TECHNICAL INFORMATION

BANKS Dynafact™

BANKS DYNAFACT
INERTIAL DYNAMOMETER

BANKS

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DYNAFACT™ TECHNICAL INFORMATION

HISTORY

During the eighteenth century, James Watt introduced a unit of power to compare the power output of the steam engine he had developed with a familiar source of work, the draft horse. This unit of power became known as horsepower and was defined as the amount of power required to lift a 550 pound weight one foot in one second. Over the next 200 years, the Prony Brake Dynamometer and variations of same were developed to measure engine horsepower. These dynamometers became known as absorption dynamometers and modern day versions of them are in use today to determine automotive engine horsepower.

MODERN DYNAMOMETER

The absorption dynamometer uses an absorption unit to dissipate power in the form of heat and is generally restricted to engines with rotational type output. During the process of testing, the torque in pound/feet and RPM are measured and the horsepower is then derived by the use of the following formula:

$$\textbf{Horsepower} = \frac{\textbf{Torque x RPM}}{\textbf{5252}}$$

There are two basic types of absorption dynamometers; the engine dynamometer which takes horsepower directly from the output shaft of the engine, and the chassis dynamometer which takes horsepower from the drive wheels of a vehicle. Although these dynamometers are the most commonly used to test equipment for the determination of automotive engine horsepower, they have several drawbacks as follows:

- They are limited to stationary operation as they are not capable of measuring the horsepower of the engine in a moving vehicle.
- The engine dynamometer often requires the removal of the engine from the vehicle.
- They are frequently abusive to the engine as they often require tests at peak horsepower for sustained periods in order to take readings.
- They do not test the engine under real world conditions i/e: Driving the vehicle on the road or track under true environmental conditions.

Cost is also a considerable factor with the above dynamometers as basic unit costs start at many thousands of dollars. Additionally, they often require support systems such as a test cell, control console, large water supply, exhaust system, and large air circulation system. The use of these dynamometers is therefore generally limited to the automotive professional or the serious auto racer.

Another method whereby the horsepower of an automotive engine may be determined is to employ a torque sensor in the vehicle of the engine under test. This sensor may be of the type that is installed in series with the drive train of the vehicle or it may take on the form of a sensor that detects the rotation of the engine against its mounts. The torque and RPM are measured and the horsepower is calculated in the same manner as the absorption dynamometer. This method does not require support systems and has the advantage of being able to determine horsepower while driving the vehicle under real world conditions. The disadvantage is that a torque sensor with any degree of accuracy is generally very expensive and difficult to implement.

A significant shortcoming of both the absorption dynamometer and in-vehicle torque sensor methods is in the fact that they determine the output horsepower of the engine only. They are not capable of measuring the horsepower dissipated by the vehicle due to such dynamic vehicular characteristics as:

- Frictional drag due to the tires and moving parts of the vehicle.
- Viscous drag due to the lubricants of the vehicle.
- Aerodynamic drag due to air resistance.

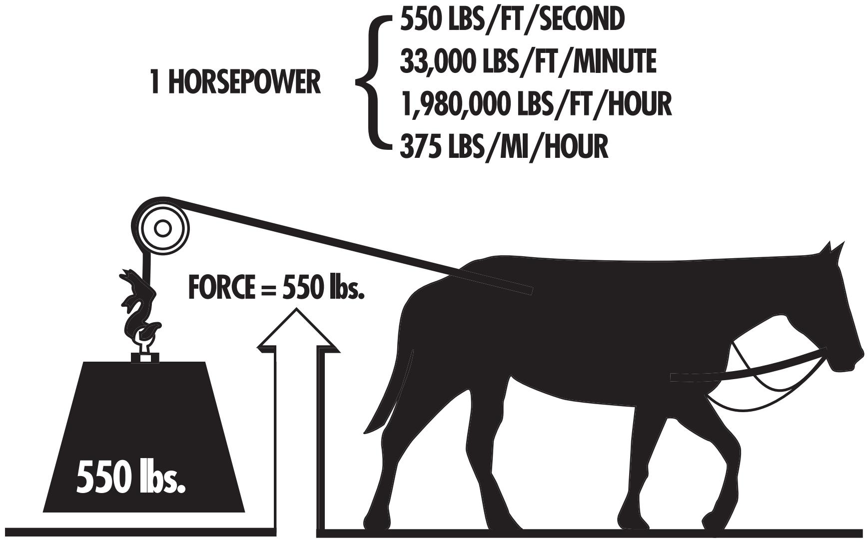
The amount of horsepower lost to drag can become quite large with some vehicles, even at relatively low speeds. High amounts of drag due to friction may indicate a vehicular malfunction. Excessive drag causes a proportionate loss of fuel economy. Aerodynamic drag becomes the limiting factor when it comes to the top speed of a racing vehicle. Because of these facts, it is very desirable to be able to measure the amount of horsepower lost to vehicular drag as well as the engine horsepower to determine overall vehicular performance.

A BETTER WAY

The basic laws of physics show that there is another way of measuring engine horsepower or the drag characteristics of a moving vehicle. From these laws it can be shown that the horsepower required to accelerate a vehicle may be determined if the weight of the vehicle is known and the speed and acceleration of the vehicle can be simultaneously determined.

The above may sound a little mysterious, so, let's return to Watt's definition of horsepower and take the mystery out of it. He said that a work horse of his time could lift a 550 pound weight one foot in one second (see Figure 1). With a little math, we can convert Watt's definition into terms that make more sense to the automotive field. If the time required to lift the weight is increased to one hour (3600

FIGURE 1



seconds), that amount of weight that can be lifted by one horsepower will be increased by 3600 to 1. Therefore, one horsepower can lift 1,980,000 pounds one foot in one hour. Now if the lift distance is increased to one mile (5280 feet), the amount of weight that one horsepower will lift will be reduced by 5280 to 1 for a new weight of 375 pounds. The definition of horsepower in automotive terms is therefore the power required to lift 375 pounds one mile in one hour.

Now, referring to Figure 2, imagine that the 375 pound weight is actually a 375 pound automobile and the source of power is the engine of the vehicle. For the time being, the vehicle will be on a hill that goes straight up and the assumption will be made that the drive wheels will be able to maintain traction under these conditions. If the hand brake is set, the full 375 pound weight of the vehicle will be applied to the ground by the drive wheels of the vehicle. To put it another way, the drive wheels will be applying a force 375 pounds to the ground just to keep the vehicle from rolling backwards. Assume now that the vehicle has an automatic transmission and the engine is used to hold the vehicle at a standstill on the hill. The force being applied to the ground by the drive wheels will again be 375 pounds. The amount of power being applied to the ground at this time will be zero as the vehicle is not moving and no work is being done. The engine is actually putting out power but it is dissipated in the form of heat by the torque converter of the transmission. If the engine is given more throttle, a force of greater that 375 pounds will be applied to the ground and the vehicle will begin to climb the hill. If the vehicle is allowed to reach one mile per hour and then held at that speed, the force will return to a steady 375 pounds. With the vehicle now moving up the hill at one mile per hour and the drive wheels applying a force of 375 pounds to the ground, it can be shown through the use of the automotive definition of horsepower that one horsepower is being applied to the ground. If the speed is doubled, the horsepower will be doubled. It now appears that all that needs to be done to determine how much horsepower is being applied to the ground, is to measure the force being applied to the ground, measure the vehicle speed, multiply force times speed, and divide by 375.

Thus:

$$\textbf{Horsepower} = \frac{\textbf{Force x Speed}}{\textbf{375}}$$

The measurement of vehicle speed is a simple matter of monitoring the output of a speed transducer that is located in the speedometer system of the vehicle. The determination of the amount of drive wheel force is a little more complicated and is resolved by the use of a device that is commonly used in the aerospace and inertial guidance industry. This device is called an inertial accelerometer and it is used to measure acceleration.

Assume now that the vehicle in Figure 2 has both a speed transducer and an inertial accelerometer whose sensitive axis is parallel to the surface of the road and points in the direction of travel sensing fore and aft acceleration only. The output of the speed transducer will indicate the speed of the vehicle in miles per hour while the accelerometer will indicate the acceleration of the vehicle in g's (gravity units). As the vehicle is pointed straight up, the output from the accelerometer will be one g due to the pull of gravity. If the vehicle is increasing or decreasing in speed, the accelerometer will sense more or less than one g as the vehicular acceleration or deceleration will be adding to or subtracting from the gravitational pull of one g.

FIGURE 2

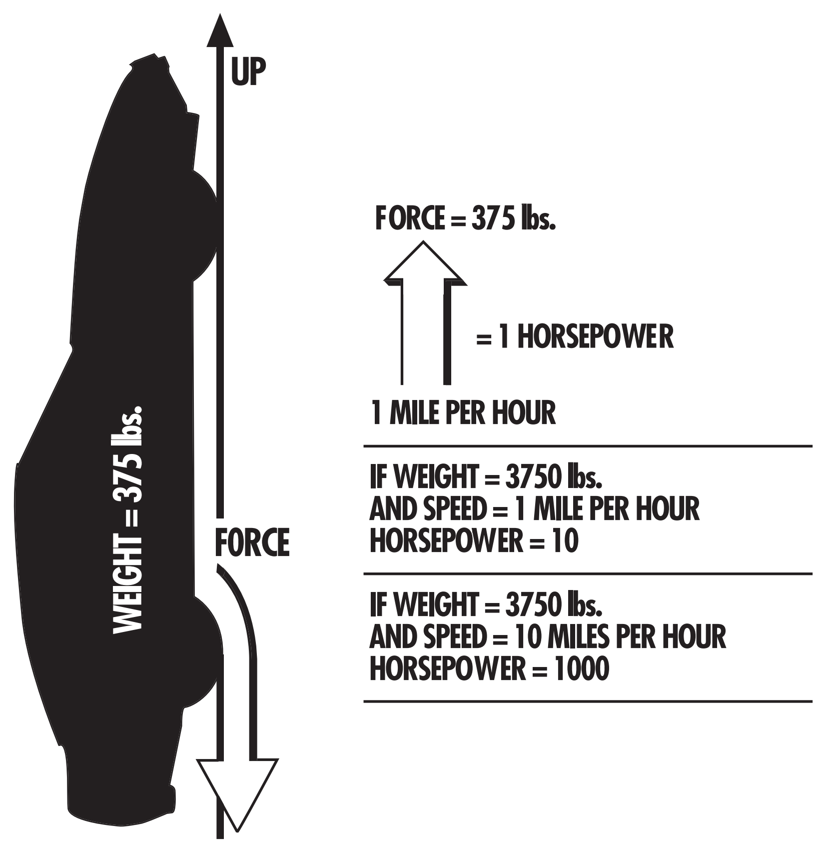
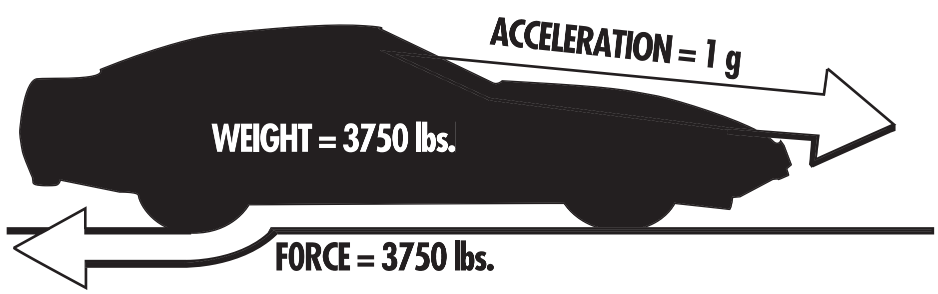


FIGURE 3



Note: There is no way that a human or an accelerometer can tell the difference between acceleration due to gravity or acceleration due to vehicular acceleration.

Another law from physics states that Force = Mass x Acceleration. For the purpose of this discussion, the term Mass will be replaced with Weight. Therefore, Force = Weight x Acceleration. It can be shown from this law that all that is necessary to determine the force at the drive wheels of the vehicle is to multiply the weight of the vehicle times the acceleration. From this it can be seen that a new horsepower formula may be derived by rewriting the above formula in the following manner:

$$\text{Horsepower} = \frac{\text{Force} \times \text{Speed}}{375} = \frac{\text{Weight} \times \text{Acceleration} \times \text{Speed}}{375}$$

Armed only with knowledge of vehicle weight, acceleration, and speed, it should now be apparent that this new formula may be used to calculate horsepower in a moving vehicle, all without connecting anything to the engine itself. This can be confirmed with the vehicle of Figure 2 that is moving up the hill at one mile per hour under one g of acceleration:

$$\frac{\text{Weight} \times \text{Acceleration} \times \text{Speed}}{375} = \frac{375 \times 1 \times 1}{375} = 1 \text{ Horsepower}$$

THE BANKS DYNAFACT INERTIAL DYNAMOMETER

Suppose now that the vehicle of Figure 2 is equipped with a small computer that is capable of accepting the weight, acceleration, and speed of the vehicle and continuously performing the above calculation while providing a visual indication of the computer output via analog and/or digital displays. This assemblage of components provides a system for the continuous measurement of horsepower and is the basis for the DYNAFACT. Although this calculation is the primary function, other vehicular factors must be considered in order to make truly meaningful horsepower measurements.

Now consider the vehicle in Figure 3. It is now travelling along level ground and weight is now a more realistic 3750 pounds. This vehicle is also equipped with the same components as the vehicle in Figure 2. If the vehicle were to be accelerated, the accelerometer would sense the acceleration just as though it were being caused by the pull of gravity. The contribution due to the pull of gravity, however, would be zero as the sensitive axis of the accelerometer is now at a right angle to the surface of the Earth. Therefore, the acceleration being sensed by the accelerometer would be that of the actual acceleration of the vehicle.

As it was shown in Figure 2, the gravitational pull of one g would cause a force equal to the weight of the vehicle to be applied to the ground by the drive wheels of the vehicle. It can also be shown in Figure 3 that a force equal to the weight of the vehicle being applied to the ground by the drive wheels of the vehicle will cause a vehicular acceleration of one g. This can be confirmed by rewriting the force formula in the following manner:

$$\text{Force} = \text{Weight} \times \text{Acceleration (or) Acceleration} = \frac{\text{Force}}{\text{Weight}}$$

Using this new formula it can be shown that if the drive wheels of the vehicle in Figure 3 were to apply a force of 3750 pounds to the ground, the vehicle would accelerate at a rate of one g. This exercise illustrates the fact that the accelerometer is sensitive only to acceleration caused by the force being applied to the ground from the drive wheels of our vehicle. It does not matter whether the vehicle is on level ground or a hill when measurements are being made. This same exercise may also be used to show that the accelerometer is sensitive only to the deceleration caused by the force of vehicular drag acting against the vehicle when it is allowed to coast in neutral and is again not effected by hills. Vehicular drag will be discussed in greater detail later.

Let's now imagine that the vehicle in Figure 3 is accelerating from a standstill to 50 MPH. As the vehicle continues to accelerate, the computer, having had a weight of 3750 pounds entered into it by the operator, will continuously monitor the acceleration and speed of the vehicle and provide an indication of the horsepower. As an example, suppose that the acceleration is .750 g at 30 MPH. The computer will use values to compute horsepower in the following manner.

$$\frac{\text{Weight} \times \text{Acceleration} \times \text{Speed}}{375} = \frac{3750 \times .750 \times 30}{375} = 225 \text{ Horsepower}$$

If the computer is to determine the amount of "GROSS" horsepower being applied to the ground by the drive wheels of the vehicle, it will first have to determine the drag characteristics of the vehicle at all speeds within the operating range of the vehicle. The computer may then use this knowledge of vehicular drag during the measurement and computation of "GROSS" horsepower. The problem of determining the drag characteristics at all speeds is simplified by the fact that the drag characteristics of an automobile are highly predictable with the knowledge of a single low speed drag value and a single high speed drag value.

Although the drag characteristics vary greatly from one vehicle to the next, the engineers of the automotive industry have established that the drag characteristics of a modern mid-sized automobile will cause it to more or less decelerate with the following characteristics when allowed to coast in neutral:

- Deceleration due to frictional drag is approximately equal to: 015 g at all speeds
- Deceleration due to viscous drag is approximately equal to: .0001 g x MPH
- Deceleration due to aerodynamic drag is approximately equal to: .000005 g x MPH^2

From the above, it can be shown that if the deceleration values are known for each of the drag characteristics at a given speed, they can then be calculated for any other speed. It is then a simple matter of adding together all of these deceleration values for a total deceleration value at said speed. As the total deceleration is equal to the amount of additional acceleration the vehicle would have if it had *zero* vehicular drag, it is only necessary to add this deceleration to the acceleration of the "NET" horsepower formula to create a new formula for the determination of "GROSS" horsepower.
Thus:

$$\textbf{NET Horsepower} = \frac{\textbf{Weight x Acceleration x Speed}}{\textbf{375}}$$

(and)

$$\textbf{GROSS Horsepower} = \frac{\textbf{Weight x (Acceleration + Deceleration) x Speed}}{\textbf{375}}$$

Assume now that the computer on board the vehicle in Figure 3 is the DYNAFACT and it is operating in the "GROSS" mode. In order to make accurate measurements of "GROSS" horsepower, the computer must first determine the drag characteristics of the vehicle and this is done in the following manner:

(1) The vehicle is first allowed to coast in neutral at a speed between 10 and 15 MPH. At low speeds, the aerodynamic and viscous drag on the vehicle will be almost nonexistent and the main deceleration of the vehicle will be the result of frictional drag on the vehicle. The value of deceleration is established and the frictional drag constant is stored in the memory of the computer. (Frictional drag = Total drag - viscous drag - aerodynamic drag.) Frictional drag is the same regardless of the speed of the vehicle.

(2) The viscous drag on a vehicle is considered to be insignificant except at very high speeds or for very heavy vehicles. Therefore, a viscous drag constant of .0001g at one mile per hour has been found to suffice for virtually all automotive type vehicles. For this reason, the viscous drag deceleration value is not actually measured and a viscous drag constant of .0001g at one mile per hour is permanently stored in the memory of the computer.

(3) The vehicle is allowed to coast in neutral at a speed that is greater than 50 MPH. The deceleration and speed of the vehicle are then measured by the computer.At high speeds the deceleration of the vehicle will be the result of combined effects from frictional, viscous and aerodynamic drag. In order to determine a deceleration value for aerodynamic drag only, the computer must first calculate the values for frictional and viscous drag at the speed which the high speed measurement was made. These values are then subtracted from the total deceleration value, and the speed at which it was determined calculates an aerodynamic drag constant for the vehicle at one mile per hour. This value is then stored in the memory of the computer.

Once the drag characteristics of the vehicle are determined and converted to drag constants at one mile per hour, the computer will be ready to calculate the total deceleration due to vehicular drag at any other speed within the operating range of the vehicle.

As an example, suppose the vehicle is traveling at 65 MPH and it has the drag characteristics of the modern mid-size automobile described above. The computer will calculate the total deceleration due to vehicular drag in the following manner:

$$\mathbf{.015 + (.0001 \times 65) + (.000005 \times 65^2) = .043g}$$

The computer may now use this deceleration value during the computation of "GROSS" horsepower. As the vehicle is traveling at a steady 65 MPH on level ground, the accelerometer will sense zero g's and the computer will, using the "GROSS" formula, calculate the "GROSS" horsepower as follows:

$$\frac{3750 \times (0 + .043) \times 65}{375} = 28 \text{ Horsepower (GROSS)}$$

This 28 horsepower is the total power being applied to the ground by the drive wheels of the vehicle and is equal to the amount of power required to overcome vehicular drag at 65 MPH. If the computer were to be switched to the "NET" mode and the vehicle allowed to coast in neutral at 65 MPH, the accelerometer would sense a deceleration (negative acceleration) of -.043g. The computer would then, using the "NET" horsepower formula, calculate the amount of horsepower being consumed by vehicular drag. Thus:

$$\frac{3750 \times (0 + (-.043)) \times 65}{375} = -28 \text{ Horsepower (NET)}$$

As a second example of the measurement of "GROSS" horsepower, suppose that the vehicle is under an acceleration of .500g at 65 MPH. The "GROSS" horsepower being applied to ground by the drive wheels of the vehicle will be calculated in the following manner:

$$\frac{3750 \times (.500 + .043) \times 65}{375} = 353 \text{ Horsepower (GROSS)}$$

Of this 353 horsepower, 28 horsepower is used to overcome vehicular drag, while the remaining 325 horsepower is used to accelerate the vehicle.

THE REAL WORLD

In the above discussion of the BANKS DYNAFACT INERTIAL DYNAMOMETER, certain assumptions were made to simplify the explanations. In the real world, with real automotive type vehicles, these assumptions will not hold true and the DYNAFACT must give consideration to them.

With regard to the weight of the vehicle, it was assumed that the weight of the vehicle was the only weight that needed to be considered. The total weight of the vehicle should in fact include the weight of the driver, passengers, and any additional weight that may be carried on board. Also, when the vehicle is under acceleration, the increase in rotational speed of each tire, wheel and brake rotor or drum should be considered. The rotational acceleration of these components tends to resist the acceleration of the vehicle and makes the vehicle seem heavier than its measured weight. Bulletin J1263 from the S.A.E. states that a value of 3 percent may be used to estimate the effective increase in vehicular weight due to these components. Therefore, during the calibration of the DYNAFACT to the vehicle in which it is being used, the operator should input a weight that is 3 percent greater than total measured weight of the vehicle.

Although it was stated in the above discussion that the speed transducer would indicate the vehicle speed in miles per hour, the output of the transducer is actually a series of pulses and the number of pulses per mile varies from one automobile to another. For this reason, it will be necessary to calibrate the DYNAFACT with respect to the speedometer system of the vehicle in which it is being used. If the number of pulses per mile is not known at the time of calibration, it may be entered automatically by driving the vehicle through a measured mile. (Mile markers may be found on most state roads and freeways.)

During the discussion of the vehicle in Figure 3, it was stated that the sensitive axis of the accelerometer was at a right angle to the surface of the Earth. This is not necessarily true as most automotive type vehicles will pitch up while under acceleration due to the springs of their suspension systems. This pitch-up will cause the accelerometer to sense an additional acceleration, albeit very small, due to the pull of gravity. This additional acceleration will make the accelerometer's output higher than the actual acceleration. The DYNAFACT provides the operator with a method of compensating for the vehicular pitch-up. During the calibration of the DYNAFACT, the operator will be asked to input an appropriate pitch-up angle in degrees for the vehicle. The table below is a listing of the pitch-up angle of several different types of vehicles.

SUSPENSION	VEHICLE TYPE	PITCH
Rigid	No springs	0.0
Hard	Dragster	0.5
Semi Hard	Race Car	1.0
Medium	Production Sport Car	1.5
Soft	Production Sedan	2.0
Very Soft	Early Production Sedan	2.5

During the measurement of horsepower, it will not be unusual to note a significant difference in power between the lowest and highest gears of the vehicle. The reason for this is the fact that the engine must not only accelerate the vehicle, but the RPM of the engine flywheel, crankshaft, connecting rods, pistons, etc. The inertia of these components tends to resist an increase of engine RPM. The effect will be most pronounced in low gear as the engine RPM will be increasing more rapidly than in the higher gears and the inertia of the engine components will have a greater tendency to resist the increase. There will also be apparent loss or gain of horsepower when the vehicle is accelerating down hill or up hill respectively. When the vehicle is going down hill, the engine will gain RPM more rapidly and the inertia of the engine components will cause a greater loss than if the vehicle were accelerating up hill. The loss of horsepower at the rear wheels due to the inertia of the engine components is real and illustrates the desirability of lighter engine components in high performance engines. The DYNAFACT and the chassis dynamometer are similar in that they both measure rear-wheel horsepower. However, the effects of the engine component inertia will make the horsepower readings for a given engine RPM different unless the RPM is held steady by the amount of load on the engine.

MULTI-FUNCTION

In addition to being able to measure "GROSS" and "NET" horsepower, the DYNAFACT is capable of determining other vehicular characteristics. The complete capabilities of the instrument are delineated below.

Gross Horsepower

In this mode, the total horsepower being applied to the ground by the drive wheels of the vehicle may be determined. The value of "GROSS" horsepower indicated by the DYNAFACT will be nearly that of the actual output of the engine. The drive train losses of most vehicles are lower than one might expect and a good portion of these losses are accounted for during the calibration of the inertial dynamometer to the vehicle in which it is being used. If the vehicle is allowed to coast in neutral, the indication will be zero. If the brakes are applied, the indication will be that of the horsepower dissipated by the brakes.

If the vehicle is allowed to coast while in gear, the indication will be that of the frictional horsepower losses of the engine and drive train.

Net Horsepower

This mode is typically used to measure the horsepower dissipated by vehicular drag. If the vehicle is allowed to coast in neutral, the indication will be that of the horsepower lost to the combined effects of frictional, viscous, and aerodynamic drag. Any changes of vehicular drag will be noted quickly in this mode.

Acceleration

While in this mode, the acceleration or deceleration of the vehicle may be measured. It is useful for optimizing such traction controlling items as tires, tire pressure, suspension, etc., and acceleration controlling items such as gear ratios, clutches, etc. The deceleration caused by the brakes of the vehicles is an indication of the efficiency of the brakes. The deceleration of the vehicle, when allowed to coast in neutral is the result of the combined effects of aerodynamic, frictional, and viscous drag. The force of this vehicular drag may be calculated by multiplying the deceleration times the weight of the vehicle.

Banks Power Factor™

This mode provides a means whereby the potential performance of a vehicle may be determined. When run in the NET horsepower mode, the higher the indicated value, the higher the potential performance of the vehicle. The display will indicate a number that is proportional to the horsepower available per pound of vehicle weight. The number indicated will be horsepower divided by vehicular weight times 1000. This number, being much like a batting average, will be proportional to the percentage of horsepower available per pound. NET mode BPF indicates the amount of horsepower available to accelerate the vehicle while accounting for vehicular drag.

Example:

Horsepower = 375   Weight = 3750

$$\textbf{Banks Power Factor} = \frac{375 \times 1000}{3750} = 100 \text{ (10 percent)}$$

As it was explained above, when the power levels are lower in the lower gears of the vehicle, so will be the BANKS POWER FACTOR due to inertia of the engine components. BANKS POWER FACTOR values should be considered with the speed at which they were observed. (i.e. a BPF of 100 at 60 MPH.)

Speed

While in the speed mode, the indication will be that of the speed of the vehicle in miles per hour. If the measured mile method is used during the calibration, the indications will be extremely accurate as most states do a very accurate job of placing the mile markers. The indications may be then used to check the accuracy of the vehicle speedometer.

Peak Reading

During the normal operation of the DYNAFACT, the peak positive and/or negative values of horsepower, acceleration, BANKS POWER FACTOR and MPH will be detected and stored in memory. These values can be recalled for use at a later time. In the case of positive horsepower and acceleration, the mile per hour at which the peak occurred will also be stored.

Vehicular Drag

The drag characteristics of the vehicle are stored in memory during the drag calibration of the DYNAFACT to the vehicle in which it is being used. Of these, the frictional and aerodynamic constants may be recalled and displayed. The display of the frictional drag constant will be that of the deceleration of the vehicle, in g's, due to frictional drag while coasting in neutral. A typical value of .015g would be displayed as .015. The display of the aerodynamic drag constant will be that of the deceleration of the vehicle, in micro g's, due to the aerodynamic drag on the vehicle at one mile per hour. A typical value of .000005g would be displayed as 5.00. If the drag calibration procedure is repeated occasionally and the constants are recalled, the drag characteristics of the vehicle may be monitored for any changes that might occur. These changes may be the result of vehicular malfunction or deliberate changes. As an example, an increase of the frictional constant from .015 to .030 may indicate that the brakes are dragging or a tire may be low on air. The aerodynamic value is not likely to change unless modifications are made to the vehicle. The aerodynamic constant may however be used to calculate the aerodynamic drag coefficient of the vehicle if the projected frontal area is known.

The formula for the calculation of the aerodynamic drag coefficient is as follows:

$$Cd = \frac{Ca \times W}{2560 \times A}$$

Where: **Cd = aerodynamic drag coefficient**
Ca = aerodynamic drag constant (micro g's)
W = weight of the vehicle (pounds)
A = projected frontal area (square feet)

Example: **Ca = 5.00 W= 3750 A= $20ft^2$**

$$Cd = \frac{5.00 \times 3750}{2560 \times 20} = .366$$

If modifications are made that change the aerodynamics of a vehicle, the results of these changes may be determined by the use of the aerodynamic constant and the above procedure. Aerodynamic changes can also be quantified in terms of horsepower.

Electronic Wind Tunnel

Based on the various calibration factors for a given vehicle, the DYNAFACT can calculate the horsepower required to do any speed between 10 and 200 MPH in 10 MPH steps. This works two ways. If the horsepower output of the engine is known, the terminal velocity (maximum speed) can be determined. If a desired maximum speed is known, the horsepower necessary to do that speed can be determined.

Data Logging

A laptop computer can be connected to the DYNAFACT permitting all four parameters to be logged (saved to disk) in real time. Horsepower, g-force, BPF and mile per hour are sent out the serial communications port at a rate of 20 times per second. Additionally, all calibration factors (weight, frictional and aerodynamic drag constants, etc.) can be saved with the data files for future reference.

RPM Interface

The RPM Interface is an optional module which goes between the Dynafact and the laptop computer. When connected to an engine RPM signal, data logging will include engine RPM as well as the above four parameters.

SUMMARY

The DYNAFACT is a multi-functional instrument primarily intended for the measurement of the gross horsepower of a moving vehicle while accounting for frictional, viscous, and aerodynamic drag of the vehicle. In addition, it is capable of measuring and indicating net horsepower, acceleration, deceleration, BANKS POWER FACTOR, and speed. The aerodynamic and frictional drag characteristics of the vehicle may also be determined as a result of the calibration of the instrument to the vehicle.

A visual dictation of the output of the DYNAFACT is provided by both a high resolution digital and a fast response analog display. The instrument is controlled by four push buttons: a SELECT button, used to select the various modes of operation; a CALIBRATE button, used to initiate the automatic calibration functions; and the HORSEPOWER (+) and METER (-) buttons which provide multi-function control. Annunciators are provided on the digital display to indicate which mode of operation is active and indicator lights display the status of the multi-functional modes.

The DYNAFACT is a viable alternative to both the engine and chassis dynamometers. The instrument is a true dynamometer in every sense of the word. It's ability to measure the horsepower and vehicular parameters of a moving vehicle under real world conditions will open new chapters in the book of automotive development and analysis.