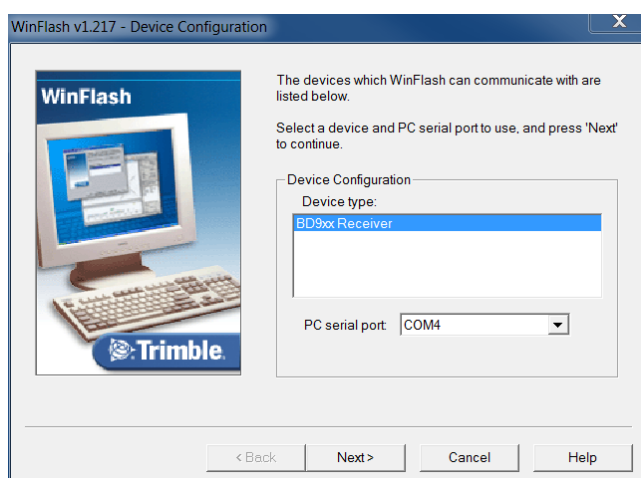
Chose "Configure ethernet settings"
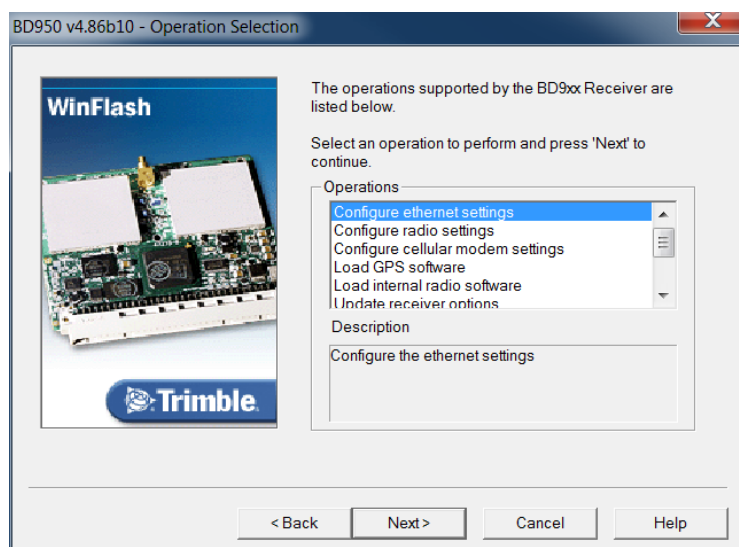
Click "Next" then "Finish"

The program now tries to communicate via COM

The default setting is DHCP

Change that to "Static IP address"

and enter IP Address: 192.168.1.19

Press OK and the BX 982 will reboot

Exit WinFlash
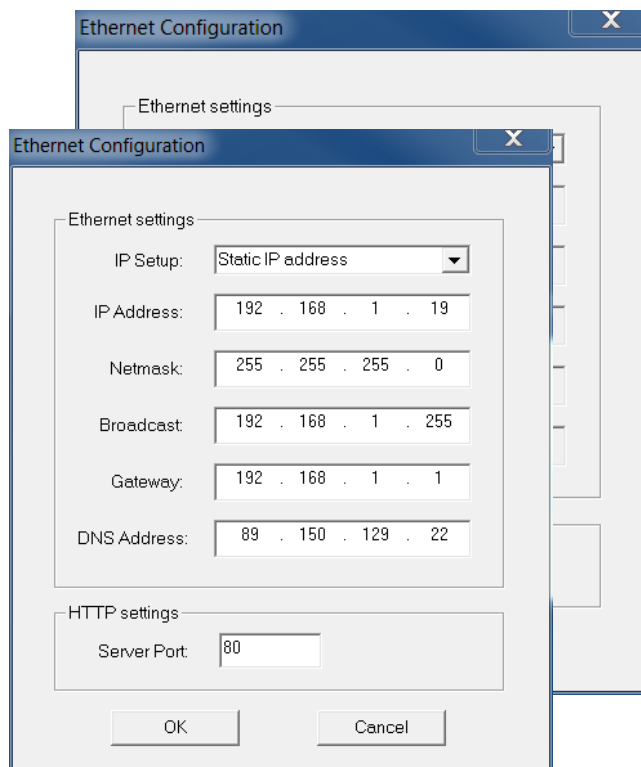
Open an Internet browser and enter 192.168.1.19 in the address line

User name: admin

Password: password
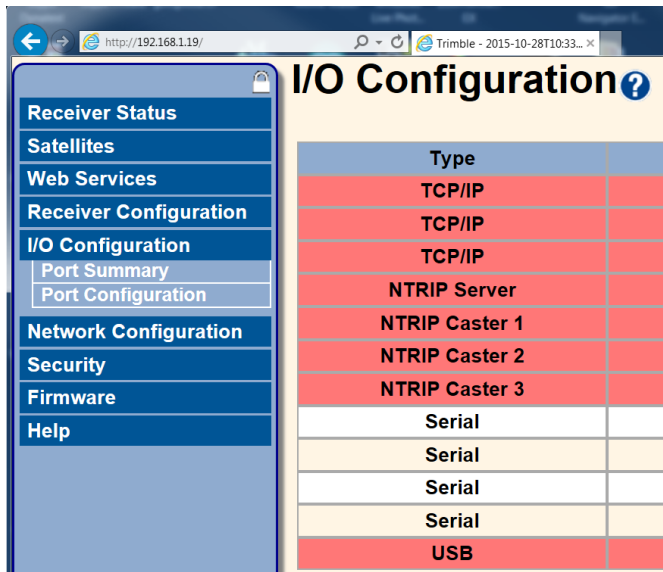
In I/O Configuration click one of the TCP/IPs

Chose: **NMEA,** Listen port: **15919, GGA** at **10 Hz**

Press OK
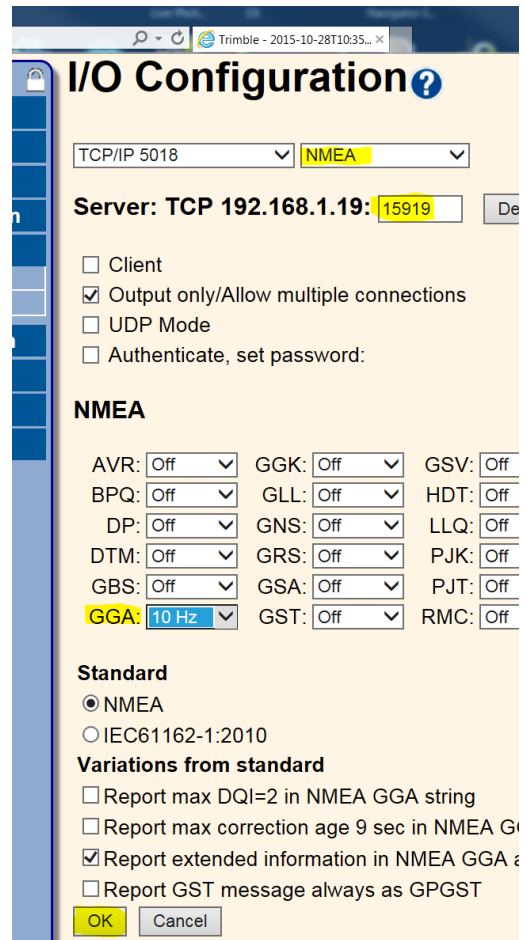
Chose Serial COM1 and setup for

NMEA, 38400 Baud, GGA at 10Hz

And Press OK

Close the browser
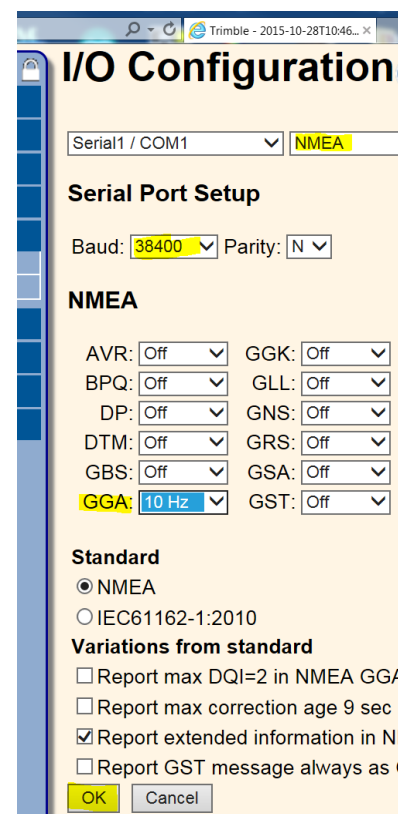
Start DDC with GPS applet colored
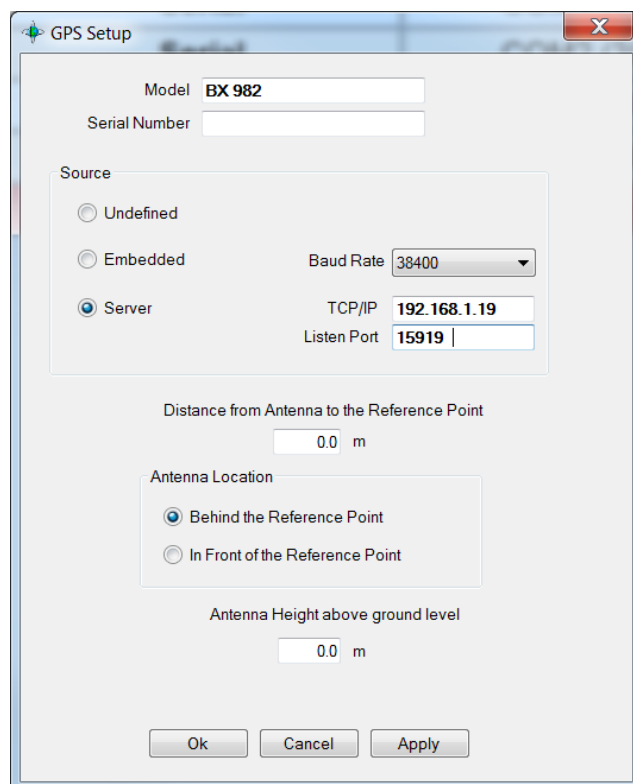
Right click the GPS window and chose [Setup]

Set Server to 192.168.1.19 and Listen port 15919

Enter figures for antenna position

(there will be two Distance from Antenna fields, one for FWDs and one for RSPs)

For standard GPSs the "Reference Point" is the location of the Antenna. For Applanix the Reference Point can be chosen freely. For an RSP this will typically be the Laser spot produced by the Center Line laser or the center of the IMU unit.
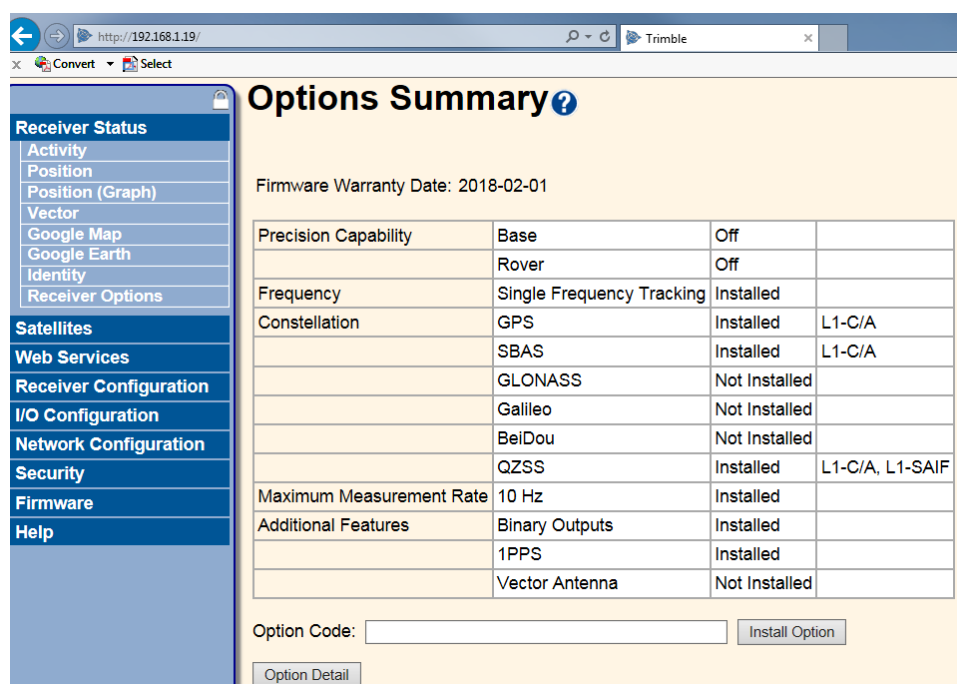
When the setup (of a standard, basic version BX982, Version 85992-01) has been completed, the Options Summary should look like this:
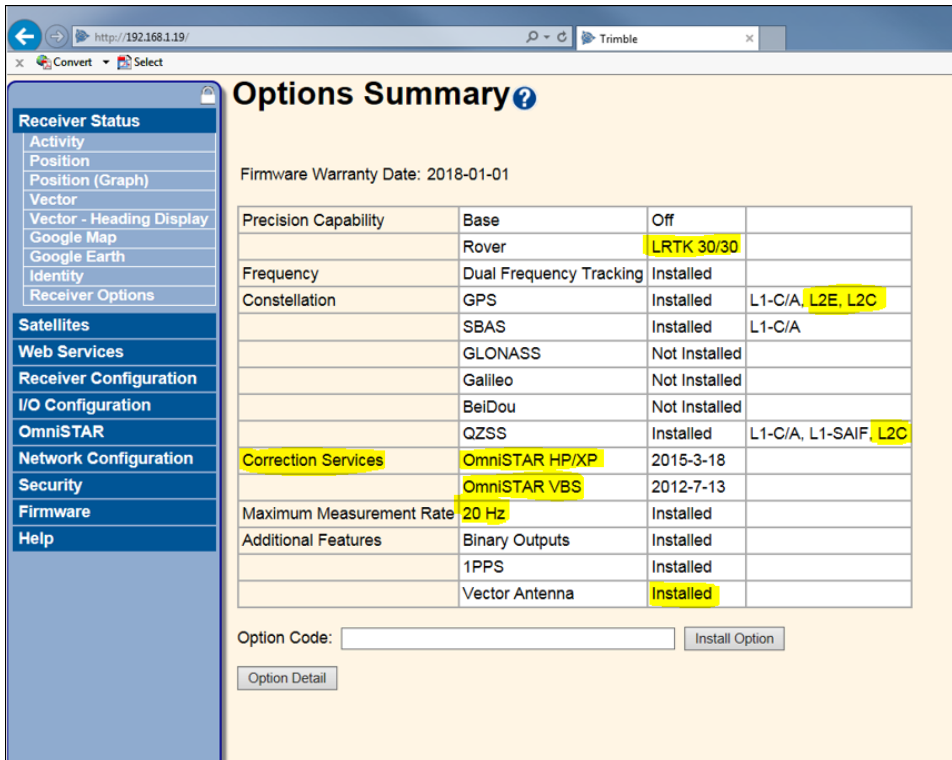
14.1.4 Upgrading a BX982 to Ver. 85992-<u>02</u>

To upgrade a ver. 85992-01 (which has been set up as described above) to a ver. 85992-02, do the following:

1. Use the equipment laptop PC (or a computer with the usual 192.168.1.xxx network)
2. Connect an Ethernet cable to the BX 982 "Dongle"
3. Open a web-browser and type 192.168.1.19 in the address field
4. Press "Enter"
5. Click "Receiver Status"
6. Click "Receiver Options"
7. Enter the supplied Password / Code in the "Option Code" field
8. Press the "Install Option" button, which should result in an updated "Options Summary" window as shown below
9. Check additions marked with yellow highlighting

14.2 *Cameras*
14.2.1 Mounting

Camera Suction Disc Mount
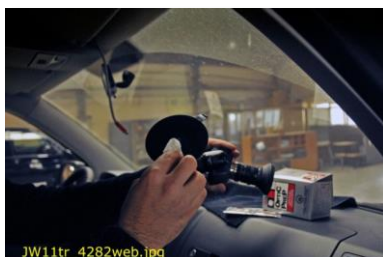
Clean the suction disk

Clean the window

Pull back the plastic housing to protrude
the rubber suction disk

Press the rubber suction disk firmly against
the window.

Apply suction with the lever and lock in position.

Adjust focus and aperture.

14.2.2 Exposure

Aperture Adjustment
Shutter Speed and Field of Depth depends on the F-stop setting, the size of the aperture opening. The lens aperture ranges from F 1.4 to F 22 typically

Smaller F-stops numbers = larger opening.

Larger openings = more light.

Larger openings = faster shutter speed.

Larger openings = narrows the Field of Depth. Background and foreground becomes blurred, out of focus.

Balancing Shutter and Aperture
F stop 4 is a good all-round setting. On bright sunny days this gives fast shutter speed, to avoid motion blur, together with "full" Field of Depth.

On dark overcast days and when approaching sunset you can continue to drive as fast as the trucks do and produce good sharp images.

Shutter is defined as the integration time of the incoming light where both the Manual and Auto Shutter are supported.

The shutter range varies from 1us ~ 3600sec.

Camera Auto Exposure Control
The automatic shutter/gain mode is based on a feedback loop which calculates the average pixel luminance. Then the average is compared with the exposure reference value, adjusting shutter and gain accordingly.

14.2.3 Unibrain Camera

Unibrain Fire-i™ 780c 1394b SXGA, 2/3" CCD camera with a 12.5mm Fujinon C-mount "Megapixel lens"
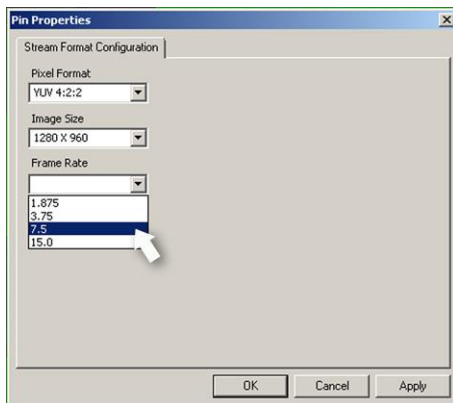
Right click the Camera applet and chose "Picture Format"

Values shall be:

Pixel Format: YUV 4:2:2

Image Size: 1280 x 960.

Fire-i 780c Frame Rate 7.5 (Frames/Sec).
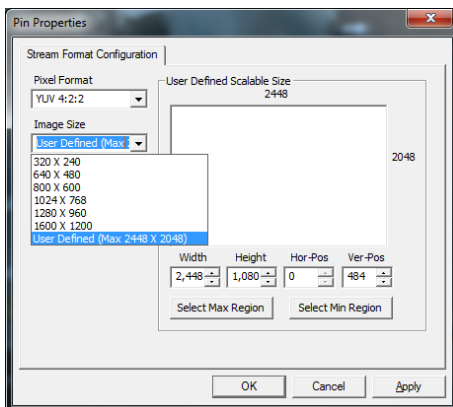
Unibrain Fire-i 980c

Max resolution 2448 x 2048 pixels.

The following items are normally "one-time adjustments" only, or should be done if any unusual problems with picture focusing or brightness occur.

Park the vehicle and make sure to have an object (preferably vertical) with some text on it (a road sign, a paint bottle or the like) some 10-15m from the camera.

Boot the system, so that ROW pictures are shown on the monitor.

Right-click on the ROW picture and select "Aspect/Size", then select "Full Screen".

Right-click on the ROW picture and select "Camera Settings" and then "Exposure"
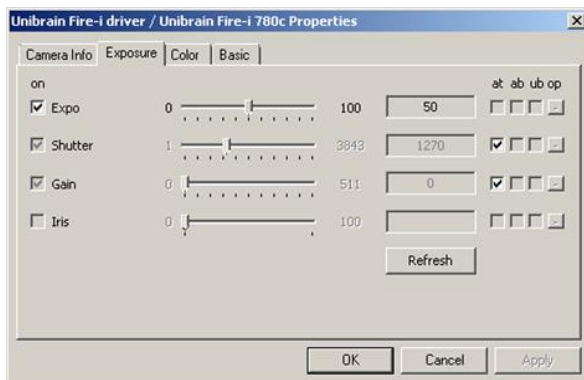
For "Shutter" as well as for "Gain", check the "at" box.

Expo: Regulates the total amount of light. Can be used to regulate the overall "lightness / darkness" of the pictures.

Shutter: and Gain: With check marks in Shutter and Gain "at" the camera automatically adjusts the optimum exposure value.
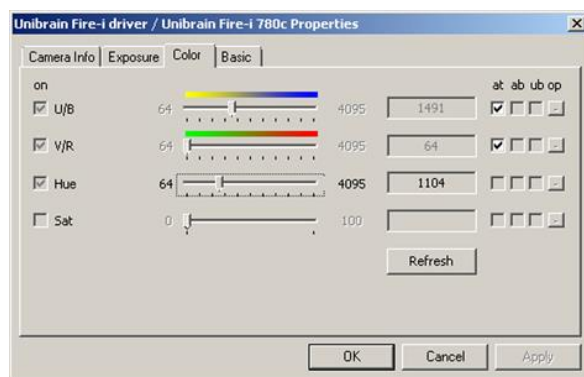
Right-click on the ROW picture and select "Camera Settings" and then "Color".

For "U/B" as well as for "V/R", check the "at" box

Color (White Balance):

With check marks in U/B and V/R the camera automatically adjusts correct color balance.

U/B Ultraviolet-Blue.

V/R Visible-Red.

Hue: Can be used to adjust overall color cast of the pictures.

Right-click on the ROW picture and select "Camera Settings" and then "Basic".
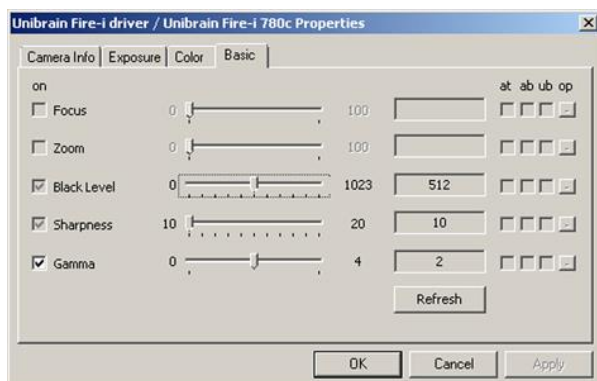
Black Level: Adjust brightness and tonal range by specifying the location of complete black.

Sharpness: Sharpening enhances the definition of edges in an image. Too high setting will create "noise" in the picture.

Gamma ~ "Brightness". Corrects the ratio between maximum light (white areas) and minimum light (black areas) in the picture.

If too high "contrast" in your picture adjust gamma down.

If necessary (normally a one-time adjustment), adjust the focus manually as follows:

a) Loosen the f-stop ring locking screw and set the f-stop to the minimum No. (1.4), i.e. maximum aperture opening (maximum light)
b) Then loosen the focusing ring locking screw and adjust the focusing till you get max. sharpness of the object 10-15m away
c) Lock the focusing ring lock screw
d) Set the f-stop No. to 4
e) Lock the f-stop ring locking screw

It is recommended that the Focus Adjustment is done with camera image displayed on the monitor in the camera chip's native size.

Unibrain Fire-i 780c: 1280x960 pixels.

Unibrain Fire-i 980c: "Panoramic View", typ. 2448x1080 pixels.

14.2.4 Unibrain Troubleshooting

Camera has not been recognized by Windows:
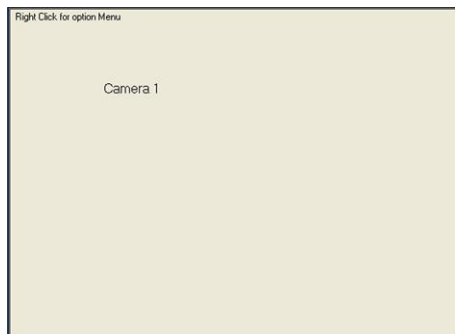
Empty Image Holder

.

Is the LED on the camera on?

Check all cable connections.

Power and connection ok and still empty Image Holder?
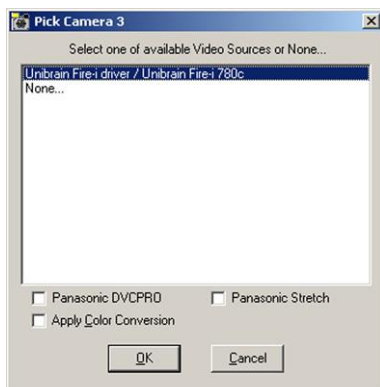
Drivers for laptops build-in web-camera may also be listed

Right Click Image Holder.

In the pop-up Menu Click "Pick Camera".

Choose "Unibrain Fire-I driver / Unibrain Fire-i 780c".

Click OK.

![Dynatest logo]

Still no image?

Camera(s) working, signals received by DDC, but image are scrambled:

Scrambled / Distorted Image

Frame Rate
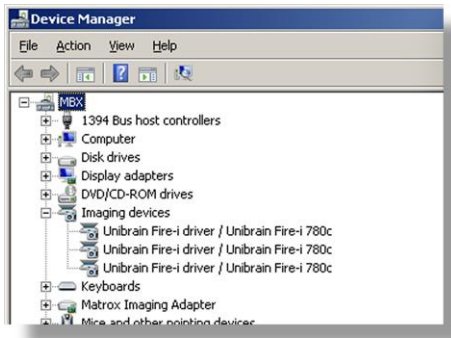
Check Windows' Device Manager -> Imaging devices.

Under "Imaging devices" the "Unibrain Fire-i driver…" must be listed.

If no "Imaging devices" listed, or only the laptop's build-in web-camera?

Check that the PC-card is in place.

Check cables for loose connections.

Reinstall drivers.
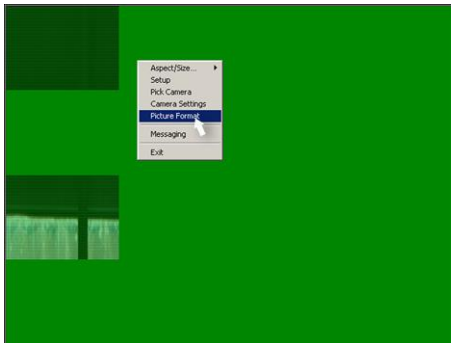
Right-Click image holder to bring up the menu.

Click "Picture Format".
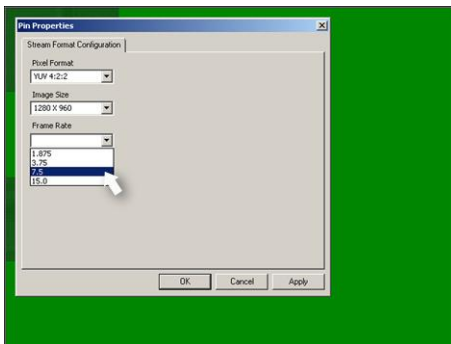
Fire-I 780: Values should be:

Pixel Format: YUV 4:2:2

Image Size: 1280 x 960.

Frame Rate 7.5 (Frames/Sec).

15. Electrical control system

15.1 The Compact15F System Controller
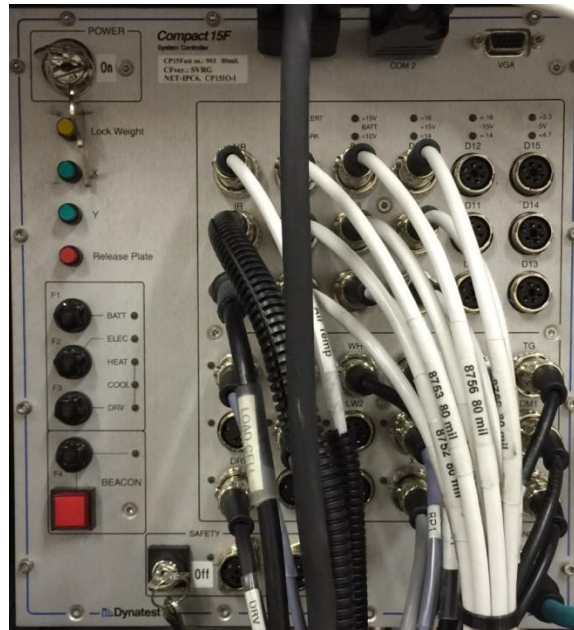
The Compact15F (CP15F) System Controller

15.1.1 Key Features

- Light and compact design
- Based on Embedded PC technology
- Performs control of the FastFWD system operation
- Performs scanning and conditioning of up to sixteen transducer signals (from one load cell + fifteen deflection transducers max).
- Scans and stores the time history of the transducer signals and calculates peak values.
- Self-test.
- Ethernet interface for connection to host computer
- COM1 port for diagnostics and GPS.
- COM2 port not assigned.
- 12VDC powered, current drain approx. 4 Amps.

15.1.2 General Description

The Dynatest Compact15F System Controller is a compact, PC based electronic unit, interfaced with the electrical components of the FASTFWD unit as well as with the Computer.

The main functions of the System Controller are:

- Control of the FastFWD operation via the motor controller.
- conditioning, scanning, digitizing and transmission to the computer of the signals from up to sixteen transducers, i.e. one load cell and fifteen deflection transducers (Deflectors).

- A continuous testing of system performance to reveal functional or operational errors.

A standard CAT5 Ethernet patch cable connects the Compact15F System Controller to an Ethernet Switch in the Trailer.

For diagnostics and setup purposes the COM1 port may be connected through a "NULL-Modem" cable to a PC running a simple terminal program.

COM1 (Diagnostics and GPS) and COM2

The only power source needed to power the Compact15F System Controller is 12VDC (10 to 15VDC).

Key Specifications

Power Requirements:

Voltage: 12VDC nominal, range 10 to 15VDC

Current drain: Approx. 2 Amps. (Not including output power for extern solenoids etc.)

Ambient Temperature Ranges

Operating: -20 to 50°C (0 to 120°F)

Storage: -40 to 85°C (-40 to 185°F)

15.1.3 Notes on Specifications

Note that the temperature range of the connected Computer may be narrower than that of the Compact15F. Note also that the upper limit of 50°C (120°F) will be exceeded at a lower ambient temperature when the unit is exposed to direct sunlight.

With respect to moisture, condensing should be avoided. Normally, this is not a problem with the electronics operating, as the built-in temperature control dries out the unit. But if the unit is colder than the ambient (e.g. after a cold night in a garage), condensing can occur, and if problems are observed, the electronics has to be kept switched on for a while to dry out the box. Condensing moisture may e.g. result in a wrong load cell shunt calibration value and/or amplifier offset(s), which will be detected as "excess vibration or drift".

15.1.4 Switch ON

The Compact15F contains an Embedded PC. The sequence of events when the system is powered is as follows:

1. BIOS initializes the standard PC components.
2. The Embedded PC boots up and initializes the network drivers.
3. A "Stand-Alone" program named CP15BOOT starts (sounds a short beep).
4. When CP15BOOT detects the Host computer, then it requests a connection.
5. When DDC has established the connection, then CP15F starts the main embedded program named CP15MAIN (sounds another short beep).

Step one and two above lasts approximately 30 seconds.

CP15BOOT starts by sounding a short beep. After that the manual buttons are operable.

The whole boot process and the output of both CP15BOOT and CP15MAIN can be observed by running a terminal program with a Null-Modem cable from Compact15F COM1 to a computer.

15.1.5 Description

LED indicator lights

ALERT   Indicates any "forbidden" Status Sensor Signal combination.

PARK   Towing vehicle Park indicator

BATT   Trailer battery voltage indicators.

+15V   Internal, stabilized +15V supply.

-15   Internal, stabilized -15V supply.

5V   Internal, stabilized +5V supply.
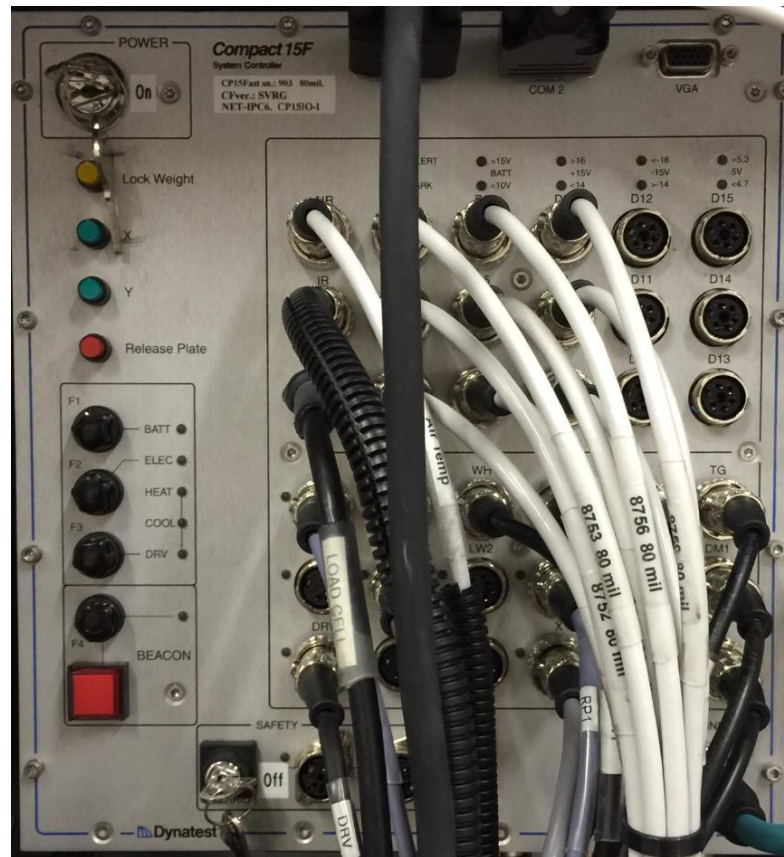
CP15F Front Panel

Transducer Connections Sockets:

AIR   Socket for air-temperature probe.

IR   Socket for Infra-Red temperature sensor.

LC   Socket for Load Cell cable.

D1-D15   Sockets "D1" through "D15" for Seismic Detectors.

WR1   Weight Release 1 switch (short when weight can pass)

WR2   Weight Release 2 switch

WH   Weight High Proximity Sensor

PH   Plate High Proximity Sensor

PR   Plate Released switch (short when hit plate can pass)

TG   Trigger Proximity Sensor

FAN   Power for fan in Air Temperature device

LW1	Lock Weight 1 Solenoid (active to support the weight at WH position)
LW2	Lock Weight 2
RP1	Release Plate 1 (active to allow the hit plate to pass)
RP2	Release Plate 2
DRV	Drive Controller
A	Spare A
B	Spare B
X	12V power outlet (Activated by pressing the X button)
Y	12V power outlet (Activated by pressing the Y button)
DMI1	Distance Measurement Instrument Sensor 1
DMI2	Distance Measurement Instrument Sensor 2

15.1.6 Fuses

F1: 12A BATT fuse.

F2: 2A ELEC fuse.

F3: 12A DRV fuse.

F4: 12A BEACON fuse.

Four green diodes indicate "Fuses OK".

15.1.7 CP15F Front Panel lower part

The "BEACON" button: Turns power on/off to the two coaxial 12V sockets and the three pin socket positioned at the bottom panel of the CP15F. (See image "*CP15F Bottom Panel*" below.)

"SAFETY / OVERRIDE" switch: Overrides the two safety panel switches connected to the two DIN sockets to enable operation of the system with the safety screens removed, for e.g. servicing purposes. – ONLY to be used by trained personnel.

"ETHERNET": A standard CAT5 Ethernet patch cable connects the Comapct15 System Controller to the Trailer network.

CP15F Bottom Panel.
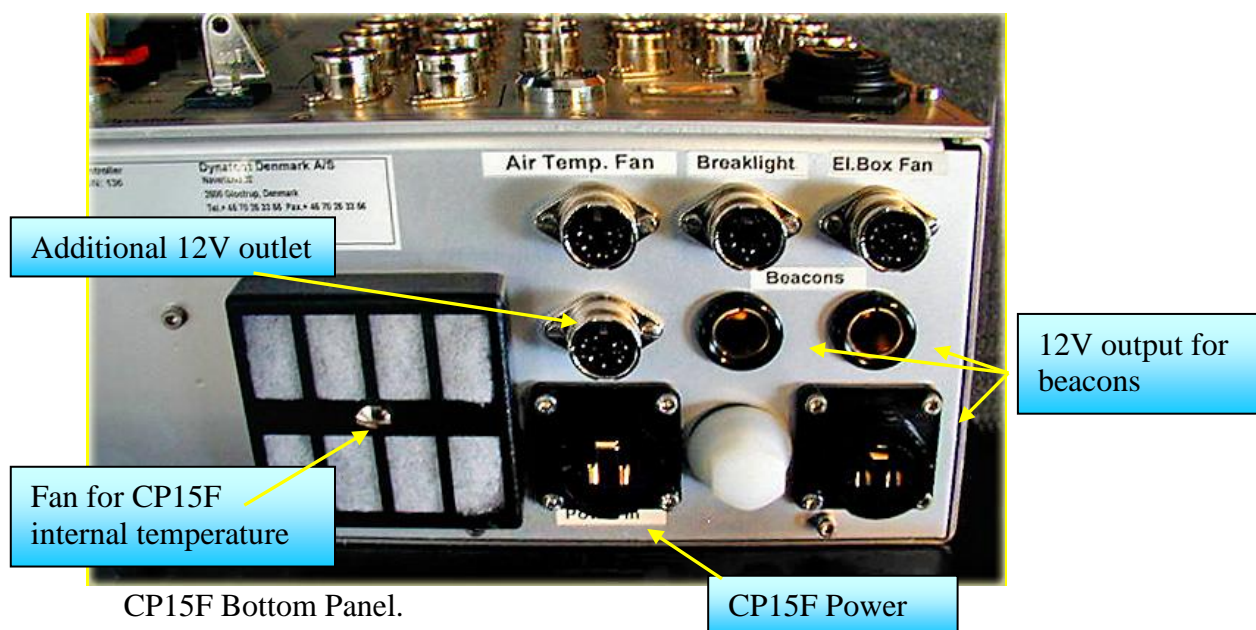
"Air Temp. Fan" 12V power outlet for fan in Air Temperature device.

"Brake light" Alternative Park Alarm input from brake light.

"El. Box Fan" 12V power outlet for (optional) fan in FWD Electronics Box.

"Beacons" Two coaxial 12V outlet plus one additional 12V outlet for beacons.

15.2 *Motor controller*

The Fast FWD motor is driven by an Etel motor controller. This takes power from a 600V DC bus and sends it to the motor phases to produce the desired movements. It also reads the motor position from the encoder feedback signal. The operator laptop and CP15F communicate with the drive and no direct intervention from the operator is required.

To operate the motor controller must receive:

- A 24V supply. This comes from the FPS600.
- An "enable" signal. Also supplied by the FPS600
- A "run" signal. Hardwired in the small, black plug on top.

Operation also relies on commands sent from FwdWin. If powered up and operating normally, two LEDs will be lit by the Ethernet cable. A constant orange light and a blinking green light. If the motor controller encounters any errors during operation these are displayed through FwdWin.

15.3 *FPS600 Power supply*

The FPS600 performs several functions in the control system.

Firstly it monitors and stabilizes the 600V DC bus which feeds the motor controller and ultimately powers the motor. It will not allow the motor controller to start until the DC bus voltage is above 500V. Additionally, if the bus voltage exceeds 623V a discharge resistor is connected, ensuring the bus voltage does not reach dangerous levels.

Secondly the FPS600 monitors the temperature of the windings in each phase of the motor. If the motor temperature exceeds 100 deg C then a warning is issued. If this temperature exceeds 130 deg C then an error is triggered.

Thirdly it monitors the cabinet conditions before allowing the high voltage components to power up. The main relay, which provides power to the 24-600V converter will only be closed if the cabinet temperature is over 2 deg C and relative humidity is under 95%.

Fourthly, it provides a stable 24V power supply, and an enable signal to the motor controller. This enable signal allows the motor controller to make movements.

Finally, the FPS600 drives various outputs. These control:

- The fan below the motor controller. This runs constantly when the system is on.
- The ventilation fans in each cabinet. These run when the cabinet temperature is over 40 deg C.
- The optional heater below the motor controller. This is powered if the temperature is below 10 deg C.

15.3.1 Status LEDs

The FPS 600 has various status LEDs. Their functions are given below.

- Blue. Bus voltage over 623V and discharge resistor is connected.
- Green. DC bus over 500V. Enable signal sent to motor controller.
- Green. 24V seen on plug M4, meaning the main relay is closed and 24-600V converter is powered.
- Red. Motor temperature is over 100 deg C.
- Red. Motor temperature is over 130 deg C.

The two final red LEDs are reset once the motor temperature drops below 90 deg C.

There are also two more LEDs that are installed, one under each fuse in the FPS600 case. If a fuse blows then the red LED underneath it will illuminate to highlight the problem.

15.4 Other electrical components

The remaining equipment in the control cabinets is described here.

15.4.1 24-600V converter

This converter creates the 600V required by the motor controller to power the motor. Whilst large, it is a very simple in operation. Whenever 24V is supplied to the input terminals, 600V is produced at the output terminals. No other inputs or controls are required.

When the unit is powered and producing 600V, a bright green LED is lit inside the casing of the converter. This can be seen at the top of the case. Also, two ventilation fans run whenever it is powered, blowing air through the unit from the bottom to the top.

15.4.2 12-24V converter

When the Fast FWD is connected to a tow vehicle it can be powered from a heavy duty 12V supply. This 12V supply is fed to the 12-24V converter which charges the batteries. Again this is a simple unit in operation. No controls are required, and when supplied with 12V, 28V (required to charge a 24V battery) is produced at the output.

A fan blows air through the unit from the bottom whenever it is powered.

Note that the connection to this converter, and the output from it DO NOT run through the main switch. This means that this converter may still be live when the main switch is open. During troubleshooting and service ensure the 12V plug to the tow vehicle is removed.

15.4.3 AC-24V charger

The onboard generator (or a normal power wall socket if the Fast FWD is in a garage) generates AC power which is fed to the AC-24V charger. This converts it to 28V to charge the batteries (28V is required to charge a 24V battery). Again this is a simple unit in operation. No controls are required, and when supplied with AC, 24V is produced at the

output. The charger can operate on both 110V and 220V with no adjustments required if changing between them.

A fan blows air through the unit from the bottom whenever it is powered.

Note that the connection to this charger, and the output from it DO NOT run through the main switch. This means that this converter may still be live when the main switch is open. During troubleshooting and service ensure the generator is not running and there is no connection to external power.

15.4.4 24-12V converter

This small converter is used to power the CP15F. It is supplied with constant 24V, but a second 24V input, on the "control" wire is required before 12V is output. The control input is supplied either from the PoE splitter, or the manual override switch in the controller cabinet.

16. FastFWD System Maintenance

16.1 Wheels/Brake System – European Spec Trailers

1) Tire pressure should be set at 2.8 bar (ato) (40 psi) cold.

2) Check that all wheel lug nuts are tight. (Torque: 10 kgm / 100 Nm / 75 lb.ft.)

3) Ensure that all nuts, bolts and pins are secured on all exposed parts of the brake system (i.e. all parts that move when the handbrake is pulled).

4) Check brake adjustment to ensure that trailer will stop its own weight and not push the tow vehicle. First check brake shoes adjustment:

- release hand brake completely
- jack up one side of the trailer, so that the wheel(s) can be rotated by hand
- tighten (clockwise) the 8 mm adjustment nut (on the rear (i.e., the inner side) of the wheel hub), until the wheel gets very hard to turn
- turn wheel in direction of travel to center brake shoes
- loosen again the adjustment nut only so much that the wheel turns freely
- repeat above procedure for the other wheel(s)
- check for uniform brake response in both sides of the trailer.

  If trailer now pushes tow vehicle, then adjust (shorten) pull rod behind hand brake, so that hand brake travel decreases. Hand brake should become active when pulled a few "clicks".

5) Grease inertial brake system every 5.000 km (3,000 miles). Two grease fittings are located by the hand brake. Use high quality grease.

16.2 Drop Weight Subassembly

1) In case of a 4-segment loading plate, apply silicone oil or grease into the 4 segment swivel bearings periodically.

2) All exposed nuts and bolts should be periodically checked and retightened if necessary.

3) Check that raise/lower bar cable has no bends or broken strands and check that it is in place on both guide pulleys. Check that the length of cable is properly adjusted and that cable holding clamps are tight. Check that the two cable tightening springs are not broken.

4) Check that all parts of the movable deflector holders are tight, especially the bottom measuring tips.

16.3 *Electrical/Electronic Parts:*

1) Battery terminal clamps must be kept clean and coated to prevent corrosion.

2) Check all proximity sensors to ensure that they are securely fastened.

3) The heavy trailer fuse box should be periodically checked for possible corrosion. All metal parts inside the fuse box should be sprayed regularly with e.g. WD40 to prevent corrosion.

17. Troubleshooting

If a problem arises during the operation of the Fast FWD, check this section to find and rectify the issue so testing can continue. Note that error messages generated by the control system contain important information and troubleshooting suggestions. A listing of all error messages can be found in Section 20.

In this section it is assumed the reader is a competent technician able to use basic hand tools and a multimeter.

17.1 *Safety procedures*

17.1.1 General safety while troubleshooting

Troubleshooting can increase the risk an operator or technician is exposed to as unusual machine movements may be required and individual components may need to be inspected or checked. Pay attention to the simple rules listed on page iii.

17.1.2 Electrical safety

Up to 600V is generated in the machine. Always leave adequate time for capacitors to discharge before working on any high voltage part of the machine. And install all protective covers before testing or operating the machine.

There are three possible sources of power on the machine: the batteries on the trailer, the towing vehicle, and AC power from the generator or a power outlet. Check each one of these to ensure they are all isolated before working on the electrical system.

Water or moisture in the cabinets can cause personal injury or system malfunction. Do not work on the electrical system in wet environments.

Never turn the main switch on without the high voltage shield mounted in the controller cabinet.

17.1.3 Mechanical safety

There is the risk of pinching or crushing when the machine is in operation. Ensure safety guards are fitted whenever possible while the machine is moving.

Never rely on the motor to hold any part of the machine up for any length of time. A power failure or the motor overheating will cause the weights or hit plate to drop. So always use mechanical supports (such as blocks of wood) under the hit plate or weights when working on them. These supports should be placed symmetrically around the loading plate, so both sides of the hit plate/weights are supported.

Always ensure that buffers and any extra weight blocks are firmly secured to the machine before performing drops.

17.2 Troubleshooting procedure

17.2.1 Preparations

If possible get the machine into a clean workshop to perform any work on it. If it must be repaired in the field then find a location away from traffic and other possible dangers. Ensure a suitable toolkit and spare parts are on hand. The spare parts kit supplied with the Fast FWD is ideal here.

One common cause of problems is undercharged or defective batteries. So before working on the machine ensure it has had time to charge, from the onboard generator, the tow vehicle or an external power supply.

17.2.2 Identify the error

Try to gather as much information about what is causing the error. Usually the first step is to record the error number and message thrown. The Operation Manual lists error messages along with possible causes and remedies. But be aware that a failure can cause further errors and the error message seen may be an effect of the first problem, not the root cause. The log file can reveal important information about a failure (see Section ???).

If possible, where there is no danger to people or the equipment, replicate the error and record the sequence of commands that causes the error. This will help in checking that the problem has been solved and also if further support is required from Dynatest.

Once the error is localized the individual components can be tested and checked to see where the issue lies.

17.3 System startup

The normal startup of the system is described here so that any deviation from this can be identified.

17.3.1 Powering up

Several conditions must be met before the Fast FWD electrical system will start up and allow movement of the weights. The startup sequence is laid out below.

1. The main switch below the cabinets must be closed. This connects battery power to the electrical cabinets.
2. A trigger must be given from the operator to start the system. This can either be:
   a. via Power over Ethernet (PoE) from the router in the tow vehicle.
   b. from the green illuminated override switch below the fuse boxes in the controller cabinet. This switch is usually used for service/troubleshooting when the operator laptop is connected directly to the Ethernet switch in the cabinet.
3. The CP15F will now start up (taking ca. 30 seconds). Once started up the CP15F will beep, the "DRV" output will be active and its LED is lit. This has two functions:
   a. It closes a relay and provides power to the Ethernet switch.
   b. Sends the "DRV" signal to the FPS600.

4. The FPS600 monitors temperature and humidity in the cabinet (for ca. 10 seconds) and if safe it will connect the "DRV" output to the main relay, providing power to the high voltage circuitry.

Now the system is powered up and ready to connect to the operating software and start movements. An easy way to tell if the process is complete is to look for the green glow from the LEDs inside the 600V converter. These are always lit if the main relay is closed and the high voltage circuitry is powered.

Situations may arise during troubleshooting where the operator wishes to power the system up but disable the high voltage circuits and motor movements. This can be done by simply unplugging the DRV plug from the CP15F. This ensures the main relay remains open and the high voltage circuits, along with some of the 24V circuits, cannot function. Remember to reinstall the plug once investigation is complete.

17.3.2 Ethernet and software connections

Once the electrics of the Fast FWD are started up, the operating software must be started to control motor movements for testing or troubleshooting. The basics of this is explained in the Operator Manual. It should be noted that there are four units which must have Ethernet communication if the machine is to function (see Figure 1):

1. The operator laptop   IP 192.168.1.99
2. The CP15F   IP 192.168.1.15
3. The FPS600   IP 192.168.1.9
4. The motor controller   IP 192.168.1.18
5. Park alarm box   IP 192.168.1.20

There may be more optional equipment mounted on the Ethernet network, such as a GPS, but these are not critical for machine functioning.

The Ethernet components are usually connected via a router in the vehicle, and a switch and PoE splitter in the electrical cabinets. This setup is shown in the diagram below. A quick check to see if a certain device is communicating is to see whether the green LEDs beside each plug are flashing on the cabinet Ethernet switch.
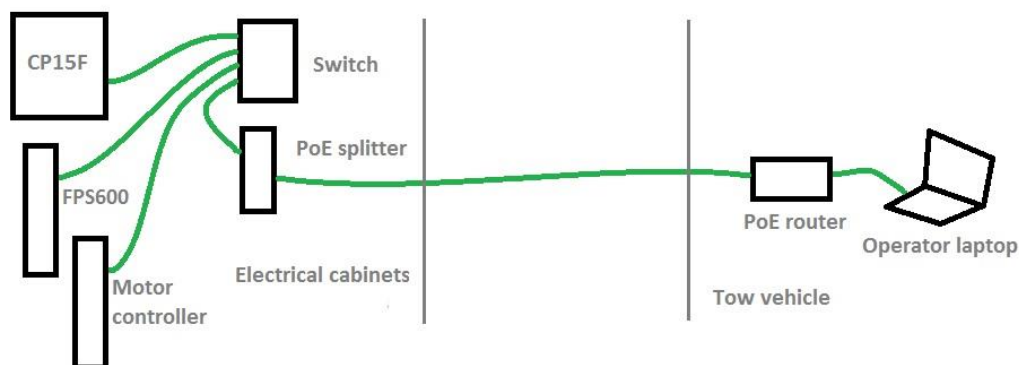
Figure 1 – Basic Ethernet connections

If there is correct communication the operator software, DDC, can be started. It should detect the equipment and allow the FWDWin control software to launch. This process is covered in the Section 9.

When running FWDWin the connection status of the CP15F, FPS600 and Controller can be seen by the colour of the "LEDs" in the left of the status window (see Figure 2). Green shows proper connection, grey means no connection (see Section 9.3.5 for details). If they are not all green try:

- Check that each device has power and has had time to startup. The CP15F can take up to 30 seconds to startup.
- Check that all Ethernet cables are properly connected.
- If all LEDs are grey try restarting the CP15F.
- If there are still communication problems, try connecting the operator laptop directly to the switch in the electrical cabinet. This bypasses the in-vehicle router and the PoE splitter.
- If there is still no connection try using new or known good Ethernet cables to each device.
- If problems persist then the network setup of the devices may be incorrect.
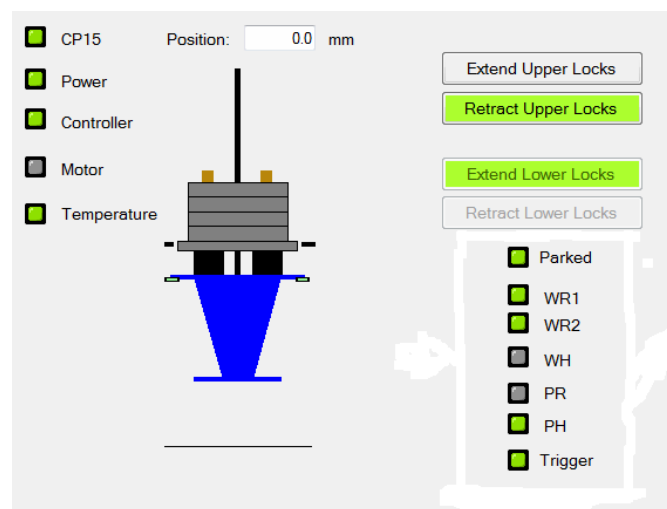
Figure 2 – Fast FWD status window

During operation if Ethernet communication is lost then a "Network timeout error" will be thrown. Other errors may also be created as the lack of network communication means that various signals will be missing and some processes may time out, generating an error.

17.4 *Powering system*

Given the large weight of the Fast FWD weight package and the high speed at which it moves, large peak power is required. If this cannot be provided then issues will arise. The powering system is made up of:

- On board 24V battery (Two 12V batteries in series).
- 12-24V converter drawing power from the tow vehicle.
- AC-24V charger drawing power from the onboard generator or an external power supply.

- 24-580V converter producing power for the motor controller.
- 24-12V converter producing power for the CP15F.
- Lock driver box.
- Sign control box.
- A battery balancer to maintain equal charge in the two batteries.

Note that the 600VDC and 110/220VAC circuits on the machine can be dangerous and should only be checked and tested by suitably qualified personnel, therefore they are not included in this manual.

Note that the safety system prevents the main relay from providing power to the high voltage parts of the system while the controller cabinet door is open. This can be overridden using the "override" key on the CP15. However care must be taken to only use this for investigation/testing in the workshop. The "override" key must not be used during normal operation.

17.4.1 Batteries

Failed or undercharged batteries can cause unexpected behaviour of the Fast FWD and in our experience is the root cause of many problems. Ideally the batteries should be load tested on a suitable testing device to determine their health, but if this is not available then the following checks can be used. Ensure the batteries have been charged for at least an hour before testing them, and preferably are fully charged.

- In resting state (not charging and with the machine switched off) each battery should measure at least 12.0VDC.
- Sometimes a failed battery can show a suitable voltage at rest, but decrease catastrophically when it is loaded. To test for this ensure the batteries are not being charged and using manual operation lift the weights. Measure the voltage across each battery during these movements. If it drops below 10.0VDC then the battery has a problem.
- If, during use, the batteries are not being charged as quickly as they are being depleted they will eventually run flat. In the extreme case the machine will stop and a "Bus undervoltage" error will be reported. This is not actually a battery problem and the charging system should be investigated.

The two batteries should always be identical units and should be replaced as a pair.

17.4.2 12-24V converter

This unit converts 12V power from the towing vehicle to 24V to charge the batteries on the Fast FWD. The actual output voltage is 28.4VDC. This is used to power the system when the onboard generator is not used or is not running. To check correct operation of this unit:
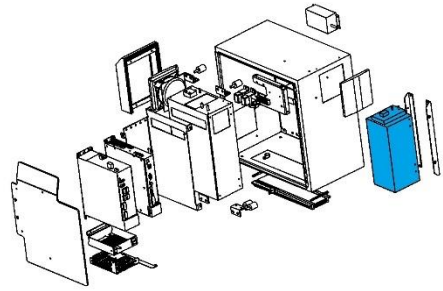
- Turn the main switch off, disconnect the heavy charge cable from the vehicle and ensure the generator is not running. Wait at least 5 minutes and remove the high voltage shield from the controller cabinet.
- Measure the resistance between the small output terminals. This should be in the kOhm range or higher. If this is lower or a short circuit then there is an internal problem in this converter or the AC-24V charger.
- Connect the heavy charge cable to the vehicle or another 12V source. Measure the voltage at the large input terminals to ensure it is receiving power. 10-15VDC is acceptable. If it is not getting power check the cables from the heavy charge cable plug to the converter.
- Whenever the converter is connected to input power the cooling fan in the bottom runs. Check that it is blowing air up through the unit. If not then the fan or entire unit may be defective.
- Measure the voltage at the large output terminals, it should be 28-29VDC. If it is 24V or lower then the unit is not running. This could be due to a defect or overtemperature protection.
- If the unit is hot let it cool down and test the output voltage again. If it is still 24V or below then the unit is defective.
- Also check the 50A charging fuse in the fuse box near the batteries. If this is blown, then the converter will not be able to charge the batteries.

Remember to reinstall the high voltage shield before turning the main switch on.

17.4.3 AC-24V charger

Driven by the onboard generator (or an external power source) this unit will run on either 110 or 220VAC and create 24VDC to charge the batteries. Again its actual output is 28.4VDC. To check the operation of this charger:
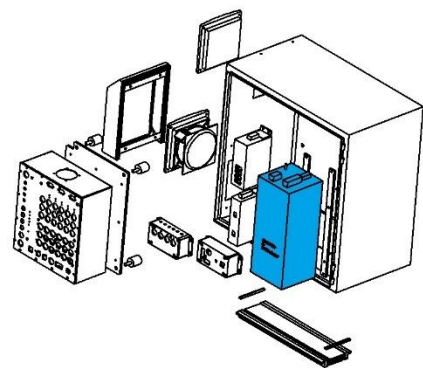
- Turn the main switch off, disconnect the heavy charge cable from the vehicle and ensure the generator is not running, nor is any other AC power source connected.
- Measure the resistance between the larger output terminals. This should be in the kOhm range or higher. If this is lower or a short circuit then there is an internal problem in this charger or the 12-24V converter.
- The fan in the bottom of the unit should run any time input power is connected. Check that it is blowing air out through the top of the unit. If not then the fam may have failed or the unit is defective.

- Start the generator or connect the charger to an external power supply. Measure the output voltage of the charger. Given the proximity of the output terminals to the high voltage supply terminals this measurement should be taken at the 50A charge fuse in the fuse box near the batteries. It should show 28-29VDC. If 24V or lower is seen then the charger is not functioning. This could be due to overtemperature protection.
- If the unit is hot let it cool down and test the output voltage again. If it is still 24V or below then the unit is defective.
- Also check the 50A charging fuse. If it is blown the charger will not be able to charge the batteries.

17.4.4 24-600V converter

This unit creates the high voltage needed by the motor controller to power the motor and drive the weights up and down. Given the voltages involved, there is little that can be done by the operator to check this converter.
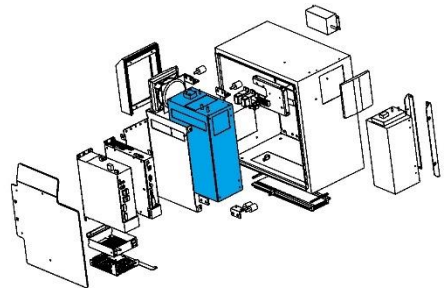
- Turn the CP15F override key to "override" so that the system can be powered up with the controller cabinet door open.
- Power up the system (see Section 17.3.1)
- Check that the main relay is closed and providing 24V to the high voltage system. Measure the voltage at fuse F1, F3 or F6. This should be at least 24VDC. If this is not the case then the system has not powered up correctly.
- If 24V is seen at these fuses check the lights on the FPS600. The green "Bus >560V" LED should be lit. If this is not the case then the 24-580V converter may have failed.
- If the LED is lit then try making some manual movements of the weights. If the LED darkens or the controller produces a "Bus undervoltage" error then the 24-600V converter may be defective.

Remember to turn the override key on the CP15F away from "Override" once testing is complete.

17.4.5 24-12V converter

This small, purple box provides 12VDC for the CP15F unit. If it is faulty then the CP15F cannot run and the machine will not start up. Aside from 24VDC at its input, the converter also requires 24VDC on its control input before 12VDC will be produced.
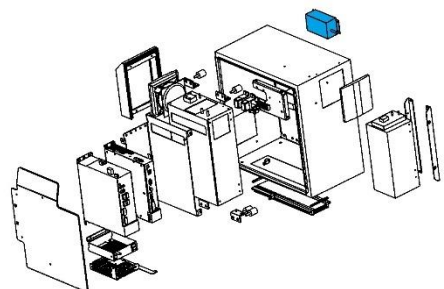
To check its operation, activate the "control" input while the machine is powered up. This is done by:

- Switching on the router in the vehicle, so power is provided on the PoE cable cores.
- Or pressing the override switch below the fuse boxes so that it is lit green.

To check the power input, measure both sides of fuse F5 (15A). This should have 24VDC. To check power output, measure both sides of fuse F7 (20A). This should have 12VDC. Replace any fuses needed.

If input power is seen, but no output power then the converter may be faulty.

17.4.6 Lock driver box

The lock driver box is an interface between the CP15F inputs and outputs and the cables running to the individual locks. To check its operation firstly check if it has power. There should be 24VDC on both sides of the fuse F3 (7.5A). If not check and replace the fuse if required.
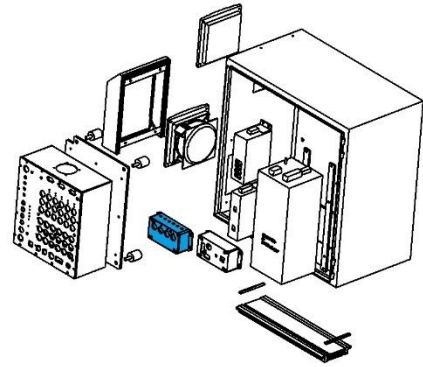
The LEDs on the lock driver box should light up when each lock is activated. Pressing the manual operation buttons on the CP15F ("Lock weight" or "Release plate") should cause the two respective LEDs on the lock driver box to light up. The LEDs are orange for a short time then change to green, this shows correct function of the driver circuit. If this is not the case check that all cables from the lock driver are connected to their matching sockets on the CP15F.

If problems still remain then there is an internal problem in the lock driver box or CP15F.

17.4.7 Battery balancer

A battery balancer is mounted on the rear of the battery box. It ensures that the two batteries are always charged equally to maintain optimal performance and maximise battery life. A basic check of its operation is to feel if it gets warm while the batteries are charging. If it is still at ambient temperature then it may have failed.

A more thorough check is to measure the voltage across each battery (while at rest or while charging). The difference in voltage measured should be less than 0.02VDC. If the difference is greater then the balancer is defective or one of the batteries has failed.

17.5 Control system

The control system is made up of the operator laptop, the CP15F, FPS600 and motor controller (as mentioned in Section 17.3.2). These work together to control the machine and collect data.

17.5.1 CP15F

If the CP15F is misbehaving then make the following checks:

Ensure it is switched on. The "Power" key in the top left must be in the horizontal, "ON" position.

The "Batt" LED is lit whenever the unit has power. This is provided through the big, black plug in the bottom. If "Batt" is not lit then check for 12V at this plug. The two parallel pins

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should have 12V and the right angled pin has 0V. If this plug has no power then check the CP15 fuses in the fuse panel.

If the CP15F is getting power, but not operating, check that the "ELEC" fuse is intact. If blown, this fuse will stop all CP15F operation.

Check the "DRV" fuse too. If blown this will prevent the "DRV" output being activated, meaning the rest of the machine will not run.

Also, if the safety covers are removed from the subunit, or the control cabinet door is open, the DRV output will only be activated if the "Safety Override" key is in the horizontal position. This position should only be used for troubleshooting, not during normal operation.

If the CP15F is getting power and all fuses are intact, then check the input and output plugs to ensure they are correctly seated in the faceplate and the lock rings are tightened.

Check correct Ethernet communication. The socket in the ethernet switch to which the CP15F cable is connected should have a flashing LED. Also, connect a laptop to the switch with an Ethernet cable and try pinging the CP15F on the IP address given in section 17.3.2.

17.5.2 FPS600

If the FPS600 is not operating correctly, check that it is getting power. Power is provided from both before the main relay (from fuse F5 via a cable permanently connected to the 24-12V converter) to socket M5. And after the main relay (from fuse F1 via cable 4000625) to socket M4.

If M5 is unplugged then the FPS600 will not start up and the main relay will never be closed. Hence various parts aren't powered and the motor cannot be moved.

If M4 is unplugged then power is not supplied to the ETEL controller and the motor cannot be moved.

The various LEDs on the FPS600 show important info about the machine state (see Section 15.3.1). If the FPS600 is still not behaving as expected a laptop can be connected directly via Ethernet to ensure it is communicating correctly. The unit can be pinged on the IP address given in Section 17.3.2.

17.5.3 Motor controller

The Etel controller commands motor movements and keeps track of the motor position using the encoder. Generally errors from this unit are displayed through the operator interface and can be referenced in the Operator manual which lists the error messages and their response.

The motor controller logic circuits are powered by the black and violet cores in X100 (pins 1 and 2 in the 4pin plug in the top). The voltage across these wires can usually be measured on the exposed ends of the wires that are crimped into the plug. It should measure 24V when the machine is powered up.

The controller requires an "Enable" signal before it can make movements. This is provided through the yellow cores of X100 (pins 3 and 4 of the 4pin plug in the top). Once the system is powered up there should be a short circuit between these two wires. Unplug from the motor controller before making this measurement.

Check that the controller Ethernet cable is plugged into X01 (there are several other similar plugs nearby) and the other end is connected to the Ethernet switch in the CP15 cabinet. To test this communication, connect a laptop to the Ethernet switch and try pinging the IP address given in Section 17.3.2.

If unusual motor behavior is still being seen, check that the three screws that hold the motor plug to the motor controller are tight. These ensure a good ground connection between the motor cable and the rest of the machine and if loose can cause mysterious problems.

17.6 *Sensors and actuators*

Various items are used around the Fast FWD to perform movements and indicate the state and position of the machinery. Malfunctions of these will cause improper operation of the machinery and errors will be generated. Here we discuss how each actuator or sensor can be checked.

For all these checks the system should be powered up, but the operator programs should NOT be open. This means that power is available for the sensors but motor movements are not possible.

17.6.1 *Proximity sensors*

The proximity sensors used on the Fast FWD are:

- WH   Weight is High.
- PH   Plate is High.
- TRG   Trigger.
- DM1 (optional, for trailer wheel)
- DM2 (optional, for trailer wheel)
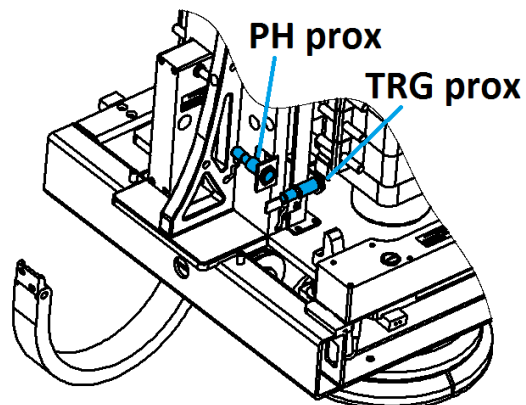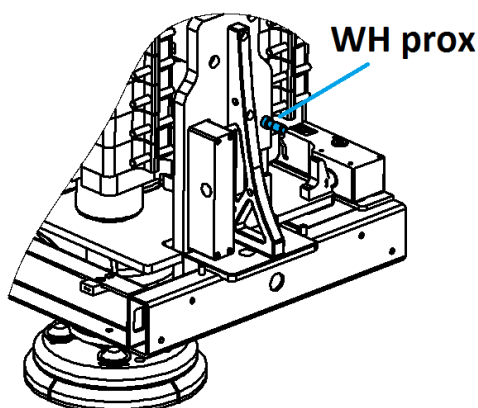
All of these sensors should be tested in the same fashion. The CP15F must be powered up for the prox sensors to receive power, however the high voltage circuits should NOT be powered during these tests. So unplug the DRV plug from the CP15F.

The machine may need to be moved into a suitable position to test each sensor. There should be free access to the sensor and nothing in front of it, already activating it.

- Place a metallic object immediately in front of the sensor and check that the LED in the sensor lights up. The sensor range is 8mm if an iron object is used. This drops for stainless steel and aluminum.
- Remove the metallic object and check the sensor LED goes dark.
- If this behavior is not seen ensure the cable is firmly fitted to the prox sensor and CP15F.
- If problems persist try swapping in a new or known good proximity sensor. If this solves the problem replace the sensor.
- If there are still problems swap in a new or known good cable from proximity sensor to the CP15F. If this solves the problem replace the cable, taking care to route it identically to the old cable.
- If problems remain then there is likely a fault in the CP15F.
- Check that the LED on the CP15F changes as the prox is activated and deactivated. Additional details regarding this can be found in the Operation Manual.
- If no response is seen swap in a new or known good cable. If this solves the problem the replace the cable, taking care to route it identically to the old one.
- If still no response is seen on the CP15F front panel then there is likely a fault in the CP15F.

17.6.2 Air temperature sensor

This sensor measures the air temperature and returns it to the CP15F so that it can be stored with measurement data (see Section 4.3.7). It consists of three main parts: the sensor itself, a fan to circulate air and a mount to hold everything to the trailer frame.

The circulation fan is powered from the "Air temp fan" plug in the bottom of the CP15F and should run continuously whenever the CP15F is powered up. If this is not the case, check the cable is correctly connected and not damaged. Also check that there is free airflow through the mount.

The temperature probe is connected to the "AIR" plug on the CP15F front panel. The measured temperature is displayed in the FwdWin "Thermometers" as "Ambient". If this is displaying incorrect values then check for correct cable connection and cable damage.

If everything appears correct, but false temperatures are still recorded, a field calibration can be performed through FwdWin (see Section 13.2) or returned to Dynatest for a full calibration.

17.6.3 Surface temperature sensor

This sensor uses an infrared (IR) sensor to remotely detect the surface temperature of the asphalt (see Section 4.3.8). This sensor is mounted under a "shade" and has an extension tube.

Firstly, check that the surface temperature sensor cable is connected to the "IR" plug on the CP15F faceplate. Also check that the cable isn't damaged.

The shade and extension tube protect the sensor from ambient light, which can compromise the accuracy of data. The extension also protects the sensor lens from dirt and grime. Do not operate without these parts installed.

If incorrect readings persist, the IR sensor may need to be recalibrated (see Section 13.3). The sensor can also be returned to Dynatest for calibration.

17.6.4 Locks

There are two sets of locks fitted to the machine. Upper locks, which hold the falling weights when required. And lower locks, which hold the hit bracket during transport. These locks have both a coil which controls the movement of the bolt and a feedback switch which senses the position of the bolt.

Both upper and lower lock bolts should be cleaned regularly (daily). Wipe any dirt/grime off the bolts with a clean cloth and remove any dirt from the lock casing around the bolt. DO NOT apply any oil or lubricant to the lock bolt. If the lock bolts are sticking, cleaning them and operating them repeatedly from the manual buttons on the CP15F can improve behavior.

To test these switches the machine must be powered up (see section 17.3.1) and the main relay must be closed (this provides power to the lock driver box). Do not have the operator software running to reduce the risk of unexpected motor movements.

17.6.4.1 Upper locks

To test the upper locks the weight package must not be resting on the upper locks, nor blocking the extension of the lock bolts. This usually means they should be resting on the hit plate with the hit plate either on the lower locks or the ground.

To test operation and feedback:

- Press the "Lock Weight" button on the left side of the CP15F. This will extend both upper lock bolts and the "WR1" and "WR2" LEDs should darken on the CP15F.
- Releasing the "Lock Weight" button should cause the lock bolts to retract until they are flush with their mounting plate. And the "WR1" and "WR2" LEDs should light up.
- If the response is not seen on the CP15F check that all cables are correctly connected to the lock, the lock driver box and the CP15F.
- If the correct response is still not seen then power down the machine, replace the lock cable with a new or known good cable and power the machine up again.
- If the correct response is still not seen then there may be an internal problem in the lock, lock driver box or CP15F.

The locks can be manually operated to check for feedback. Remove the rubber plug in the side of the upper lock case and insert the manual key (found in spare parts kit). Rotate the key to actuate the lock. Remember to reinstall the rubber plug once testing is finished.

17.6.4.2 Lower locks

When testing the lower locks the hit plate must not be resting on the them. This usually means that the hit plate and weight package are resting on the ground.

- Press the "Release Plate" button on the left side of the CP15F. Both lower lock bolts will retract and the "PR" LED will light up on the CP15F.
- If the response is not seen on the CP15F check that all cables are correctly connected to the lock, the lock driver box and the CP15F.
- If the correct response is still not seen then power down the machine, replace the lock cable with a new or known good cable and power the machine up again.
- If the correct response is still not seen then there may be an internal problem in the lock, lock driver box or CP15F.

The locks can also be actuated manually, simply by pushing the bolt in by hand. Alternatively, the metal screw on top of the lock can be removed and the manual key (found in the spare parts kit) inserted. Turning the key retracts the bolt. Both bolts must be pushed in before the "PR" LED lights up.

17.7 *Software troubleshooting*

When something goes wrong while operating the FastFWD, the Dynatest Data Collection (DDC) software will display an error message in a pop up window. This error message is the most valuable source of information for fixing the problem and should provide enough information to troubleshoot the situation. A listing of all error codes and their associated messages can also be found in the Section 20.

If the machine malfunctions without giving an error message the operator is encouraged to save the log file and send it to Dynatest. It can also be useful if the operator has a basic knowledge of the log files and what they represent.

17.7.1 *Log file*

The log file, "FwdCtrl.dtlog", records the status of the Fast FWD at all times, along with all commands given and movements performed. To avoid storing excessive data, the file is deleted and started afresh every time the software is restarted. Therefore, if an error occurred it is recommended that the log file is copied to another location for analysis/reference before the software is restarted.

While unlikely, it may be possible that the software did not give an error message but the log file recorded the error.

The log file is named "FwdCtrl.dtlog" and is found by default in "C:\Dynatest\Elements".

17.7.1.1 Configuration file

There are several parameters that control the log file. To ensure it is setup correctly look in the file "Config.xml" also found by default in "C:\Dynatest\Elements". The parameters to check are:

<FwdCtrl><logging>   This should be set to "4".

<general><log-messages>   This should be set to "false". Setting this "true" records much
                            more information to the log file, but is only required in
                            exceptional circumstances.

An example of the "Config.xml" file is shown below in Figure 3.

```
Config.xml - Notepad
File  Edit  Format  View  Help
<?xml version="1.0"?>
<!-- Copy to c:\Dynatest\Elements\config.xml -->
<qsoft>
    <general>
        <logging>0</logging>
        <log-append>false</log-append>
        <log-messages>false</log-messages>
        <show-debug-window>true</show-debug-window>
    </general>
    <FwdCtrl>
        <logging>4</logging>
    </FwdCtrl>
    <IMS>
        <logging>1</logging>
    </IMS>
    <GPS>
        <logging>1</logging>
    </GPS>
    <HCamera>
        <logging>1</logging>
    </HCamera>
    <TSI>
        <logging>1</logging>
    </TSI>
</qsoft>
```

Figure 3 – Config.xml example

17.7.1.2 *Reading log file information*

The log file contains various different pieces of information, each written as a line in the file.
Each type of information has their own line format.

Firstly, all commands and state transitions are timestamped and recorded. Also any internal
errors produced are recorded. In the following example we can see that the drive (Etel motor
controller) has given an error 7 which has triggered a subsequent error 711 "Drive not
available". This shows that there is a problem with the power supplied to the motor controller.

```
[2016-03-11 23:08:58.637] ERROR FwdCtrl.exe(1): Drive error 7: Power supply inrush error
[2016-03-11 23:08:58.637] ERROR FwdCtrl.exe(1): case MoveToDropHeight: Drive error 7: Power supply
inrush error
[2016-03-11 23:08:58.637] ERROR FwdCtrl.exe(1): Send_DriveError 711 ErrorDriveNotAvailable
[2016-03-11 23:09:06.213] ERROR FwdCtrl.exe(1): GetEtelDriveInfo: timeout error: timeout error
```

Also sensor readings are recorded in the log file. A line is written every time a sensor changes
state. The sensors that are monitored and recorded are:

- WH   Weight high
- WR1   Weight released 1 (front upper lock)
- WR2   Weight released 2 (rear upper lock)
- PH   Plate high
- PR   Plate released
- TG   Trigger
- PA   Parked. Handbrake engaged or brake lights lit.

In the log file, an "X" means the signal is active, while "." Indicates the signal is not active. An example of such a line from the log file is seen below.

```
DEBUG FwdCtrl.exe(1): Sensor change: WH=. WR1=X WR2=X PH=. PR=. TR=X PA=X
```

Looking at the following example of a log file:

```
10:44:04.117] DEBUG FwdCtrl.exe(1): case LockWeight: PlateLocked and weight below WL
10:44:04.117] INFO FwdCtrl.exe(1): Transition LockWeight -> LW_MoveWeightUpFast at pos 0.00mm (0.00t)
10:44:04.117] DEBUG FwdCtrl.exe(1): MoveTo 49
10:44:04.304] DEBUG FwdCtrl.exe(1): Sensor change: WH=X WR1=X WR2=X PH=X PR=. TR=. PA=X
10:44:04.335] INFO FwdCtrl.exe(1): Transition LW_MoveWeightUpFast -> LW_WeightHighOn at pos 15.52mm (0.24t)
10:44:04.335] DEBUG FwdCtrl.exe(1): MoveTo 25.6474625
10:44:04.678] DEBUG FwdCtrl.exe(1): &&& Send_WeightLocks True
10:44:04.678] INFO FwdCtrl.exe(1): SEND: "OUTPUT WEIGHT LOCK"
10:44:04.678] INFO FwdCtrl.exe(1): Transition LW_WeightHighOn -> LW_WaitForULExtended at pos 25.67mm (0.40t)
10:44:04.788] DEBUG FwdCtrl.exe(1): Sensor change: WH=X WR1=X WR2=. PH=X PR=. TR=. PA=X
10:44:04.897] INFO FwdCtrl.exe(1): Transition LW_WaitForULExtended -> LW_WaitExtraForULExtended at pos 25.66mm (0.40t)
10:44:05.240] INFO FwdCtrl.exe(1): IsWeightLocked:False, UpperLocksExtended:False, WeightHigh:True
10:44:05.240] ERROR FwdCtrl.exe(1): case LW_WaitExtraForULExtended: WR1 and WR2 not working. Case LW_MoveWeightUp: Expected WeightLocked during mov
10:44:05.240] ERROR FwdCtrl.exe(1): Send_DriveError 791 ErrorWeightReleased
10:44:05.240] DEBUG FwdCtrl.exe(1): LW_MoveWeightUp: WL1=False WL2=True
10:44:05.240] INFO FwdCtrl.exe(1): Transition LW_WaitExtraForULExtended -> UnlockWeight at pos 25.67mm (0.40t)
```

We see that an error has occurred. The error description given is "WR1 and WR2 not working". Reading the previous log file lines it should be clear that the machine is trying to lock the weights. But once the base weight has moved to the correct position one of the upper locks is not extending. The critical line shows a sensor change "WR1=X WR2=." meaning that only one of the two upper locks is extending. So this is where investigations should begin.

During machine operations, errors can cascade, with an initial error causing further errors, and only the last error is presented to the user. Consulting the log file shows the sequence of errors and can help to identify the root cause.

Information from the Etel motor controller is also stored in the log file. These lines contain:

- **i2t** This is a calculated, internal parameter in the controller relating to component temperatures. If it exceeds 90 then the machine will stop to allow the components to cool down.
- **ctemp** Shows the internal temperature in the controller. If this exceeds 70 degrees then the software will force a pause to allow it to cool down.
- **Alarm** This is "true" if the temperature in the motor coils exceeds 100 degrees. This will not stop the machine or produce an error, but at the end of the sequence will alert the operator that the machine needs a pause (with a flashing "Motor hot" message).

An example line is shown below. It can be particularly useful to check the state of "Alarm" to see if the motor temperature is excessive.

```
DEBUG FwdCtrl.exe(1): i2t = 2.00505108537698; ctemp=20; Alarm=False
```

The outputs from the FPS600 power supply module are also logged (on unit serial numbers 8012-015 and above). Lines are written to the log file with the following format:

MSG: <Time> "OUTPUTS FPS600 <not used> <Relay> <Fan> <Cool> <Heat> <FPSalarm> <Merr> <Malarm>

An example line is seen below:

```
MSG: 3361ms "OUTPUTS FPS600 1 1 1 0 1 0 0 0"
```

The meaning of each output is:

- Relay   1= Main relay is closed. 0= Main relay is open.
- Fan   1= Fan is on. 0= Fan is off.
- Cool   1= Cabinet cooling fans running. 0= Cabinet cooling fans off.
- Heat   1= Heating element is on. 0= Heating element is off.
- FPSalarm 1= The FPS unit is giving an alarm. 0= No alarm.
- Merr   1= Motor temperature error (coil temperature over 130 degrees). 0= No error.
- Malarm   1= Motor temperature alarm (coil temperature over 100 degrees). 0= No alarm.

On the older FPS units (up to serial number 8012-015) a serial cable needs to be connected between the FPS600 and the Etel controller. If this cable is not connected then a motor temperature alarm will be given as soon as the machine is started up.

17.7.1.3 No error message is sent

If no pop up message appeared but the machine still was in error, in the log file the error will be most likely recorded. That file can get quite long depending on how long time the machine has been running, therefore it can be useful to use the search function. To find the exact line where it is detailed, try to search for the words "Send DriveError", "drive error" or "error" and check if it fits with the time the error was observed.

18. Optional Accessories

18.1 Optional Hardware

A variety of optional accessories are available for the Dynatest FWD, FastFWD and HWD Test Systems. Unless otherwise stated these will apply for all models.

18.1.1 Distance Measuring Instrument

Distance information may be generated by the CP15F. A DMI provides automatic display and recording of distance information (in English or Metric units).

Trailer Mounted
Distance Measuring is accomplished by a Trailer mounted two phase encoder system connected to the Compact 15. Approximate resolution 0.15 m or 0.5 ft. Accuracy 0.4% when calibrated using the procedure in the DMI applet.

Vehicle Mounted
Distance Measuring is accomplished by a vehicle mounted encoder or by tapping into the vehicle's speedometer/odometer circuit. Distance pulses are processed by an adapter (EncIf/EnCam), which connects to the PC using a USB port. The DMI Applet carries out calibration and control.

18.1.2 Global Positioning System

A GPS unit may be connected directly to the COM1 port at the CP15F front panel. The GPS unit must be set to 2400, 4800, 9600, 19200 or 38400 baud and send the NMEA standard message "GGA". The maximum reporting rate is 10 Hz. At this rate you must assure that no other messages are sent from the GPS unit.

Alternatively a GPS unit may connect to the Ethernet switch and deliver NMEA messages through that.

18.1.3 Air/Pavement Temperature Probe

A Temperature Monitoring Probe, for automatic recording of Air Temperature and/or Pavement Temperature (in a drilled hole in the pavement, to get pavement MEAN temperature). Electronic (integrated circuit) sensing element in a stainless steel probe. Mounts on the FWD/HWD Unit in a special holder with air circulation and connects to the Compact15F. Resolution 0.5 deg. C, accuracy within +/- 1 deg.C (in the -18 to +70 deg.C range) when properly calibrated.

18.1.4 IR Surface Temperature Transmitter

A non-contact, Infra-Red Temperature Transmitter, for automatic recording of pavement SURFACE temperature ONLY. Features an integrated IR-detector and digital electronics in a weather-proof enclosure. Mounts on the FWD/HWD Unit and connects to the Compact15F. Resolution 0.5 deg.C, accuracy within +/- 1 deg C (in the -18 to +70 deg C range) when properly calibrated.

18.1.5 Rear Extension Bar

The "Rear Extension Bar" extends the Raise/ Lower Bar rearwards, so that two deflections can be monitored BEHIND the loading plate, for PCC slabs joint transfer measurement. Stainless steel design, mounts on the existing Raise/Lower Bar. Includes two deflector holders with a (rearward) positioning range of 200 to 300 (optionally up to 610) mm from the loading center.

18.1.6 Rear/Side Extension Bar

Same as the above mentioned Rear Extension Bar, but with two additional "wings" with two deflector holders each, to enable additional deflection measurements to either side of the load center in a 200 to 300 (optionally 450) mm distance range.

18.1.7 Video Camera/Monitor Setup

An independent Video Camera/Monitor system for easy positioning of the deflectors (normally only used with the above mentioned Rear (or Rear/Side) Extension Bar). Includes camera mounting hardware and all necessary cables.

18.1.8 Tandem Axle Trailer

The FastFWD trailer can optionally be delivered with a tandem axle system (two axles, four wheels) instead of the standard one-axle, two wheel setup. This option will give smoother riding on rough roads, but will decrease the maneuverability of the trailer when unhooked from the towing vehicle.

18.1.9 Special Trailer Colour

The standard colour of a Dynatest FastFWD trailer is bright blue (colour code: RAL 5017). At the time of ordering, any other colour with a RAL code can be specified at no or little extra cost (depending on actual colour). Colour matching to e.g., a towing vehicle color may also be possible.

18.2 Data Processing Software
18.2.1 ELMOD

For routine purposes, Dynatest can provide the ELMOD program (acronym for: **E**valuation of **L**ayer **M**oduli and **O**verlay **D**esign).

ELMOD is used to calculate the layer moduli and the remaining service life of an existing flexible pavement, and to carry out the structural overlay design.

For evaluation of rigid structures, ELMOD is used to calculate layer moduli, modulus of subgrade reaction and load transfer conditions at joints, to calculate the remaining service life and to carry out the structural overlay design or rehabilitation measure.

19. Data Formats

Data file extensions are shown in parentheses.

19.1 *MS Access 2000 (MDB)*

This is the native format for FwdWin data files. Field data is stored in a number of tables as shown in the following relational diagram:

The **Sessions** and **Transducers** tables record 'Header' information when an MDB file is created and every time it eventually is re-opened (actually this information is updated when you CLOSE the file).

The **Stations** table records information about each particular testing location.

The **Drops** table records all drops and lastly, the **Histories** table records the time history if so programmed in the Test Setup.
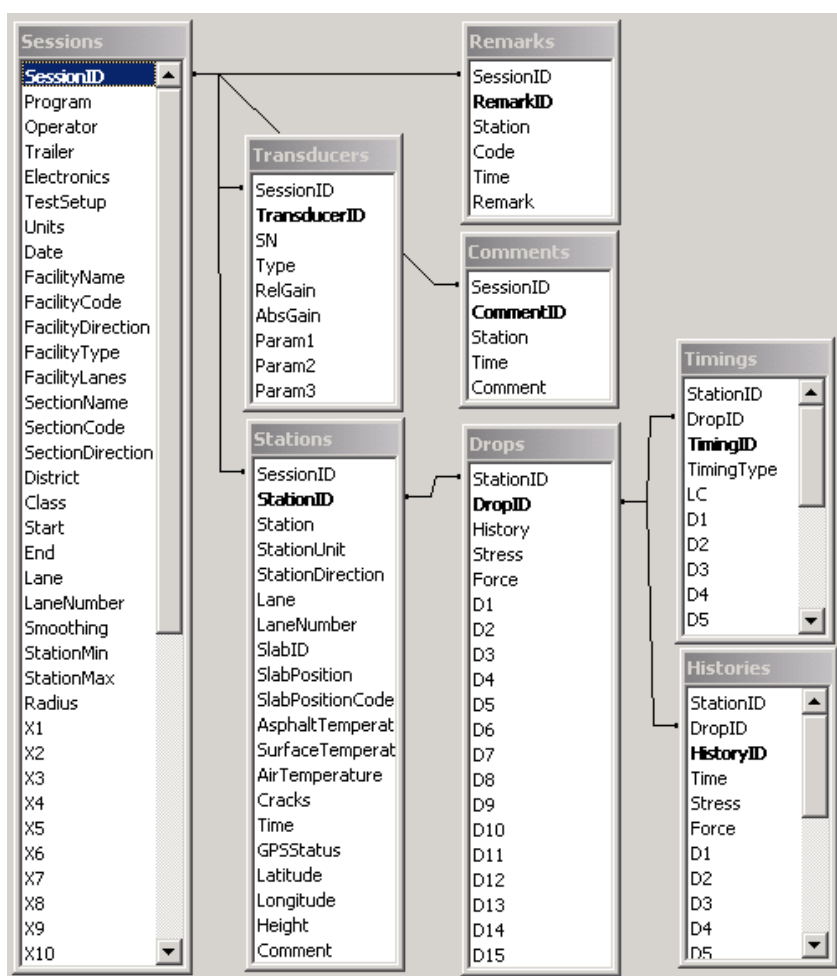
19.2 *Comma Delimited (F25)*

This file format produces files that are directly 'Importable' to most spread sheet software and easily readable by dedicated software. This is accomplished thru the following main features:

Items are separated by a comma character.

Each line is prefixed (the very first item on the line) by a

'Line-ID-Number' which is the 'key' to the contents of the line.

File Type: SEQUENTIAL UASCII Text File (Line length varies).

A file consists of 40 lines of "Header" information followed by TEST DATA, Comments etc. Optional Global Positioning data are stored BEFORE the related FWD/HWD test sequence data.

Text items

The width of a text field may vary

Most text items are "Quoted"

Numbers

May be preceded and/or padded with spaces

The special Nil value ('No use' number) is written as "N0".

The number of decimals shown are just examples

Units

Temperatures, Pressure, Deflections etc. are stored in EITHER Metric OR English systems.

Stations

meters,km,miles,feet etc.

Geographic

Decimal degrees. Latitude is positive North. Longitude is positive east. Both are floating point degrees.
Altitude is meters, always.

Common to ALL lines is the leading Line ID number.

1. Program Version

```
5001,25.80,1,40, 3, 1,"FwdWin",5.05,"92D7690D-1F87-4407-
802DBD5460A18919"

     25.08          Program Edition
         1          No of Headers (ONE always)
            40      No of Lines in Header
               3         Lines per Station Id
            1            Lines per Drop
               Fwd...                 Program Comment
                     5.05             Firmware version
                          92D7690D- GUID
```

2. Primary "Files"

```
5002,"25SI    ","8002-080","CP15-123"
     25SI      SI for metric, US for English units
          8002-080              Trailer SN
                     CP15-123  Processor SN
```

3. Secondary "Files"

```
5003,"JOHN    ","STANDARD","TEST1","F25"
     JOHN                     Operator name
          STANDARD            Test Setup name
               TEST1      The File name
                     F25 File extension
```

4. Units & Stationing options

```
5010,0,0,0,0,0,0,0,3,1,0,0,0,0,0,1,0,0,0,0,0,1,"MDB"
,"SI","kilometers"

     ----------------Legacy options-------------
                                   SI  (US)
                                   Kilometers
```

5. Date and Time

```
5011,0,1,2016,12,24,14,07,0,"Non",000
    0 1          Legacy
      2016     Year
          12   Month
            24   Day
            14     Hour
              07    Minute
                0  Non  000    Legacy
```

6. Load Cell

```
5200,"XX1      ",2,1.000,89.00,  0.02,  7.129
      XX1          Serial Number
              2    Type 2:FWD  3:HWD
               1.000          Relative Gain
                   89.00      Absolute Gain
                       0.02            Unbalanced Zero
                        7.130   Shunt Value
```

7. Centre SD

```
5201,"0231     ",4,1.000,1.000
      0231         Serial Number
              4  Type 4:2mm  5:100mil
               1.000          Relative Gain
                   1.000    Absolute Gain
```

Lines 8..24 hold SD 2 to 18 similar to Line 7.

25. Plate Radius and X-Positions

```
5020,    150,   0,   200,   300,   ......

       150    Radius of Plate
         0          D1, Center deflector
             200   D2
```

26. Diameter of Plate and Y-Positions

```
5021,    300,    0,      0,      0,   ......

       300    Diameter of Plate
         0          D1, Center deflector
               0  D2
```

27. "Other" Physicals

```
5022,0,   0,   0,  45,  97,  195,  386,

     0          Plate Type: 0=Standard  1=Split Plate
         0          NA
         0    NA
           45                   Height ONE
               97               Height TWO
                   195          Height THREE
                       386   Height FOUR
```

28. Station and Lane Information

```
5023,1,3,0,  23.800,  31.200,  31.200,   0.200,   0.000,1,1

     1 3 0Legacy
         23.800          Min Station
                 31.200  Max Station
                         31.200          Previous Station
                               0.200 Station Step
                                   0.000,1,1 Legacy
```

29. Test Setup Options

```
5024,0,1,1,1,1,1,     0, 0.0,     0, 0.0,0,0,0,  60

     0          Station Prompt
       1          Temperature Prompt(s)
      1          Condition Prompt
       1     Reject Prompt
         1   Decrease Check
          1 Roll Off Check
             0     Pressure Variation
              0.0  Pressure Variation %
                       0          Deflection Variation
                        0.0     Deflection Variation %
                          0        Temperatures "Keep"
                          0          Smoothing
                          0   60 Legacy
```

30. No of Sequences, Drops total

```
5029,        4,      12,     120,      683

             4 Sequences stored
                12 Drops stored
                    120 Sequences total
                        683 Drops total
```

31. Operator Name

```
5030,"Operator Name"
```

32. Facility Information

```
5031,"Facility Name","Code","Type","Class"
```

33. Subsection Information

```
5032,"Section Name","Code","Start","End"
```

Lines 34-35-36 presents the layout of "Station Information".

34.   Station Id

```
5301,0,1,3,3,  31.500,1,1,        3,1991,06,05,20,07

     0 1 3Legacy
           3          Location unit
             31.500  Station
                  1 1  Legacy
                     3  Lane
                      2016              Year
                        12       Month
                          05       Day
                            20    Hour
                              06 Minute
```

35.   Comments

```
5302,0,1,8,0,0,0,0,0,"Comment"

    0 1 8   Legacy
          0 Level of Cracking
            0 0 0 0 Legacy
                    Comment
```

36.   Temperatures

```
5303,0, 24.0, 27.0, 25.0

    0        0=Centigrade  1=Fahrenheit
      24.0            Asphalt
           27.0          Surface
                25.0  Air/Ambient
```

Lines 37..40 are not used.

   ------------ END of HEADER ----------

TEST data are stored chronologically from line 41 and up in groups of:

"Station Information" as lines 34,35,36 above and

one or more lines of Load and Deflection PEAK READINGS.

Remarks and optional GPS information.

Load and Deflection PEAK READINGS:

```
1,   574,   434,   396,   375,   337,  .....

2,  1194,   907,   828,   776,   712,  .....

3,  1677,  1283,  1155,  1095,  1001,  .....

1 Sequence Step No is "Line ID Number"

      574                    Peak Load (kPa)

           434                  Centre Deflection

                396               SD2 Deflection

                     375  SD3      -
```

    .

 Remarks:

```
7651,  23.846,"Railroad crossing"

7651 to 7658 for Remarks 1 to 8

     23.800  Station

             Remark text
```

GPS Navigation Results:

```
5280,0,235959.9,+90.0000000,+180.0000000,999.9, 0, 7, 0, 0

     0  Legacy

  235959.9 UTC Hours Minutes Seconds

        +90.0000000              Latitude (degrees, real)

              +180.0000000 Longitude (degrees, real)

                       999.9 Altitude (m)

                          0  Status

                            7     No of Sats

                              0

                                0
```

19.3 *Nondelimited, 7+ Deflectors (F20)*

File Type: SEQUENTIAL UASCII Text File with varying line lengths.

A file consists of 36 lines of "Header" information followed by TEST DATA.

Optional Global Positioning data are stored BEFORE the related FWD/HWD test sequence data.

Items are located within fixed fields indicated by [X,Y], which defines the first and last character positions.

Text data

> is stored exactly as entered by the operator, i.e. leading and trailing spaces may appear.

Numbers

> are right justified except for the special Nil value ('No use' number) which is stored as "N0" followed by spaces.

Units

> Temperatures, Pressure, Deflections etc. are stored to EITHER Metric (SI) OR Non-Metric (US) systems. To accommodate both, most fields are six characters wide.

Stations

> meters, km, miles, feet etc.

Geographic

Latitude is positive North. Longitude is positive east. Both are floating point degrees, elevation is in meters, always.

![Dynatest logo]

1. "S 120SI   19910212FILENAME36F25.00"

   [1]   S   Sequential type file.

   [2,3]   1   No of Headers (ONE always)

   [4,11] 20SI   NA

   [12,19] 19900212 Date: YearMtDy

   [20,27] FILENAME Name of this file.

   [28,29] 36   Number of lines in HEADER.

   [30]   F   FWD DATA File Identifier.

   [31,35] 25.99   Field Program Edition.

   [36,36] 0   NA

   [37,39] XXX   NA

   [40,42] 000   NA

2. "90   08002-XXX 8000000 120 ."

   [1]   9   No of Deflectors.

   [2]   0   Range 0=2000 mu 1=100 mil.

   [3,7]   NA

   [8]   0   Temperatures: 0=Keep 1=Blank

   [9,16] 8002-XXX FWD/HWD Serial Number.

   [17,24]   80000 DMI Calibration figure.

   [25]   0   Smoothing: 0=OFF <>0:ON

   [26]   0   History: 0=Preserved (always)

   [27,30]   60   Smoothing Filter cut off (Hz)

   [31,32]   Reserved.

3. " 150   0 200 -200 450 600 900 1200 1500 1800

These numbers are either 'mm' or 'in.

Negative values means 'Behind' the loading plate.

[1,6]   150   RADIUS of PLATE

[7,12]   0   Centre dummy, probably ZERO

[13,18]   200   Distance from center Chnl.2

[19,24] -200   -   -   -   - 3

etc. in fields: [25,30] [31,36] [37,42] [43,48] ...

4. "C:\DYNATEST\DATA\   .F200H20"

[1,2] C: Working Disc Drive

[3,28] \DYNA... Working Directory (26 characters max).

[29,32] .F20   FWD Data file Extension.

[33,33] 1   History Mode (NA)

[34,36] MDB   History stored in database

5. "Generatorvej 21 ...

[1,60] Roadway Identification.

6. NA

7. NA

8. "SUR-035 AIR-123   0.000   5.150   5.050   0.100   0.000"

   [1,8]   SUR-035 Surface temperature sensor SN

   [9,16] AIR-123 Air temperature sensor SN

   [17,24]   1000 Lowest 'Station'

   [25,32]   1150 Highest 'Station'

   [33,40]   1150 Previous Station

   [41,48]   100 Station Step

   [49,56]   0.000 NA

9. " 2015.0 3.5 5.0 2.015.0 2.0 5.0"

   Limits, four characters each.

   [1,4]   20 Vibr/Drift Limit (mu or mil)

   [5,8]   15.0 Lower Plate Time Limit

   [9,12] 3.5 Raise.Weight   -   (1.Stop)

   [13,16] 5.0 Lower Catch   -   (NO Pres2)

   [17,20] 2.0 Drop   -   (till TG)

   [21,24] 15.0 Raise Plate   -

   [25,28] 2.0 Raise Weight   -   (til NO TG)

   [29,32] 5.0 Raise Catch   -

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10. "Ld XXX   1.000 89.00   ."

   [1,3]   Ld   Load Cell Id.

   [4,11] XXX   Serial No

   [12]   Space

   [13,17] 1.000   Relative Gain

   [18]   Space

   [19,23] 89.00   Absolute Gain

   [24,32]   Reserved.

11. to 20. Deflector Serial Numbers and Gains similar to line 10.

   A vacant Deflector channel looks like:

   "D9 NA   0.000 0.000   ."

21. "Operator Name ....

   [1,32]   Operator Name.

22. Test Units and Options.

"00   20100002 1 1   ."

[1] 0 Deflections   0=mu 1=mil

[2] 0 Temperatures   0='C 1='F

[3]   NA

[4]   NA

[5]   NA

[6] 2 Location   2=Meters

                       3=km

                       5=feet

                       6=yards

                       7=Miles

[7]   NA

[8]   NA

[9]   NA

[10] 0 Pressure unit   0=kPa 1=psi

[11] 0 Weight (mass)   0=kg 1=lb

[12] 0 Distances   0=mm 1=in

[13] 0 NA

[14,15] 1 Lines per Station ID (ONE)

[16,17] 1 Lines per Drop (ONE)

[18,32]   NA

23. "   0 0.0   0 0.0   ."

Accepted Variations.

[1,6]   0 Load (kPa or psi)   @) [1,4]

[7,10]   0.0 - (percent)   @) [5,8]

[11,16]   0 Deflection (mu or mil)   @) [9,12]

[17,20]   0.0   -   (percent)   @) [13,16]

[21,32]   Reserved

24. "*Subsection ...

SUBSECTION ID

[1]   *   Subsection Prefix character

[2,61]   User specified (see line 27)

25. NA

26. NA

27. NA

28. " 300   0 200 -200   0   0   0   0   0   0

Diameter of Plate and

Y-Positions: Off center-line complement to line 3 (mm or in).

Positive to the 'Left'.

[1,6]   Diameter of Plate (mm or in).

[7,12]   0   Centre dummy, probably ZERO

[13,18]   200   Distance from centerline Chnl.2

[19,24]   -200   -   -   -   - 3

etc. in fields: [25,30] [31,36] [37,42] [43,48] ....

29. "   10   54   112   556"

   Approximate Sequence and Drop totals.

   [1, 8]   10 No of Sequences stored in this file

   [9,16]   54 - -   Drops   -   -   -   -

   [17,24]   112 Total No of Sequences

   [25,32]   556   -   -   -   Drops

30. " A1aaB2bbC3ccD4dd...........

    copy of line 31 below

31. "A111B222C333D444...........

   [1,89] Sequence step types (most recently used).

      A..D: Seating drops (never stored)

      1..4:   Drops at heights 1 to 4 (stored).

      e..n: 'Load Sensing' drops (stored).

      P: Pause.

      R: Resettle loading plate.

      S: Stop (leave plate on the ground).

32. NA

33. ".***.***.***.***

   Steps stored

34. NA

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35. NA

36. "SETUP   Standard Setup   "

   [1,8]   SETUP   First eight characters of setup name.

   [9,32]   Setup Comment.

   ------------ END of HEADER ----------

37. "*subsection ...

   [1]   *   Subsection Prefix character

   [2,61]   User specified

TEST data are stored chronologically from line 38 and up in groups of:

Optional GPS data.

One STATION IDENTIFIER and

one or more lines of Load and Deflection PEAK READINGS.

Comments may precede or follow any group of TEST data.

GPS Navigation Results:

"G0000000+90.0000000+180.0000000999.9"

[1] G   GPS prefix character

[2] 0   Failure Cause

         1: Too few satellites

         2: DOPs too large

         3: Position STD too large

         4: Velocity STD too large

         5: Too many iterations for velocity

         6: Too many iterations for position

         7: 3 sat startup failed

         8: Initial Acq.

         9: Timeout

[3,8]   000000   (UTC time, seconds into the week)

[9,19] +90.0000000 Latitude (degrees, real)

[20,31]+180.0000000 Longitude (degrees, real)

[32,36] 999.9   Height (meters, always)

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STATION IDENTIFIER (the first one):

"S   11506hvv 20.000 20 200209300110010112"

  Station_LaneAsphtCdSurAirLSHrMnWSPCEFGHsn

[1]   S   Station prefix

[2,9]   1150 Station (see [28])

[10,13] 6hvv   Lane (text)

[14,18] 20.0   Asphalt Temperature

[19,20] 00   'Condition' field (text)

[21,23] 20   Surface Temp (Optional)

[24,26] 20   AIR Temperature (Optional)

[27]   0   NA

[28]   2   'Location' unit

       (as line 22.[6])

[29,32] 0930   Time of Day (HrMn)

[33,40] 00010101 General purpose 'Conditions'

[33,35] 000   NA

[36]   Cracks   0=None 1=Moderate 2=Severe

[37,42] 000012   NA

DATA SET: (the first one)

" 751 2540 2000 1900 1800 1700 1600 1500 ....

All fields are six characters wide.

[1,6]   751 Peak Load (kPa/psi)

[7,12]   2540 Peak D1 deflection (mu/mil)

[13,18]   2000 - D2   -

etc in fields

[19,24] [25,30] [31,36] [37,42] [43,48]

[49,54] [55,60] [61,66] ...

  Notes: The lengths of these lines depend on the last USED deflector, which may vary
  within a DATA SET.

COMMENTS:

"'Comment 4:This is a Comment

[1]   '   Comment prefix character

[2,:]   Comment 4   The 'Name' (Identifier) of the 'Object'.

    :   Separator.

[:...] This is... The Comment text.

The User may store ANY Text or Numeric 'object' this way.

(The 'Name' + colon part may be omitted)

19.4 *Nondelimited, 7 Deflectors (FWD)*

FWD Data File Type: RANDOM UASCII Text File (Fixed Line length).

A file consists of 36 lines of "Header" information immediately followed by TEST DATA and Comments. Optional Global Positioning data are stored BEFORE the related FWD/HWD test sequence data.

Items are located within fixed fields indicated by [X,Y], which defines the first and last character positions.

Text data

is stored exactly as entered by the operator, i.e. leading and trailing spaces may appear.

Numbers

are right justified except for the special Nil value ('No use' number) which is stored as "N0" followed by spaces.

Units

Temperatures, Pressure, Deflections etc. are stored Metrically in positions 1 to 32. The wide 'R80' format ADDS English unit test results in the extra positions (33 to 80).

Stations

meters,km,miles,feet etc.

Geographic

Latitude is positive North. Longitude is positive east. Both are floating point degrees. GPS height is meters, always.

1. "R32   19920121FILENAME36F25"

    [1]   R   Random type file.

    [2,3] 32   Line length 32/80

    [4,11]   Reserved

    [12,19] 19900212 Date: YearMtDy

    [20,27] FILENAME Name of this file.

    [28,29] 36   Number of lines in HEADER.

    [30]   F   FWD DATA File Identifier.

    [31,32] 25   Field Program Edition.   @) 10/20

2. "70   08002-XXX   8000000 120 ."

    [1]   7   No of Deflectors.

    [2]   0   Range 0=2000 mu 1=100 mil.

    [3,7]   Reserved.

    [8]   0   Temperatures: 0=Keep 1=Blank

    [9,16] 8002-XXX FWD/HWD Serial Number.

    [17,24]   80000 DMI Calibration figure.

    [25]   0   Smoothing: 0=OFF <>0:ON

    [26]   0   History: 0=Preserved <>0:Smoothed too

    [27,30] 120   Smoothing Filter cut off (Hz)

    [31,32]   Reserved.

3. "150 0   200 300 450 650 900 1200   5.9   0   7.9 etc....

   [1,4]   RADIUS of PLATE (mm)

   [5,8]   always ZERO

   [9,12]   Distance from center Chnl.2 (mm)

   [13,16]   -   -   -   - 3 -

   [17,20]   -   -   -   - 4 -

   [21,24]   -   -   -   - 5 -

   [25,28]   -   -   -   - 6 -

   [29,32]   -   -   -   - 7 -

   [33,38]   Radius of plate (inches)

   [39,44]   Zero

   [45,50]   Distance from center Chnl.2 (inches)

   [51,56]   -   -   -   - 3 -

   [57,62]   -   -   -   - 4 -

   [63,68]   -   -   -   - 5 -

   [69,74]   -   -   -   - 6 -

   [75,80]   -   -   -   - 7 -

4. "C:\DYNATEST\DATA\   .FWD"

   [1,2] C: Working Disc Drive

   [3,28] \DYNA... Working Directory (26 characters max).

   [29,32] .FWD   FWD/HWD Data file Extension.

5. "Generatorvej 21 ...

   [1,32] or [1,60] Roadway Identification.

6. "S   11506hvv 20.000 20 20020930"

   Copy of last STATION ID stored in file (see line 38).

7. "S   12006hvv 20.000 20 20020930"

   Next Expected STATION ID.

8. "SUR-MAN AIR-MAN   1000   1150"

   [1,8]   SUR-MAN Surface 'Xducer'

   [9,16] AIR-MAN Air 'Xducer'

   [17,24]   1000 Lowest 'Station'

   [25,32]   1150 Highest 'Station'

9. "   2015.0 3.5 5.0 2.015.0 2.0 5.0"

   Limits, four characters each.

   [1,4]   20 Vibr/Drift Limit (mu or mil)

   [5,8]   15.0 Lower Plate Time Limit

   [9,12]   3.5 Raise.Weight   -   (1.Stop)

   [13,16] 5.0 Lower Catch   -   (NO Pres2)

   [17,20] 2.0 Drop   -   (till TG)

   [21,24] 15.0 Raise Plate   -

   [25,28] 2.0 Raise Weight   -   (til NO TG)

   [29,32] 5.0 Raise Catch   -

10. "LdXXX   1.000   89.00   ."

   [1,2]   Ld   Load Cell Id.

   [3,10] XXX   Serial No (File Name)

   [11,15] 1.000   Relative Gain

   [16,18]   Reserved

   [19,23] 89.00   Absolute Gain

   [24,32]   Reserved.

11. to 20. Deflector Serial Numbers and Gains similar to line 10.

   A vacant Deflector channel looks like:

   "D0NA   0.0000.000   ."

21. "Operator Name ....

   [1,32]   Operator Name.

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22. "0000120100002 1 1   ."

Test Units and Options.

[1] 0 Deflections   0=mu 1=mil

[2] 0 Temperatures   0='C 1='F

[3] 0 Stn. Prompt   0=OFF 1=ON

[4] 0 Decrease Check 0=OFF 1=ON

[5] 1 Rejection   0=OFF 1=ON

[6] 2 Location   2=Meters

               3=km

               4=km extended

               5=feet

               6=yards

               7=Miles

               8=Miles ext. ext.

               9=Miles.feet

[7] 0 Tmp. Prompt(s) 0=OFF 1=ON

[8] 1 Cnd. Prompt   0=OFF 1=ON

[9] 0 Roll off check 0=OFF 1=ON

[10] 0 Pressure unit   0=kPa 1=psi

[11] 0 Weight (mass)   0=kg 1=lb

[12] 0 Distances   0=mm 1=in

[13] 2 Station Step Mode, 0=No 1=Fixed 2=Logical

[14,15] 1 Lines per Station ID (ONE)

[16,17] 1 Lines per Drop (ONE)

[18,32]   Reserved

23. "5   2   5   2   "

   [1,4]   5 Allowed LOAD Variation (kPa)

   [5,8]   2   -   -   -   (percent)

   [9,12]   5   - Deflection -   (mu)

   [13,16] 2   -   -   -   (percent)

   [17,32]   Reserved

24. Last stored SUBSECTION ID (see line 37).

25. "DtCty PxNnnnS 000+0.0 000+0.0 St ....

   [1,32] or [1,60] Roadway ID TEMPLATE

26. " Cty P Nnnn

   [1,32] or [1,60] File name generation mask

27. "000+0.0 000+0.0 St ...

   [1,32] or [1,60] Roadway Subsection ID TEMPLATE

28. " 300   0 200-200   0   0   0   0"

Diameter of Plate and

Y-Positions: Off center-line complement to line 3.

Positive to the 'Left'.

[1,4]   300   Diameter of Plate (mm).

[5,8]   0   Centre dummy, probably ZERO

[9,12]   Distance from center-line Chnl.2 (mm)

[13,16]   -   -   -   -   - 3 -

[17,20]   -   -   -   -   - 4 -

[21,24]   -   -   -   -   - 5 -

[25,28]   -   -   -   -   - 6 -

[29,32]   -   -   -   -   - 7 -

[33,38] Diameter of plate (inches)

[39,44] Zero

[45,50] Distance from center-line Chnl.2 (inches)

[51,56]   -   -   -   -   - 3   -

[57,62]   -   -   -   -   - 4   -

[63,68]   -   -   -   -   - 5   -

[69,74]   -   -   -   -   - 6   -

[75,80]   -   -   -   -   - 7   -

29. "   10   54   112   556"

APPROXIMATE Sequence and Drop totals.

[1, 8]   10 No of Sequences stored in this file

[9,16]   54 - - Drops   - - - -

[17,24]   112 Total No of Sequences

[25,32]   556 - - -   Drops

30. Not used

31. "A1aaB2bbC3ccD4dd...........

[1,89] Sequence step types (most recently used).

    A..D: Seating drops (never stored)

    1..4:   Drops at heights 1 to 4 (stored).

    e..n: 'Target Sensing' drops (stored).

    P: Pause.

    R: Resettle loading plate.

    S: Stop (leave plate on the ground).

[65,80]   Reserved

32. Not used

33. ".***.***.***.***..........

Indication of which sequence peaks are stored.

34. Not used

35. "...*...*...*...*..........

Indication of which sequence 'Whole Histories' are stored.

36. "SETUP   Standard Setup   "

[1,8]   SETUP   Name of 'Test Setup' File.

[9,32]   Setup Comment.

------------ END of HEADER ----------

37. "*First subsection ...

Initial SUBSECTION ID (the first one)

[1]   *   Subsection Prefix character

[2,61]   User specified (see line 27)

TEST data are stored chronologically from line 38 and up in groups of:

Optional GPS data.

One STATION IDENTIFIER and

one or more lines of Load and Deflection PEAK READINGS.

Comments may precede or follow any group of TEST data.

35. "...*...*...*...*..........

GPS Navigation Results:

"G0400743+90.0000000+180.0000000999.9"

[1]   G   GPS prefix character

[2]   0   Failure Cause

>   1: Too few satellites

>   2: DOPs too large

>   3: Position STD too large

>   4: Velocity STD too large

>   5: Too many iterations for velocity

>   6: Too many iterations for position

>   7: 3 sat startup failed

>   8: Initial Acq.

>   9: Timeout

[3,8]   400743   UTC time, seconds into the week

[9,19] +90.0000000 Latitude (degrees, real)

[20,31]+180.0000000 Longitude (degrees, real)

[32,36] 999.9   Height (meters)

STATION IDENTIFIER:

"S   11506hvv 20.000 20 20I20930 68 68 68"

 Station_LaneAsphtCdSurAirLSHrMnWSPCEFGHsn

[1]   S   Station prefix, No specific 'direction'

[2,9]   1150 Station (see [28])

[10,13] 6hvv   Lane

[14,18] 20.0   Asphalt Temperature

[19,20] 00   'Condition' field (text)

[21,23] 20   Surface Temp (Optional)

[24,26] 20   AIR Temperature (Optional)

[27]   I   Station "Direction"

        I:Increasing or D:Decreasing

[28]   2   'Location' unit (as line 22.[6])

[29,32] 0930   Time of Day (HrMn)

[33,36] 68   Asphalt Temperature ('F)

[37,40] 68   PAVEMENT Surface Temp ('F)

[41,44] 68   AIR Temperature ('F)

[45,80]   Reserved

DATA SET: (the first one)

   "754 1280905 837 688 431 234 122 10730 50.39 35.63 32.95…

   [1,4]   LOAD (kPa)

   [5,8]   CENTER Defl (mu)

   [9,12] DEFLECTION 2

   [13,16]   -   3

   [17,20]   -   4

   [21,24]   -   5

   [25,28]   -   6

   [29,32]   -   7

   [33,38] Force (lbf)

   [39,44] CENTER Defl (mil)

   [45,50] DEFLECTION 2

   [51,56]   -   3

   [57,62]   -   4

   [63,68]   -   5

   [69,74]   -   6

```
    [75,80]      -      7
```

COMMENTS:

"'This is a Comment......

[1]   '   Comment prefix character

[2.80] This is... The Comment text.

19.5 *Pavement Deflection Data Exchange (DDX)*

This format is similar to the 'System.INI' in Windows. The file is divided into sections each having a bracketed header line. The data is composed of a descriptive name, an equal sign followed by the value(s), like: Operator = John Johnson. For details see:

 www.normas.com/AASHTO/pages/PDDX.html.

The following shows the beginning of a DDX data file.

[Pavement Deflection Data Exchange File]

PDDXVersionNumber = 1.0

DelimiterSymbol = ,

DecimalSymbol = .

[Operations Information]

FileLocation = C:\FwdWin\Data\DBV.DDX

EndTime = 20:07:20

EndDate = 11-Dec-2001

OperatorName = ks

[Units]

LoadPlateRadiusUnits = millimetre

LoadUnits = kilo-Pascal

DeflectionUnits = micron

TemperatureUnits = Celsius

SensorsLocationUnits = millimetre

TestLocationUnits = kilometre, millimetre, millimetre

GPSUnits = degree, degree, meter

DropHistoryDataFrequencyUnits = Hertz

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[Device Information]

DeviceDesignationName = Dynatest FWD

DeviceModelNumber = 8082

DeviceSerialNumber = 8082-061

LoadCellSerialNumber = 86205-0071

SensorSerialNumbers = 86211-3701,86211-3702,86211-3703,86211-3704,86211-3705,86211-3706,86211-3707,86211-3708,86211-3709

DeviceLoadType = impulse

[Device Configuration]

LoadCellRadius =   150

NumberOfDeflectionSensors = 9

DeflectionSensorXAxisDistances =   0, 200, 300, 450, 600, 900, 1200, 1500, 1800

DeflectionSensorYAxisDistances =   0,   0,   0,   0,   0,   0,   0,   0,   0

NumberOfTemperatureSensors = 3

TemperatureSensorUse = air, surface, mid-depth

[Device Calibration]

LoadCellCalibrationFactor =   147.8

SensorDynamicCalibrationFactor = 0.977, 0.966, 0.994, 0.998, 1.022, 0.970, 0.970, 0.974, 0.983

SensorReferenceCalibrationFactor = 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

DMIDeviceCalibrationFactor = 60000

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[Location Identification]

SiteName = Copenhagen, DK

FacilityName = Dynatest Boulevard

SectionName = East bound lane one

PavementType = ACC

[Data Configuration]

NumberOfTestLocations = 0

NumberOfDropHistoryDataSamples = 600

DropHistoryDataFrequency = 10000

[Test Location 1]

TestLocation =   8.000, 0, 0

GPSLocation = 30.0000000, -82.0000000,   5.0

TestLane = Right-1

TestTemperatures = 20.4, 24.1, 22.3

TestTime = 19:48:19

TestComment =

DropData_1 =   596, 459.8, 414.6, 392.8, 355.6, 324.3, 254.1, 182.2, 111.8, 41.6

DropData_2 =   845, 649.2, 589.3, 559.9, 503.2, 453.2, 359.2, 255.6, 158.7, 59.5

DropData_3 = 1203, 927.9, 836.8, 778.0, 712.7, 648.4, 501.8, 365.4, 223.6, 84.6

[Test Location 2]

TestLocation =   9.000, 0, 0

GPSLocation = 30.0000000, -82.0000000,   5.0

TestLane = Right-1

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TestTemperatures = 20.3, 24.2, 22.3

TestTime = 19:50:04

TestComment =

DropData_1 =   606, 461.2, 417.9, 394.5, 357.9, 321.2, 252.5, 182.6, 112.2, 41.6

DropData_2 =   855, 647.8, 583.5, 552.5, 504.4, 454.8, 359.0, 255.2, 159.7, 59.1

DropData_3 = 1190, 929.5, 823.3, 778.6, 716.7, 641.2, 507.6, 362.0, 222.9, 84.0

20. Error Messages

The following is a list of equipment error messages.

Error 536: Deflection OFF RANGE

One or more deflections exceed the specified range ! (2000/2540 mu).

Plot the test to check the shape of the **Time History**.

Error 537: Repeatability check failed

Pressure and/or Normalized Deflections of latest "Comparable" tests failed

the repeatability check.

Error 538: Roll-Off

The POST-IMPACT shape of one or more Deflection signals failed.

If peak instants of the outermost deflectors fall close to the

end of the sampling window you may cancel Roll Off check or

increase the Sampling Window Size to avoid error.

Perhaps plot the test to check the **Time History** shape.

Error 539: Deflections are not Decreasing

Peak deflections do not agree with the entered Transducer positions.

Perhaps check ACTUAL physical positions against entered positions.

Disable **Decrease** check if this test is not relevant.

Error 540: Excess Vibration/Drift

One or more channels did not settle within 1.5 seconds.

 Check that all sensors make good contact to the Pavement.

 Perhaps inspect a **Drift/Vibration** plot.

    WARNING: THE WEIGHT IS PROBABLY IN A RATHER

                DANGEROUS POSITION.

Error 581: Load Amplifier Mismatch

The Load Cell Amplifier is not the right type.

Error 582: Deflector Amplifier Mismatch

The Deflector Amplifiers are not the right type.

Error 584: Duplicate Deflector

At least one Deflector is assigned to more than one channel!

Check the setup and make sure the right UNIQUE serial numbers

match the deflectors actually plugged.

Error 603: Network time-out

```
The communication between the Computer and the Trailer fails.

Possible causes:

    Trailer boot process not completed.

    Network Cables (Ethernet) not connected.

    Power supply failure in the Trailer, maybe only momentarily!

    Computer Network Adapter defective.

- You must allow the Trailer sufficient time to boot before the computer initiates

  communication.

- Check Interface setting (Setup - Processor - Embedded)

- Check all connections.

- Check Trailer power Leds, recharge battery and/or exchange fuse(s).

- If all connections and supplies are OK, then shut down Windows, switch OFF
Trailer

  and computer power, wait 10 sec, then switch ON again to re-start.

- If re-starting the program results in another time-out failure, then exchange

  the Network cables.

- To determine if the computer is malfunctioning, exchange the computer or have

  the computer Network port verified by a technician.



After this message you will have the opportunity to exit the program.
```

Error 604: +/-15V supply OFF RANGE

```
The system has measured a too high or too low +15V or -15V supply.

Possible causes:

 Battery voltage off range.

 Power Supply defective.

- Recharge battery if low. Check car alternator regulator if voltage is too high.

- Monitor the +/-15V in the Information - Voltages window.
```

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Error 605: Offset beyond +/-2mV

```
The system has measured a too high or too low amplifier reference offset.

This MAY produce unacceptable Deflector Drift rates. If "Drift" plots

turn out acceptable, reliable measurements may still be carried out,

however it is recommended that the system be serviced.
```

Error 606: Battery voltage OFF RANGE

```
The system has measured a too high or too low battery voltage.

If too low voltage: Check alternator, charging circuits,

                      charging cable connections and fuses.

If too high voltage: Check alternator regulator. NOTE that a too high

voltage on the battery may damage system circuits.
```

Error 608: Load cell

```
A Load Cell Calibration found one or more of the following Voltages in error:

 Positive Excitation, Negative Excitation,

 Balanced Zero, Calibration Level, Shuntvalue

Possible reasons:

 +/-15V supply off range.

 Load Cell cable not connected or defective.

 Load Cell has been overloaded e.g. due to lack of grease in the loading plate

 swivel or due to dropping of weight without buffers (affects Bal.Zero and

 perhaps Shuntvalue, but rarely Excitation).

- Check +/-15V supplies (Information - Voltages).

- Check Cell resistances thru Load Cell Cable first:

  Ohms approx      DIN plug      Load Cell Socket

   240 - 243       2 - 4            2 - 4

   240 - 243       1 - 5            1 - 5

   180 - 183       2 - 1            2 - 1
```

```
   180 - 183          4 - 5                  4 - 5

   180 - 183          2 - 5                  2 - 5

   180 - 183          1 - 4                  1 - 4
```

 The middle one of the 3 male pins in the cell socket is no.5 (CW decrease).

Error 609: 5V supply OFF RANGE

The system has measured a too high or too low 5V supply.

Possible causes:

 Battery voltage Off Range.

 5V power supply defective or overloaded/short circuited.

- Recharge battery if low.

   Check alternator regulator if voltage is too high,

   which may have damaged the 5V power supply.

- Monitor the 5V in the Information - Voltages window.

Error 614: Trailer has executed Hardreset

The RESET circuit in the Trailer has been triggered.

Possible causes:

 A momentary break in the electronics battery supply.

 An abrupt fall (noise) in the battery supply voltage.

 A break in the internal 5V supply, maybe only of very short duration!

- Make sure that the power connections to the battery is good and

   stable (clips should NOT be used for this connection!).

- Monitor the trailer battery voltage with a scope WHILE testing.

   This might reveal "spikes" not captured by the Over/Under voltage detectors.

- Monitor the 5V supply in the Information - Voltages window.

- Check trailer fuses.

Error 620: Command echo

```
The system did not recognize the last command.
```

Error 621: Command fault

```
The system did not accept the last command.
```

Error 622: System Response

```
The system response to the last command is not accepted.

- Bad Numeric format.
```

Error 623: Battery needs charging

```
Voltage detectors found a too low battery voltage.

- Check alternator and charging circuits.

- Check charging cable connections and fuses.

- Check Over/Under voltage detectors by supplying "battery" power from a

  variable (9 to 15V) supply.

  NOTE: do not exceed 14.5V for a longer period of time.
```

Error 624: Battery over-charged

```
Voltage detectors found a too high battery voltage.

NOTE that battery overvoltage may damage the System.

- Check alternator.

- Check alternator regulator.

- Check Over/Under voltage detectors by supplying "battery" power from a

  variable (9 to 15V) supply.

NOTE: do not exceed 14.5V for a longer period of time.
```

Error 625: 30V OFF RANGE

Voltage detectors found a too low or too high 30V (+/-15V) supply voltage

(less than approx. 28V or greater than approx. 32V).

 Possible causes:

 Battery voltage off range.

 +/-15V power supply defective/short circuited.

- Recharge battery if low. Check alternator regulator if voltage is too high,

   which may damage the power supply.

- Monitor the +/-15V in the Information - Voltages window.

Error 626: 5V TOO LOW

Voltage detectors have caught a too low 5V supply voltage

(less than approx. 4.7V).

Possible causes:

 Battery voltage Off Range.

 5V power supply defective or overloaded/short circuited.

- Recharge battery if low. Check alternator regulator if voltage is too high,

   which may have damaged the 5V power supply.

- Monitor the 5V in the Information - Voltages window.

Error 627: 5V TOO HIGH

Voltage detectors have caught a too high 5V supply voltage (greater than approx. 5.3V).

NOTE that the digital circuits are specified to operate properly at a max. supply

voltage of 5.3V, and if the supply voltage exceeds 7V, then the digital circuits

may be damaged!

Possible causes:

 5V supply defective.

- Monitor the 5V in the Information - Voltages window.

Error 630: Transport lock

1. When Lower Plate is initiated from "Transport Position" (PH activated),

    then the PL switch must remain ACTIVATED for at least 2 seconds (typ.).

2. Deactivation of the PH switch must occur prior to PL Deactivation.

If 1 or 2 fails, then the plate will be raised automatically to release the locks.

Possible causes:

 The Transport locks have not been unlocked.

 Defective PH and/or PL proximity switches.

- Check ALL transport locks and optional unlocking hardware.

- Check switch to LED correspondence in the Trailer.

   NOTE that a Deactivated PL switch (PL LED in Trailer OFF) means that

   the Plate IS Low.

- Check that PH and PL switches appear correctly on the Computer.

Error 632: Trigger Timeout

When Raise Weight is initiated, it is tested that the trigger (TG) proximity

switch is Deactivated within a pre-determined time limit (1.5 sec. typ.), to

make sure that the catch do not elevate without the weight.

Possible causes:

 The catch was not locked to the weight.

 Trigger switch defective.

 Hydraulics needs bleeding.

- Release and lower the catch

    by use of **Manual Control** window (from the Computer) or

    by turning the MAN.KEY while pressing Drop and LP/RW buttons, and then

    LC button.

- Check Trigger (TG) switch (LED in Trailer and "TG" on Computer).

- Bleed the raise weight cylinder as explained in the Manual.

- Increase the Raise Weight (until TG off) time limit to 3 seconds max.

Error 633: PS1 activated/disconnected

Pressure switch P1 was activated or disconnected during Raise Weight.

- Check P1 wiring.

- Check that "P1" on Computer corresponds to P1 LED OFF in the Trailer.

Error 641: Lower Plate Timeout

Lower Plate has not completed within a predetermined time limit (15 sec. typ).

Possible causes:

 The catch was not locked to the weight.

 Pressure switch No. 1 (P1) defective or improperly adjusted.

 Trigger (TG) proximity switch trouble.

 Hydraulics failure.

- Release and lower the catch

    by use of **Manual Control** at Computer screen or

    by turning ON MAN.KEY while pressing Drop (LP/RW and RED button), then

    LC button.

- Check that "P1" on Computer corresponds to P1 LED OFF in Trailer

  and "TG" to TG Led ON.

- Refer to the Manual for adjustment instructions.

- Check that the hydraulic valves, the motor and the motor relay are powered

  and functioning properly (refer to the Manual).

- Increase the Lower Plate (until P1 on) time limit to 20 seconds max.

Error 642: Raise Weight Timeout

After initiation of Raise Weight the system must see the first WH (Weight

High) signal within a predetermined time limit (3.5 sec. typ.) and the time

between any two WH signals must not exceed twice this limit.

This prevents the weight from being raised to its top position

(which would cause the weight to drop!) if the WH switch fails or

if no falling height stops are applied.

Possible causes:

WH proximity switch defective.

The uppermost falling height stop (No. 1) is placed too low

(too great falling height No. 1).

Hydraulics failure.

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer.

- Reduce falling height No. 1 to less than approx. 100 mm (4").

- Check that the hydraulic valves, the motor and the motor relay are powered

  and functioning properly (refer to the Manual).

- Increase the Raise Weight (until Stop 1) time limit to 4 seconds max.

Error 643: Drop Timeout

The time from initiation of the Drop mode until activation of the trigger (TG)

proximity switch has exceeded a predetermined time limit (2 sec. typ.).

Possible causes:

TG proximity switch defective.

Hydraulics need bleeding.

Hydraulics failure.

- If the weight actually dropped, then the TG switch MAY be defective.

- Check that "TG" on Computer corresponds to TG LED ON in the Trailer.

- If Drop causes the weight to raise more than approx. 20 mm (1"),

  before it is dropped, then the raise weight cylinder needs bleeding

  (or C valve is bad).

  Refer to the Manual for bleeding instructions.

- Check that the hydraulic valves, the motor and the motor relay are powered

  and functioning properly (refer to the Manual).

- Increase the Drop (until TG on) time limit to 5 seconds max.

Error 644: Lower catch Timeout

The time from initiation of the Lower Catch mode until pressure switch No. 2 (P2) is Deactivated AND P1 is activated, has exceeded a predetermined time limit (5 sec. typ.).

Possible causes:

Pressure switch P2 and/or P1 defective or improperly adjusted.

Hyd. pump excess pressure is too low.

Hydraulics failure.

- Check that "P2" on Computer corresponds to P2 LED ON in the Trailer (and "P1" to P1 LED OFF!).

- Refer to the Manual for adjustment instructions.

- Check that the hydraulic valves, the motor and the motor relay are powered and functioning properly (refer to the Manual).

- Increase the Lower Catch (until P2 off) time limit to 6 seconds max.

Error 645: Raise Plate Timeout

The time from initiation of the Raise Plate mode until activation of the PH proximity switch(es) AND the P1 pressure switch has exceeded a predetermined time limit (15 sec. typ.).

Possible causes:

Pressure switch P1 defective or improperly adjusted.

Hyd. pump excess pressure is too low.

PH proximity switch(es) defective or not activated when plate is high.

Hydraulics failure.

- Check that "P1" on Computer corresponds to P1 LED OFF in the Trailer (and "PH" to PH LED ON).

- Refer to the Manual for adjustment instructions.

- Check that PH activator gap(s) is less than 4 mm (5/32") when the plate is in its locked position.

- Check that the hydraulic valves, the motor and the motor relay are powered

    and functioning properly (refer to the Manual).

- Increase the Raise Plate (until PH on) time limit to 20 seconds max.

Error 646: Release Catch Timeout

The time from initiation of the Release Catch mode until activation of the

P1 pressure switch has exceeded a predetermined time limit (2 sec. typ.).

Possible causes:

 Pressure switch P1 defective or improperly adjusted.

 Hyd. pump excess pressure is too low.

 Hydraulics failure.

- Check that "P1" on Computer corresponds to P1 LED OFF in the Trailer

- Refer to the Manual for adjustment instructions.

- Check that the hydraulic valves, the motor and the motor relay are powered

    and functioning properly (refer to the Manual).

- Increase the time limit to a maximum of 5 seconds.

Error 647: Raise catch Timeout

The time from initiation of the Raise Catch mode until activation of the

P1 pressure switch has exceeded a predetermined time limit (5 sec. typ.).

Possible causes:

 Pressure switch P1 defective or improperly adjusted.

 Hyd. pump excess pressure is too low.

 Hydraulics failure.

- Check that "P1" on Computer corresponds to P1 LED OFF in the Trailer

- Refer to the Manual for adjustment instructions.

- Check that the hydraulic valves, the motor and the motor relay are powered

    and functioning properly (refer to the Manual).

- Increase the time limit to a maximum of 10 seconds.

Error 648: Auto Raise Plate Timeout

```
The hyd.motor has been running continuously for more than 20 seconds in the

(auto-) RAISE PLATE state, to keep the loading plate high.

Possible causes:

 Pressure switch P1 defective or improperly adjusted.

 Hyd. pump excess pressure is too low.

 PH proximity switch defective or not activated when the plate is high.

 Hydraulics failure.

- Check that "P1" on Computer corresponds to P1 LED OFF in the Trailer

   (and "PH" to PH LED ON).

- Refer to the Manual for adjustment instructions.

- Check that PH activator gap(s) is less than 4 mm (5/32") when the plate is

   in its locked position.

- Check that the hydraulic valves, the motor and the motor relay are powered

   and functioning properly (refer to the Manual).
```

Error 650: PS2 was ACTIVATED

```
The P2 pressure switch was activated on completion of the Raise Plate mode.

Possible causes:

 Pressure switch P2 defective.

 P2 wires short-circuited.

 P2 setting too low.

 -Check that "P2" on Computer corresponds to P2 LED ON in the Trailer.

 -Refer to the Manual for adjustment instructions.
```

Error 651: PS2 was NOT activated

```
The P2 pressure switch was not activated on completion of Raise Weight mode.

Possible causes:

 Pressure switch P2 defective.
```

P2 wires disconnected.

P2 setting too high.

- Check that "P2" on Computer corresponds to P2 LED ON in the Trailer.

- Refer to the Manual for adjustment instructions.

Error 652: PH was ACTIVATED

The Plate High Proximity Switch Signal was ACTIVE.

Possible causes:

 The plate IS high (of course).

 PH proximity switch defective.

 P1 pressure switch defective or too sensitive.

- Check that "PH" on Computer corresponds to PH LED ON in the Trailer.

- Check P1 adjustment.

Error 653: PH was NOT activated

The Plate High Proximity Switch was not activated on completion of the

Raise Plate mode.

Possible causes:

 PH Proximity Switch defective.

 PH signal is not active when plate is high.

- Check that "PH" on Computer corresponds to PH LED ON in the Trailer

- Check that activator gap(s) is less than 4 mm (5/32") when the plate is in

  its locked position.

Error 654: PL was ACTIVATED

The PL (Plate Low) proximity switch was activated (i.e. Plate is NOT low!):

Possible causes:

 The plate is NOT low (of course).

 PL proximity switch defective.

P1 pressure switch defective or too sensitive.

- The length of raise plate cylinder shafts limits the depth of "below ground"

  tests.

- Check that "PL" on Computer corresponds to PL LED in the Trailer.

- Check P1 adjustment.

Error 655: PL was NOT activated

The PL (Plate Low) proximity switch was not activated (which means that the

Plate WAS low!) on completion of the Raise Plate mode.

Possible causes:

 PL proximity switch defective.

 PL activator trouble.

- Check that "PL" on Computer corresponds to PL LED in the Trailer

- Check that the PL proximity switch is activated when the plate is raised.

Error 656: WH was ACTIVATED

The WH (Weight High) proximity switch was activated.

Possible causes:

 WH switch defective.

 Falling height stop No. 1 is misplaced.

 Hydraulics malfunction.

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer

- Lower falling height stop No. 1 (the uppermost hexagonal stop in the rail

  on the falling weight).

- Check the Hydraulics, in particular the C Valve (refer to the Manual).

Error 657: WH was NOT activated

The WH (Weight High) proximity switch was NOT activated on completion of the

Raise Weight mode.

Possible causes:

 WH switch defective.

 Too great distance (clearance) between hexagonal stop and WH switch.

 Hydraulics failure.

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer.

- Check that clearance is less than 6 mm (1/4").

- Check that the hydraulic valves, the motor and the motor relay are powered

   and functioning properly (refer to the Manual).

Error 658: TG was ACTIVATED

The TG (Trigger) proximity switch was activated (which means that the

weight was low) Prior to DROP.

Possible causes:

 TG switch defective.

 Falling height stop No. 1 is misplaced.

 Hydraulics failure.

- Check that "TG" on Computer corresponds to TG LED ON in the Trailer

- Increase falling height No. 1 to at least 40 mm (1.5"), but no more than

   100 mm (4").

- Check that the hydraulic valves, the motor and the motor relay are powered

   and functioning properly (refer to the Manual).

Error 659: TG was NOT activated

The TG (Trigger) proximity switch was NOT activated (which means that the

weight was not low) Prior to Raise Weight.

Possible causes:

 The weight WAS not low (of course).

 TG activator trouble.

 TG switch defective.

- Check the TG activator (located at bottom of the falling height stops rail).

  NOTE that the Trigger MUST be activated as long as the weight is raised less

  than 6 to 12 mm (1/4" to 1/2") !

- Check that "TG" on Computer corresponds to TG LED ON in the Trailer.

Error 660: Vehicle was NOT PARKed

The PARK (ALARM) signal obstructed the initiation of Lower Plate.

Possible causes:

 You DID not Park (of course).

 PARK circuit troubles.

- Check the connection to the ALARM socket at the control box (refer to

  the Installation Section in the Manual).

- Check that the PRK LED at the control box light up when you park.

- Check that the PRK LED in the Trailer reflects the actual status.

Error 661: MAN.KEY was ON

The MAN.KEY in the Trailer was switched ON, which Disables

control of the hydraulics from the Computer.

Possible causes:

 The MAN.KEY WAS on (of course).

 MAN.KEY switch element troubles.

- Check that hydraulics cannot be operated from the trailer buttons

  unless the MAN.KEY is turned ON.

- Check that "MN" on the Computer reflects the actual status

Error 662: PS1 was ACTIVATED

Pressure switch P1 was activated or disconnected continuously for a period

of more than 4 seconds, while the hyd. motor was NOT running.

- Check P1 and wiring (Trouble Shooting Procedure in the Manual).

- Check that "P1" LED on Trailer and Computer is lit when pressure is low.

Error 671: Trailer Battery Drained

                    WARNING !!

At completion of Raise Plate, the Trailer Battery

Voltage was TOO LOW !!

Error 672: CP15 Battery Drained

WARNING!!

    To avoid uncontrolled operation,

  please charge the battery immediately!

 The CP15 power supply is CRITICALLY LOW!

Error 675: Load Cell Excitation

A Load Cell Calibration found one or both of the following Voltages in error:

 Positive Excitation, typ +5.3V for FWD, +6.65V for HWD

 Negative Excitation, typ -5.3V for FWD, -6.65V for HWD

Possible reasons:

 Load Cell cable not connected or defective.

 Connections exposed to moisture.

 +/-15V supply off range.

 Compact15 circuits defective or exposed to condensing moisture.

- Check cables and connections.

- Check +/-15V supplies (Information - Voltages).

- Check Cell resistances thru Load Cell Cable DIN plug first:

  Ohms approx   DIN plug   Load Cell Socket

    240 - 243   2 - 4   2 - 4

```
240 - 243     1 - 5          1 - 5

180 - 183     2 - 1          2 - 1

180 - 183     4 - 5          4 - 5

180 - 183     2 - 5          2 - 5

180 - 183     1 - 4          1 - 4
```

The middle one of the 3 male pins in the cell socket is no.5 (CW decrease).

Error 676: Load Cell Balance

A Load Cell Calibration found one or both of the following in error:

 Balance Step (typ zero)

 Balanced Zero (typ zero)

Possible reasons:

 Load Cell cable not connected or defective.

 Connections exposed to moisture.

 +/-15V supply off range.

 Load Cell has been overloaded e.g. due to lack of grease in the loading plate

 swivel or due to dropping of weight without buffers.

 Compact15 circuits defective or exposed to condensing moisture.

- Check cables and connections.

- Check +/-15V supplies (Information - Voltages).

- Check Cell resistances thru Load Cell Cable DIN plug first:

```
 Ohms approx    DIN plug      Load Cell Socket

 240 - 243      2 - 4          2 - 4

 240 - 243      1 - 5          1 - 5

 180 - 183      2 - 1          2 - 1

 180 - 183      4 - 5          4 - 5

 180 - 183      2 - 5          2 - 5

 180 - 183      1 - 4          1 - 4
```

 The middle one of the 3 male pins in the cell socket is no.5 (CW decrease).

Error 677: Load Cell Calibration

A Load Cell Calibration found one or both of the following Voltages in error:

 Calibration Level

 Shunt value type 3.5V for FWD, 3.25V for HWD

Possible reasons:

 Load Cell cable not connected or defective.

 Connections exposed to moisture.

 +/-15V supply off range.

 Load Cell has been overloaded e.g. due to lack of grease in the loading plate

 swivel or due to dropping of weight without buffers.

 Compact15 circuits defective or exposed to condensing moisture.

- Check cables and connections.

- Check +/-15V supplies (Information - Voltages).

- Check Cell resistances thru Load Cell Cable DIN plug first:

```
  Ohms approx      DIN plug        Load Cell Socket

   240 - 243        2 - 4              2 - 4

   240 - 243        1 - 5              1 - 5

   180 - 183        2 - 1              2 - 1

   180 - 183        4 - 5              4 - 5

   180 - 183        2 - 5              2 - 5

   180 - 183        1 - 4              1 - 4
```

 The middle one of the 3 male pins in the cell socket is no.5 (CW decrease).

Error 682: Deflector Amplifier Mismatch

The Deflector Amplifiers are not the right type.

Error 711: Drive Controller Not Available

The Motor Controller is not available.

Possible reasons:

The Controller is not properly powered.

The FPS600 (Controller Power supply) is not properly powered.

- Check cables and connections.

- Check fuses.

- Switch off and on again after 1 minute.

- Check if Controller is ON.

- Check if FPS600 is ON.

Error 712: Drive Not Ready

The Drive has not performed the initial Homing procedure.

Possible reasons:

 Batteries are low

 Cable failure

 Encoder mounting

 Encoder failure

 The Controller is not properly powered.

 The FPS600 (Controller Power supply) is not properly powered.

- Check the voltage on both batteries

- Switch OFF

- Check the encoder cable and connectors

- Check the motor cable and connectors

- Make sure the screws in the motor plug are properly tied

- Check encoder mount

- Check if Controller is ON.

- Check if FPS600 is ON.

- Contact Dynatest if the error persists

Error 715: Excess Motor Controller Current

The maximum allowed current in the controller was exceeded.

Possible reasons:

 Increased friction

 Something is blocking the movement

 The machine is tilted

- Contact Dynatest if the error persists

Error 716: Excess Motor Load

The motor is overloaded and probably too hot. This is a power protection of the motor and/or the controller.

Possible reasons:

 Too many drops in the sequence

 Too short interval between sequences

 Cooling problems (for water cooled systems)

- Wait 10 minutes

- Reduce the amount of mass you drop with

- Check cooling system

- Contact Dynatest if the error persists

Error 717: Excess Motor Controller Load

The motor controller is overloaded and probably too hot. This is a power protection of the controller.

Possible reasons:

 Too many drops in the sequence

 Too short interval between sequences

- Wait 10 minutes to allow the motor to cool down

- Reduce the dropping mass

- Contact Dynatest if the error persists

Error 718: Motor Overvoltage

The induced voltage in the motor exceeded the maximum allowed.

Possible reasons:

 Increased friction

 Something is blocking the movement

 The machine is tilted

- **Switch OFF**

- Reduce the dropping mass if possible

- Contact Dynatest if the error persists

Error 719: Motor Undervoltage

The induced voltage in the motor is below the required one to operate. The motor should receive 600V to work properly.

Possible reasons:

 Charging failure

 Batteries too old

 Batteries out of balance

 The FPS600 (Controller Power Supply) is not properly powered.

- Check the charging system

- Check that both batteries are well above 12V

- Check that the batteries are at the same voltage level (balanced)

- Check that the FPS600 has the PoE ethernet cable connected and it is receiving 24V

- Contact Dynatest if the error persists

Error 741: Lower Plate Timeout

```
Lower Plate operation has not completed within a predetermined time limit (15 sec.
typ).

Possible causes:

 Drive, Motor or Encoder failure

 Trigger (TG) proximity switch trouble.
```

Error 742: Move Weight Timeout

```
Move Weight operation has not completed within a predetermined time limit.

Possible causes:

 Drive, Motor or Encoder failure
```

Error 743: Drop Timeout

```
Drop operation has not completed within a predetermined time limit.

Possible causes:

 Drive, Motor or Encoder failure

 Trigger (TG) proximity switch trouble.
```

Error 745: Raise Plate Timeout

```
Raise Plate operation has not completed within a predetermined time limit (15 sec.
typ).

Possible causes:

 Drive, Motor or Encoder failure

 Weight Jaws: Actuators or Sensors

 Base Locks: Actuators or Sensors

 Trigger (TG) proximity switch trouble.
```

Error 748: Weight Release 1 (front) Micro Switch Activated

```
The Micro Switch in Weight Lock 1 is activated when it should not be.
```

```
Possible causes:
```

```
 Electrical short
```

```
 Lock malfunction
```

```
 Micro Switch malfunction
```

```
Check:
```

```
- Check Micro Switch connection, Cable, WR1 plug
```

```
- Check that the lock retracts when the LW1 plug is disconnected
```

```
- Use button [Lock Weight] to check LW1 output and Lock function
```

Error 749: Weight Release 1 (front) Micro Switch is NOT Activated

```
The Micro Switch in Weight Lock 1 is not activated when it should be.
```

```
Possible causes:
```

```
 Electrical break
```

```
 Lock malfunction
```

```
 Micro Switch malfunction
```

```
Check
```

```
- Check Micro Switch connection, Cable, WR1 plug
```

```
- Check LW1 plug, cable, connection at lock
```

```
- Use button [Lock Weight] to check LW1 output and Lock function
```

Error 750: Weight Release 2 (rear) Micro Switch Activated

The Micro Switch in Weight Lock 2 is activated when it should not be.

Possible causes:

 Electrical short

 Lock malfunction

 Micro Switch malfunction

Check:

- Check Micro Switch connection, Cable, WR2 plug

- Check that the lock retracts when the LW2 plug is disconnected

- Use button [Lock Weight] to check LW2 output and Lock function

Error 751: Weight Release 2 (rear) Micro Switch is NOT Activated

The Micro Switch in Weight Lock 2 is not activated when it should be.

Possible causes:

 Electrical break

 Lock malfunction

 Micro Switch malfunction

Check

- Check Micro Switch connection, Cable, WR2 plug

- Check LW2 plug, cable, connection at lock

- Use button [Lock Weight] to check LW2 output and Lock function

Error 752: PH was ACTIVATED

```
The Plate High Proximity Switch Signal was ACTIVE.

Possible causes:

 PH proximity switch defective

 Activator misplaced

 Electrical short

- Check the LED indicator on the Proximity Switch

- Check that "PH" on Computer corresponds to PH LED ON in the Trailer.

- Check activator position

- Check cable and plug
```

Error 753: PH was NOT activated

```
The Plate High Proximity Switch was not activated at completion of the

Raise Plate mode.

Possible causes:

 PH proximity switch defective

 Activator misplaced

 Electrical short

- Check the LED indicator on the Proximity Switch

- Check that "PH" on Computer corresponds to PH LED ON in the Trailer.

- Check that activator gap(s) is less than 4 mm (5/32") when the plate is in

  it's locked position.

- Check cable and plug
```

![Dynatest logo]

Error 754: Both TG and WH were ACTIVATED (ON)

The TG (Trigger) proximity switch AND the WH (Weight High) were activated
simultaneously.

These sensors are mutually exclusive (only one can be active at a time).

Possible causes:

 Trigger or Weight High malfunction

- Check that "TG" on Computer corresponds to TG LED ON in the Trailer

- Check Trigger position (vertical) and clearance (6 mm max)

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer

- Check WH activator position (vertical) and clearance (6 mm max)

Error 755: Both TG and WH were DE-ACTIVATED (OFF)

The TG (Trigger) proximity switch AND the WH (Weight High) were both de-activated.

In Idle state the Weight must either rest on the Plate (TG ON) or rest on the Locks
(WH ON).

Possible causes:

 Trigger or Weight High malfunction

- Check that "TG" on Computer corresponds to TG LED ON in the Trailer

- Check Trigger position (vertical) and clearance (6 mm max)

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer

- Check WH activator position (vertical) and clearance (6 mm max)

Error 756: WH was ACTIVATED

```
The WH (Weight High) proximity switch was activated.

Possible causes:

 WH switch defective.

 Activator misplaced.

 Electrical short

- Check the LED indicator on the Proximity Switch

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer

- Check activator position

- Check the cable and plug
```

Error 757: WH was NOT activated

```
The WH (Weight High) proximity switch was NOT activated on completion of the

Raise Weight mode.

Possible causes:

 WH switch defective.

 Activator position and clearance

 Electrical short

- Check the LED indicator on the Proximity Switch

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer

- Check activator position

- Check that clearance is less than 6 mm (1/4").

- Check the cable and plug
```

Error 758: TG was ACTIVATED

The TG (Trigger) proximity switch was activated when it should not be.

Possible causes:

 Trigger malfunction

 Drive failure

- Check that "TG" on Computer corresponds to TG LED ON in the Trailer

- Check Trigger position (vertical) and clearance (6 mm max)

- Increase falling height No. 1 to at least 40 mm (1.5"), but no more than 100 mm (4").

Error 759: TG was NOT activated

The TG (Trigger) proximity switch was NOT activated when it should be.

Possible causes:

 The weight WAS not resting at the base plate (of course).

 TG activator trouble.

 TG switch defective.

- Check the TG activator (located at weight base plate).

NOTE that the Trigger MUST be activated as long as the weight is raised less

   than 6 to 12 mm (1/4" to 1/2") !

- Check that "TG" on Computer corresponds to TG LED ON in the Trailer.

Error 760: Vehicle was NOT PARKed

The PARK (ALARM) signal obstructed the initiation of Lower Plate.

Possible causes:

 You DID not Park (of course).

 PARK circuit troubles.

- Check the connection to the ALARM socket at the control box (refer to the Installation Section in the Manual).

- Check that the PRK LED at the control box light up when you park.

- Check that the PRK LED in the Trailer reflects the actual status.

Error 762: Plate Release 1 (front) Micro Switch Activated

The Micro Switch in Plate Release 1 is activated when it should not be.

Possible causes:

 Electrical short

 Lock malfunction

Check:

- Check Micro Switch connection, Cable, PR plug

- Check that the lock extends when the RP1 plug is disconnected

- Use button [Release Plate] to check RP1 output and Release function

Error 763: Plate Release 1 (front) Micro Switch is NOT Activated

The Micro Switch in Plate Release 1 is not activated when it should be.

Possible causes:

 Electrical break

 Lock malfunction

 Micro Switch malfunction

Check

- Check Micro Switch connection, Cable, PR plug

- Check RP1 plug, cable, connection at solenoid

- Use button [Release Plate] to check RP1 output and Release function

Error 764: Plate Release 2 (rear) Micro Switch Activated

The Micro Switch in Plate Release 2 is activated when it should not be.

Possible causes:

 Electrical short

 Lock malfunction

Check:

- Check Micro Switch connection, Cable, PR plug

- Check that the lock extends when the RP2 plug is disconnected

- Use button [Release Plate] to check RP2 output and Release function

Error 765: Plate Release 2 (rear) Micro Switch is NOT Activated

The Micro Switch in Plate Release 2 is not activated when it should be.

Possible causes:

 Electrical break

 Lock malfunction

 Micro Switch malfunction

Check

- Check Micro Switch connection, Cable, PR plug

- Check RP2 plug, cable, connection at solenoid

- Use button [Release Plate] to check RP2 output and Release function

Error 780: Motor Encoder

The position feedback from the motor encoder was lost.

Possible reasons:

 Cable failure

 Encoder mounting

 Encoder failure

- **Switch OFF**

- Check the encoder cable and connectors

- Check the motor cable and connectors

- Check encoder mount

- Contact Dynatest if the error persists

Error 781: Homing Impossible

```
The initial homing process failed.

Possible reasons:

 Batteries are low

 Cable failure

 Encoder mounting

 Encoder failure

- Check the voltage on both batteries
```

- **Switch OFF**

```
- Check the encoder cable and connectors

- Check the motor cable and connectors

- Make sure the screws in the motor plug are properly tied

- Check encoder mount

- Contact Dynatest if the error persists
```

Error 782: Safety Relay Open

```
The controller is powered ON and the safety relay is opened. With this error it is
impossible to do any movement using the software.

Possible reasons:

The bridge between PSCR and 24V on top of the ETEL controller is missing.

- Check the manual for more information

- Contact Dynatest if the error persists
```

Error 783: Inrush Power Supply

This error occurs when the motor is enabled and there is no power voltage on the DC bus.

Possible reasons:

 Charging failure

 Batteries too old

 Batteries out of balance

 The FPS600 (Controller Power Supply) is not properly powered.

- Check the charging system

- Check that both batteries are well above 12V

- Check that the batteries are at the same voltage level (balanced)

- Check that the FPS600 has the PoE ethernet cable connected and it is receiving 24V

- Contact Dynatest if the error persists

Error 791: Weight Released Activated

Weight Released. The Upper Locks (Weight Locks) are retracted when they should not be, or the feedback signals (Micro Switches) in the Upper Locks are activated when they should not be. That means that it is not possible to lock or unlock the weights.

Possible causes:

 Lock malfunction

 Microswitch malfunction (feedback signal)

Check:

- Check Micro Switch connections, Cables, WR1 and WR2 (Weight Released) plugs

- Check that the locks retract when the LW1 and LW2 (Lock Weight) plugs are disconnected

- Use button [Lock Weight] to check LW1 and LW2 outputs and Lock function

Error 792: Weight Released NOT Activated

Weight Not Released. The Upper Locks (Weight Locks) are not retracted when they should be. Or the feedback signal (Micro Switches) in the Upper Locks are not activated when they should be. That means that it is not possible to lock or unlock the weights. Neither it is to perform drops.

Possible causes:

 Electrical break

 Lock malfunction

 Micro Switch malfunction (feedback signal)

Check

- Check Micro Switch connections, Cables, WR1 and WR2 (Weight Released) plug

- Check LW1 and LW2 (Lock Weight) plugs, cables, connections at locks

- Use button [Lock Weight] in CP15 to check LW1 and LW2 outputs and Lock function

Error 793: Plate Released Activated

Plate Released. The Lower Locks (Transport Locks) are retracted when they should not be. Or the feedback signal (Micro Switches) in the Lower Locks are activated when they should not be. Therefore, the plate cannot be lowered, nor raised.

Possible causes:

 Electrical short

 Lock malfunction

 Wrong feedback signal from microswitches (it could be that the lock is not extended but the feedback signal is wrong)

Check:

- Check Micro Switch connections, Cables, PR (Plate Released) plug in CP15

- Check that the locks extend when the RP1 and RP2 (Release Plate) plugs are disconnected

- Use button [Release Plate] in CP15 to check RP1 and RP2 outputs and Release function

Error 794: Plate Released NOT Activated

```
Plate not Released. The Lower Locks (Transport Locks) are not retracted when they
should be. Or the feedback signal (Micro Switches) in the Lower Locks are not
activated when they should be. The plate cannot be lowered, nor raised. It can be
one or both locks malfunctioning at the same time.


Possible causes:

 Electrical break

 Locks malfunction

 Micro Switch malfunction (the locks actually move as they should but the feedback
signal is wrong)

Check

- Check Micro Switch connections, Cables, PR (Plate Released) plug

- Check RP1 and RP2 plugs (Release Plate), cables, connections at solenoids

- Use button [Release Plate] in CP15 to check RP1 and RP2 outputs and Release
function
```

Error 795: WH was activated (ON) too early

```
The WH (Weight High) proximity switch was activated too early during Raise Weight.

This can happen if the Plate is locked in transport position AND the PH proximity
signal is OFF.

Possible causes:

 PH switch disconnected or defective.

 WH switch defective.

 Activator misplaced.

 Electrical short

- Check that "PH" on computer corresponds to PH LED ON in the Trailer

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer

- Check the LED indicators on the Proximity Switches

- Check activator positions

- Check the cables and plugs
```

Warning 796: Load Cell signal does not match the Plate position

The PH (Plate High) proximity switch should indicate either

Transport Position: Load Cell is unloaded

 - or -

Plate on the ground: Load Cell is loaded by the console and the weight package

The Load signal does not agree.

Possible causes:

 PH switch disconnected, shorted or defective

 Load Cell change

- Check that "PH" on computer corresponds to PH LED ON in the Trailer

- Check that "WH" on Computer corresponds to WH LED ON in the Trailer

Error 797: Plate Seated Too Early

During lowering of the plate, it is seated too early. This can happen during loadcell calibration if the cell is supported by a reference loadcell.

- Load the right Test Setup for Load Cell calibration

Error 798: Motor Temperature Sensor Malfunction

The Motor Temperature Sensor is disconnected or malfunctioning.

- Check the sensor and the cable that goes from the Motor to the FPS600