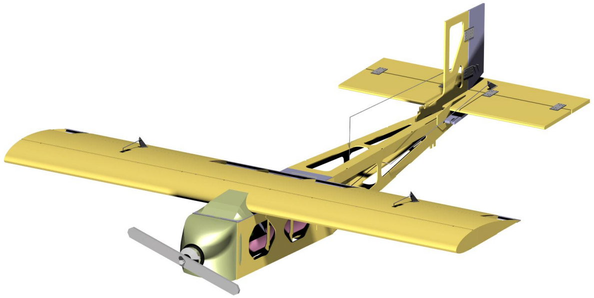
RACCET



designed by

VECTR Aerospace

Wichita State University
College of Engineering
Department of Aerospace Engineering

BOEING

Meet the Team

Ian Buhman-Wiggs

Location: Wichita, KS

- Structural Lead, Payload Design, Team Leader
- Lab Technician at NIAR Crash Dynamics Lab
- Specialization in Nastran/FEA Structural Analysis

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Danial Imran Salmaan Hussain

Location: Kuala Lumpur, MY

- Stability and Control Lead
- Former Avionics Flight Test Engineering Intern at Bombardier
- Commercial Pilot
- Specialization in Flight Simulation

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Hock Chin Low

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- Aerodynamics Lead
- Aerospace Engineering Student

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Ian McMurtry

Location: Columbia,MO

- Licensed VFR Pilot
- Aerospace Engineering Student
- Masters of Science of Aviation Finance (Starting Fall 2020)

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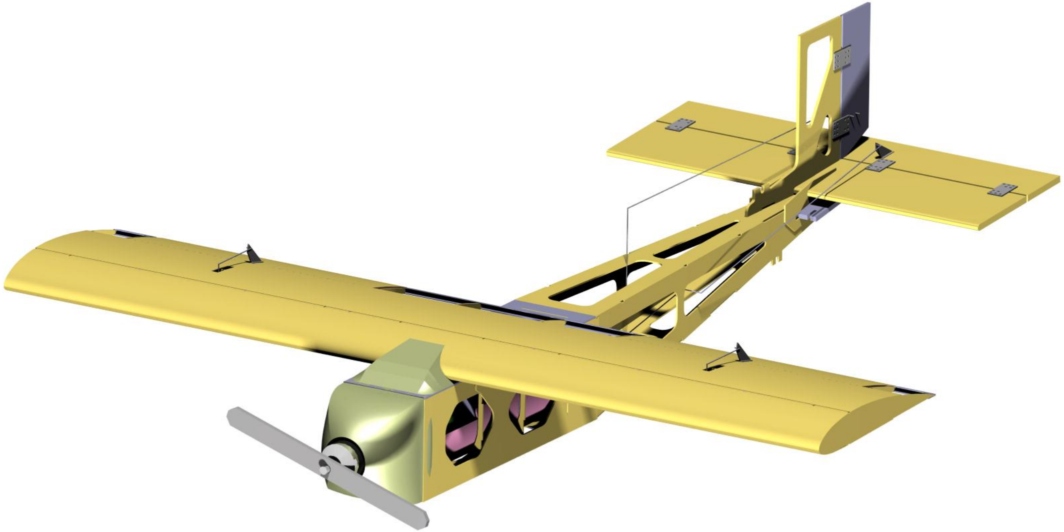
Rapid Assembly Climb Cruise Ejection Touchdown



*Exposed areas for visibility

A Storable Semi-Autonomous Emergency Supply Aircraft

from The Bronze Propeller Competition by WSU Aerospace Engineering Dept. & The Boeing Company

Mission Performance:

- Modular design that allows the entirety of the aircraft to fit in a 11x7x36 in storage box and quick assembly right out of the box
- Optimized for hand launch
- Features an autonomous payload release system
- Minimizes crash damage from hard landings and multiple flights

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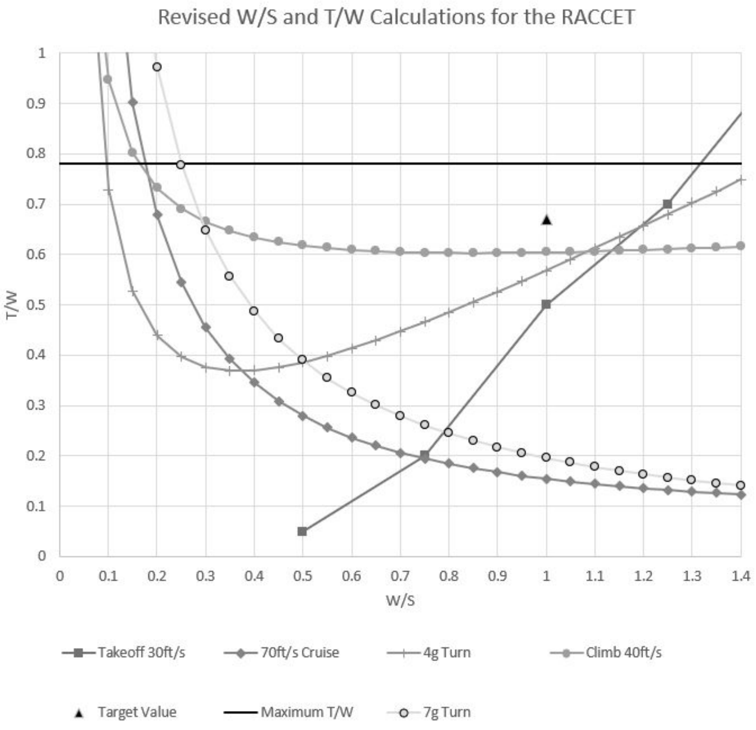
Thrust-to-Weight and Wingloading Determination

- Target values for all phases of the flight were considered

- Designed for tight turns and fast lap times



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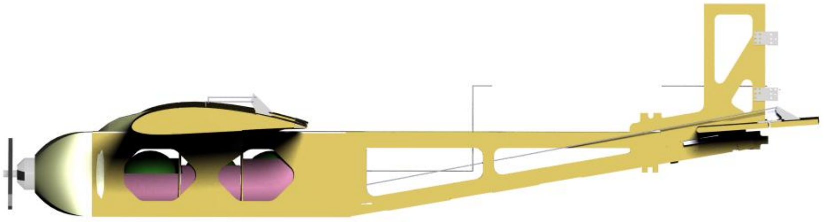
Aerodynamics



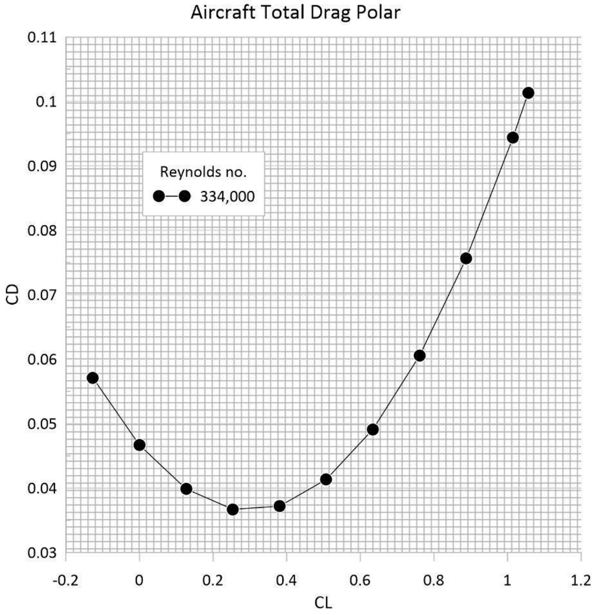
Raccet aerodynamic design has been carefully calculated to be performing well within the design point.

- The main straight wing of the aircraft features the NACA 4415 airfoil
- The horizontal and vertical tail has a flat plate design with negative incidence angle to improve in stall characteristics
- VSPAero was used to obtain an estimation of the aircraft lift curve slope and validating with Matlab's program

Aerodynamics

The streamline design minimizes the drag count produced in order for the aircraft to achieve the desired performance

- The nacelle/nose cone design helps the flow to remain attached
- Aft tail that tapers down remains at a low drag count



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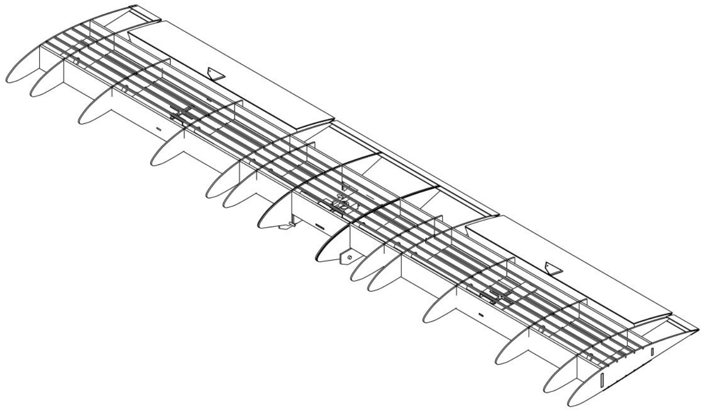
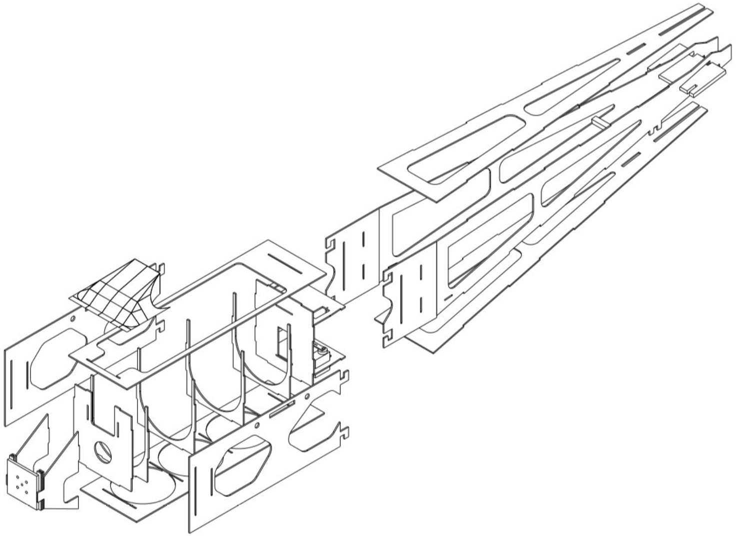
Structures

- Semi-monocoque wing is both light and stiff
- Robust fuselage can take repeated impacts
- Designed to withstand loading and fatigue





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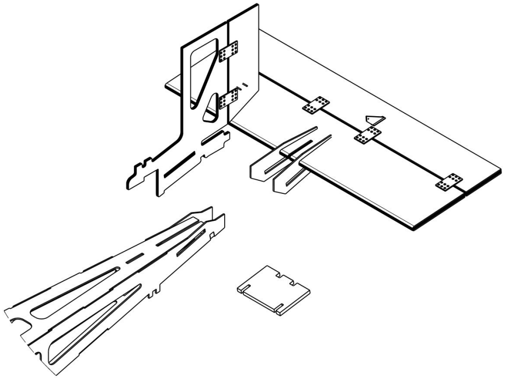
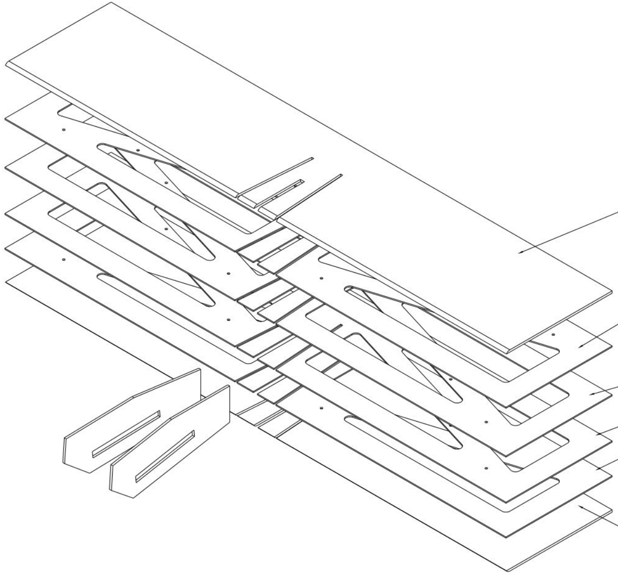
Structures

- Laminated tail for critical weight savings
- Double-interlock for secure assembly onsite





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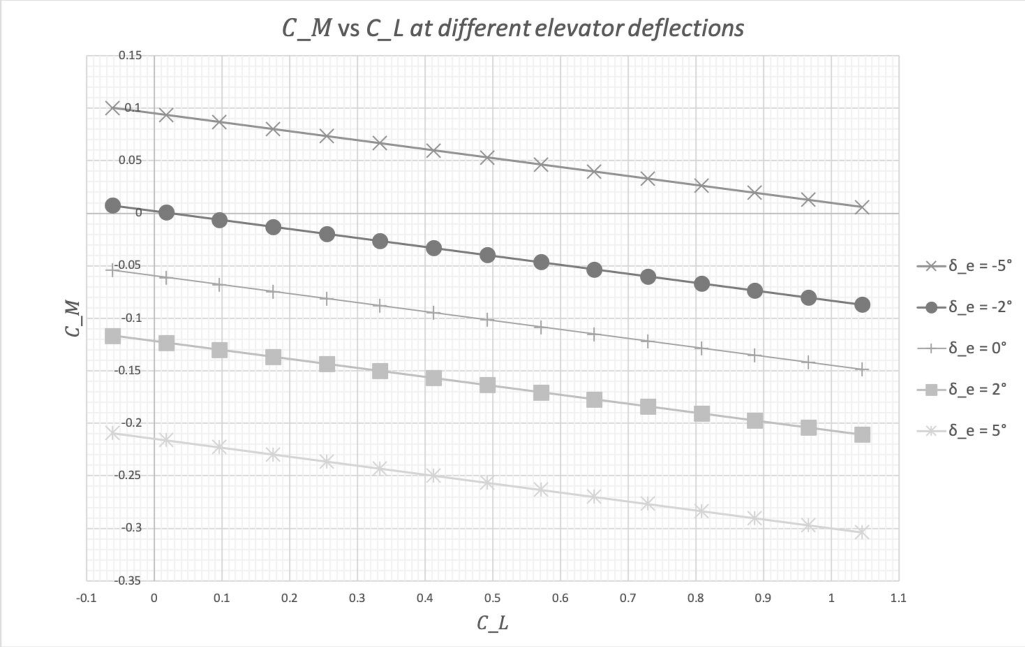
Stability and Control

- Calculations performed in MATLAB and validated using OpenVSP software
- Primary goal is to ensure RACCET is statically stable and maneuverable by the pilot.
- Secondary goal is to ensure dynamic stability.



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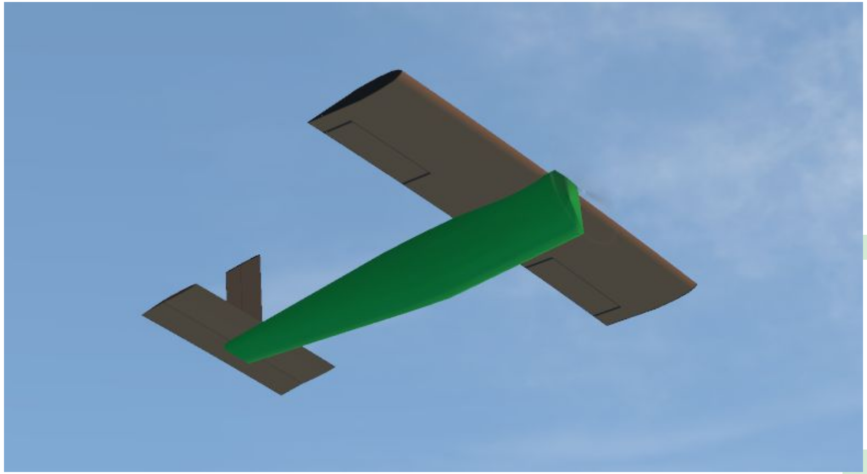
Stability and Control

- ❑ Further validation and analysis performed using X-Plane 11 software.
  - ❑ Utilizes blade element theory to model the aircraft.
  - ❑ Gives an accurate representation of the handling qualities of RACCET.



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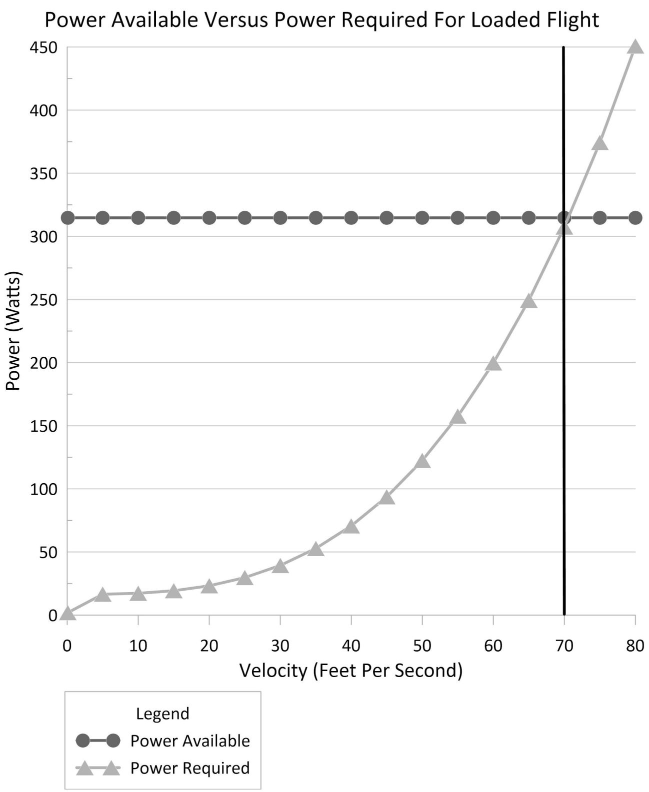
Propulsion

- Battery: Spektrum 11.1V, 30C, 2200mAh

- Motor: Rimfire 0.15 35-36-1200 Brushless

- ESC: Spektrum Avian 45 Amp Brushless Smart ESC

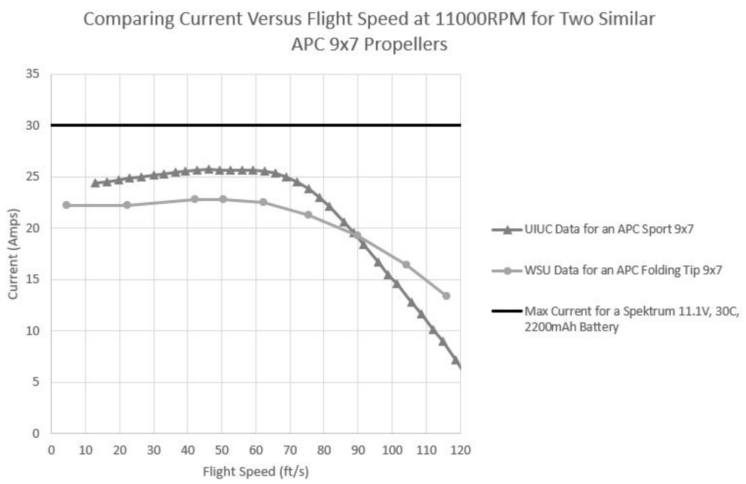
- Analysis of propulsion systems showed that the chosen battery, ESC, and motor would achieve the targeted top speed

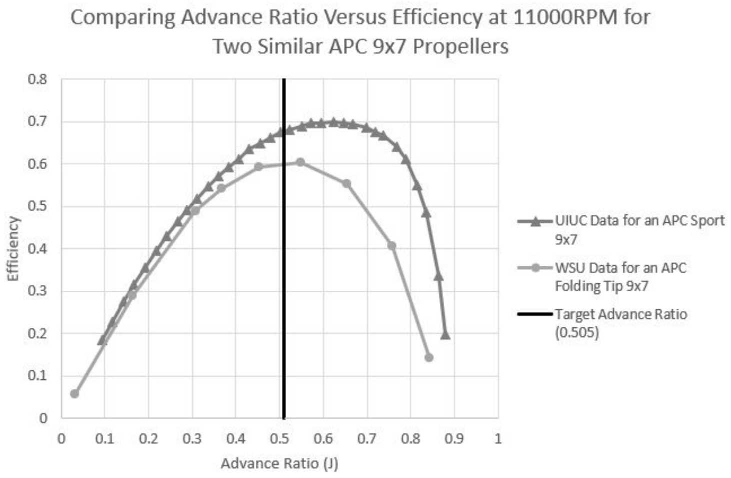


Propulsion

- Propeller Data was analyzed from both University of Illinois-Champaign/Urbana and Wichita State University databases

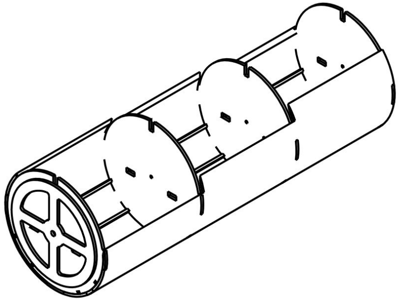
- Data was measured and plotted against expected target values and max battery performance values

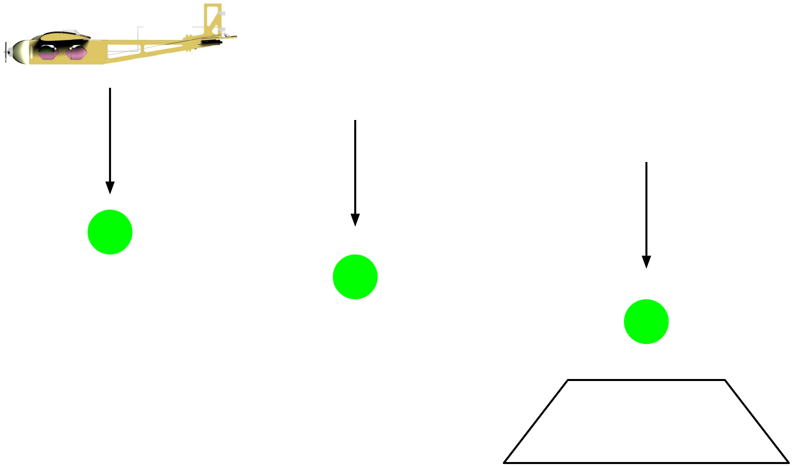




Payload Release

- Competition conditions are uncertain, so system must be error tolerant
- At least one ball must hit for run to be scored
- Twisting tube allows for staggered release pattern
- Extremely high hit probability





Design Data Table			
Wing Area	288 sq.-inches	Propeller Diameter	9.0 inches
Wing Span	35 inches	Total Propulsion System Weight (motor, battery pack, wires, connectors, fuse, prop, etc.)	1.3 lb
$C_{D,0}$	0.0366	Battery Pack (nominal volts, # of cells, & mAhr)	11.1 V, 3 cells, 2200 mAhr
$C_{L\,max}$	1.056	Endurance	270 seconds
(L/D)max	13	Stall Speed	31 ft/s
Aerodynamic Center Location	9.17 inches	Max Speed	95 ft/s
$C_{M,0}$	-0.0859	Corner Speed (V*)	90 ft/s
$C_{M\text{-}alpha}$	-0.360	Minimum Turn Radius	36 ft
Static Margin	9.90 %	Empty Weight (ready to fly, no payload)	1.49 lb
Required Elevator Deflection for Trim at V_{Cruise}	-2.05 deg	Maximum Payload	0.5 lb
Required Elevator Deflection for Trim at $1.2V_{Stall}$	-4.52 deg	CG Location	8.09 inches
Required Elevator Deflection for Trim at Maneuver Point	-11.7 deg	Wing Tip Deflection at V*	.128 inches
Max Power Available	130 W	+/- n_{max}	+19 g, -19 g