CHEAP HORSES

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WILLKOMMEN

BIENVENIDOS

VIENVENUE

WELCOME

CHEAP HORSES

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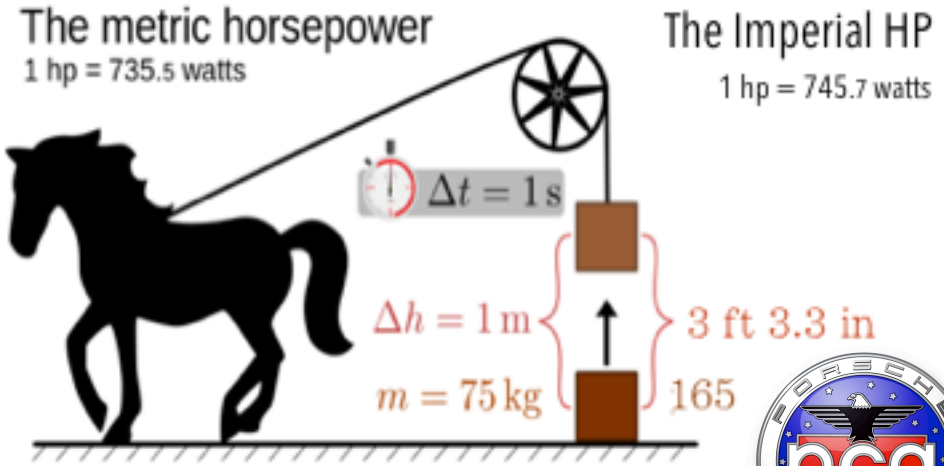
Horsepower:
The rate at which work is done.
A unit of power equal to 550 pound-feet per second.
This is known as **Imperial HP** and equals 745.7 watts.
Metric HP differs slightly and equals 735.5 watts.

"Horsepower" is not recognized in the International System of Units (ISU) and the term horsepower, in most countries, is permitted only as a supplementary unit.

The term horsepower was adopted by James Watt to compare the output of steam engines with the power of draft horses.



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NEWSFLASH:
Horsepower doesn't really exist, just torque.

Horsepower = (torque x engine speed) / 5252
So, horsepower is just a function of torque.

FORCE:
Is the pressure of one mass against another. In the metric system it is calculated in Newtons.
Gravity is an example and in our system its unit is the pound.

WORK:
Is defined as force over distance:
Work = Force x Distance.
Work is achieved when a force causes an object to move.

POWER:
Is the amount of work that can be done in a certain amount of time:
Power = Work / Time.
Power was originally defined by James Watt, inventor of the steam engine.

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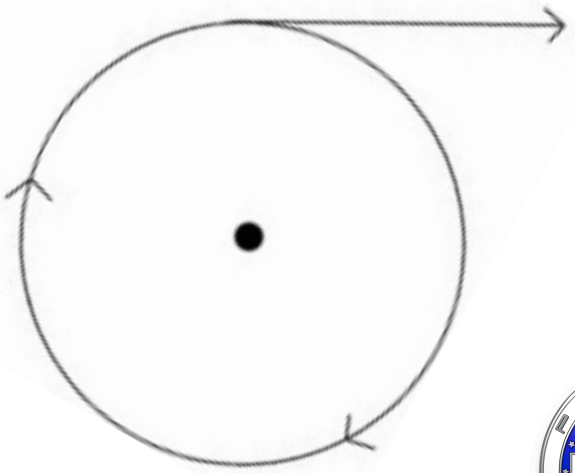
Horsepower as a unit can be defined in many ways.
Basically, it is work done in a straight line.
When the work is not done in a straight line, such as with a car engine it must be defined in a different way: Torque

TORQUE:
Is the tendency of a force to rotate an object around its axis and is defined as the force at any one point on the edge of a circle in the exact direction of rotation, multiplied by the radius (distance from the center).

Since force is measured in pounds and distance in feet, torque is measured in “pound-feet” in our system or in “Newton-meters” in RoW.

Horsepower = (torque x RPM) / 5252



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FORMULA:
Horsepower = (torque x engine speed) / 5252
Horsepower = (torque x RPM) / 5252

Where does the 5252 come from?
Glad you asked!

Watt's definition: 1HP = 550 lb-ft/sec or 550lb x 1ft x 1sec
Converting straight line to its rotational equivalent:
1 HP = 550 lb-ft x 1rad x 1sec
Converting rads to revs and minutes to seconds:
1 HP = 5252 lb-ft x 1 rev / min or 5252 lb-ft x 1RPM

So, Horsepower = Torque x RPM / 5252

Note: 6.28 (2π) rad per RPM

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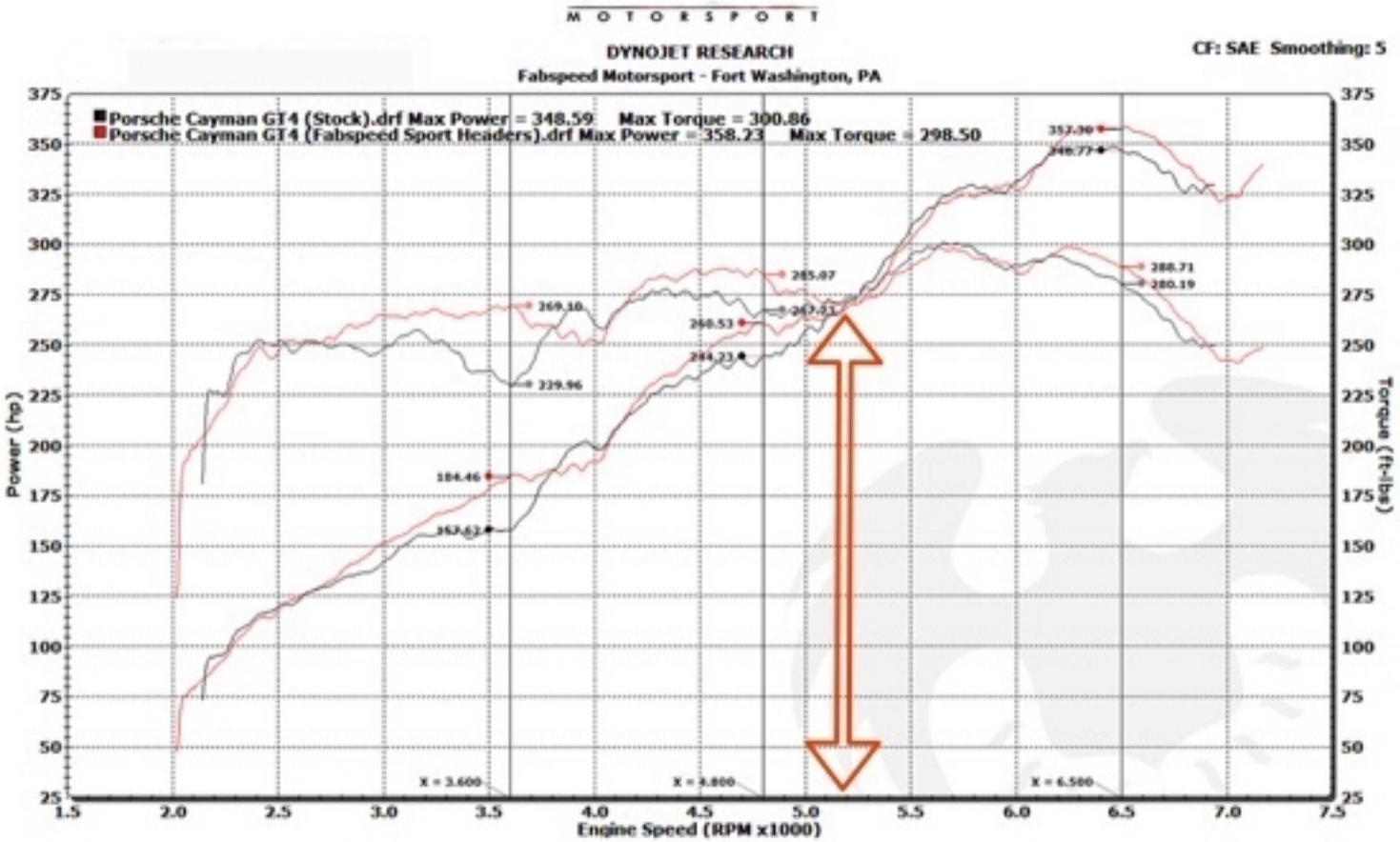
FORMULA:

Horsepower = (torque x RPM) / 5252



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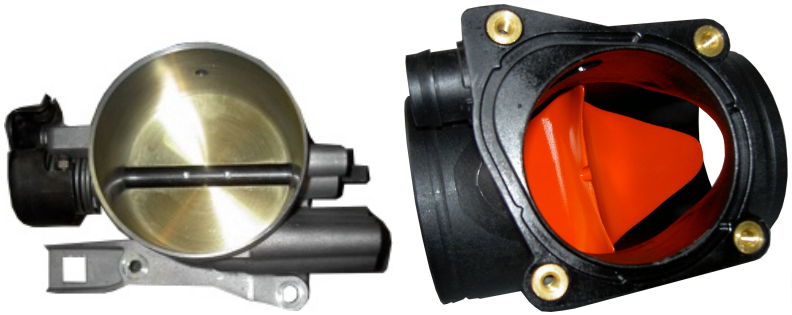
NEWSFLASH:
In an internal combustion engine the ONLY way to make more HP (torque) is to push more air through it, period.
You can do this by increasing the displacement (boring out the cylinders), by adding forced air induction, such as with a turbo or a supercharger, or by making your engine's airflow more efficient.

TURBOs:
Very easy to get additional (HP) torque by just increasing the boost. (software)

Normally Aspirated:
You physically need to make mechanical changes such as bigger throttle boy and intake, Less restrictive exhaust, etc.



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GET IT BACK!

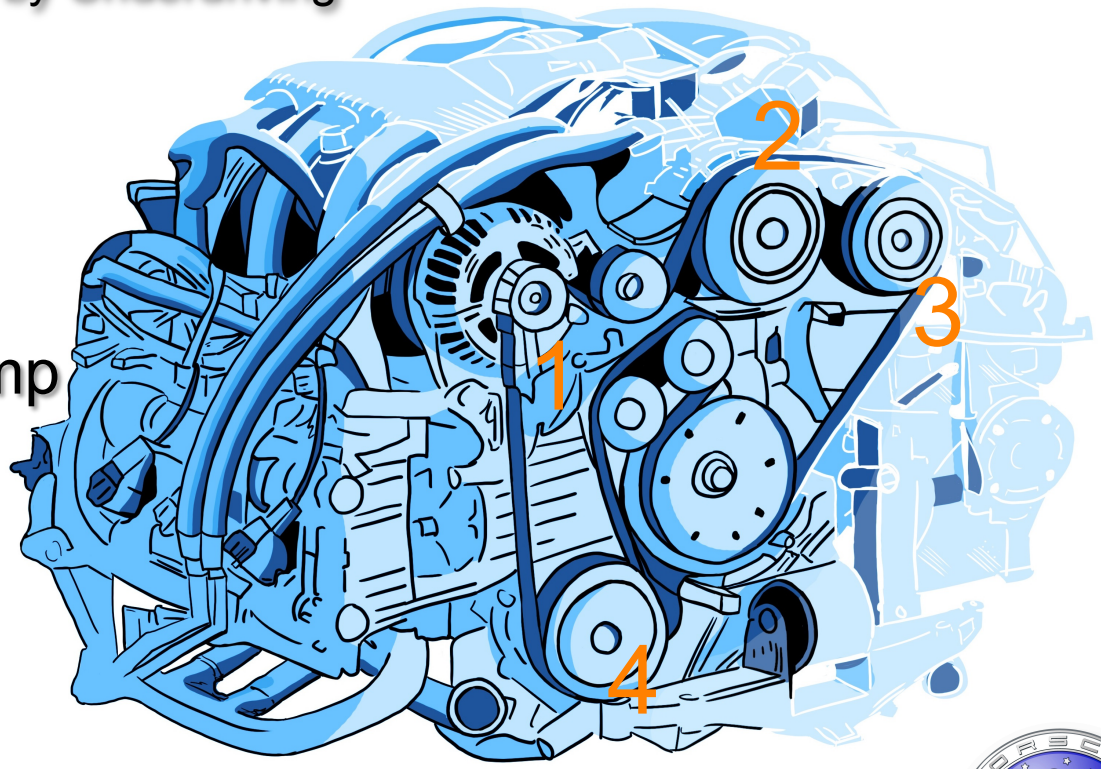
One way to get back HP is by Underdriving

1 - Alternator

2 - Power Steering Pump

3 - A/C Compressor

4 - Water Pump



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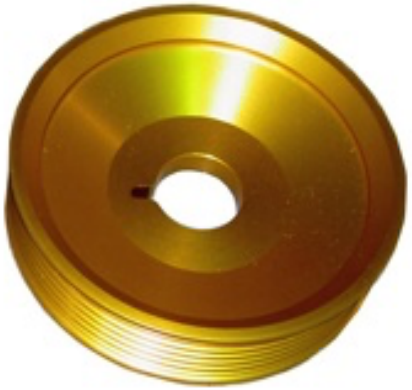
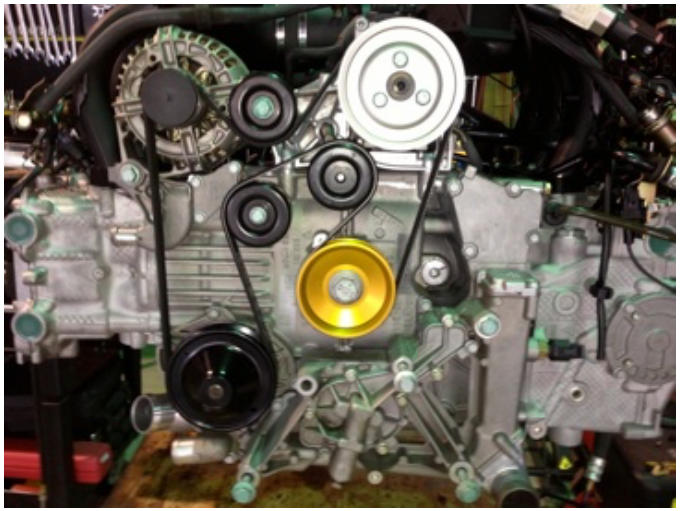
UNDERDRIVING:

- Does not add power to the engine
- It frees up power that was wasted on over-driven accessories

OEM 6” pulley



4” underdrive pulley



$$C = \pi \cdot d$$

C = 3.14 x 6”
C = 18.84 in

C = 3.14 x 4”
C = 12.56 in

33.3% reduction

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UNDERDRIVING:

Why was it used in the first place?

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QUESTIONS:

- *Do underdrive pulleys really give me more power?*
  UPs free up power lost to parasitic drag. They are also lighter than OEM.
- *How much HP can I get by installing an underdrive pulley?*
  In a wasserboxer expect 7-10 HP.
- *Don't underdrive pulleys cause charging problems?*
  Porsche builds in extra capacity in newer cars. They can operate hi beams, seat and steering wheel heater, cabin heater, radio, wipers, windows, etc. all at once while idling!
- *Won't underdrive pulleys cause the engine to overheat?*
  Coolant spends more time around the engine, but also more time in radiators.
- *Are there any additional benefits?*
  In high speed situations, it reduces water pump impeller cavitation.
- *How hard is the installation?*
  45 minutes – 1 hour.
- *How much do they cost?*
  $200 - $300

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GET IT BACK!

One way to get back HP is by installing HEADERS

Headers don't add power to the engine, they free up power by reducing wasted energy

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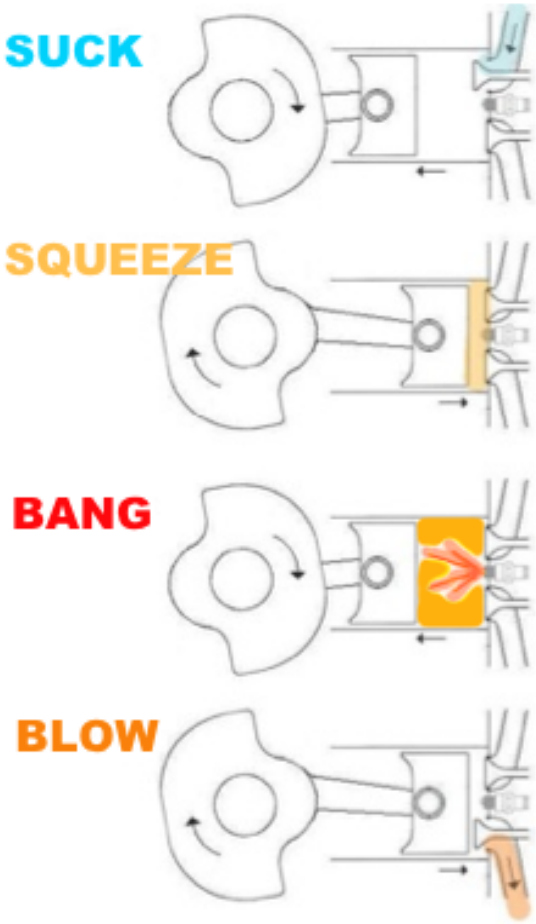
4-Stroke engine: Intake • Compression • Power • Exhaust



The engine produces all its power during the power stroke.

The Intake, Compression and Exhaust strokes are required to make the power possible but they drain power from the Power stroke.

In the Power stroke the compressed fuel/air mix explodes when it is ignited by the spark. As the hot gasses expand, they push the piston back, generating power (torque).

At the exhaust stroke, anything in the way of the gasses, such as back pressure is a sure way to lose power.

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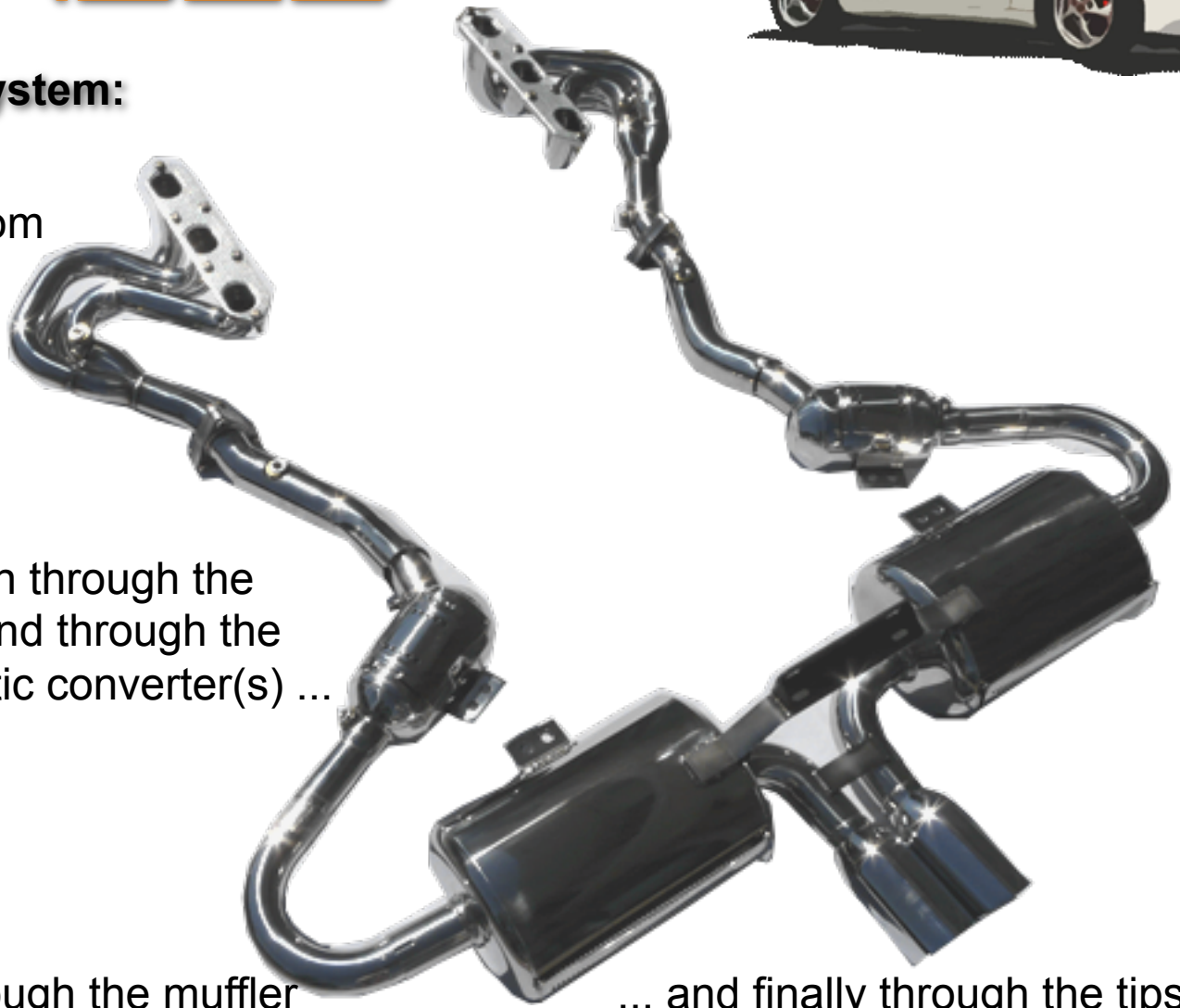
Exhaust system:

Hot gases from the engine end up in the manifold ….



… then through the pipe and through the catalytic converter(s) ...

... through the muffler and its baffles ...

... and finally through the tips and into the atmosphere

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Exhaust manifold:

At the exhaust manifold, one cylinder's exhaust creates **back pressure** for the other two cylinders.

standard exhaust manifold

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With manifolds:
All 3 cylinders from each bank
share a common exhaust manifold

standard exhaust manifold

With equal-length headers:
Each cylinder gets its own exhaust pipe

equal length headers

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More HP:

Remember that if you want to **MAKE** more power you have to increase the airflow from the air filter all the way to the exhaust tips. Many times this requires replacing parts:

- **AIR FILTER**
- **INTAKE TUBE**
- **THROTTLE BODY**
- **INTAKE MANIFOLD**
- **ENGINE DISPLACEMENT & VALVES**
- **EXHAUST MANIFOLD**
- **CATALYTIC CONVERTERS**
- **MUFFLER**
- **REMAP OF THE ECU**

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TECH TACTICS

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Happy Porsche'ing

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