SANTA's PHYSICS:

Population of Earth will be 6,032,955,912 on Dec 25, 1999. According to the UN population clock. The percentage that is children is 31.2 % in 1998 (although that will be going down to about 20% in 2025).
That gives 1, 882, 282,245 children on the Earth. (1.88 billion)

Percentage of children that believe in Santa or Percentage of "Christian"s of population ..... the % of Santa believing households is 33.53% in 1999. So the number of children to deliver to is 631, 129, 237. (631 million)

Number of children per household is about 2.64. To calculate the number of households then, take the number of children to deliver to and divide by 2.64 to get 239, 064, 105 households (239 million)

Mass of Santa's sleigh is about 500 pounds (227 kg), the mass of Santa is about 350 pounds, including suit (159 kg), and the mass of each of 8 reindeer is about 300 lbs . The total mass of Santa, the sleigh and 8 reindeer is about 3250 pounds (1477 kg).

Dimensions of Santa's sleigh, let us assume it is about 10 m(25 feet) long, 4 meters wide, and 4 meters deep. It's volume is 160 cubic meters (2500 cubic feet), its bottom area is about 30 square meters (187 square feet), after leaving room for Santa and his controls. Area of sleigh from front would be about 16 square meters (100 square feet).

Average present mass, assuming a box of Legos, or some such, about 2 pounds or .9 kg. The dimensions of a typical boxed present might be height of .25m, width of .4m, and length of .5m (7.5 by 12 by 15 inches).

Calculating the total mass of the presents, we get 631 million times .9 kg as 574 million kilograms, or 1.262 billion pounds or 630 thousand tons.

The total mass of sleigh, Santa, reindeer, presents is 574 million kilograms.

The bottom area of each present is .4 meters width times .5 meters length, which is about .20 meters squared. If the sled has 30 square meters, then the area divided by each present area leaves room for 150 presents at the bottom. This means that the stack of presents is 631 million divided by 150 is 4.2 million presents high, which at .25 meters each, is 1,051,882 meters high, or 654 miles high!!!

That is obviously going to effect the aerodynamics of the sled, so Santa should pack the presents in a super dense black hole type holder. To pack it 2 meters tall, that is a volume of .4meters width times .5 meters length times 2 meters height or, 0.4 cubic meters (4000 cubic centimeters, or 4 Liters). The density of the present holder would have to be its mass divided by volume so 574 million kilograms divided by .4 or 574 billion grams divided by 4000 gives a density of 1.4 billion kilograms per cubic meter or 143 million grams per cubic centimeter.
Assumption: Surface Area of earth:

196,940,400 square miles (509,917,870 square kilometers).
Assuming households evenly spread, the average area between households would be the area of the Earth divided by the 239 million households to get 2.1329 square kilometers per household (.824 square miles)..... If each household was on a square, then the average distance between each would be the square root of the area, so it is 1.4605 kilometers, 1460.47 meters, or .90763 miles.

ASSUMPTIONS: The average hours of nightfall on Dec. 21, if mostly Northern Hemisphere, and accounting for children going to bed at 8, and waking at 6, is about 10 hours. But the earth rotates in 24 hours, so Santa can use the time zones to his advantage (if he travels in the right direction!!), and get a total of 34 hours of travel, which is 2040 minutes, which is 122,400 seconds.

The time Santa has to make each trip between households, assuming instantaneous dropoff, is the time divided by the houses, which is 239 million divided by 122,400 seconds, which is .0005119 seconds between each household.

Average speed between each household:(Average distance/average time) is 1460.47 meters divided by .0005119 seconds, or 2.852446 million meters per second, or 2.9 thousand kilometers per second, or 1772.8 miles per second!!

Sound travels at 334 meters per second, or .2075 miles per second, so Santa is going 8540 times faster than the speed of sound, creating a massive sonic boom. For purposes of comparison, the fastest man-made vehicle on earth, the Ulysses space probe, moves at a poky 27.4 miles per second -- a conventional reindeer can run, tops, 15 miles per hour. The speed of light is about 299 million meters per second, so Santa is going only 100 times slower than light! Escape velocity from the earth is 11000 meters per second, so Santa could easily escape Earth's velocity and go into outer space.

Santa has to stop at each house as well, so his maximum speed must be reached at the halfpoint of the trip between each house, so he goes a maximum of twice his average speed or 5.7 million meters per second. The acceleration/deacceleration for each half of the trip between each household is his change in speed (5.7 million meters) divided by his change in time (half of the .0005119 seconds), giving him an acceleration of 22.2 billion meters per second per second. Since the acceleration due to gravity is 9.8065 meters per second per second, Santa is accelerating 2.3 billion times more than gravity (2.3 billion G's)

The total force required by the reindeer to accelerate such a sled is given by Force in Newtons equals mass in Kg times Acceleration. F=mA. So the force is 12.786 quintillion Newtons, which is 2.874 quintillion pounds of force, or 1.437 quadrillion tons of force. Each reindeer pulls a simple eighth of that amount... a little more than the 300 pounds they can normally pull.

The physics quantity of work or energy in Joules is given by Force times distance, or 12.786 quintillion Newtons times 1460.47 meters W= Fd , so the work is 18.67 sextillion (18 followed by 21 zeros) Joules of energy. We can convert that to Calories of energy by dividing by 4187, so that gives 4.46 quintillion Calories. If Santa consumes a payload of 3 cookies and a glass of milk he is consuming 390 Calories per household (assuming 3 chips deluxe cookies and 2% milk), he and the reindeer (they have to eat too!!), need to consume 11.4 quadrillion snacks!!. But, Santa might use electrical fuel. To convert Joules to kilowatt hours you can divide by 3.6 million to get 5.19 quadrillion kilowatt hours. (you use about 1200 kw hrs a month).. Maybe Santa uses coal, he seems to have a supply. Each gram of coal produces 9.03 BTU's of energy. To convert Joules to BTU, you can divide by 14.29 million to get 130.65 quadrillion BTU's, or 144.69 billion kilograms of coal.

The power required by the reindeer in watts is given by the energy divided by the time, so 18.67 sextillion Joules divided by .0005119 seconds gives 36.47 septillion Watts of power. We sometimes use horsepower, so taking that number and dividing by 8, then divide by 745.7 to get a horsepower per reindeer of 6.11 sextillion horsepower (a bit more than your car).

The heat of vaporization of water, and thus most humans and reindeer, is about 2.26 million Joules per kilogram. Santa and the reindeer together have the mass of 1250 kilograms. That means only 2.825 billion Joules are needed to vaporize them. 18.67 Sextillion Joules divided by 2.825 billion will mean that Santa and the reindeer will be vaporized 6.6 billion times over.

Note, if Rudolph is added to the sled, then there is some help, but keep in mind that Santa is moving so fast that the Doppler Effect will also change the wavelength of light emitted by Rudolph's nose at the same time