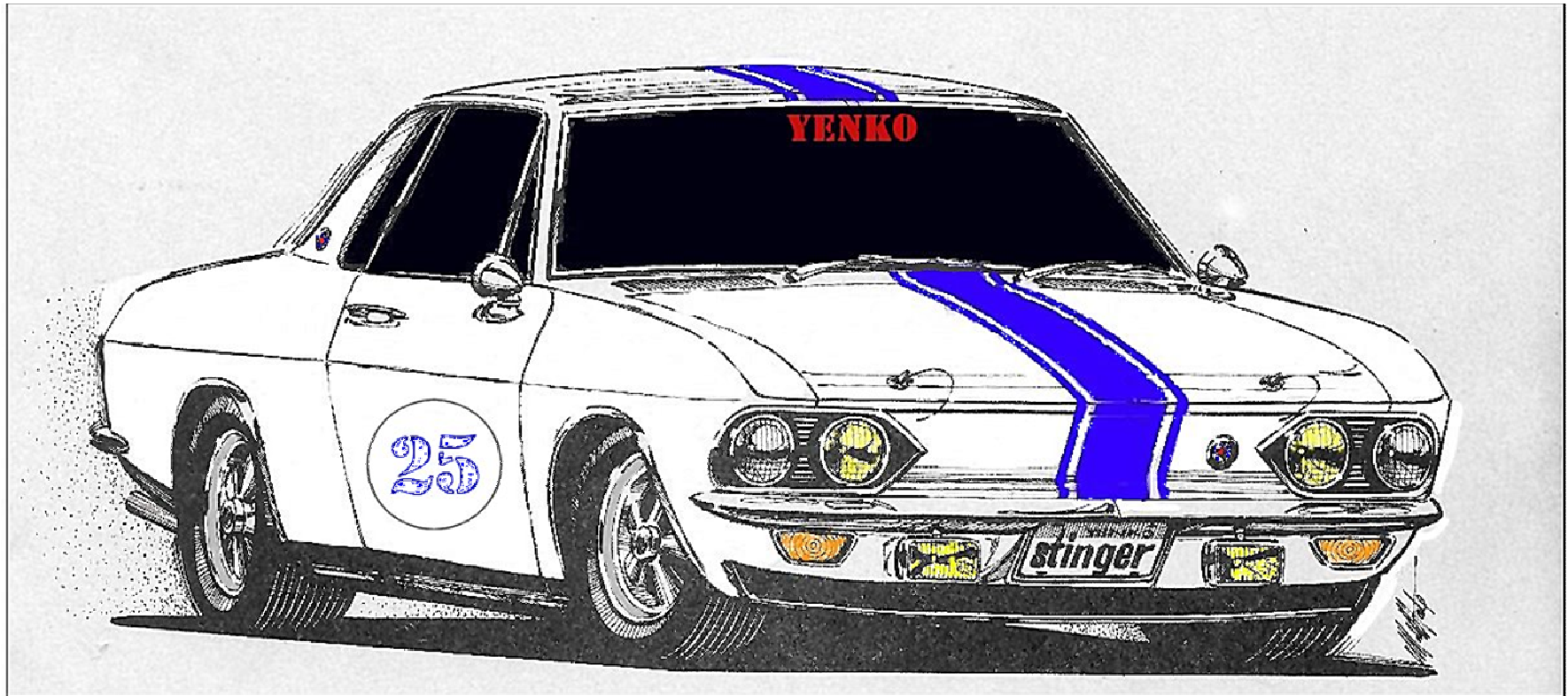


Corvair



Aerodynamics

GoNed Racing
We have the balls to race Corvairs!

Disclaimer

- Data Sources
 - Published
 - Actual testing
 - Totally made up

Your Results May Vary!

Topics of Discussion

- Aerodynamics?
- Mathematics
- Drag
- Lift
- Cooling

Aerodynamics?

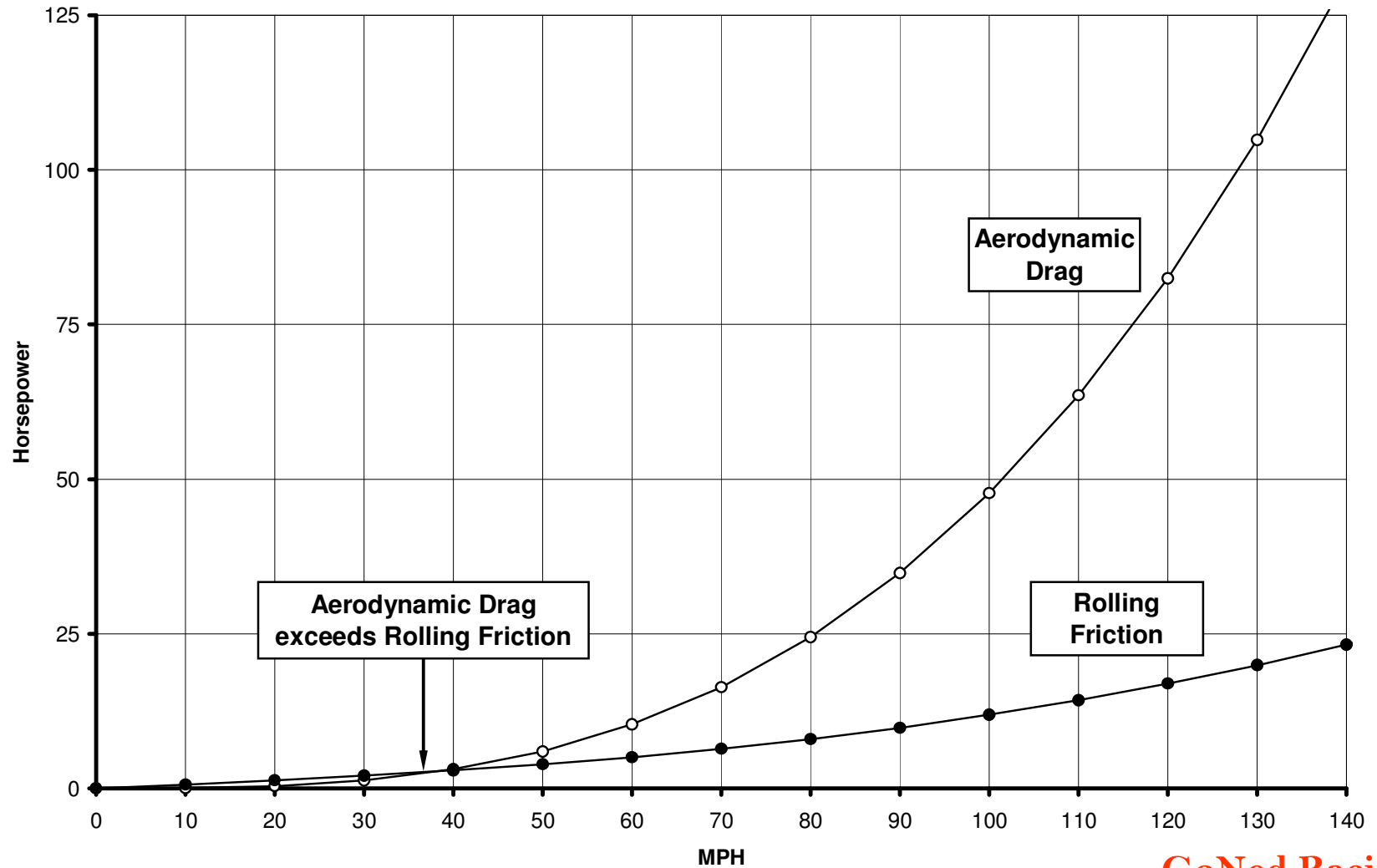
- What is Aerodynamics?
 - Science of moving air
 - Aerodynamic forces based on pressure
 - Lift acts perpendicular to ground
 - Drag acts parallel to ground
- Why is it important?
 - Effects top speed, handling and cooling
- When does it matter?
 - Anytime speed is greater than 40 MPH

Power Lost to Drag

- Basic Equations
 - Aerodynamic Drag Force
 - $\text{Drag} = 0.002558 \times C_D \times S \times \text{MPH}^2$
 - Force to Horsepower
 - $\text{HP} = F \times \text{MPH} / 374.5$
 - Horsepower Lost to Aerodynamic Drag
 - $\text{HP} = C_D \times S \times \text{MPH}^3 / 146400$
 - HP increases 800% every time speed doubles
 - If HP at 50 MPH is 10 HP then at 100 MPH drag is 80 HP!

Corvair Losses

Horsepower Required

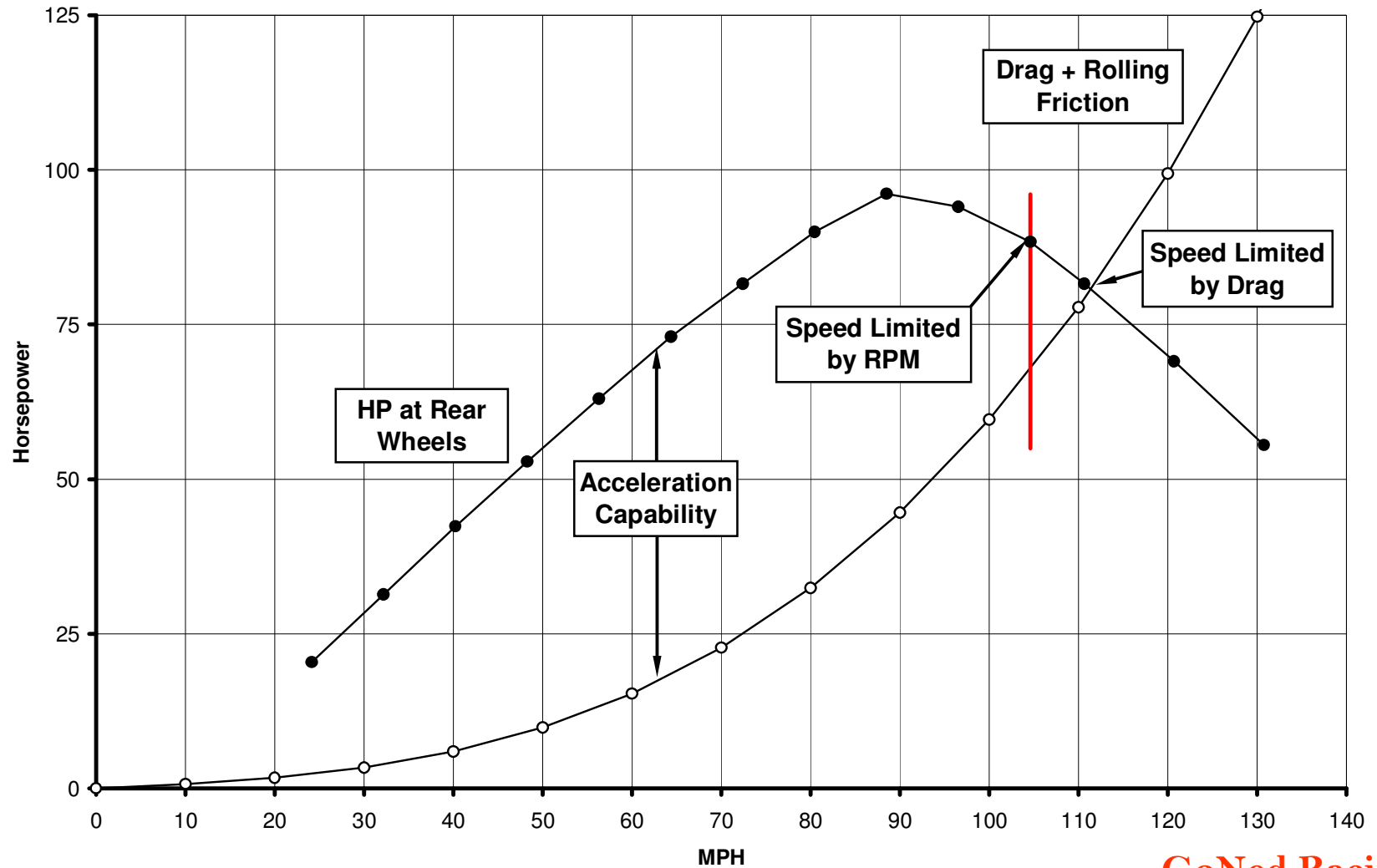


Maximum Speed

- RPM limited
 - Based on maximum RPM of engine and gearing
 - $\text{MPH} = \text{RPM} \times d_t / (336.1 \times G_t \times G_d)$
- Drag limited
 - Speed where drag equals power available from engine

Maximum Speed

Maximum Speed



Drag

- Profile Drag
 - Smack and stumble
 - Shape of car moving through air
- Drag from Lift/Downforce
- Excrescence
 - Junk hanging in the breeze

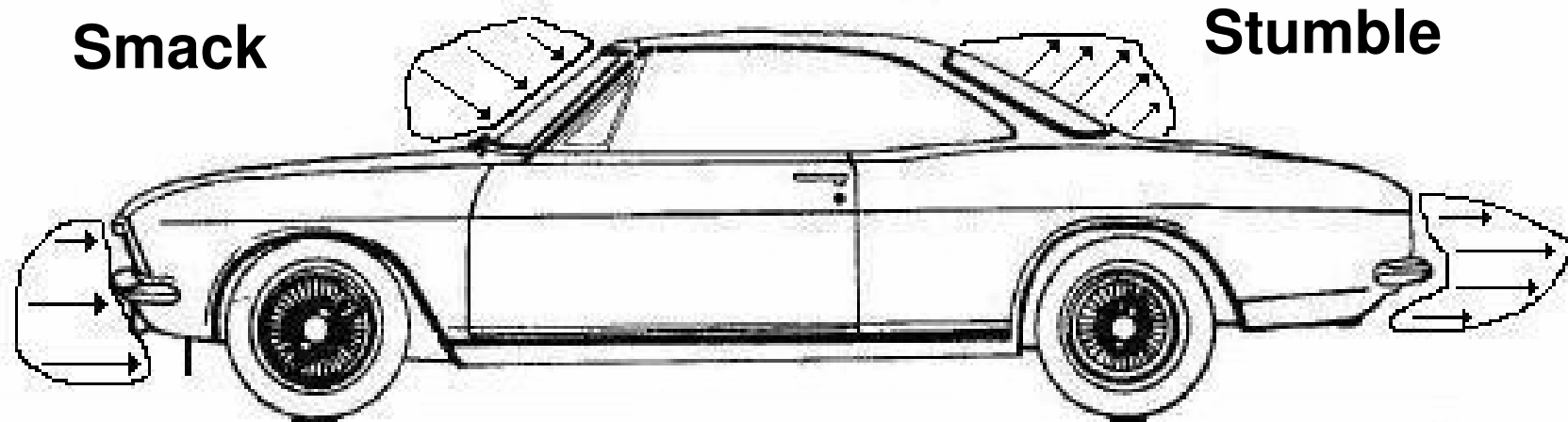
Calculating Drag

- Estimating from “Cookbook” Equations
 - An educated guess
- Computer Modeling
 - Complex modeling
 - Extensive computer power
 - Common in aircraft industry
- Wind Tunnel Tests
 - Expensive
 - Find existing data
- Road Test
 - Simple coast down test

Drag

Source	Early Coupe	Late Coupe
Body Shape	0.016	0.014
Ground Effect	0.016	0.014
Windshield	0.040	0.036
Rear Shape	0.064	0.058
Cabin Airflow	0.016	0.014
Wheel Openings	0.072	0.065
Underbody	0.080	0.072
Engine Cooling	0.032	0.029
Protruding Parts	0.064	0.058
Total	0.400	0.360

Pressure Areas



Drag Reduction

- “Easy” to reduce by 5-15%
 - Remove bumper
 - Remove headlights
 - Remove trunk lock
 - Remove wipers
 - Remove antenna
 - Remove door handles
 - Close gaps around trunk
 - Better side view mirrors
 - Good, low front spoiler

Drag Reduction

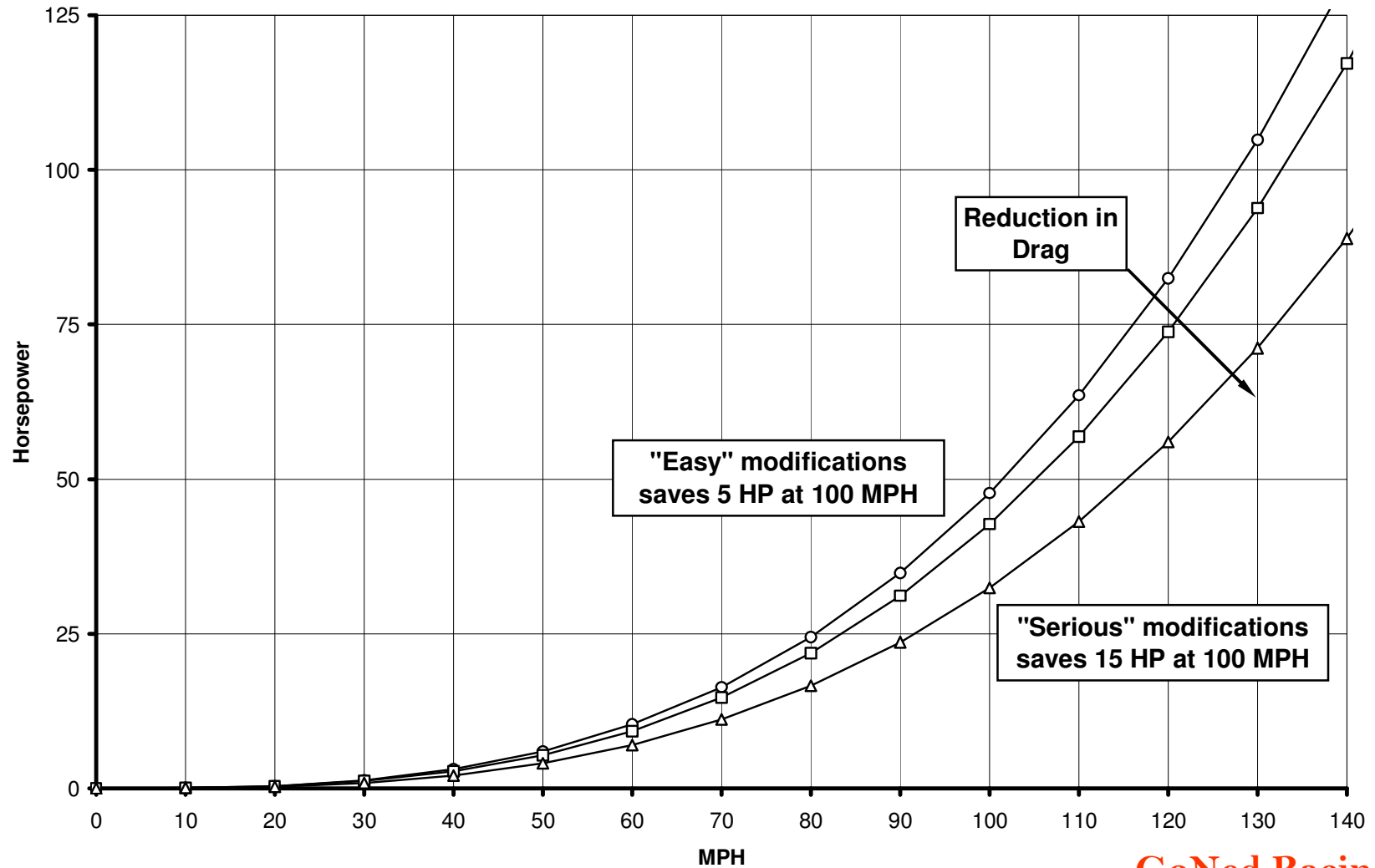
- More involved to get more than 15%
 - Airflow control
 - Exhaust cabin air at top of rear window
 - Remove rain gutter
 - Flush rear quarter windows
 - Reshape nose of car
 - Efficient air inlets
 - Engine cooling air
 - Oil cooler inlet
 - Improve airflow under car
 - Belly pan

Drag Reduction

Source	Late Coupe	“Easy”	“Serious”
Body Shape	0.014	0.014	0.014
Ground Effect	0.014	0.014	0.014
Windshield	0.036	0.036	0.018
Rear Shape	0.058	0.058	0.050
Cabin Airflow	0.014	0.014	0.007
Wheel Openings	0.065	0.054	0.047
Underbody	0.072	0.054	0.043
Engine Cooling	0.029	0.029	0.022
Protruding Parts	0.058	0.040	0.018
Total	0.360	0.313	0.234
% Change	-	13%	35%

Drag Reduction

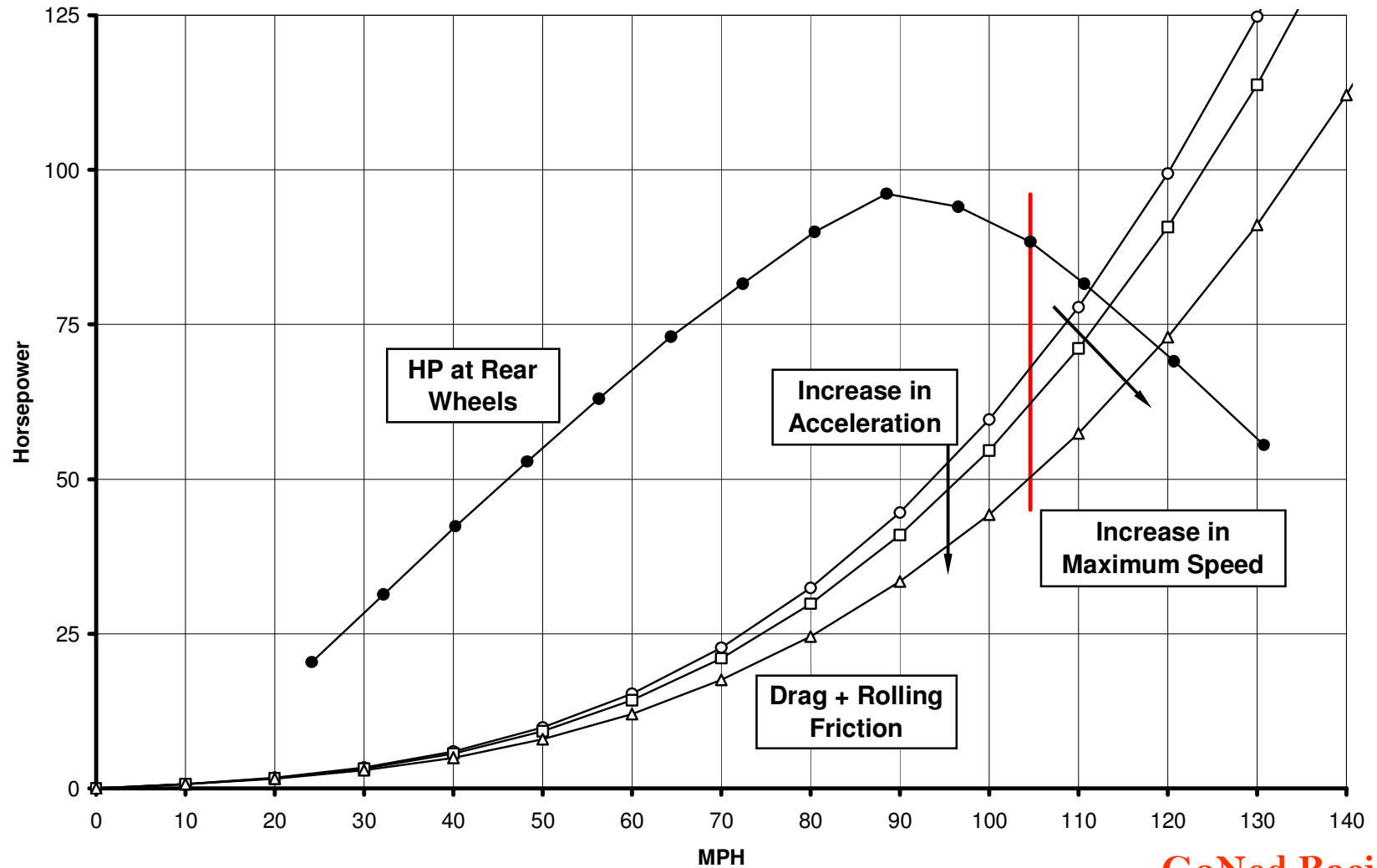
Effect of Drag Reduction



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Drag Reduction

Effect of Drag Reduction on Maximum Speed



Lift/Downforce

- Sources of Lift
 - Shape of car
 - High pressure areas under car
- Sources of Downforce
 - Front and Rear Spoilers
 - Increases rolling resistance and drag

Front Spoilers

- Airdam
 - Stock LM style
 - Reduces air under car
- Spoiler
 - Forward rake (cowcatcher)
 - Reduces air under car
 - Pressure generates downforce
- Splitter
 - Parallel to ground
 - Better use of pressure to generate downforce

Front Spoilers



Airdam



Spoiler



Splitter

Rear Spoilers

- Stinger Style 'Flip'
 - Generates downforce
 - Increases drag
 - bigger 'hole' in air
- Wing
 - Generates downforce
 - Very effective
 - Adjustable
 - Increases drag
 - more area

Engine Cooling

- Complete System
 - Intake Location
 - Stock intake on LM is a low pressure area
 - Internal Flow
 - Minimize restrictions
 - Shroud modifications
 - Extra Cooling Items
 - Oil Cooler

Cooling Intake

- Improved Inlet Location
 - Further back on engine lid – Stinger
 - Top of rear quarter panel
 - Side of rear quarter
 - Use airflow into cabin
 - Ducting from windshield vent

Internal Cooling Flow

- Minimize restrictions
 - Deflash heads
- Shroud modifications
 - Removing lower shrouds
 - Modifying lower shrouds
 - Use heater outlets for air intake

Extra Cooling Items

- Oil Cooler
 - Proper location of inlet
 - Efficient ducting
 - Proper location of exhaust