



**TECHNOLOGY FOR  
AIRCRAFT**



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## **EXECUTIVE SUMMARY**

### **TURBO WING TECHNOLOGY HAS BEEN RESEARCHED, DEVELOPED, TESTED AND REDUCED TO PRACTICE**

- Wind Tunnel and Water Tunnel Tests
- Tests and Demonstration with Flying Model Aircraft and Powered Model Watercraft
- Flight Test and Demonstrations with Full Scale Aircraft
- Sea Tests and Demonstrations with Full Scale Watercrafts
- Covered by world-wide patents

### **TURBO WING TECHNOLOGY WILL**

- Provide dramatic improvements in the performance and a 100% increase of security of the retrofitted aircraft
- Provide dramatic improvements in the performance of retrofitted watercraft
- Be the technology, that among other things permits the production of new aircraft with the capability to transport up to 3,000,000 pounds of cargo, 3,000 miles at 200 miles/h without refueling
- Be the technology, that among other things permits the production of new cargo watercrafts with the capability, at lower cost per ton-mile, to operate at higher speeds than current cargo crafts and to transport heavier payloads with extended range.

### **ECONOMIC IMPACT FOR INDUSTRY**

- Dramatic increase in the profitable production of commercial, industrial and military aircraft
- Increase usage of watercraft as commuters and ferries along coastal waters
- Low cost retrofit for improved performance of crafts already paid for and in operation
- Dramatic increase in airport safety and capacity

## **ECONOMIC IMPACT FOR GOVERNMENTS:**

- Provide a new major industry
- Rapid and low cost upgrading of civil and military systems
- Utilize labor force in distressed areas
- Maintain and increase lead in worldwide maritime operations
- Effective patrol and combat of search and rescue operations

## **ENVIRONMENTAL IMPACT:**

- By retrofitting the aircraft we will reduce overall fuel consumption, exhaust, and noise pollution.

## **TURBO WING TECHNOLOGY DRAMATICALLY IMPROVES AIRCRAFT PERFORMANCE AND SAFETY**

The adaptation of Turbo Wings to existing aircraft is accomplished by the addition of new Turbo Wings to the aircraft or by a simple, low cost modification to the existing wings so as to conform to a Turbo Wing.

## **PERFORMANCE IMPROVEMENTS:**

- Drastic reduction of minimum flight speed
- Considerably increase take-off and landing lift capability . The Coefficients are between 5 and 8, depending on the wing/rotor configuration
- Level flight on rotors along
- Rate of climb at least doubled
- Take-off and landing distance 1/3 or less than those distances for comparable aircraft with conventional flapped wings
- For the same Take-off speed, take of gross weight 2 to 3 times that of conventional aircraft
- Operating range 50% to 100% increased
- Considerably less sensitivity to air turbulences

## **OPERATIONS AND SUB-SYSTEMS:**

- Considerable increase in operational safety because of low minimum flight speed, low speed/short distance Take-off and landing, high climbing rate and ability to fly on rotors alone.
- System components readily available in aircraft inventory
- Operational and maintenance skill levels identical to those levels on conventional aircraft

## **A RELUCTANCE TO STALL:**

In addition to improved performance capabilities of aircraft equipped with Turbo Wings, it is of extreme importance to point out that Turbo Wing has a reluctance to stall. This practical, essentially non-stalling capability of the Turbo Wing in itself provides an important factor of safety in flight not available in currently operating aircraft

## **RETROFITTING IMPROVES WATERCRAFT PERFORMANCE**

Any marine craft, including hydrofoils, surface effect ships and SWATH crafts can be retrofitted with Turbo Wings by attaching the wing system to the crafts above the waterline.

The total lift of the wing plus rotor reduces the weight of the craft on the water and therefore reduces the drag on the hull. The forward thrust of the wing partially overcomes the remaining drag of the hull. The power required therefore to move the craft forward is considerably reduced.

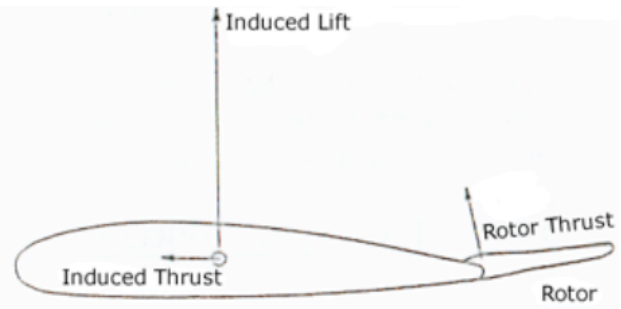
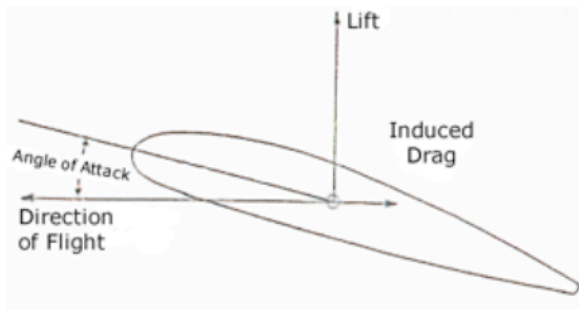
## **PERFORMANCE IMPROVEMENTS:**

- Increased high speed capability, especially for search and rescue
- Improved craft stability and control at all speeds
- Reduced pounding, reduced vertical „G-Loads“
- Improved riding comfort
- Reduced power and fuel requirements
- Increased range per pound of fuel
- Reduced speed loss in high seas
- Increased acceleration from "in the hole planing"
- No increase in maintenance requirements
- System components readily available in marine inventories

## **OBJECTIVE:**

To bring products and engineering innovations to a safer and more cost effective transportation environment for the world's public, commercial, military and search & rescue transportation.

# HERE'S HOW THE TURBO WING WORKS



## CONVENTIONAL WING

The conventional wing of an aircraft generates the lift required to support in flight weight of a moving aircraft by virtue of the wing moving forward at some speed and at the same time inclined at some angle (angle of attack) to the direction of motion of the wing. That is, the wing is not sliding through the air but pushing down on the incoming air as it moves forward.

The reaction of the air to the “pushing” action of the moving wing is such that it generates on the wing a “reaction” resultant force that can be resolved into a **lift force** and a **drag force** “due to lift” commonly called “**induced drag**”. Other drag forces acting on the wing are the so-called zero lift drag forces also referred to as parasite drag.

The lift force acting on the wing essentially supports the weight of the aircraft. The drag forces acting on the wing, plus the drag forces acting on other components of the aircraft, dictate the power requirements to propel the aircraft forward at some specific speed.

The drag “due to lift” force that is **the induced drag is a large contributor to the magnitude of the required power**. This is particularly true for heavy aircraft, which operate at moderate to high angles of attack.

## TURBO WING

The unique wing/rotor combination defined herein as the “**Turbo Wing**” as it moves forward, generates on the wing “**not only a lift-force, but also a thrust force that assists in propelling the aircraft forward!**”

These forces are induced on the wing by virtue of an aerodynamic induction process that occurs when the flow fields of the wing and the rotor components of the Turbo Wing interact with each other. “**The Turbo Wing does not need to be at an angle of attack for this induction process to occur!**”

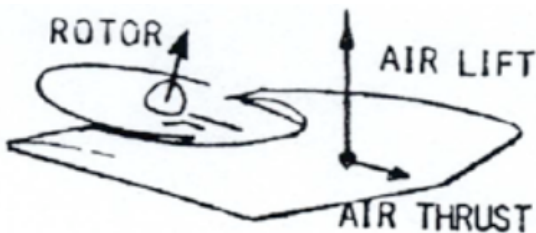
The magnitude of the total lift, that is the induced lift plus rotor lift at low to moderate speeds is a minimum of 2 > 3 times the lift due to angle of attack (reaction lift) of a comparable conventional wing, operating at the same speeds. The magnitude of the induced thrust force for the Turbo Wing is between 7 and 15% of the magnitude of the induced lift force. The magnitude of the total thrust force, that is the induced wing thrust plus the component of rotor thrust in the direction of flight, is between 10 and 20% of the magnitude of the total lift of the wing.

The power required by the rotor to generate this total forward thrust is considerably less than the power required by a propulsive device, such as a propeller, to generate forward thrust of the same magnitude.

# TURBO WING

## THE ESSENCE

The Turbo Wing Technology is generically a powered lift system. Physically, is a unique combination of a wing and a rotor as illustrated below. Please note that the rotor is located in a semi-circular cutout of the aft portion of the wing with a part of the rotor unit extending behind the cutout and therefore the trailing edge of the wing. The power source for the rotor operation is the main propulsion system of the aircraft, or an auxiliary power unit. At forward speeds above 30 mph, a Turbo Wing, depending on speed and wing/rotor configuration, will yield 60 to 200 pounds of aerodynamic lift and 6 to 20 pounds of forward aerodynamic thrust per shaft horsepower applied to the rotor. Wing lift to drag ratios are extremely high.



## TURBO WING BENEFITS

**More Lift!**

**More Thrust!**

**Less Cost!**

Extremely Low Minimum Flight Speeds, carrying Heavier Payloads, Lower Fuel Consumption, Traveling Farther, Lower Capital and Operating Costs!

## WIND TUNNEL TESTS

Turbo Wing Technology was first wind tunnel tested at the LTV facility in Texas and at the "David Taylor Wind Tunnel Facility" of the U.S.-Navy. These wind tunnel tests demonstrated that the Turbo Wing produced **lift** and **lift to drag ratios** considerably higher than for comparable aircraft with conventional wings.



## MODEL TESTS

From free flight tests of models with Turbo Wings, it was demonstrated that the **Aerodynamic Forward Thrust** is of sufficient magnitude to sustain level flight on **Rotors Alone**. This was later validated in flights of a Turbo Wing equipped Cessna 207!



## **SUBSTANTIATION OF SYSTEM TECHNOLOGY**

### **Flight Test**

The realistic basis for estimating the lift and thrust forces and other performance quantities for a Turbo Wing System is principally the gross test data from 100-plus flights of a Turbo Wing retrofit to a full-scale Cessna 207 Skywagon.

Flight tests of the Turbo Wing 207 consistently reveal the following flight characteristics for this craft.

- Wing lift per shaft horsepower (**SHP**) of the rotor between 60 to 65 pounds at craft speeds between 35mph and 35 mph.
- Excellent stability and control at all speeds

### **Wind Tunnel Tests**

Results of wind tunnel tests of a number of model turbo wing reveal that:

- For a specified amount of wing lift that is required to support the weight of an aircraft at some speed, the total aerodynamic drag of the Turbo Wing is a very small fraction of a total lift of the wing. Aerodynamically this means, that the Lift to-Drag ratio of a Turbo Wing is consistently higher than the value of this ratio for an aircraft with conventional wings.



# *TURBO WING*

## TURBO WING DEMONSTRATION AIRCRAFT

Turbo Wing designed and built experimental “Three Passenger Airplane“ to demonstrate the high lift capability of an aircraft equipped with “Turbo Wing Technology“

### VIEW OF WING/ROTOR CONFIGURATIONS



# *TURBO* *WING*

## DEMONSTRATED IN A CESSNA 207

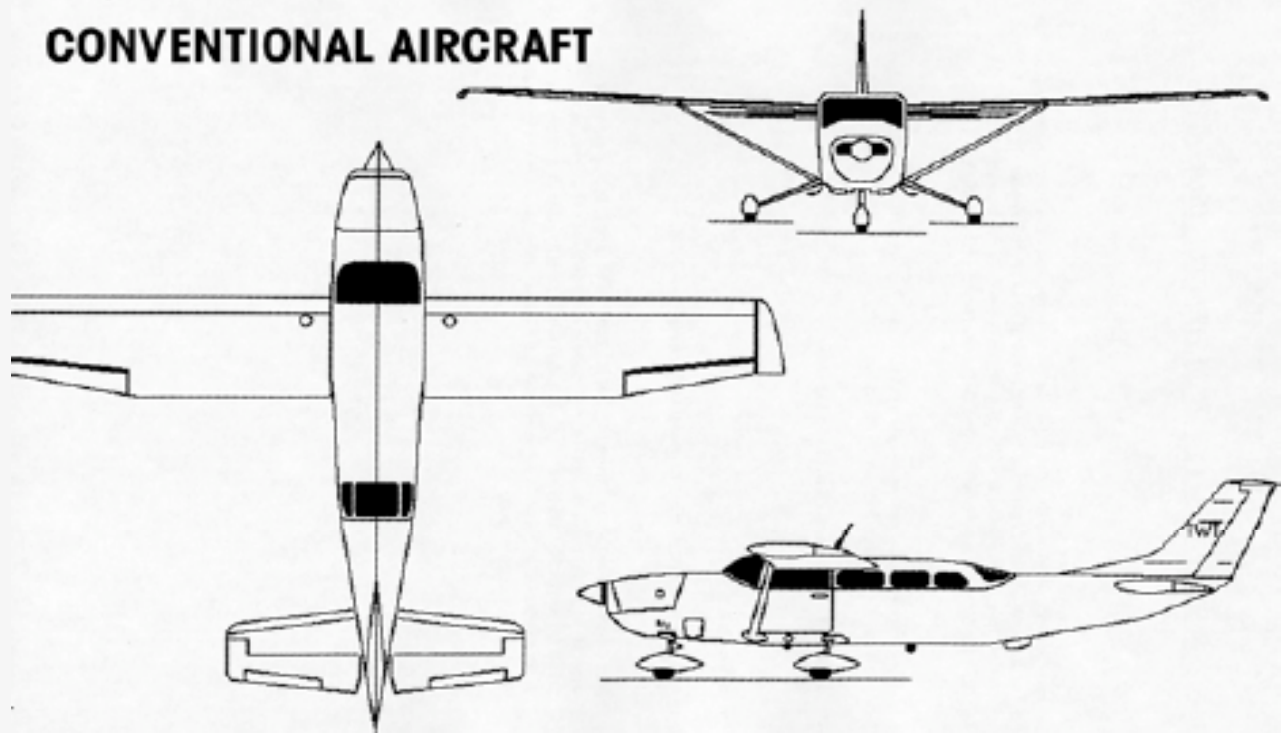
### FLIGHT TESTED

A Cessna 207 aircraft was modified by providing a semicircular cutout on the aft edge of each wing panel. In each of these areas a Rotorsystem was installed. This Cessna was flight tested over 100 times with the following results:

- The Wing and Rotor lift per shaft horsepower (**SHP**) applied to the rotor was between 60 and 65 pounds at craft speeds as low as 30 to 35 mph. Total lift per **SHP** was higher at higher speeds
- Considerably lower minimum flight speeds than conventionally winged aircraft. Wing stalling was almost non-existent
- Level flight capability on rotors alone. The aerodynamic forward thrust of the wing plus the component of rotor thrust in direction of flight velocity was greater than the aerodynamic drag of the aircraft
- The rate of climb has been doubled while the net drag of the aircraft was considerably reduced.
- Excellent stability and control at all speeds including high angle of attack flight
- Reduced response to cross winds, gusts and turbulence

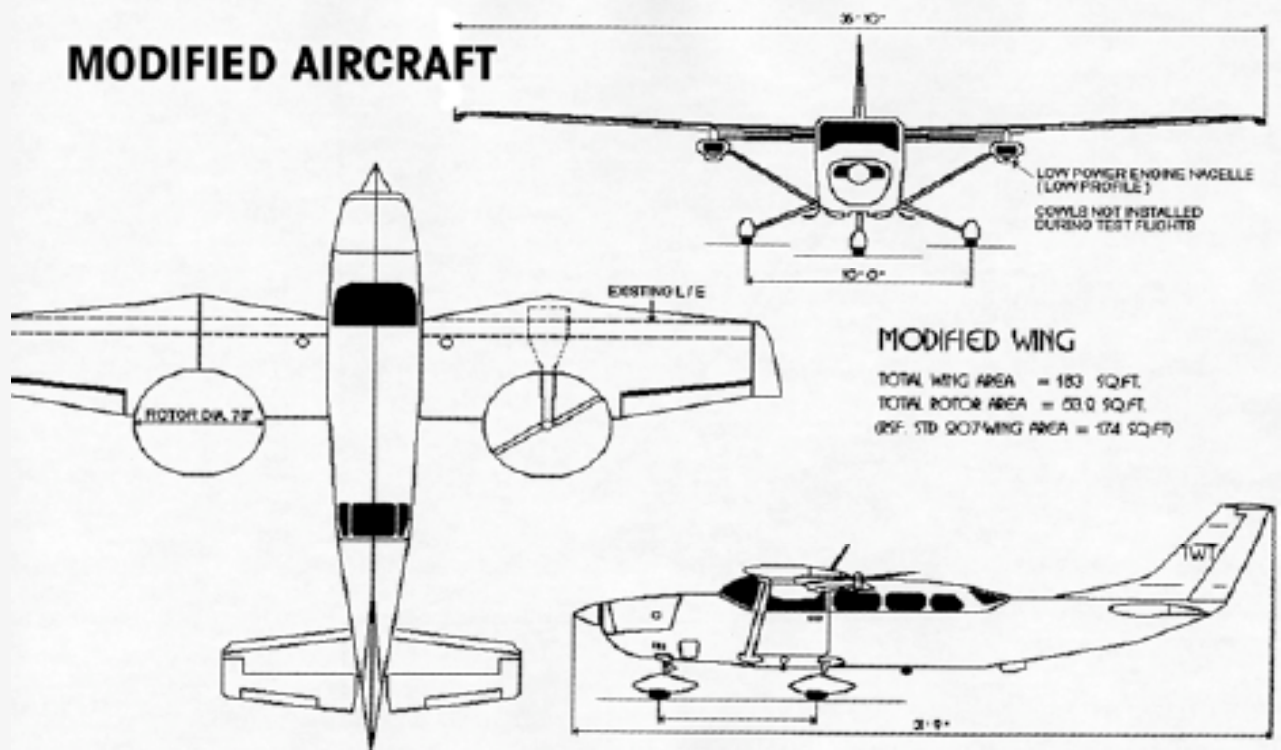


## CONVENTIONAL AIRCRAFT



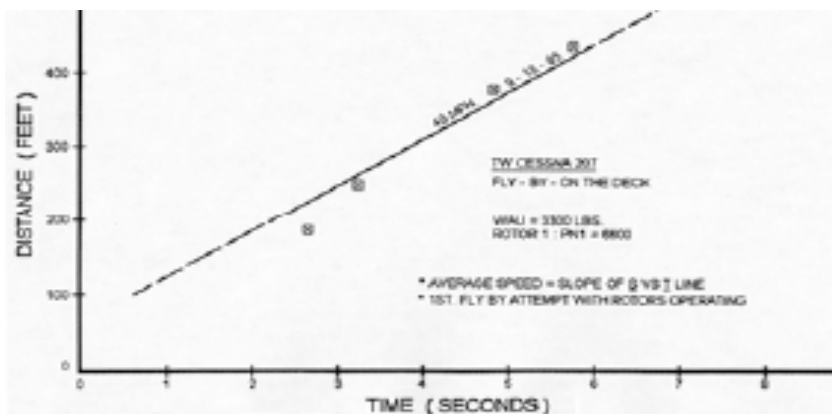
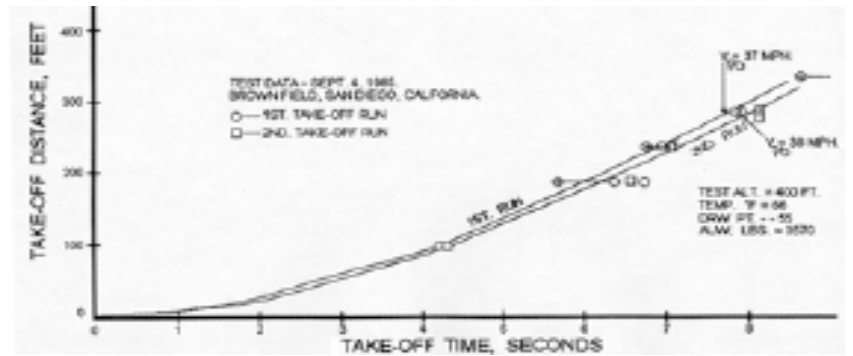
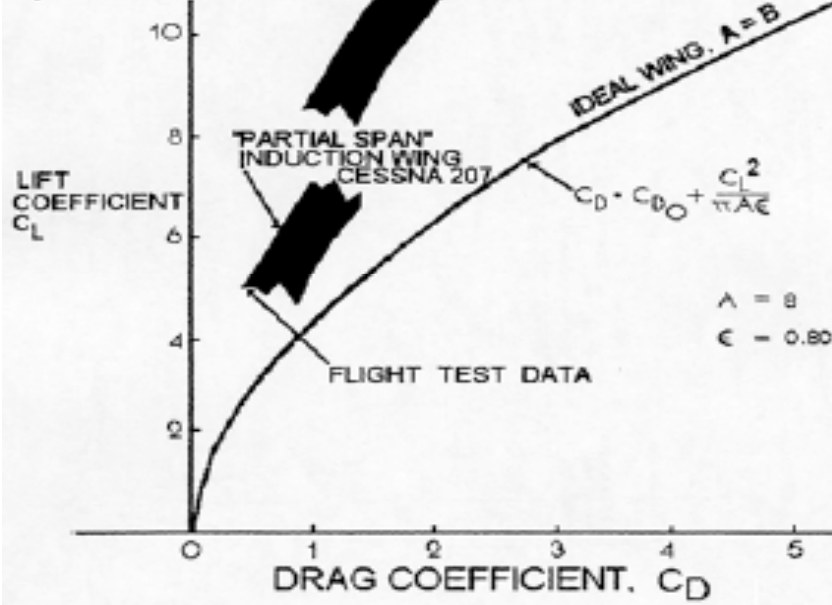
GENERAL ARRANGEMENT DRAWING OF THE CESSNA SKYWAGON 207

## MODIFIED AIRCRAFT

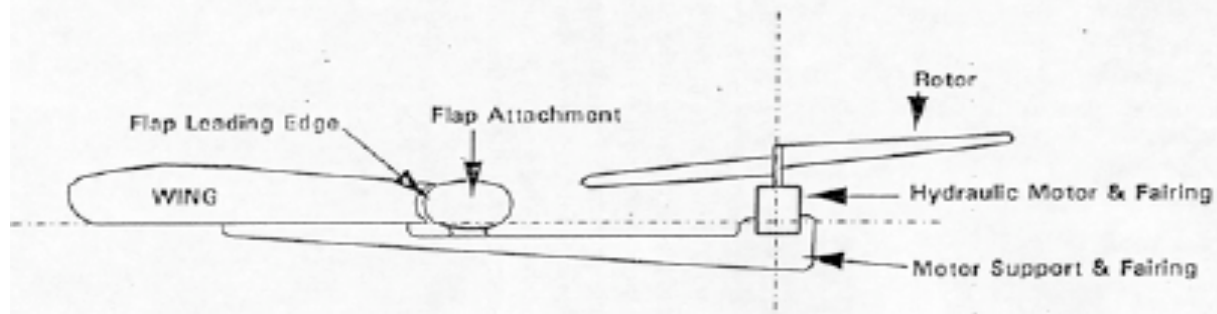
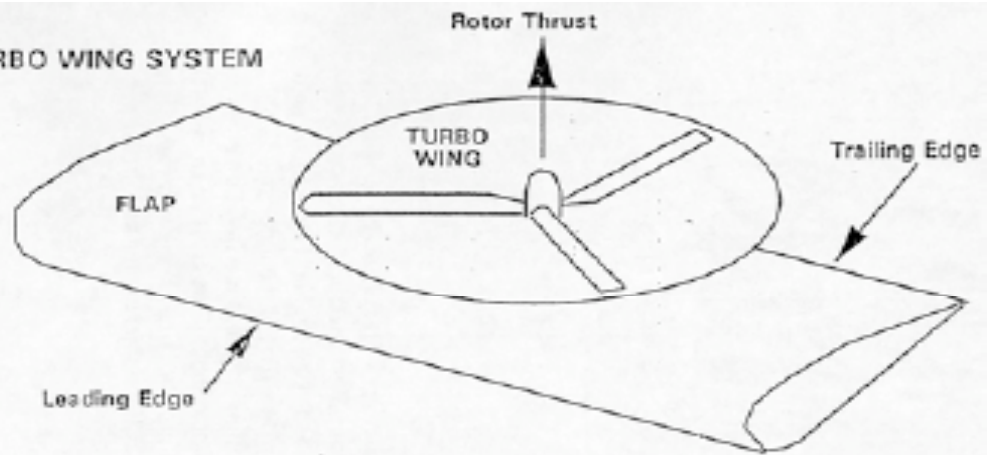


GENERAL ARRANGEMENT OF MODIFIED CESSNA SKYWAGON 207

**"FULL SPAN" INDUCTION WING AIRCRAFT ( see Figure 14 )**

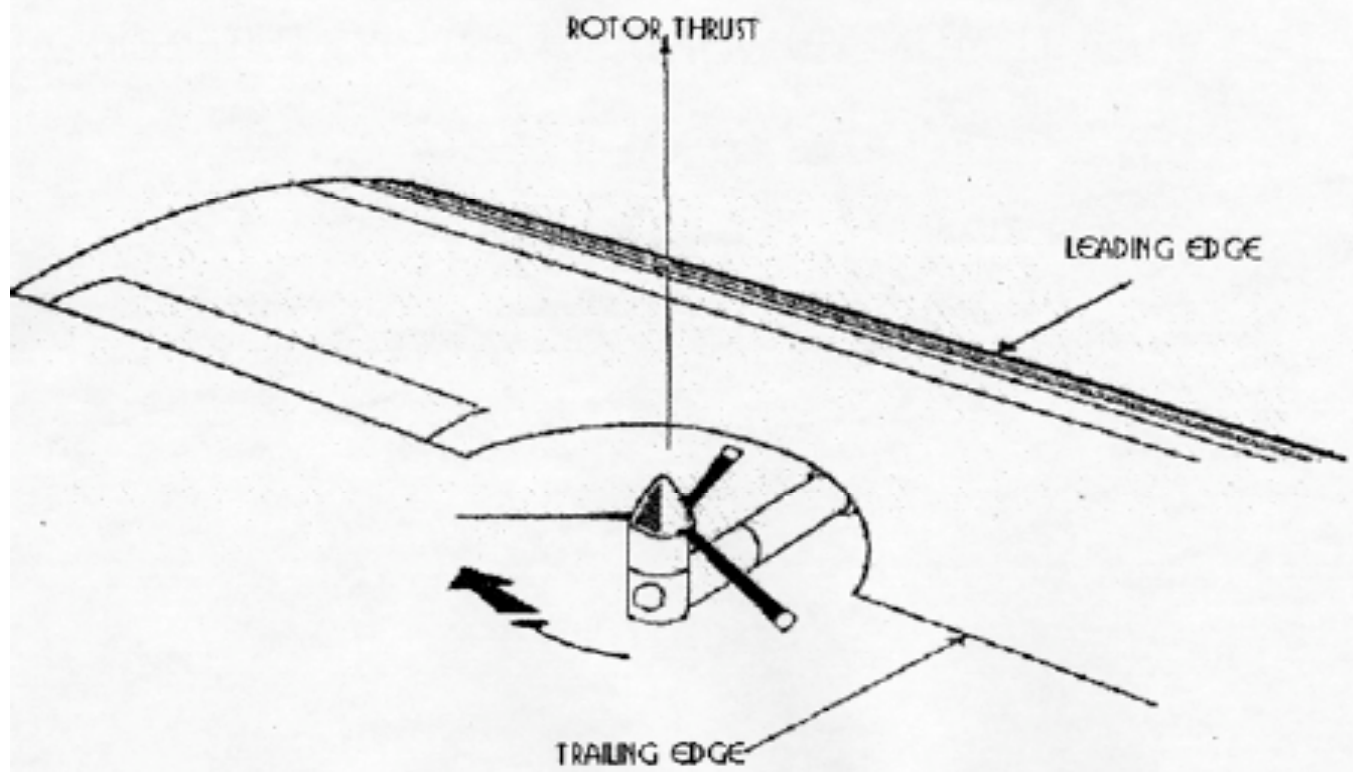


SKETCH 4-A : BASIC TURBO WING SYSTEM



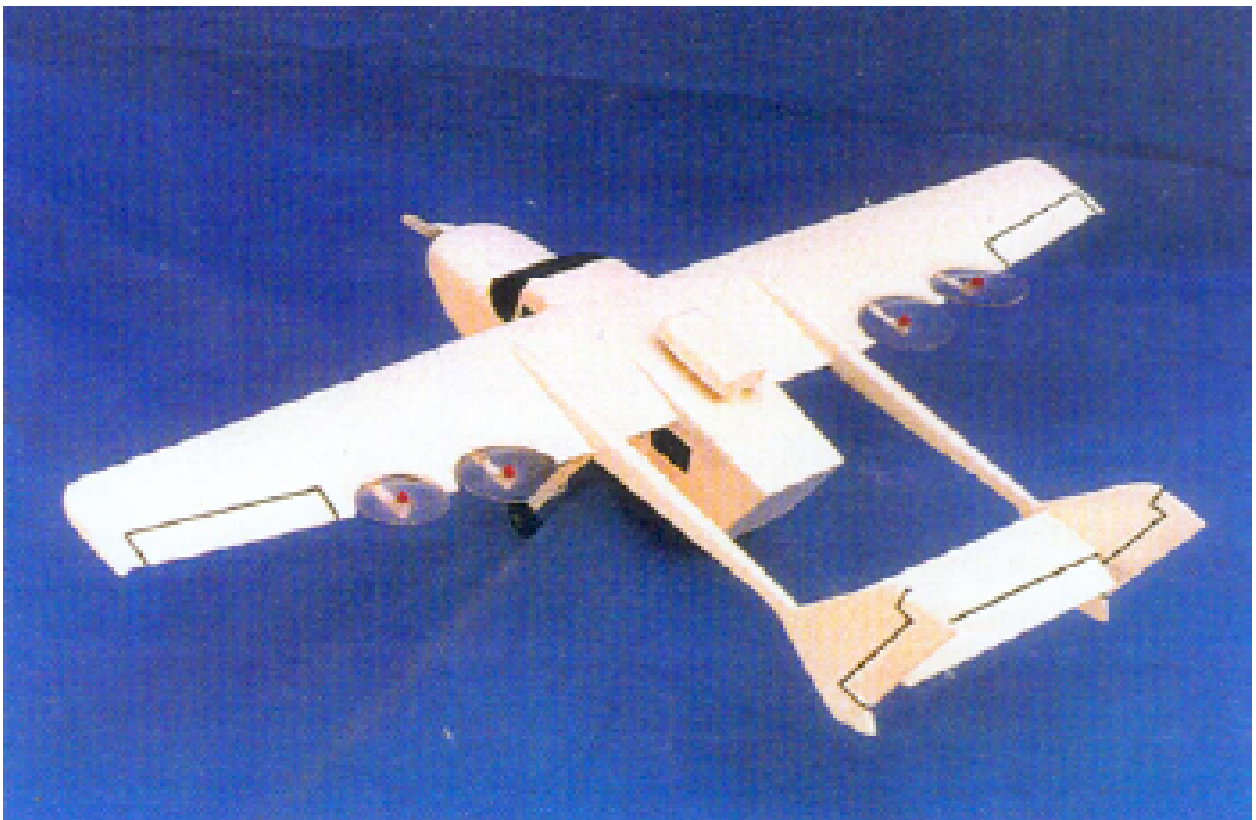
SKETCH 4-B : SCHEMATIC TURBO-WING ROTOR & FLAP INSTALLATION

## ILLUSTRATION OF WING AND ROTOR





**Model of a Cessna 337 equipped with Turbo Wings  
Showing the flaps removed and rotors installed**





## **PROPOSED AIRCRAFT CONVERSIONS**

### **CESSNA SKYMASTER 337 PASSENGER AIRCRAFT**

The Cessna 337 continues to be a reliable and efficient aircraft used by governments and private enterprises world wide. Retrofitting them with Turbo Wing Technology, as shown in the illustrations on the previous pages, will dramatically improve their utility and economy, as indicated in the table below.

Reducing the take off run from 1,000 feet to 150 feet will permit Cessna 337's, worldwide, to service remote areas with short landing strips.

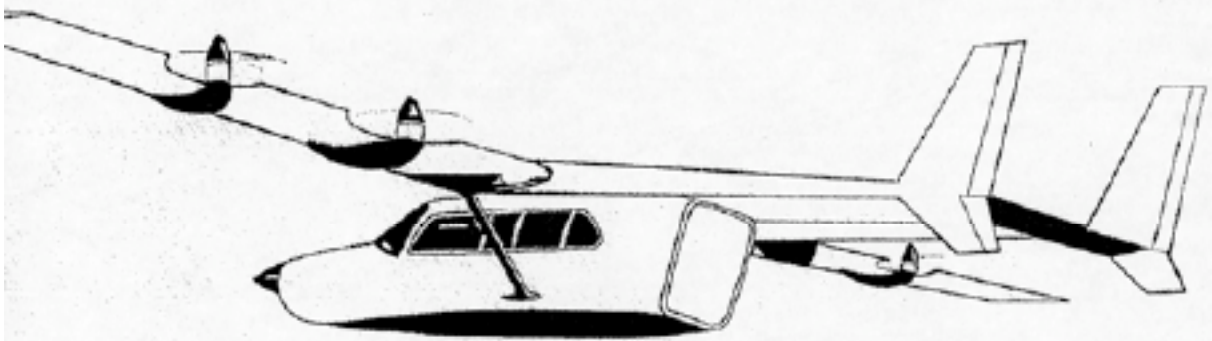
### **PERFORMANCE ENHANCEMENTS**

Retrofitting the Cessna 337 will provide the performance enhancements given in the table below:

<b>Item</b>	<b>Conventional Skymaster</b>	<b>Modified Skymaster</b>
Maximum level speed	‘200 mph	‘220mph
Maximum cruising speed	‘190 mph	‘205mph
Minimum flight speed	‘ 85 mph (flaps down)	‘ 30mph (no flaps)
Takeoff Speed	‘ 76 mph    "	‘ 35mph    "
Takeoff Run	1‘000 feet    "	‘150 feet    "
Landing speed	‘ 78 mph    "	‘ 35 mph    "
Landing run	1‘650 feet    "	‘200 feet    "
Range at max cruise speed	1‘100 miles	1‘800 miles

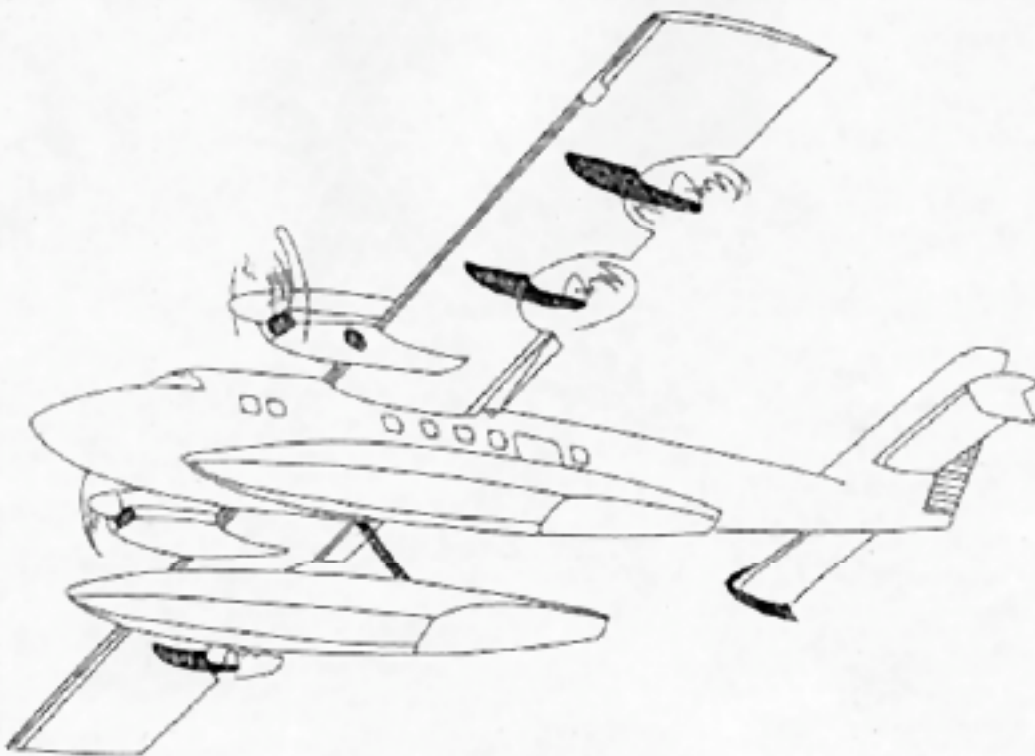
#### **NOTE:**

The model shows a retrofit that removes the aftengine and replaces it with a cargo door and ramp.



CONCEPTUAL - SKETCH OF SKYMASTER RETROFITTED

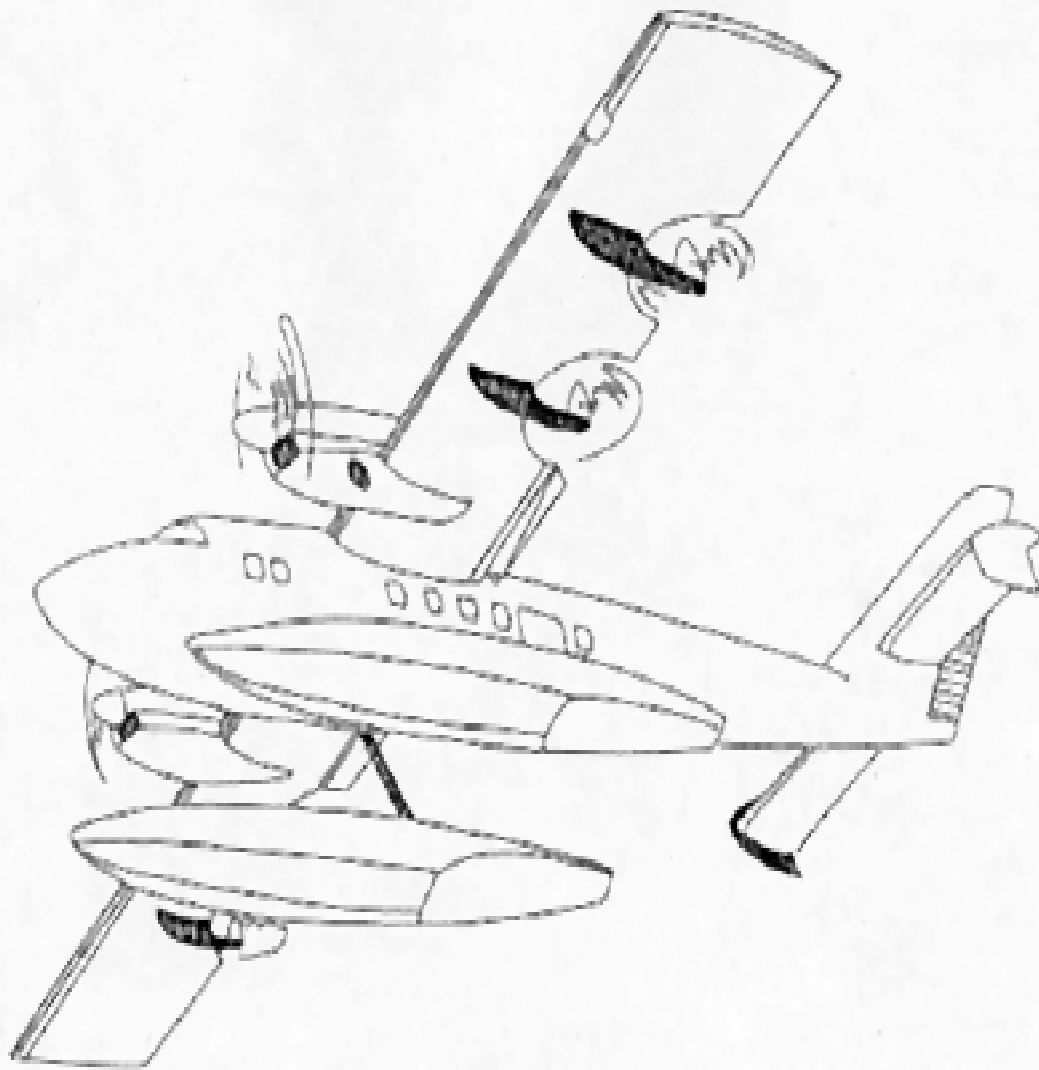
CONCEPTUAL - SKETCHES OF AMPHIBIOUS AIRCRAFT RETROFITTED WITH TURBO WINGS



RETROFITTED UTILITY TRANSPORT WITH FLOAT LANDING GEAR



CONCEPTUAL - SKETCHES OF AMPHIBIOUS AIRCRAFT RETROFITTED WITH TURBO WINGS



RETROFITTED UTILITY TRANSPORT WITH FLOAT LANDING GEAR



## PROPOSED AIRCRAFT CONVERSIONS

### Lockheed C-130 Hercules

The C-130 Hercules continues to be a reliable and efficient aircraft, used by government and private enterprises world wide. Retrofitting them with Turbo Wing Technology as shown in the illustrations on the next page, will dramatically improve their utility and economy as indicated in the table below.

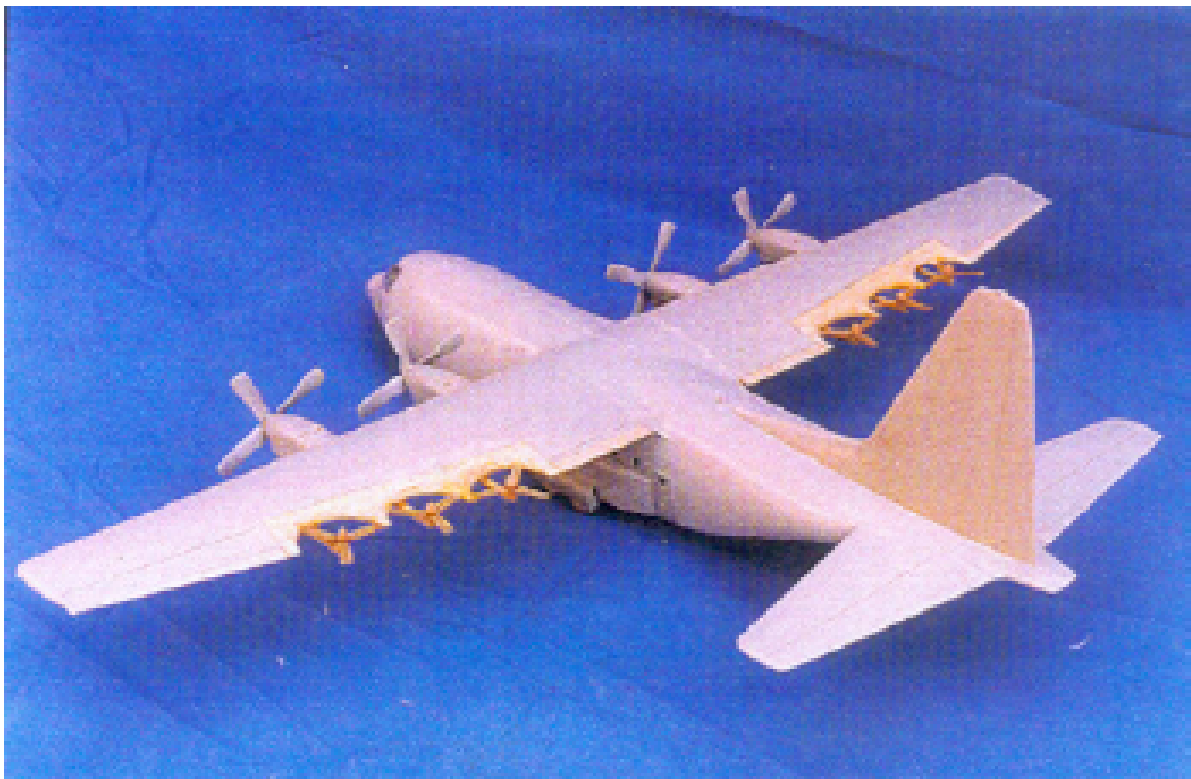
Item	Conventional Lockheed C-130	Modified Lockheed C-130
Maximum Takeoff Weight	155'000 lbs	155'000 lbs
Four 4050 e.s.h.p. Allison T56-A-7A Turbo Props	16'200 eshp	16'200 eshp
Total HP Transmitted to Rotors	n.a.	1'200 eshp
Maximum Cruise Speed	'386 mph	'386 mph
Takeoff Speed	' 45 mph (flaps down)	' 60 mph (no flaps)
Stalling Speed	'129 mph "	' 35 mph "
Minimum Flight Speed	'135 mph "	' 50 mph "
Takeoff Distance	5'169 feet "	1'000 feet "
Landing Distance	1'799 feet "	'400 feet "
Maximum Rate of Climb	1'800 ft/min	3'600 ft/min
Range with 38,536 lb payload	2'200 miles	3'500 miles

### A RELUCTANCE TO STALL

In addition to the dramatic performance capabilities of the C-130 equipped with Turbo Wings, it is of extreme importance to point out that the Turbo Wing C-130 will have a reluctance to stall. This practical, essentially non-stalling capability of the Turbo Wing in itself provides a factor of safety in flight not available in currently operating aircraft.



**Model of a Lockheed C-130 equipped with Turbo Wings  
Showing the flaps removed and rotors installed**





## **OPERATION AND SUBSYSTEMS**

- The adaption of the “Turbo Wing“ to an existing aircraft, manned or unmanned is accomplished by the addition of new Turbo Wings to the aircraft or by modifying the existing Wing to conform to a Turbo Wing.
- All system components are readily available in aircraft inventory.
- Operation and maintenance skill levels are identical to those levels for conventional aircraft.
- There is routine field handling with storage and integration in normal patterns.

## **RETROFIT ROTOR/FLAP KIT**

- The “Induction Flap“ is a low mechanically simple and reliable device that replaces the existing flap of the wing of an aircraft. The “Induction Flap“ is the result of an application of the Turbo Wing Technology to the flaps of an aircraft.
- The induction flap provides the aircraft with dramatic improvements in the airport cruise performance of the aircraft. The flap further provides significant improvements in flight safety and drastically reduces the cost to operate and maintain the aircraft!
- The Induction flap, prior to installation is illustrated in the sketch (A) on the page after next. An illustration of the flap retrofitted to the wing of an aircraft, precisely in the rectangular space that was occupied by the original flap is presented in the sketch (B) on the page after next.
- The rotor components of the Induction flaps are “powered rotors“.
- The power source to operate the rotors is the existing power plant (engine) of the aircraft. The required power to the rotor from this source is accomplished via a hydraulic transmission system, similar to the wing.
- The replacement of the existing flap system of the wing of an aircraft with an “Induction Flap System“ will result in the following notable improvements in aircraft performance, in-flight safety and in operating costs.

## **AIRPORT PERFORMANCE**

- Takeoff and landing speeds reduced by 50%
- Takeoff and landing distances reduced by 75%
- Rate of climb increased by 50 to 100%
- Airport noise significantly reduced by 50 to 75%

## **CRUISE PERFORMANCE**

- Range increased by 50 to 75%
- Fuel consumption reduced by 25 to 50%
- Riding comfort improved due to large reduction in response to gusts and turbulence
- “Wing Stalling“ eliminated (practical stall-proof wing)
- Reduced response to crosswinds, gusts and turbulence
- Extremely low speed lotter and low speed takeoff and landing

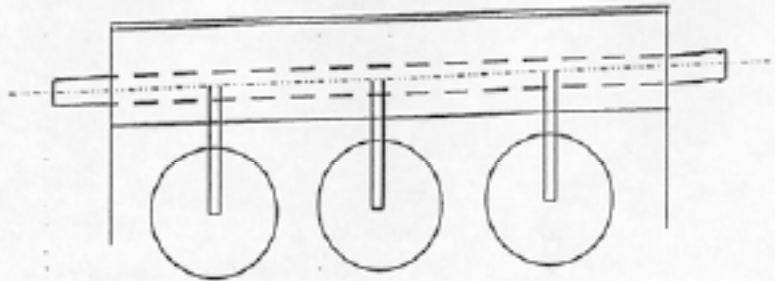
## **OPERATING COSTS PERFORMANCE**

- Reduction in gallons of fuels per fuel of cruise
- Reduction in gallons of fuel required for takeoff, landing and climb

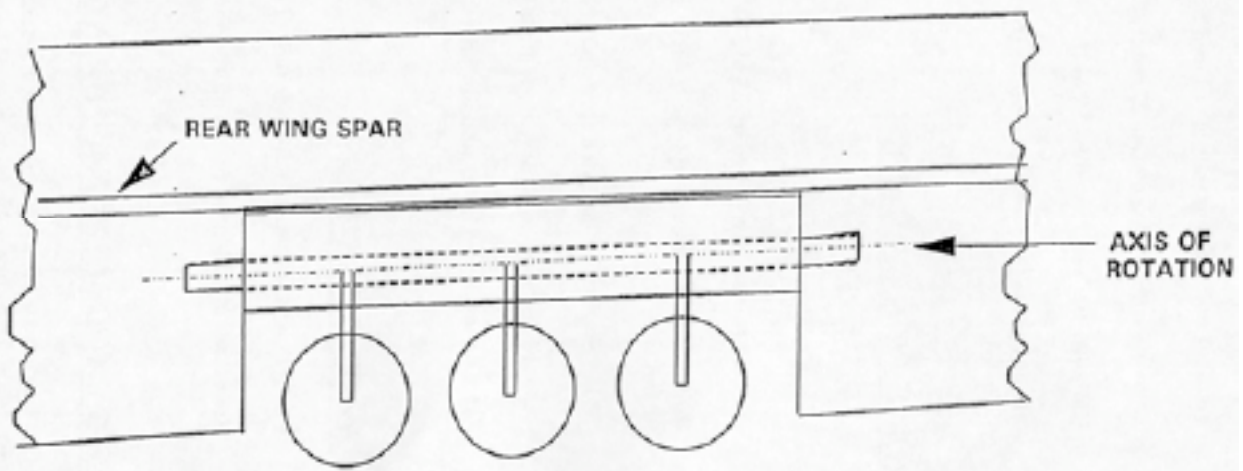
## **DESIGN AND MANUFACTURING**

- The flap kit consists of several components, some of which are off-the-shelf and available world wide and some are to be fabricated
- The prototype components are to be made in the United States and appropriate certification by the U.S. Federal Aviation Administration (FAA) will be acquired
- These items will be structurally tested. The manufacturing processes and tools will be developed.

SKETCH 5-A : ISOLATED FLAP



SKETCH 5-B : FLAP RETROFITTED TO WING



## WORLD WIDE PATENT COVERAGE

The U.S. Patent Office has issued three patents to Frank Malvestuto relating to the Turbo Wing Technology. In addition, the following countries have issued letters of patent to Frank Malvestuto covering the Turbo Wing Technology:

- Australia
- Argentina
- Belgium
- Brazil
- Canada
- France
- Germany
- Greece
- Israel
- Italy
- Mexico
- Poland
- South Africa
- Spain
- Switzerland
- Russian Federation (former U.S.S.R.)
- United Kingdom

Additional patent applications are pending.

Improvements on the technologies will be the subject of added applications.

ITEMS	CONVENTIONAL SKYMASTER	TURBO WINGED SKYMASTER	REMARKS
Weights Empty (lbs)	2'850	3'100	
Max. T-O Weight (lbs)	4'630	6060	
Max. Landing Weight (lbs)	4'400	5'400	
Max. Wing Loading (sq.ft.)	23	30	
Max Power Loading (hp)	11	10	
Installed Horse Power (hp)	420	520	Additional Rotor Engine
Fuel Capacity (U.S.-Gallons)	92	140	
Wing Span (ft.)	38/2	38/2	
Wing Area (sq.ft.)	202	202	
Length Over All (ft.)	29/9	29/9	
Cabin Length (ft.)	10	10	
Max. Width (ft.)	3/8.25	3/8.25	
Max. Height (ft.)	4/3.25	4/3.25	
Volume (cu. ft.)	138	138	
Max. Level Speed (mph)	200	220	
Max. Cruising Speed (mph)			
(5'500 ft. / 75% Power)	190	205	
Max Rate Of Climb at			
Max.Cruising Speed (ft./min.)	1'100	2'300	
Stalling Speed (mph) (flaps)	70	CLASSIFIED	
Min. Flight speed (mph) ( " )	85	30	
Take-Off Speed (mph) ( " )	76	35	
Take-Off Distance (ft.) ( " )	1'000	150	
Take-Off to 50 ft.Alt. (ft.) ( " )	1'675	230	
Landing Speed (mph) ( " )	78	35	
Landing from 50 ft. Alt.(ft.) ( " )	1'650	200	
Range at Max. Cruise Speed	1'100 miles	1'800 miles	



## **C-130 RETROFIT, MANUFACTURING AND SALES PLAN**

The C-130 airplane, now hangared in Alabama, USA, will be flown to an aircraft maintenance facility in California for modification.

Under the direct supervision of Mr. Frank Malvestuto, the wings will be modified to include the "Patented Turbo Wing Technology"

This vehicle will then be used to demonstrate to C-130 owners the significant improvements in the operating performance of C-130 aircraft with the application of Turbo Wing technology. For the world wide profitable sales of "Rotor Flap" retrofit kits, there will be established the following manufacturing marketing and sales plan:

- Development of facilities and process for the manufacturing of retrofit kits
- Sublicense of manufacturing rights for production of retrofit kits
- Development of facilities world-wide for the installation of "Rotor Flap" retrofits on C-130 aircraft
- Acquire government contracts directed at developing "Special Mission" revisions of C-130's, using "Rotor Flap" retrofits.
- Develop improved versions of current C-130 aircraft

## **Retrofitted C-130 Performance**

From both, scientific and operational point of view, there is absolutely no question of the improved performance of a C-130 or any other aircraft, equipped with the "Turbo Wing Rotor Flap System".

The inventor, patent holder and designer of this technology has conducted over one hundred full scale flight tests of a Cessna 207 aircraft, equipped with the first generation of Turbo Wing Rotor Flaps.

Every single test flight proved and validates the significant performance improvements of the aircraft.

Last but not least, there is a large impact on the environmental side, mostly due to the extremely low fuel consumption level of aircraft retrofitted with the Turbo Wing Rotor Flap System, relative to their weight (payload) and the distances flown.





## **AIRCRAFT OF THE FUTURE**

### **SUMMARY**

Aircraft with utilities and performance characteristics, not heretofore contemplated, become possible and probable with the application of the Turbo Wing concept. Airborne vehicles that can take off and land on short runways are among the possibilities. Aircraft that can carry loads in the millions pound plus range are possible. Vehicles that can hover and others that can reduce freight costs are all in the future of the Turbo Wing Technologies.

### **AIR TANKER EXAMPLE**

The sketch on the next page illustrates the application of Turbo Wing on a Super Cargo Carrier that can carry 1'500'000 pounds of freight or liquid 3'000 miles at a cost per ton mile approximately 10% of the cost using present day cargo planes.

### **PERFORMANCE DATA**

Payload	1'500'000 pounds
Range	3'000 miles
Speed	'200 mph
Total Horsepower	21'000 hp

### **Take off and Landing**

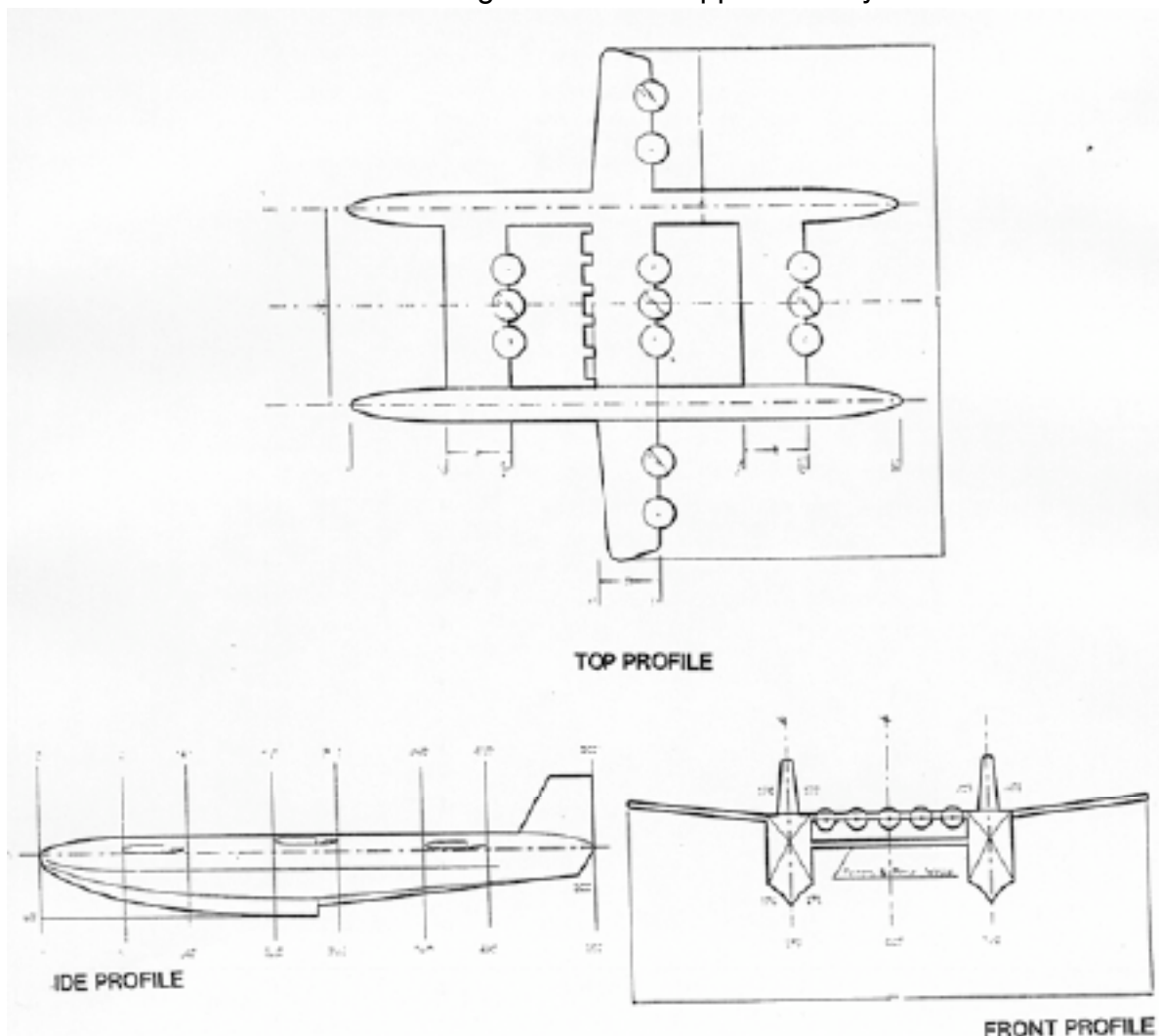
Speeds on water	Under 65 mph
Speeds on land	Under 55 mph
Distance on water	Under 1'500 feet
Distance on land	Under 1'000 feet



## TURBO WINGED CARGO CARRIER

### AMPHIBIOUS SUPER CARGO CARRIER

This amphibious Super Cargo Carrier can carry 1'500'000 pounds of payload 3'000 miles at 200 miles per hour without refueling and at a cost per ton mile that approaches that of water tankers. It's 510 foot length and 350 foot wing span includes five conventional aircraft engines and propellers and thirteen Turbo Wing Rotors. Among its utilities will be taking oil from of shore rigs to shoreline refineries. Take off and landing distance are approximately 1'000 feet.



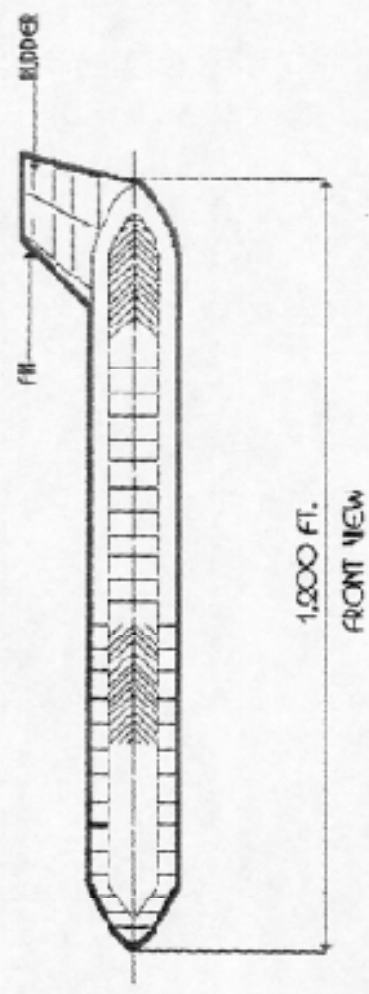
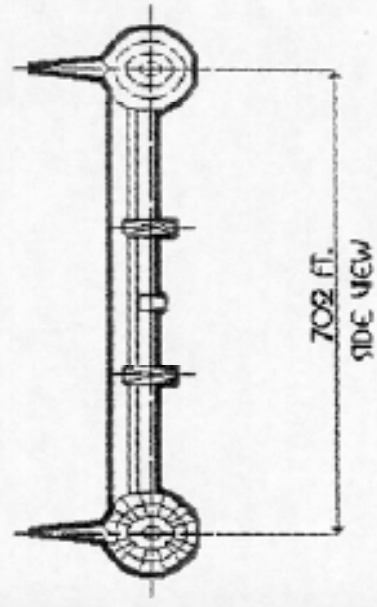
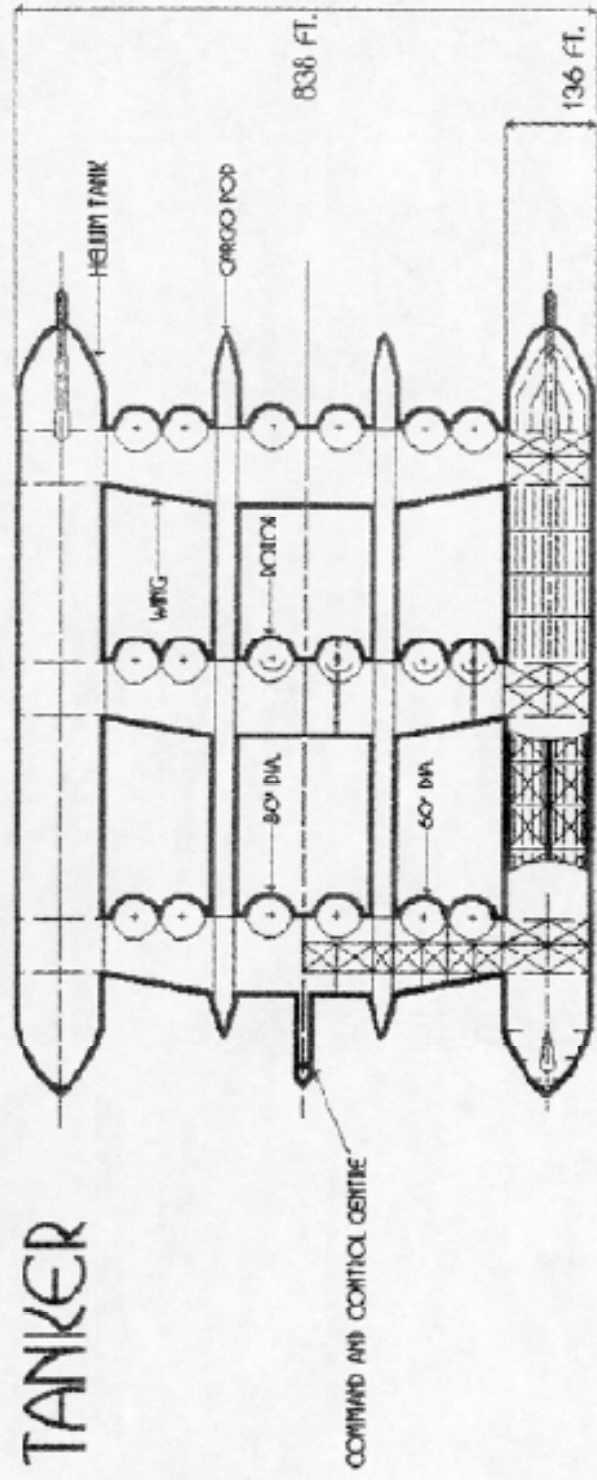
CONCEPTUAL AIR SUPERTANKER

LOW SPEED  
SUPER TANKER  
3W - 1200



TURBO WING DEVELOPMENT COMPANY

# AIR SUPER TANKER 3W - 12000



5



**PERFORMANCE IMPROVEMENTS**  
**LOW COST RETROFIT**

**SIGNIFICANT INCREASE IN**

Deliverable Payload  
Rate of Climb  
Range

**SIGNIFICANT REDUCTION IN**

Fuel Consumption

**NEARLY STALL-PROOF WING PERMITS**

Extremely Low Flight Speed Capability  
Short Distance Take-Off and Landing  
Low Speed Take-Off and Landing



## **SAFETY**

The full scale flight tests of a Cessna 207 aircraft equipped with Turbo Wing rotor Flaps were NOT able to “Stall“ the aircraft in flight. This result can be called “Stall-Proof“!

During the tests, the pilots were always easily able to control and fly the aircraft with only ONE Rotor Flap in operation.

Other manufacturers have so far been unsuccessful to design rotors with such capability with several accidents involving their test flights.

### **NOTE:**

It is to be noted that in 1992, an experimental prototype vertical takeoff aircraft equipped with rotors designed by Bell Helicopter and Boeing Helicopter of the United States, crashed into the Potomac River, Washington, during a test flight.

According to eyewitness reports, the aircraft with seven people onboard, stalled out during flight and hit the water.

This crash was the second involved in the program funded by the U.S. Government. The U.S. Government has appropriated US\$ 1.5 Billion fund through the U.S. Marine Corps for the said program.

The contract endangered through these accidents was worth 26 Billion United States Dollars.

These amounts should be compared with the amounts necessary to install “Turbo Wing Technology“, not to forget that the Safety requirements are satisfied perfectly by the “Turbo Wing Technology“!