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WREX2000

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Friction Values of Sliding Commercial Vehicles vs. Autos

Force/Weight tests were conducted utilizing several vehicle configurations including an aluminum MC-306 cargo tanker, 40' Dry Van Semi-Trailer, 1971 Conventional School Bus and a 1986 Mercury Sable sedan. Presenters determined each vehicle's weight utilizing a Dillion ED 2000 Plus Dynamometer (Load Cell).

The methodology utilized the well established and accepted scientific principle of the relationship between normal force to horizontal force in relationship to gravity. Each test vehicle was weighed and subsequently dragged on the concrete test area surface. The force required to drag the test vehicles was recorded through the use of a Dillion ED-2000 50,000 pound rated load cell, which was monitored



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via a radio remote readout. The values reported in the raw data represent the drag factor as calculated by the force divided by the weight of the test unit for the relative percentage in relation to gravity for the μ value. Two semi trailers and the school bus were slid on their sides, and the automobile was slid on its roof.

Subsequent tests were conducted to establish drag factors of fully locked truck tires compared to fully locked passenger vehicle tires on both dry and wet surfaces by dragging the vehicles with a heavy duty wrecker.

TEST VEHICLES

1986 Mercury Sable Sedan
VIN 1MEBP87U9GA611188
Suspended Weight = 3,030lbs.

1980 Trailmobile Semi-Trailer
VIN 1PT011RJXA9002642
Length 41'3"
Height 9'6"

| Weight: | Left | Right | Total |
|--------------|-----------|----------------|-------------------|
| Axle #4 | 1,600 lbs | 2,400 lbs..... | 4,000 lbs |
| Axle#5 | 1,300 lbs | 1,780 lbs..... | 3,080 lbs |
| Landing Gear | 3,180 lbs | 2,680 lbs..... | 5,860 lbs |
| Total | 6080 lbs | 6,860 lbs..... | 12,940 lbs |

1991 Fruehauf MC306AL Cargo Tanker
VIN 1H4TO4325NL001201
GVWR 68,000
Overall Tank Length 43'4"
Vessel Width 92"
Vessel Height 57"
Suspended Weight: 11,880 lbs



1971 Carpenter Ford Chassis School Bus
Model 71 FD Conventional
Suspended Weight 13,570 lbs
VIN 81841
Overall Length 399"
Wheelbase 243"



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TEST SURFACE

The test surface was concrete composition with a directional grade of .004. The area was cleared of dirt, dust and loose material. Hand held drag sled and ASTM test trailer coefficient testing conducted at several locations along the test area produced the following data:



| Test | Sled Material | Sled Wt. | Force | f (μ) |
|-------------|----------------------|-----------------|--------------|--------------|
| 1 | Auto Tire | 30 lbs | 24 lbs | .80 |
| 2 | Auto Tire | 30 lbs | 20 lbs | .67 |
| 3 | Auto Tire | 30 lbs | 24 lbs | .80 |
| 4 | Auto Tire | 30 lbs | 24 lbs | .80 |
| 5 | Smooth Steel | 30 lbs | 10 lbs | .33 |
| 6 | Smooth Steel | 30 lbs | 10 lbs | .33 |
| 7 | Smooth Steel | 30 lbs | 10 lbs | .33 |
| 8 | Auto Tire | 30 lbs | 22 lbs | .73 |
| 9 | Auto Tire | 30 lbs | 24 lbs | .80 |
| 10 | Auto Tire | 30 lbs | 24 lbs | .80 |

ASTM Skid Test Trailer –

| | | | | | |
|-----|----------|-----------|-----|----------|-----------|
| Dry | 20 MPH | SN = 81.4 | Wet | 20 MPH | SN = 57.8 |
| Dry | 31 MPH | SN = 83.4 | Wet | 31 MPH | SN = 45.1 |
| Dry | 40.5 MPH | SN = 82.4 | Wet | 40.5 MPH | SN = 42.4 |

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**Full Scale Force/Weight Tests of Air Braked,
Dolly Converter & Semi-Trailer Compared To Passenger Automobile**

Vehicles:

1995 53' Lufkin Dry Van Semi-Trailer, T30/30 air chambers, 5.5" slack adjusters

1984 Utility Tandem Dolly Converter, T30 air chambers, 5.5" slack adjusters



| Test | Vehicle | Force | Weight | Speed | Surface/tire psi | f (μ) |
|------|---------------|-------------|-----------|---------------|------------------|-------|
| 1 | Trailer/Dolly | 13,500 lbs | 19,580 | 3 MPH | Dry/105 psi | .69 |
| 2 | Trailer/Dolly | 13,600 lbs | ----- | 3 MPH | Dry/105 psi | .69 |
| 3 | Trailer/Dolly | 13,400 lbs | ----- | 3 MPH | Dry/105 psi | .68 |
| 4 | Van | G-Analyst | N/A | 29 MPH | Dry/35 psi | .78 |
| 5 | Van | -----“----- | N/A | 30 MPH | Dry/35 psi | .78 |
| 6 | Van | -----“----- | N/A | 33 MPH | Dry/35 psi | .75 |
| 7 | Van | -----“----- | N/A | 35 MPH | Dry/35 psi | .79 |
| 8 | Van | 3,260 lbs | 4,240 lbs | 9 MPH | Dry/35 psi | .77 |
| 9 | Van | xxx | VOID | Rolling Wheel | xxx | xxx |
| 10 | Van | 3,200 lbs | ----- | 11 MPH | Dry/35 psi | .75 |
| 11 | Van | 2,900 lbs | ----- | 15 MPH | Dry/35 psi | .68 |
| 12 | Van | 2,200 lbs | ----- | 15 MPH | Wet/35 psi | .52 |
| 13 | Van | 2,300 lbs | ----- | 15 MPH | Wet/35 psi | .54 |
| 14 | Van | 2,200 lbs | ----- | 10 MPH | Wet/35 psi | .52 |
| 15 | Trailer/Dolly | 12,500 lbs | 19,580 | 5 MPH | Wet/105 psi | .64 |
| 16 | Trailer/Dolly | 10,900 lbs | ----- | 10 MPH | Wet/105 psi | .56 |
| 17 | Trailer/Dolly | 10,500 lbs | ----- | 10 MPH | Wet/105 psi | .54 |
| 18 | Trailer/Dolly | 11,400 lbs | ----- | 9 MPH | Wet/105 psi | .58 |
| 19 | Trailer/Dolly | 13,800 lbs | ----- | 8 MPH | Dry/30 psi | .70 |
| 20 | Trailer/Dolly | 14,200 lbs | ----- | 7 MPH | Dry/30 psi | .73 |
| 21 | Trailer/Dolly | 14,200 lbs | ----- | 9 MPH | Dry/30 psi | .73 |
| 22 | Trailer/Dolly | 11,000 lbs | ----- | 10 MPH | Wet/30 psi | .56 |
| 23 | Trailer/Dolly | 11,500 lbs | ----- | 10 MPH | Wet/30 psi | .59 |
| 24 | Trailer/Dolly | 11,200 lbs | ----- | 10 MPH | Wet/30 psi | .57 |

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Vehicle Drag on Side & Top

Test pulls were conducted throughout the day of September 26, 2000. Listed below are the preliminary results of all of the test pulls.

| Test | Vehicle | Force | Speed | Cable Angle | f (μ) |
|-------------|----------------|--------------|--------------|--------------------|--------------|
| 1 | Tanker | 8,800 lbs | 20fpm | | .74 |
| 2 | Tanker | 8,500 lbs | 20fpm | 45" to 46" | .72 |
| 3 | Tanker | 8,500 lbs | 20fpm | 46" to 46" | .72 |
| 4 | Tanker | 8,000 lbs | 6.7 mph | 31" to 45" | .67 |
| 5 | Semi-trailer | 7,700 lbs | 7.4 mph | Level | .60 |
| 6 | Auto | 1,600 lbs | 14 mph | Level | .53 |
| 7 | Auto | 1,800 lbs | 13.6 mph | Level | .59 |
| 8 | Semi-trailer | 6,400 lbs | 8.8 mph | Level | .49 |
| 9 | Semi-trailer | 6,700 lbs | 6.8 mph | Level | .52 |
| 10 | Auto | 1,500 lbs | 10.7 mph | Level | .50 |
| 11 | Tanker | 6,800 lbs | 10.7 mph | 31" to 45" | .57 |
| 12 | Tanker | 6,300 lbs | 6.7 mph | 31" to 30" | .53 |
| 13 | Tanker | 6,700 lbs | 7.1 mph | 31" to 30" | .56 |
| 14 | School Bus | 6,800 lbs | 6.5 mph | 31" to 28" | .50 |
| 15 | School Bus | 7,200 lbs | 7.2 mph | 31" to 28" | .53 |
| 16 | School Bus | 7,600 lbs | 10 mph | 26" to 28" | .56 |
| 17 | School Bus | 7,700 lbs | 10.5 mph | 26" to 28" | .59 |