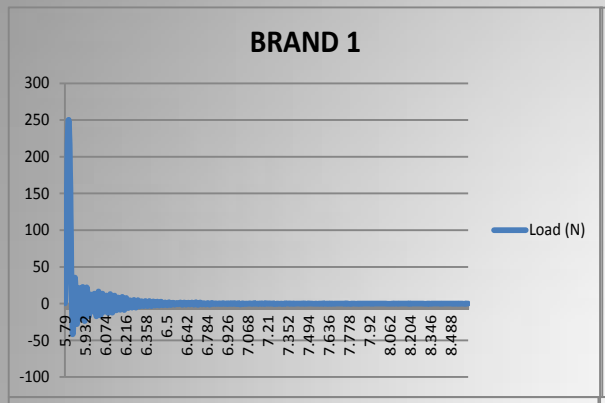
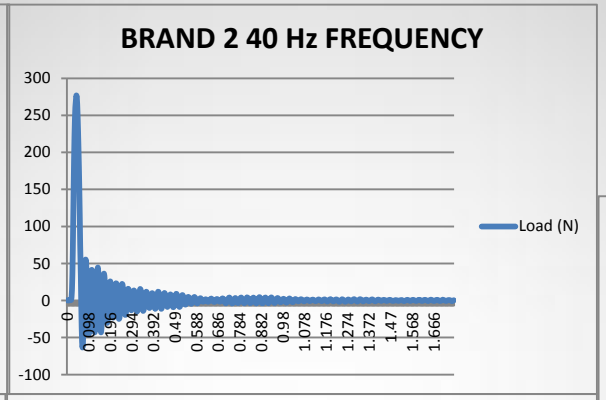
RACQUET SHOCK STUDY

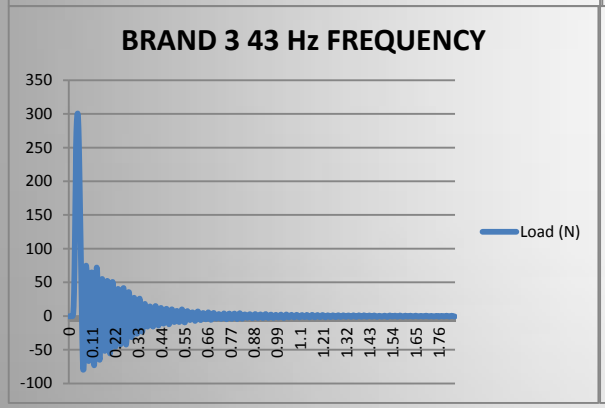
MULTI CORE RACQUETS VS. AIR MOLDED RACQUETS

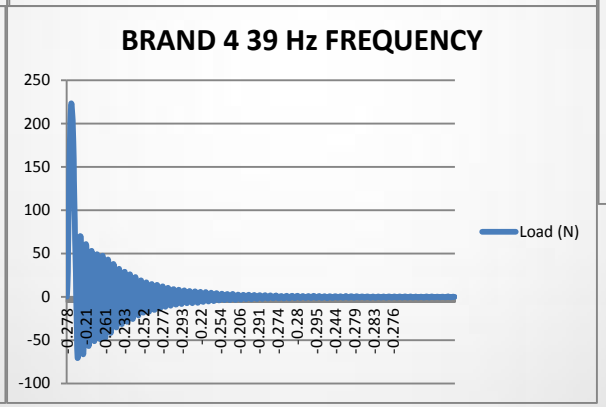
AIR MOLDED RACQUETS TRANSMIT OVER 43,000 lbs OF FORCE PER MATCH ON THE ARM. SOLID MULTICORE RACQUETS TRANSMIT LESS THAN 14,000 lbs OF FORCE.

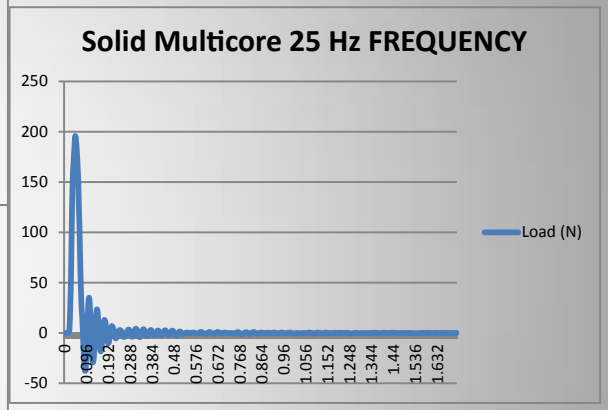
SHOCK AMPLITUDE





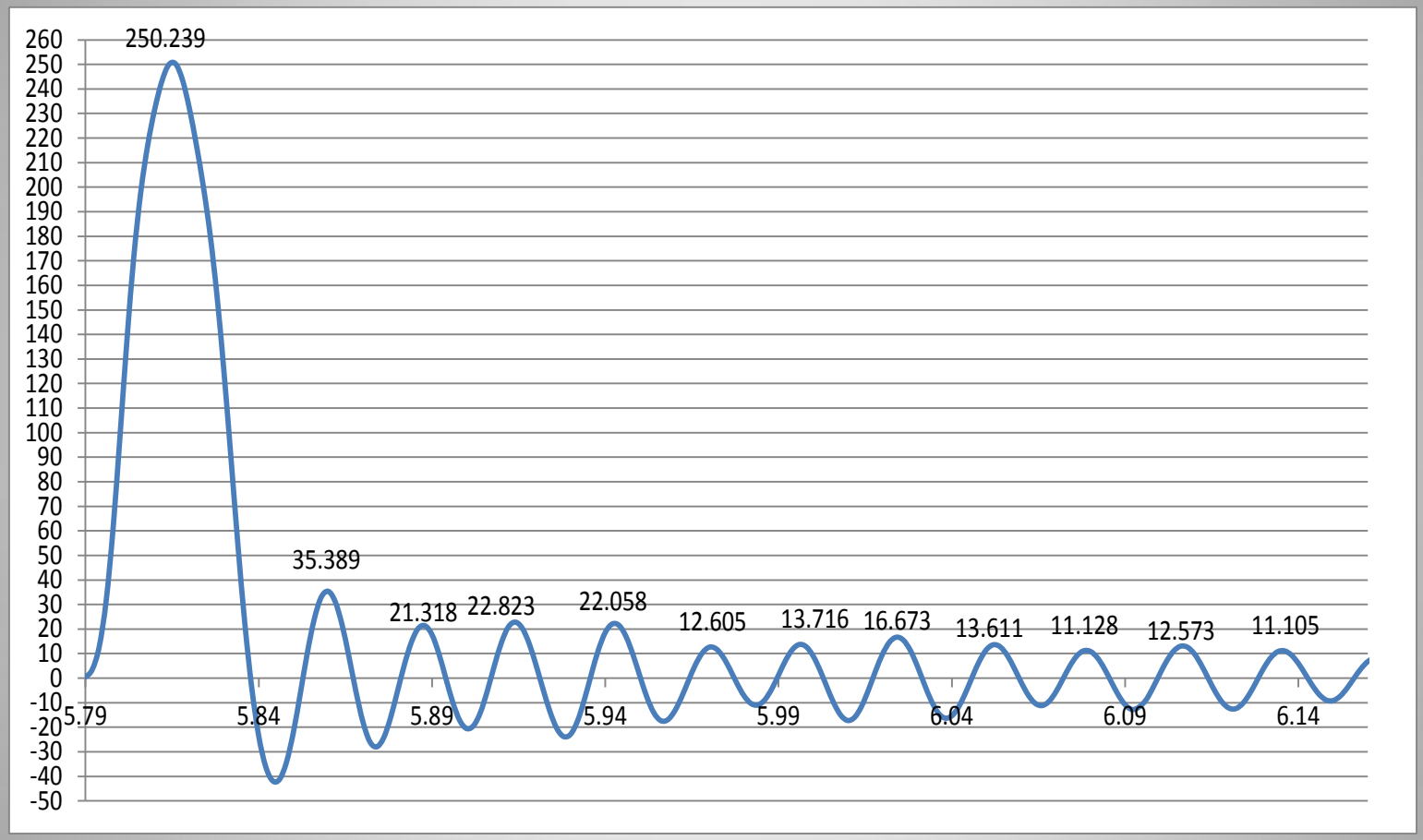






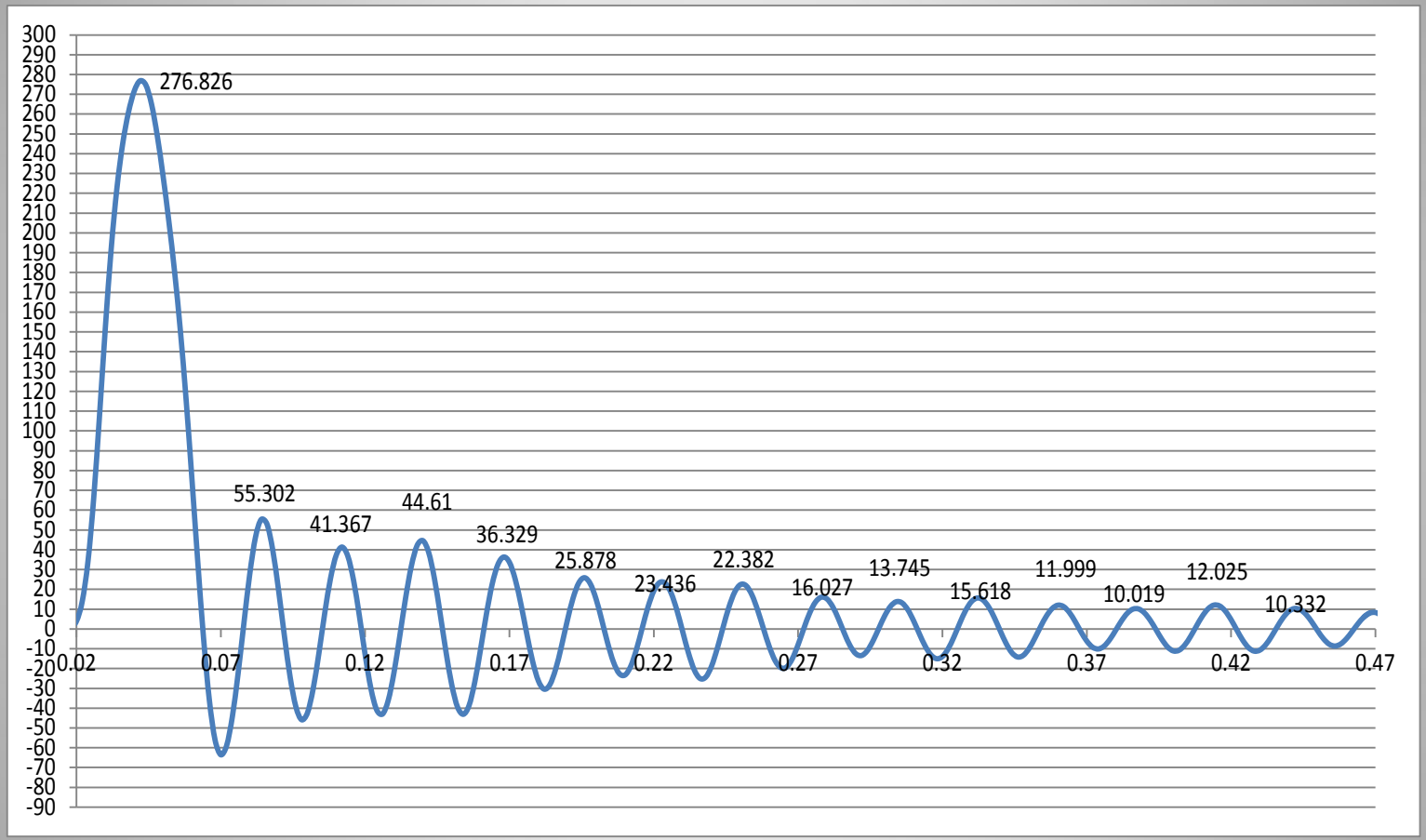
Multi solid core racquets showed lower frequencies (25Hz) or cycles per second of vibration cycles compared to 40Hz average with the air molded racquets. This is significant as the number of oscillations corresponds to the amount of energy transmitted to the arm. If you add the amplitude of all the oscillations you will get the amount of energy transmitted to the arm in a single hit of the ball. We call this shock amplitude. In a typical match you hit the ball 180 times. If you multiply the shock amplitude by how many times you hit the ball you will find out how much energy your arm is absorbing.

BRAND 1



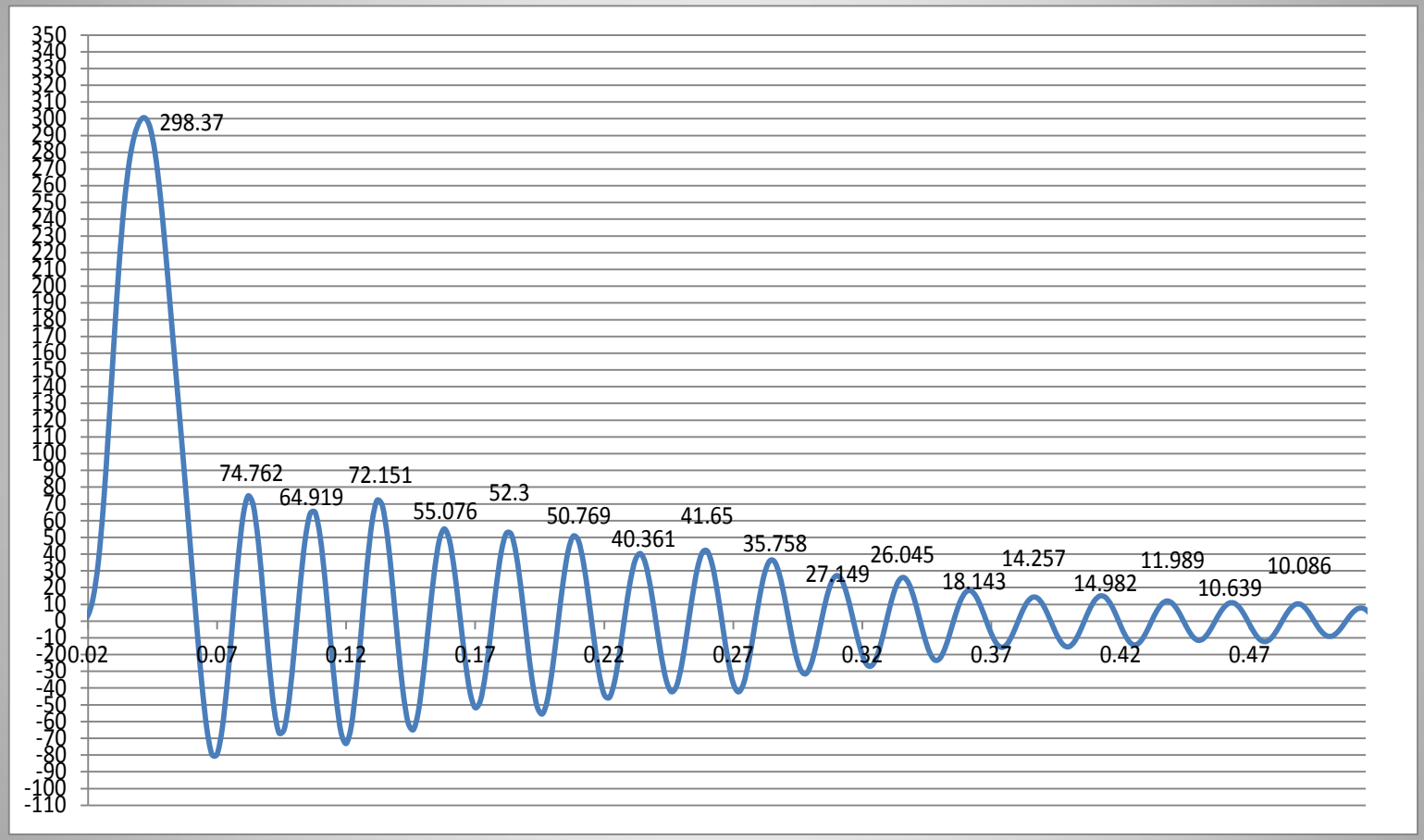
12 cycles over 0.344 seconds with a total of 604.2 newtons (135.829 pound-force) per ball hit. During a typical match this brand expells 108,756 newtons (24,449.321 pound-force) to your arm.

BRAND 2



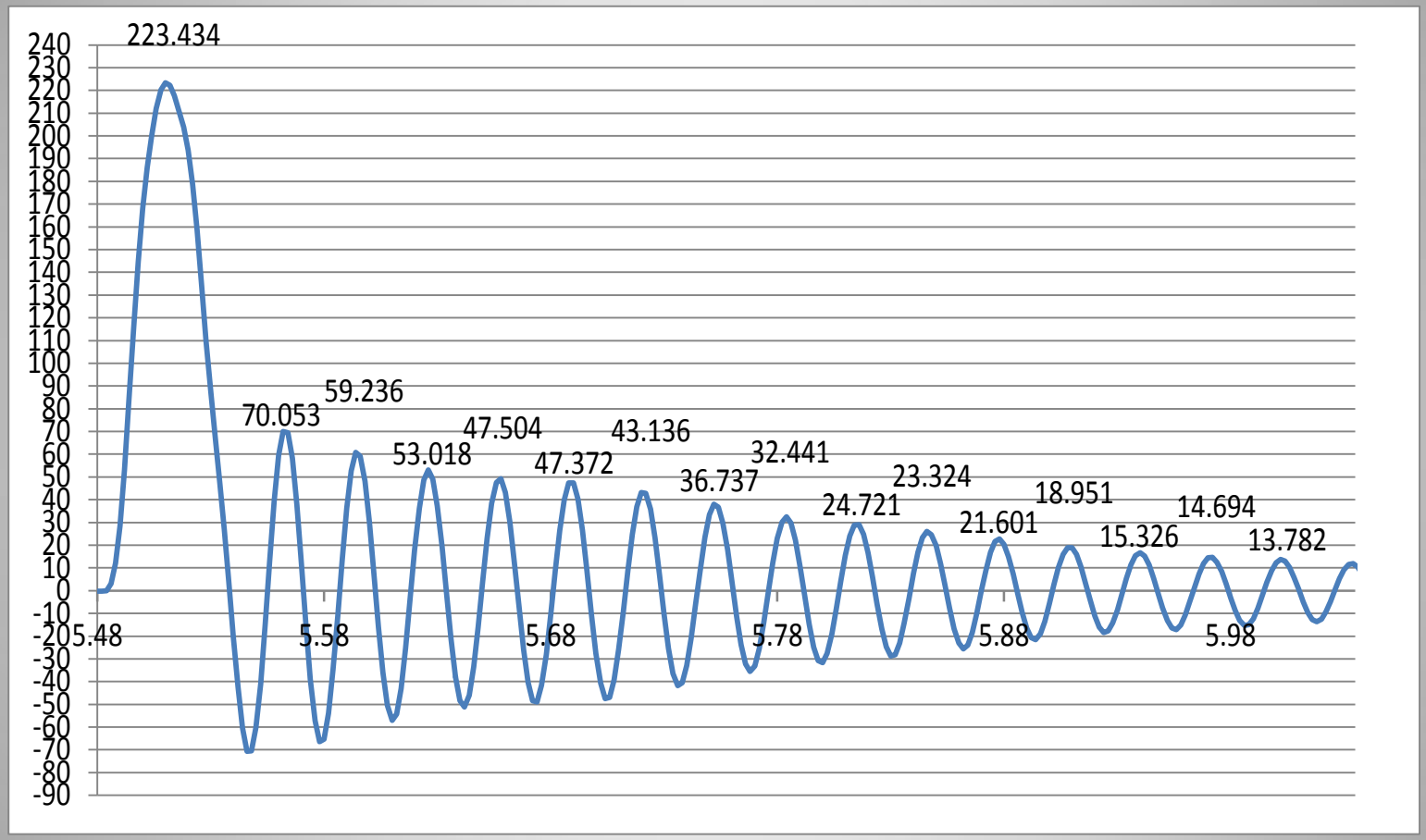
15 cycles over 0.506 seconds with a total of 954.963 newtons (214.684 pound-force) per ball hit. During a typical match this brand expells 171,893.34 newtons (38,643.160 pound-force) to your arm.

BRAND 3



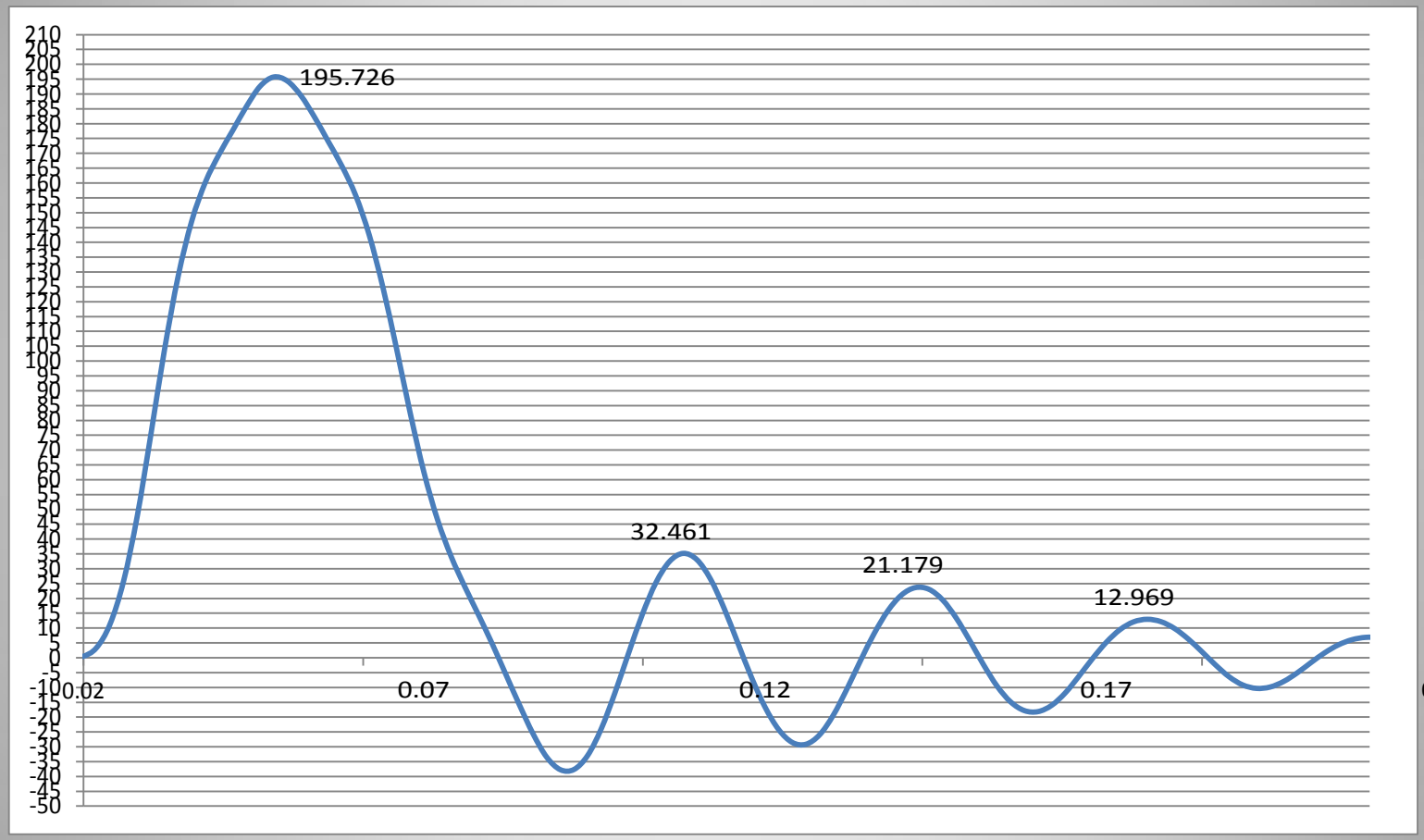
18 cycles over 0.594 seconds with a total of 1,540.442 newtons (346.305 pound-force) per ball hit. During a typical match this brand expells 277,279.56 newtons (62,334.925 pound-force) to your arm.

BRAND 4



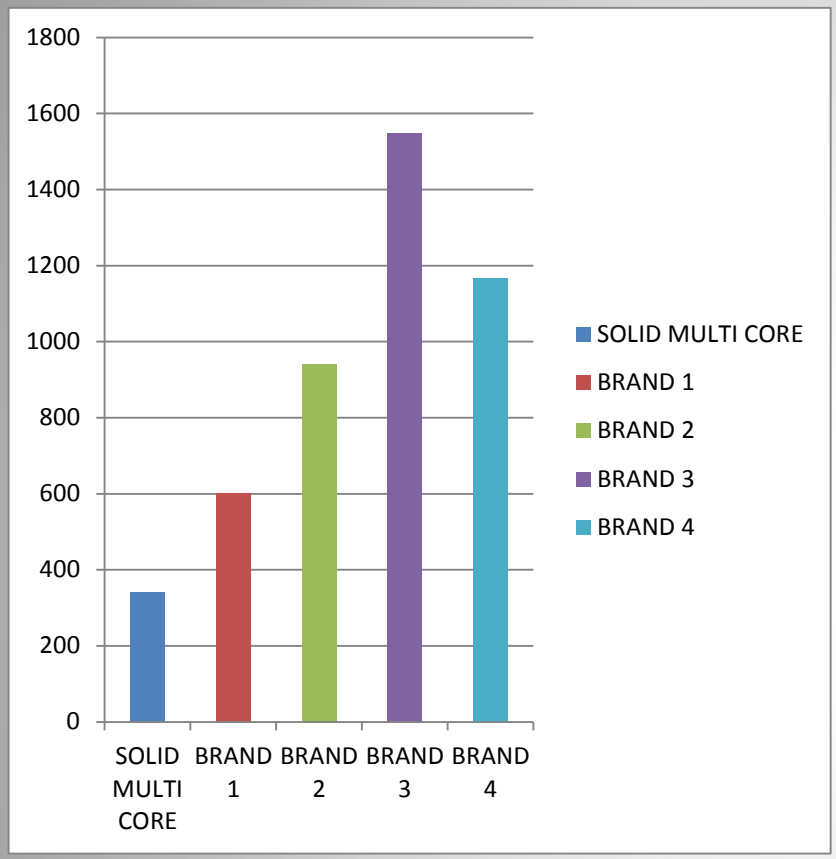
16 cycles over 0.584 seconds with a total of 1,172.218 newtons (263.525 pound-force) per ball hit. During a typical match this brand expells 210,999.24 newtons (47,434.516 pound-force) to your arm.

SOLID MULTI CORE

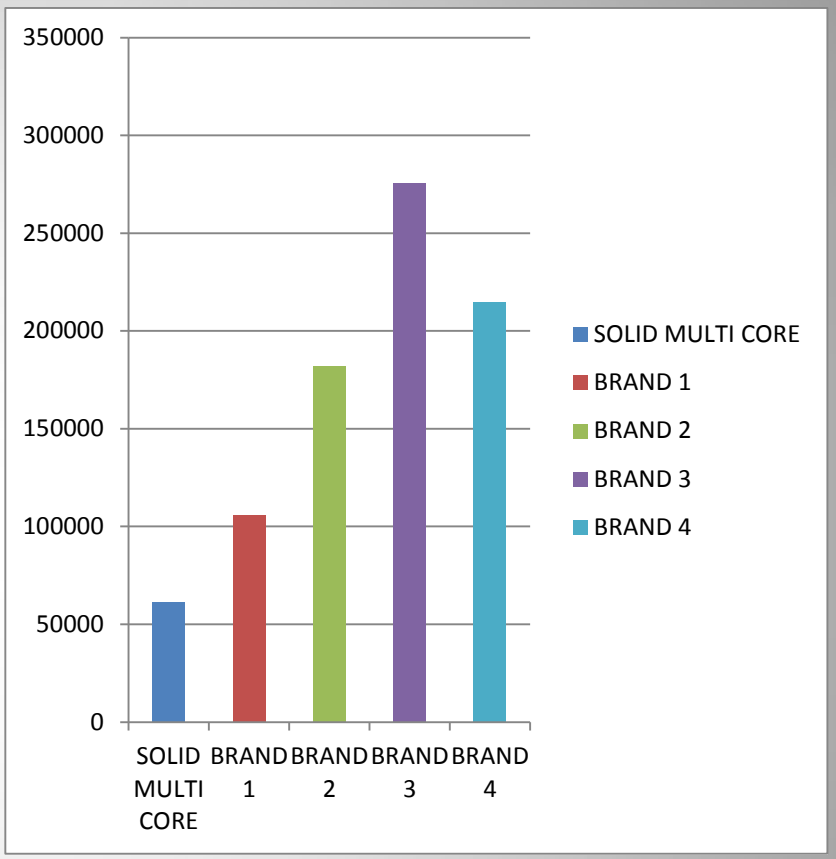


4 cycles over 0.16 seconds with a total of 341.13 newtons (76.689 pound-force) per ball hit. During a typical match this brand expells 61,403.4 newtons (13,804.033 pound-force) to your arm.

SHOCK AMPLITUDE



PER BALL HIT



PER MATCH

An average air molded racquet expells 1,067.955 newtons (240.086 pound-force) to your arm during a single ball hit compared to 341.13 newtons (76.689 pound-force) a solid multi core racquet expells during a single ball hit. This can be extrapolated to a typical match of 180 ball hits. The results of which would be that an average air molded racquet would expell 192,231.9 newtons (43,215.450 pound-force) to your arm during a typical match where as a solid multi core racquet would expell 61,403.4 newtons (13,804.033 pound-force) to your arm during a typical match. Over 3 times lower.

METHODS

A 2.5lb weight dropped 18" along a guide to precisely hit the center of each racquet head. This is equivalent to an 80 mph tennis ball (see chart on next page).
Only one bounce (shock force) was allowed for the weight. The weight did not experience a repeat hit to the center of the racquet.
The center was measured for each racquet head, so it was comparable between racquets with heads of different sizes
The grip was mounted to a load cell on a calibrated MTS materials test machine
Since each grip varied, the grips were all mounted to the load cell in the same consistent fashion with the butt end of the grip in line with the edge of the load cell, the exposed grip to the center of the racquet head was measured for every racquet tested
Tests were run for each racquet and the load vs. time continuously recorded
Data was sampled at a rate of 250Hz.
The distance from the center of the racquet to the exposed grip was measured for each racquet mounted.
The load was directly read from the grip mounted to the load cell
All rackets were strung with synthetic gut and similar tension

BALL IMPACT FORMULA

Time of Impact velocity		
t = Sqrt(2*d/g)		
d	18	in
	0.46	m
g	9.8	m/s
t	0.3	s

Velocity of impact	
1.52	meters/second
3.35	miles/hour

Mass of Tennis Ball		**Mass of Impactor**	
50	grams	1135	grams
0.11	pounds	2.5	pounds

Velocity of Tennis Ball		**Velocity of Impactor**	
80	mph	3.4	mph
35.7	meters/second	1.55	meters/second

Momentum of Tennis Ball		**Momentum of Impactor**	
Mass* velocity		**Mass* velocity**	
1.79	kg*m/s	1.75	kg*m/s