R-27 Missile Family Aerodynamics

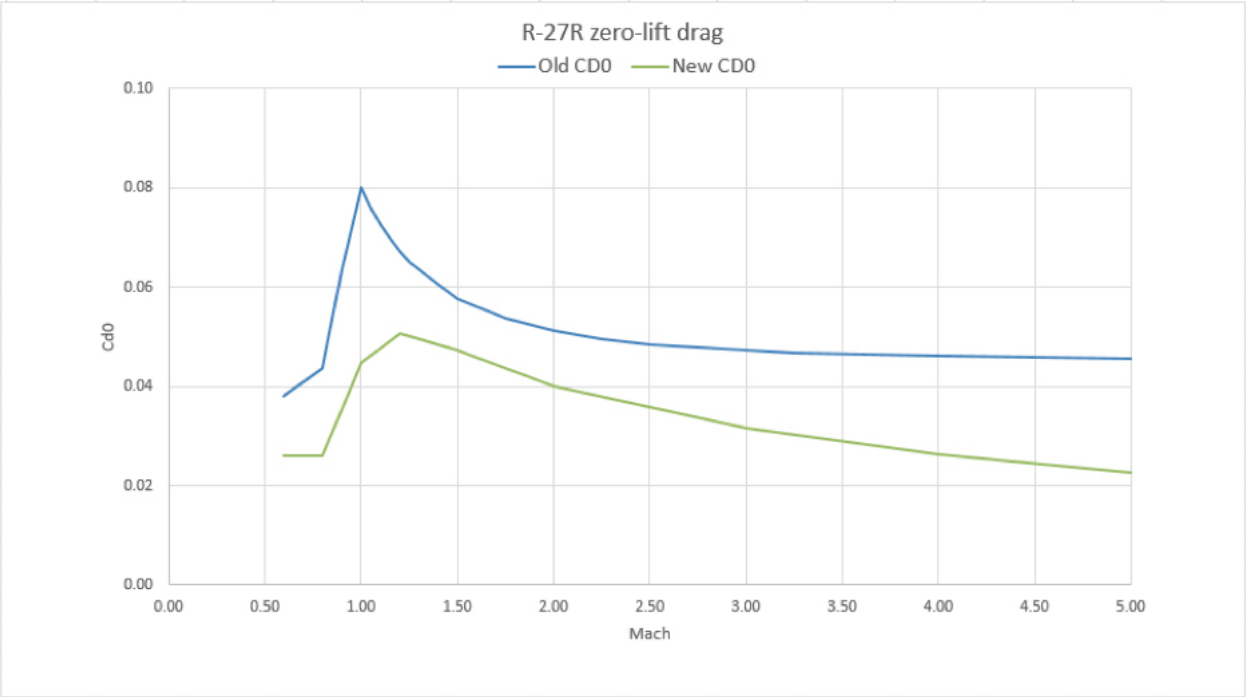
Development Report

In April, we completed a preliminary CFD study of the aerodynamics of R-27 missiles. The main goal of this study was to calculate the drag of missiles and to correct the ballistics.

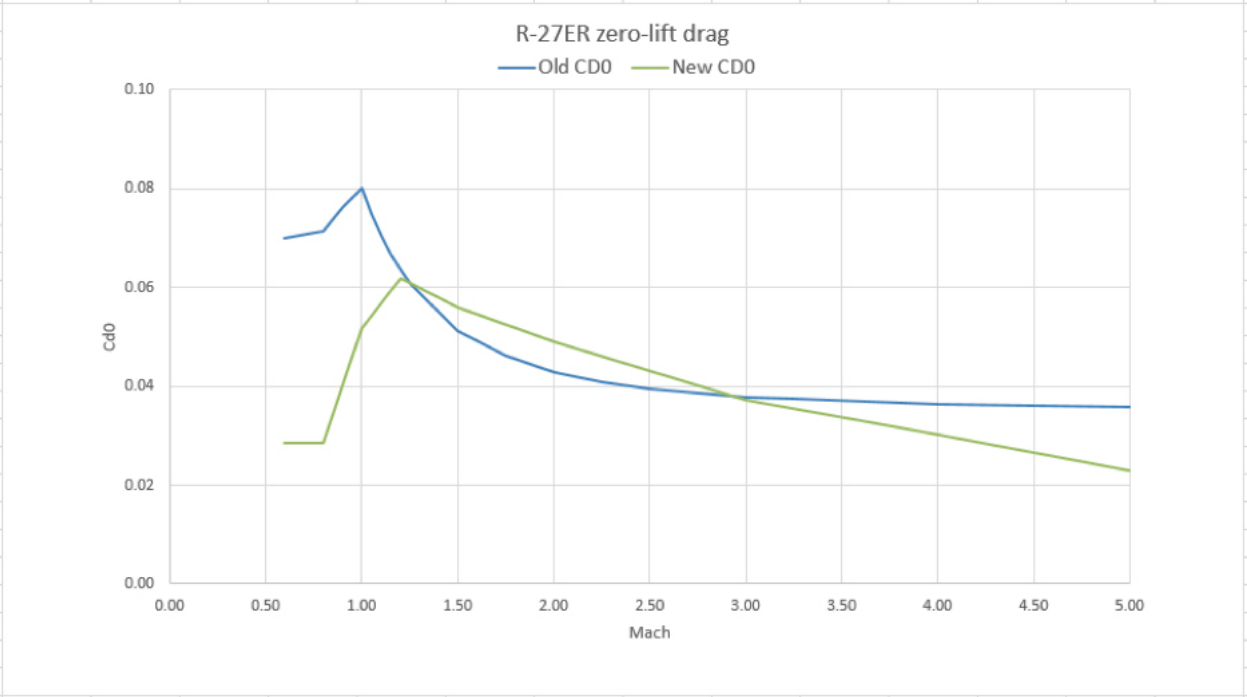
Chizh

Eagle Dynamics Team

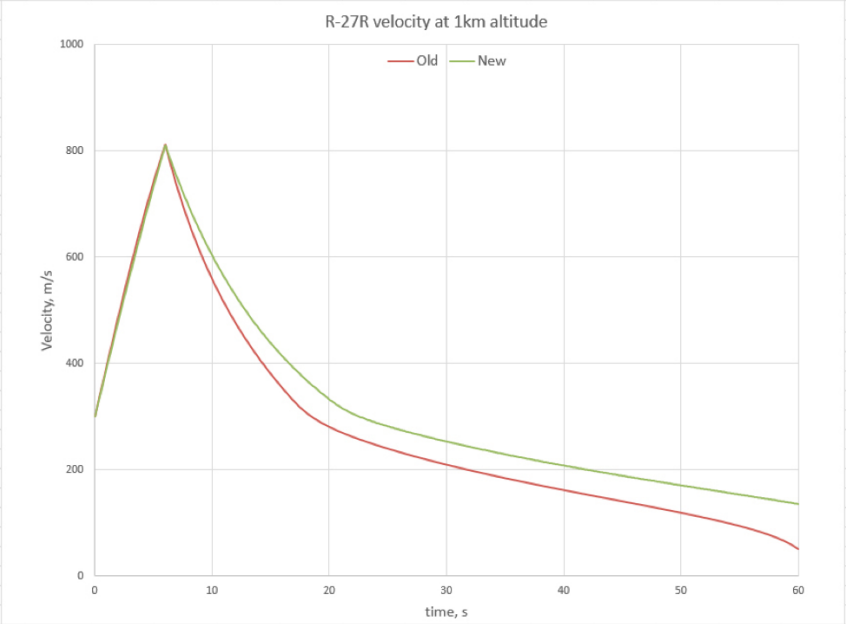
As a result of our research, the zero-lift drag coefficient was reduced for all R-27 missile types. IR missile versions have a slightly higher drag than RF ones, so we decided not make separate charts for them. Below, the comparison between the drag coefficients.

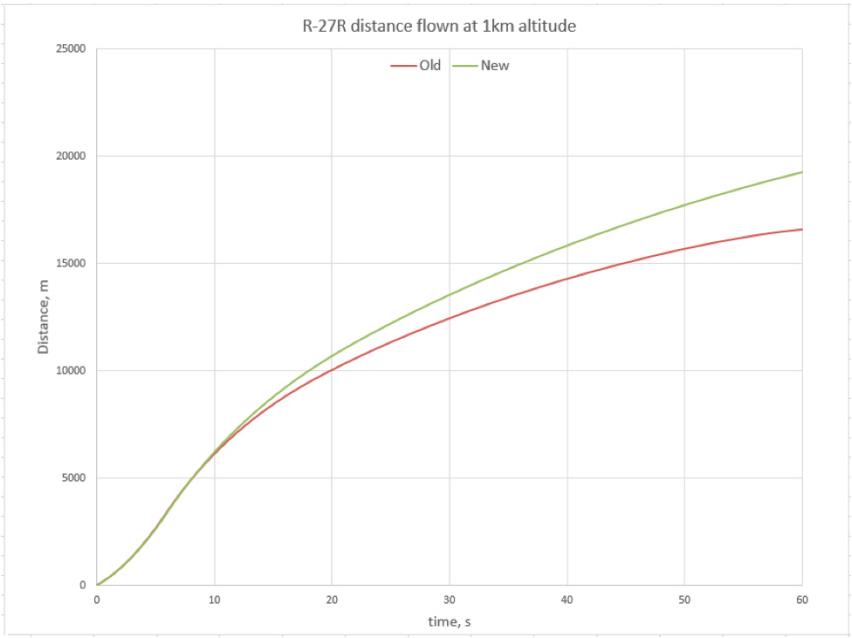


As you may see from the chart, the drag coefficient of ordinary R-27R/T missiles became lower at all Mach numbers, that gave a noticeable performance enhancement. Extended range versions of the R-27ER/ET drag were reduced in subsonic and high supersonic regions, which improves missile performance at long range and high-speed.

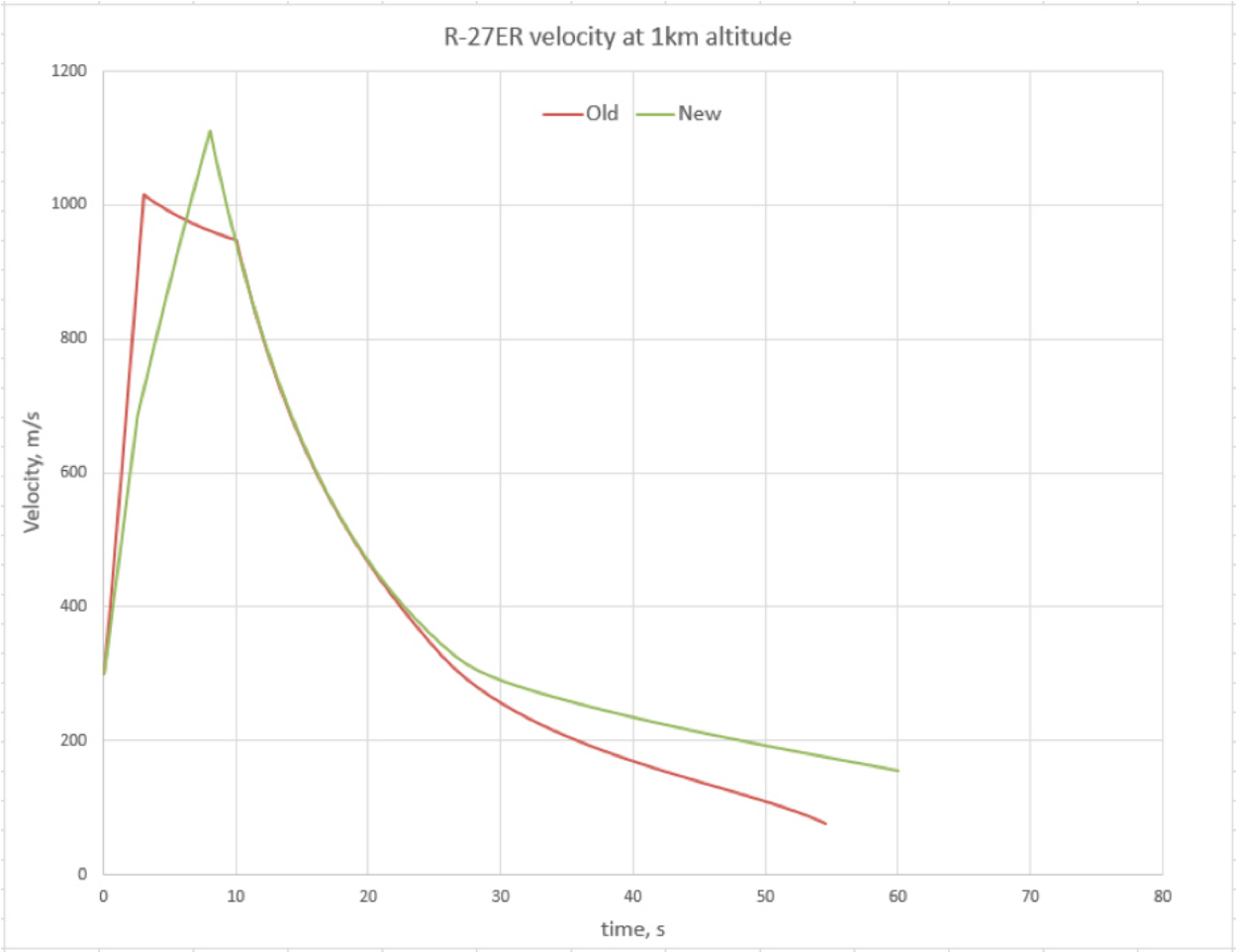


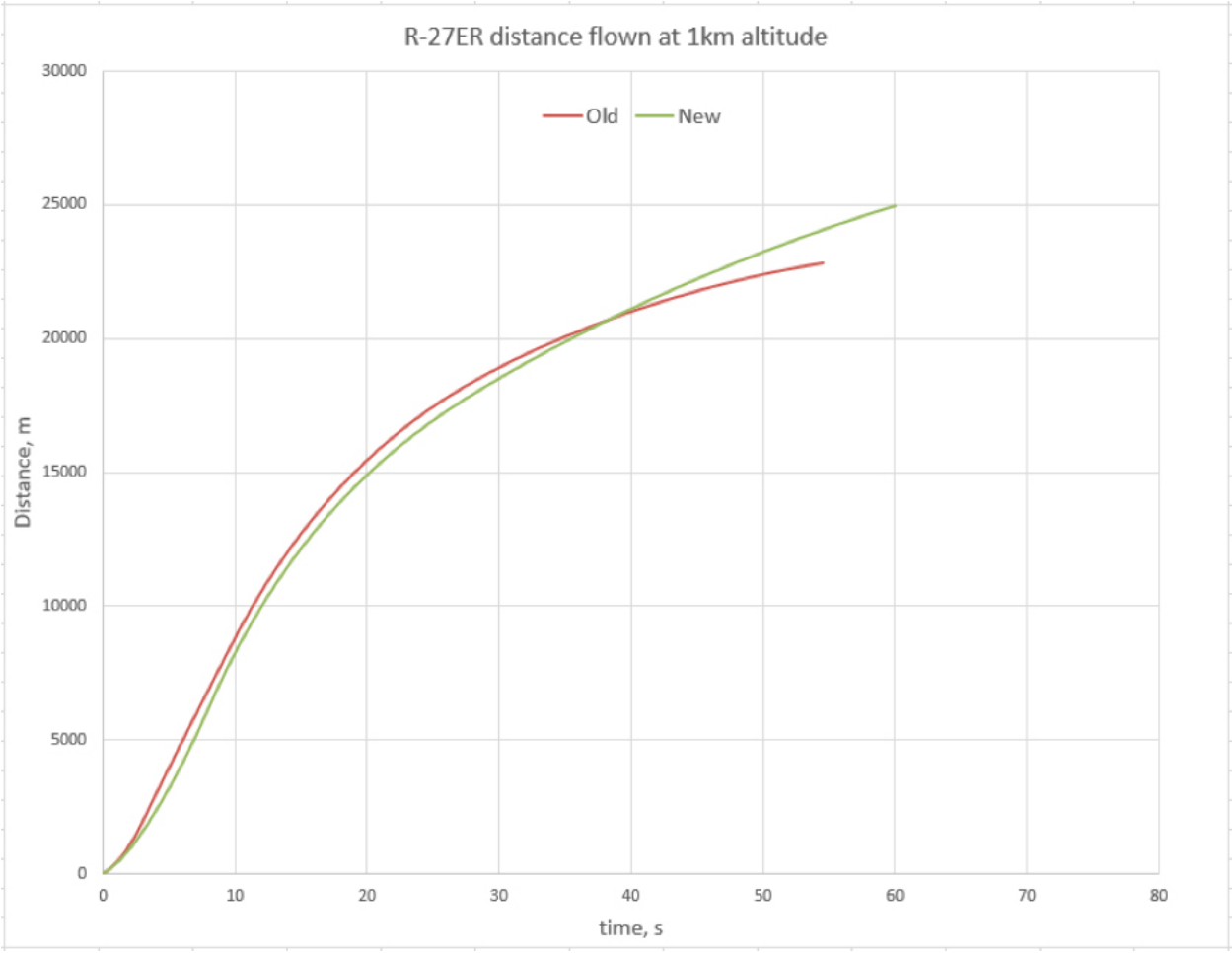
The Velocity vs. Time and Range vs. Time diagrams below show how missile performance has changed.

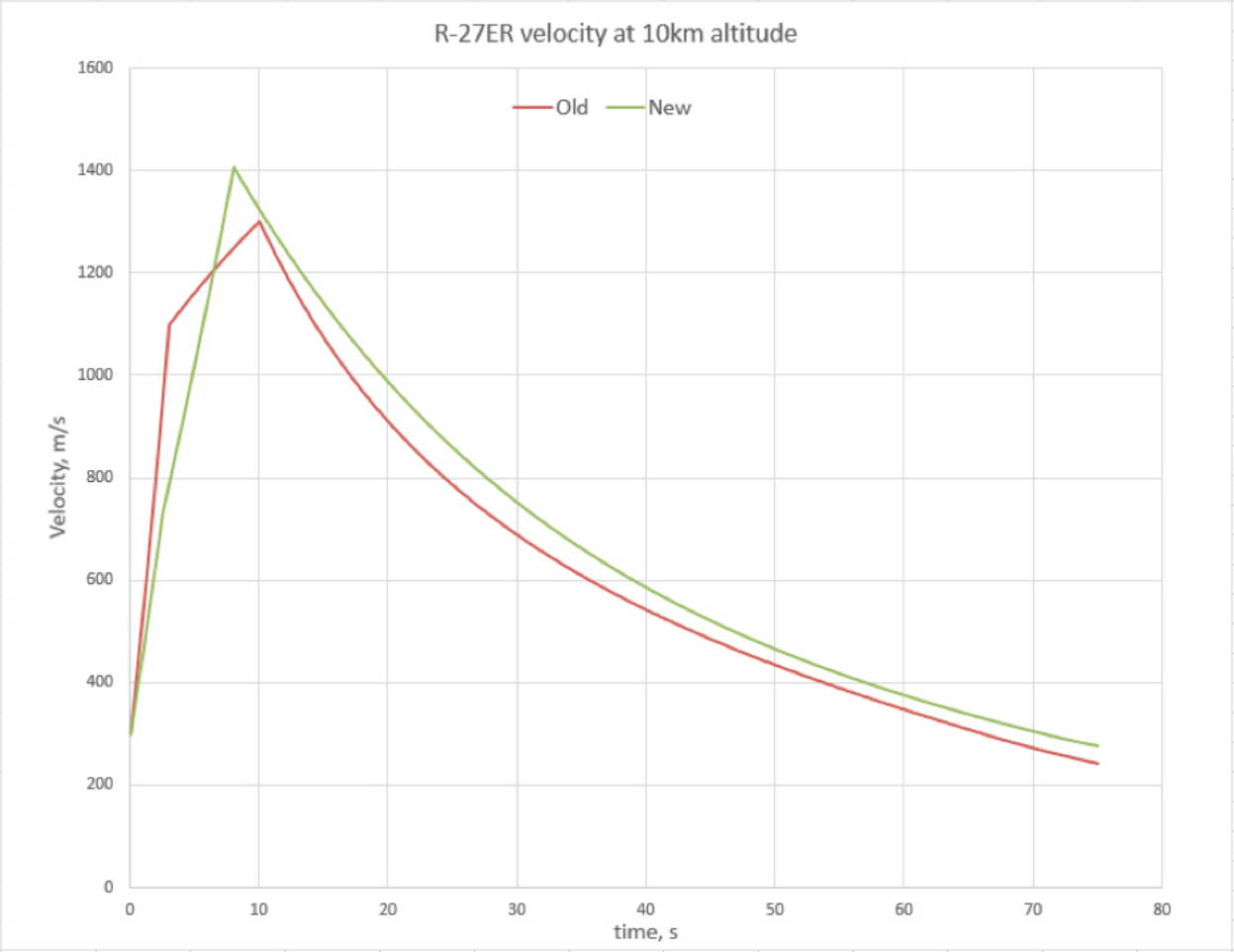


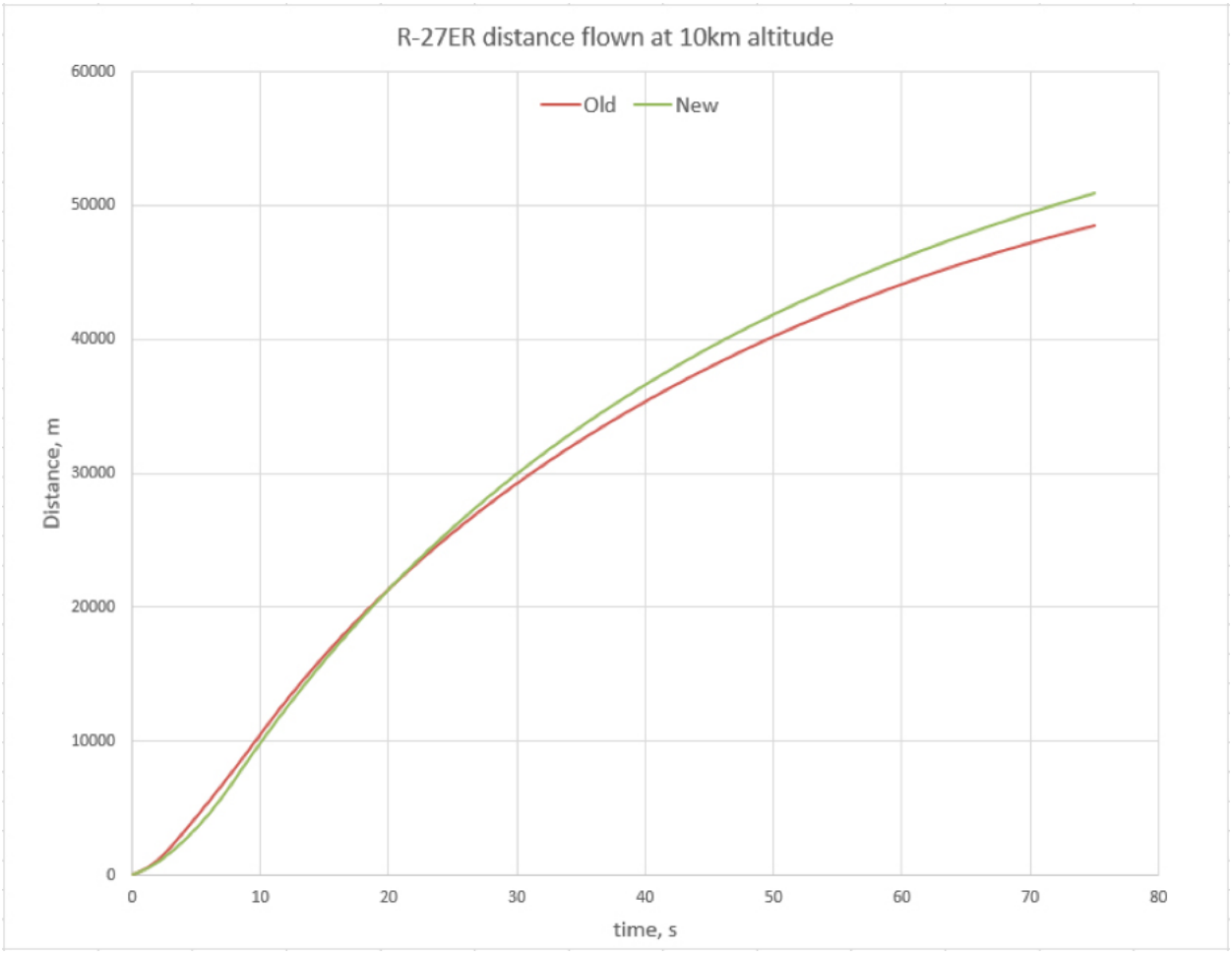


In addition to the new drag coefficients, the R-27ER/ET received an updated thrust profile. According to our research, the missile should have a boost-sustain ratio of 5/3 instead of 5/1, whilst retaining motor total impulse. Thrust dependence on altitude was also corrected for all R-27 missiles.

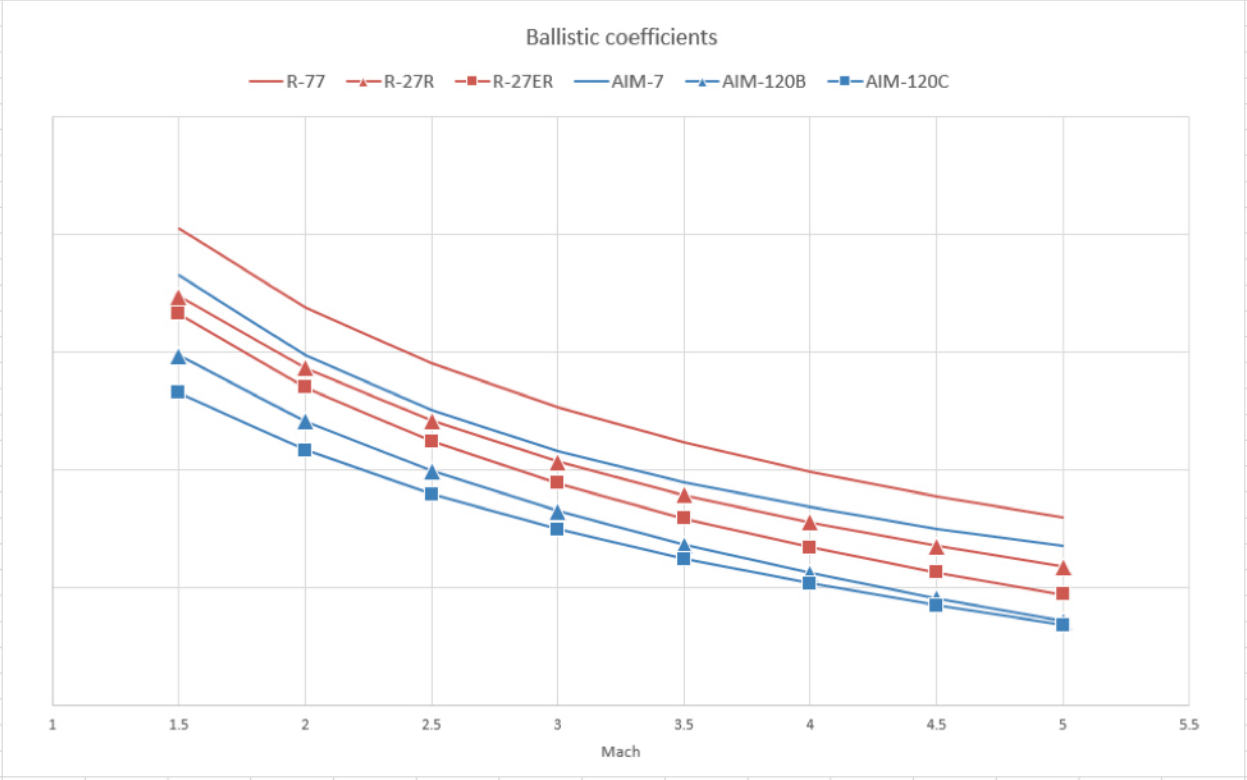




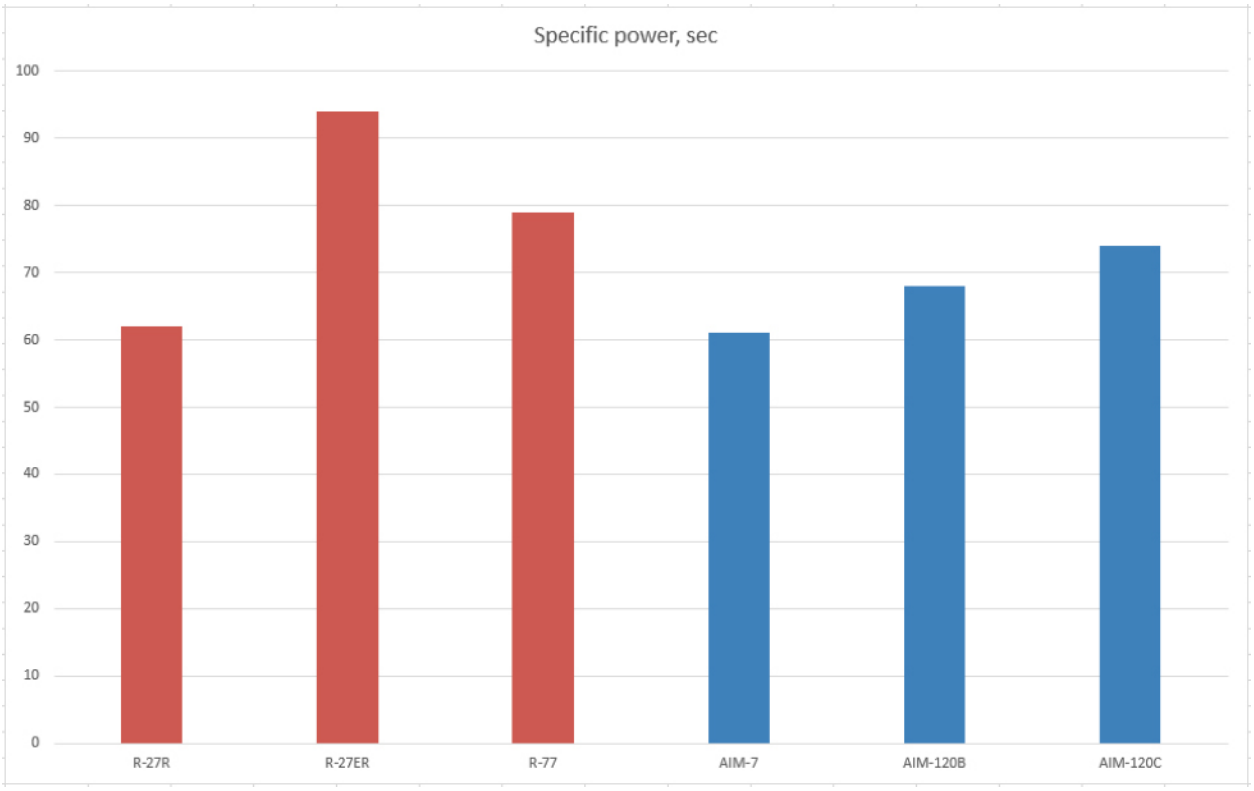




The pivot charts below provide a demonstration of performance for primary medium range missiles. The first ballistic coefficients chart shows Missiles Deceleration Rate vs. Mach number, so the lower line lies, the better. For example, AIM-120C has the best ballistic coefficient due to a small wingspan and more streamlined design, R-77 has a worst ballistic coefficient due to lattice fins with relatively high drag and almost the same burnout mass as the AIM-120C.



The chart below represents Specific Power in seconds. Specific Power is equal to the total impulse of the rocket motor and divided by the rocket mass. This value defines the missile's ability to accelerate, and thus the higher this value the better.



We hope that this small insight into the R-27 Missile Family Aerodynamics improvements will give you a better understanding of the missile's capabilities .

Yours sincerely,

Eagle Dynamics Team