Comparison of Brake Pedal Frictional Characteristics

Illinois Institute of Technology

IPRO 313

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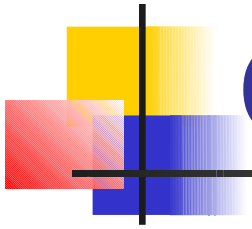


Overview

- Introduction
- Problem Statement
- Solution Methods
- Results
- Conclusions/Recommendations

Problem Statement

- DaimlerChrysler is interested in determining the relative frictional characteristics of current pedals and newly developed prototype pedals.

Brake Pedals For Comparison

DaimlerChrysler Aluminum Ridged Pedal

DaimlerChrysler Aluminum Smooth Pedal

Corvette Aluminum Pedal

DaimlerChrysler Rubber Pedal

Problem Statement

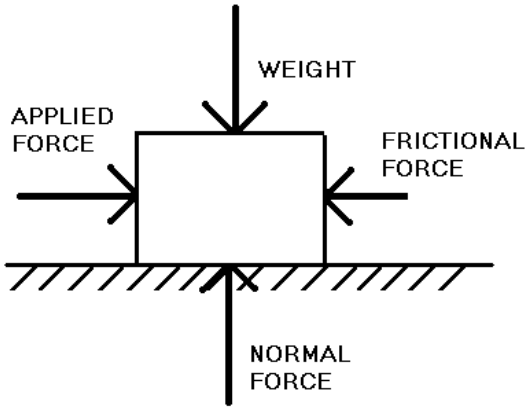
- DaimlerChrysler is interested in determining the relative frictional characteristics of current pedals and newly developed prototype pedals.
- In addition, the performance of the pedals is to be examined for different shoe sole material and different environmental conditions.

Friction…

- Friction is a force that acts at an interface and always opposite to the direction of the applied horizontal force.
- The frictional force (F) can be given as:

$$F = \mu N$$

where N is the applied normal force and μ is a constant of proportionality known as the coefficient of

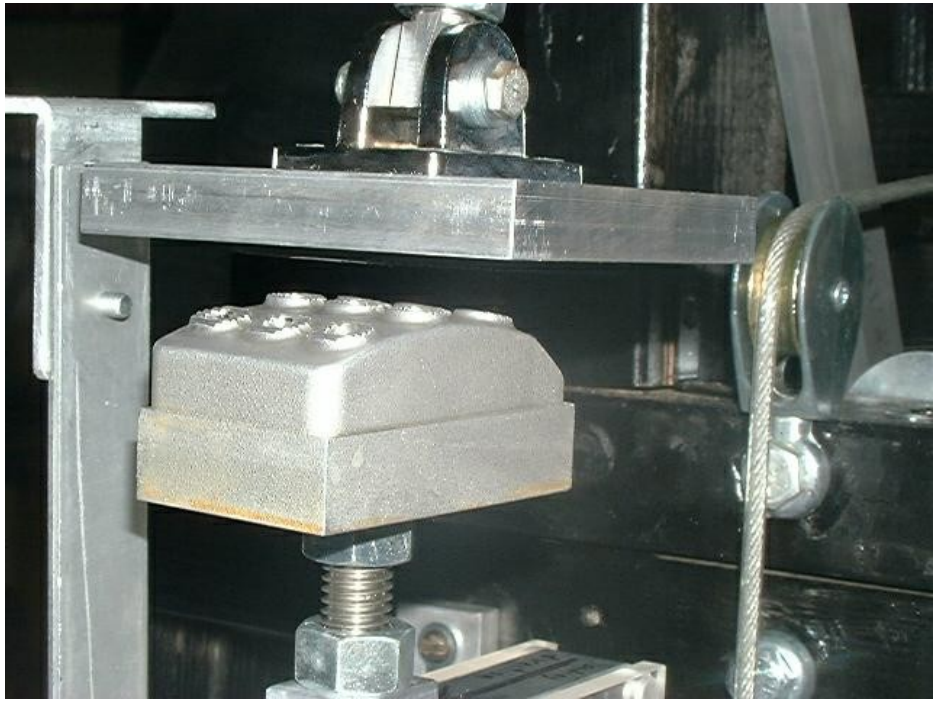


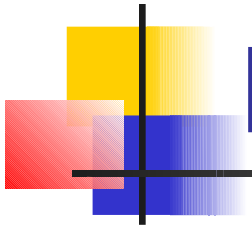
Solution Methods

- The coefficient of friction can be used to describe the frictional behavior of each of the pedals.
- To find the coefficient of friction, a method for measuring the horizontal and vertical loads while the interaction between the pedal and shoe material occurs is necessary.
- Two devices were used to obtain the measurements
  - Horizontal pedal tester
  - Universal pedal tester (IPRO design)

Horizontal Pedal Tester (HPT)

Universal Pedal Tester (UPT)

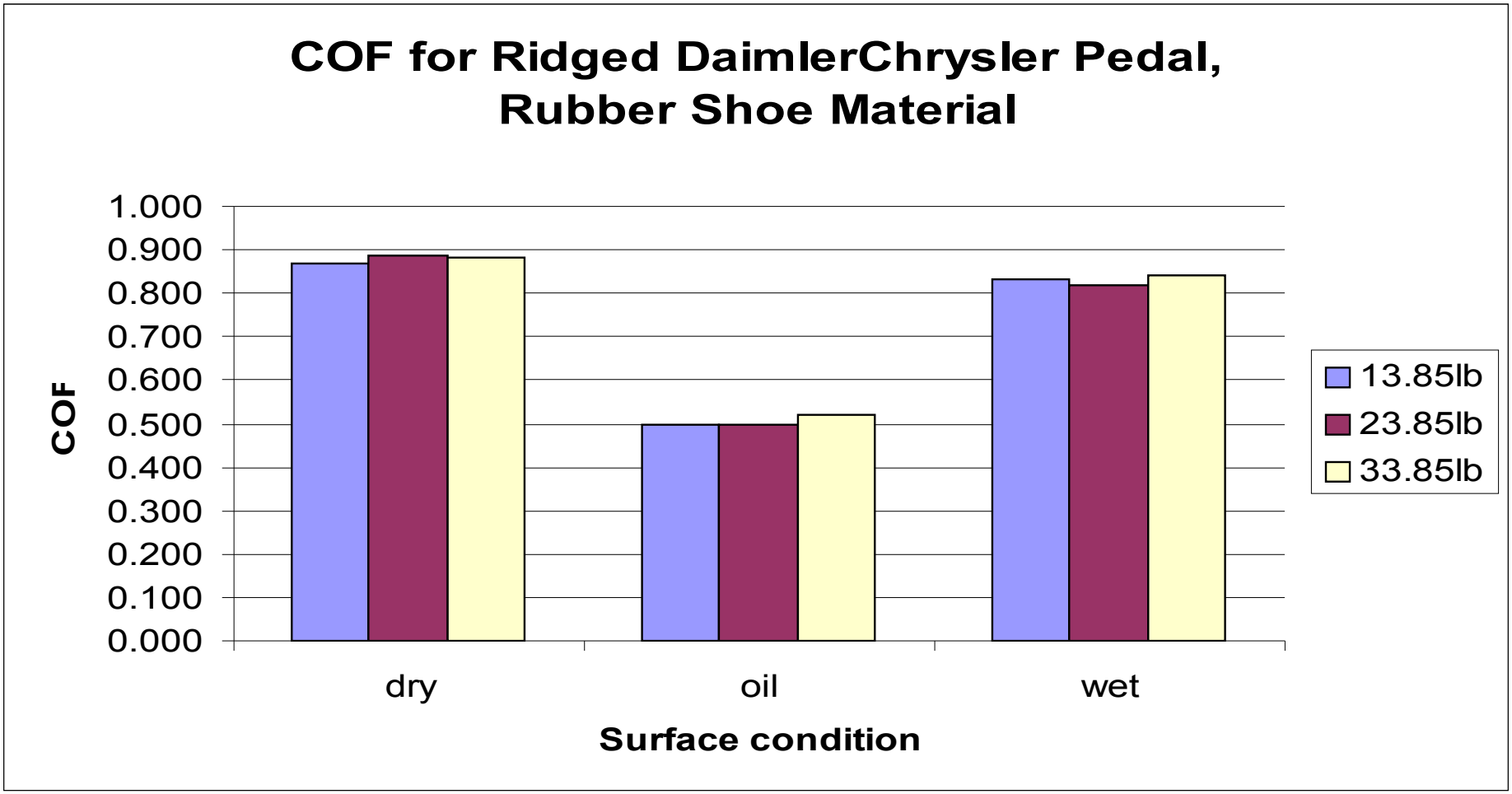




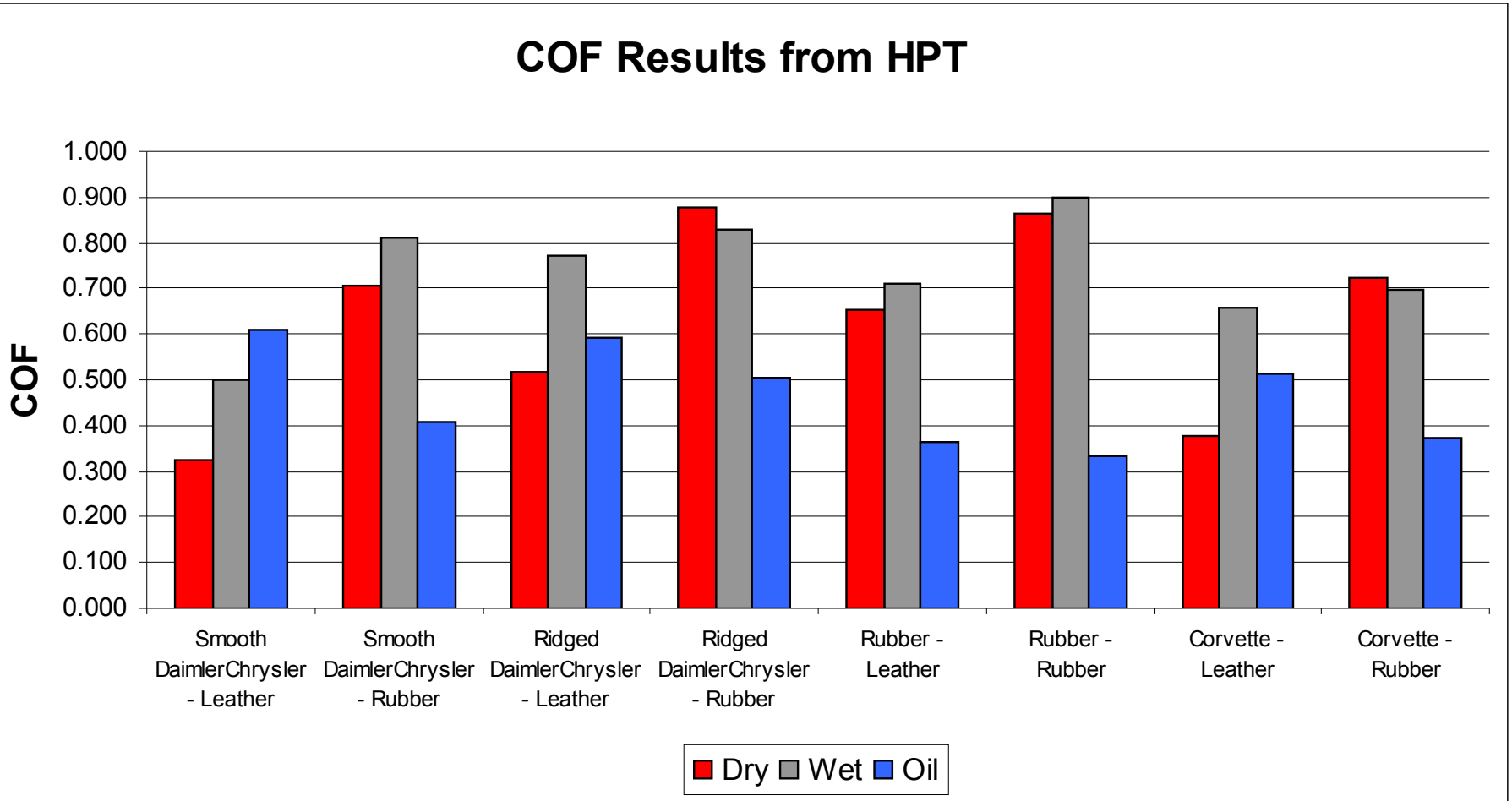
Results

- Report of characteristics for each pedal
- Ranking scheme for use in recommendations to DaimlerChrysler
- Correlation and comparison of HPT and UPT data

Representative Data from HPT



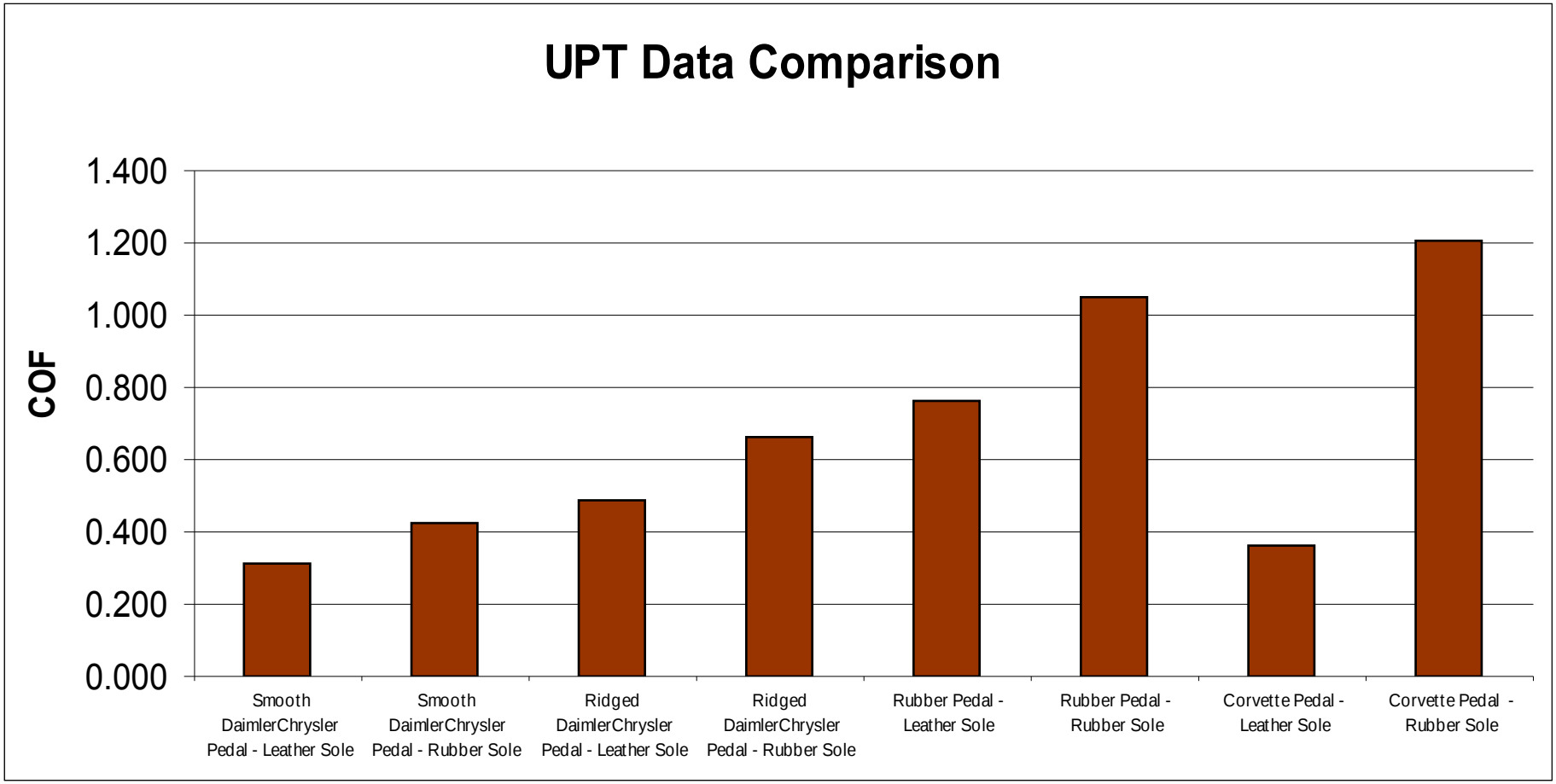
Final HPT Results



Pedal Ranking Based on HPT Data

Pedal Material Combination	Rank (Dry)	Rank (Wet)	Rank (Oil)	Total Rank
Smooth DaimlerChrysler - Leather	8	8	1	6
Smooth DaimlerChrysler - Rubber	4	3	5	3
Ridged DaimlerChrysler - Leather	6	4	2	3
Ridged DaimlerChrysler - Rubber	1	2	4	1
DaimlerChrysler Rubber - Leather	5	5	7	6
DaimlerChrysler Rubber - Rubber	2	1	8	2
Corvette - Leather	7	7	3	6
Corvette - Rubber	3	6	6	5

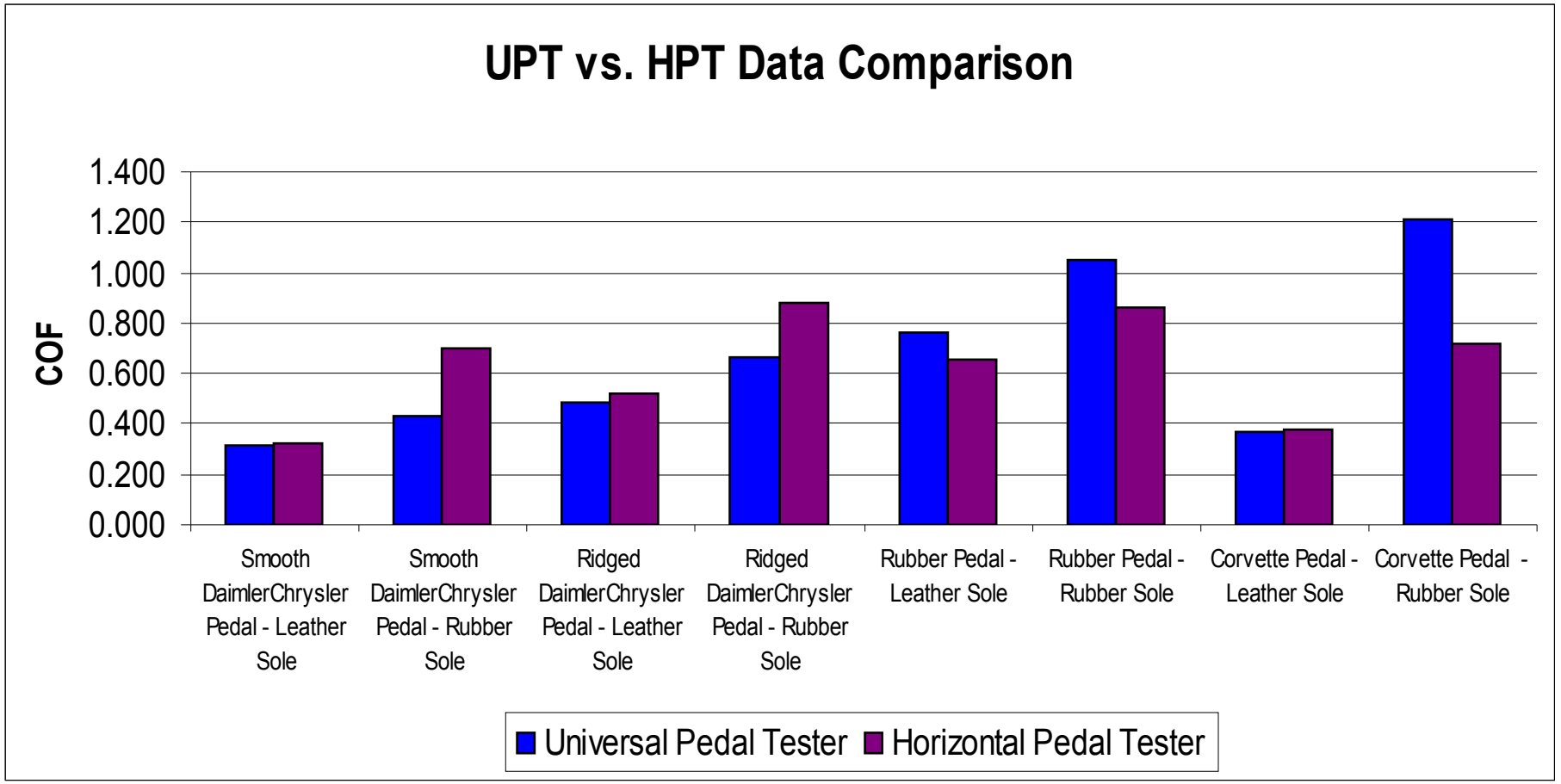
Representative Data for UPT



Pedal Ranking Based on UPT Data

Pedal Material Combination	Rank
Smooth DaimlerChrysler - Leather	8
Smooth DaimlerChrysler - Rubber	6
Ridged DaimlerChrysler - Leather	5
Ridged DaimlerChrysler - Rubber	4
DaimlerChrysler Rubber - Leather	3
DaimlerChrysler Rubber - Rubber	2
Corvette - Leather	7
Corvette - Rubber	1

Comparison of Data with HPT Results

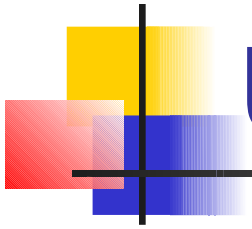


Conclusions and Recommendations

- Final Pedal Selection Recommendation
- UPT Design Issues
- UPT Recommendations
- Patent Search

Final Recommendation to DaimlerChrysler

- The relative overall performance (from best to least) of the pedals is as follows:
  - 1. DaimlerChrysler Ridged Pedal (Aluminum)
  - 2. DaimlerChrysler Rubber Pedal
  - 3. DaimlerChrysler Smooth Pedal (Aluminum)
  - 4. Corvette Pedal (Aluminum)



UPT Design Issues

- Elimination of bouncing
- Better determination of dynamic regions in the data
- More consistent application of horizontal load

UPT Solutions/Patenting Issues

- Replacement of wooden frame with aluminum
- Better placement of dashpots
- Possible software revision
- Replacement of horizontal force application system with pneumatic cylinder
- Patent possibilities