GRUMMAN STUDYING AMPHIBIAN MARKET

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By David M. North

Bethpage, N. Y.—Grumman Aerospace is in the conceptual design phase of a new project that could result in the first commercial amphibian built by the company in more than 30 years.

Grumman is a veteran in the amphibian field and, in an attempt to determine if there will be a market for a new amphibian in the 1980s, for the last year has been conducting interviews with operators of such aircraft.

Preliminary studies yielded four designs: two single-engine and two twin-engine aircraft, with gross weights ranging from 4,000 to 7,500 lb. Different performance goals were set for each design. From the discussions with amphibian pilots, owners and operators, a single set of specifications has evolved that Grumman calls Design 711.

Factors that influenced the design of the proposed amphibian include:

- Size—to replace the Goose and Widgeon and carry nine passengers and one pilot.
- Engines—reciprocating, with a turboprop option.
- Costs—minimal for fabrication and repair.

Weight, hydrodynamic and aerodynamic considerations also had a key influence in the design.

The earlier Widgeon had a capacity of four-five people, while the Grumman Goose's capacity was for 8-11. The newer Mallard could accommodate up to 13 passengers.

From the interviews with users, Grumman ascertained that a passenger capacity of nine, with one pilot, was the most desirable. A large cargo capacity for utility operators also was determined to be an important factor for the proposed amphibian. "It had to be able to carry a 4 × 8-ft. piece of plywood," one Grumman official said.

The design of the 711 allows either piston or turboprop engines to be used on the aircraft with little center-of-gravity change and very little outward metal appearance change. "It would be a 15-to-20-year production project, so the new design can go either way with its powerplant selection," Joseph Cerruto, Grumman's assistant to the vice president of corporate development, said.

Grumman found commercial operators more often chose the piston engines because of the less expensive initial price. Corporate and government operators more often opted for the turboprop engines because of the longer time between overhauls, modern design and easier operation in the winter. The turboprop engines would improve the performance of the aircraft and increase the maximum speed by more than 30 kt.

Grumman picked a hull similar to the Goose in its initial design, in order to satisfy the requirements for a twin-engine, 10-place aircraft. The Mallard hull was selected later in the concept phase because it was more compatible with the tricycle landing gear and the seating arrangement Grumman wanted.

One of the conflicting requirements Grumman had to resolve was the use of the tricycle landing gear rather than a tail-wheel arrangement. "The operators, especially in Alaska, were strong on the tail wheel, while other operators were just as adamant for the need of tricycle landing gear," Cerruto said.

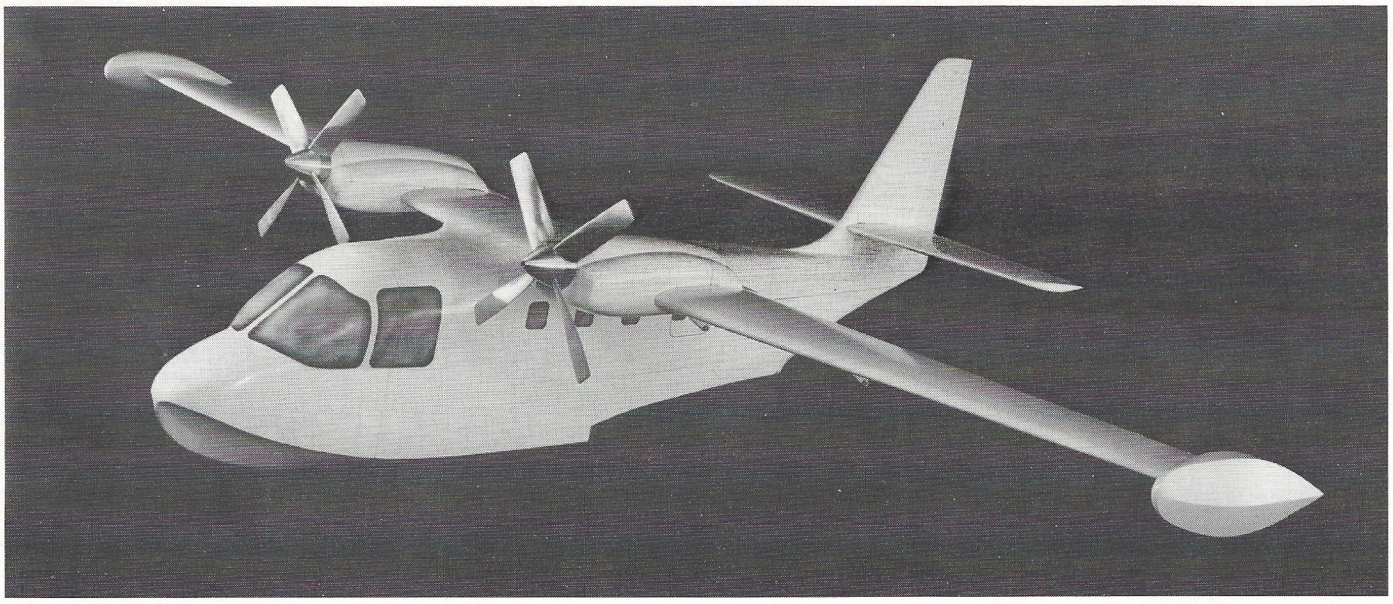
Another factor that influenced Grumman to adopt the Mallard hull design was the ability to have one long flat section in the cabin for a "station wagon" approach, according to Cerruto. Grumman also determined that the operators were happier with the spray characteristics of the Mallard hull.

Spray characteristics were important in terms of reduced operating cost. Grumman's operator survey found that amphibian aircraft propellers must be overhauled after 200-300 water takeoffs because of the impact of the water on the propellers.

Grumman used computer sizing techniques that resulted in an 8,000-lb. aircraft with an approximate 30 psf. wing loading and a 9-11 lb./hp. power loading.

The original Grumman design for a new amphibian incorporated a rectangular wing, but this was dropped in favor of the National Aeronautics and Space Administration's General Aviation Wing Two (GAW 2). This wing, used on Piper Aircraft's Tomahawk, incorporates a generous leading edge with a cusp in the trailing edge and was used primarily for the better single-engine-out rate of climb it gives.

The GAW 2 design allows the same stall speeds with a smaller wing and has benign stall characteristics. Its higher lift-over-drag at low speeds affords a better



Grumman Aerospace Design 711 started wind tunnel testing recently with a 1/7-scale model to examine the lift, drag and moment characteristics of the baseline configuration. The 10-place amphibian is designed to incorporate either piston or turboprop engines. The individually retractable floats form an endplate on the wing when retracted. Design 711, which is still in the conceptual design phase, with no commitment for further development, incorporates a hull similar to the company's earlier Mallard amphibian.

rate of climb. The aspect ratio of the wing is expected to be approximately 10.

Grumman tried spoilers initially, but dropped the idea in favor of conventional ailerons, primarily because of the drag affecting single-engine-out rate of climb using spoilers and the lack of control feel.

The 711 design incorporates an externally hinged, single-slated 30% chord flap with overlap at 85% chord.

This design was chosen as an efficient and simple solution to provide adequate stall speeds and good land and water field performance, Mark Siegel, of Grumman Aerodynamics Product Engineering Div., said.

The amphibian's vertical stabilizer and rudder were sized so that the aircraft could accept growth to higher horsepower options with single-engine-out capability without a design change.

The aircraft was designed and shaped to reduce fabrication and repair costs by the use of flat hull sides, single pieces of glass in the windshields, single wing construction, electrically actuated systems rather than hydraulic and standard cable linkage for the flight controls.

Michael Ciminera, Grumman's director of advance aircraft and systems, said: "We have studied the cost aspect of this design very closely and have done what we could to cut cost from an operations and maintenance standpoint."

Grumman has looked at the possibility of fabricating the hull and wing box from glass fiber but has not decided whether the additional cost would justify its use or whether glass fiber could be used effectively. The company is in the middle of its research on the weight-versus-cost of the glass fiber, especially for use in the hull. If that route is chosen, Design 711 would use a standard glass fiber to eliminate problems with repairs and certification. Titanium and 60/61 aluminum also are being considered for the hull.

The amphibian has been designed to incorporate full-size watertight compartments below floor level in the cockpit and cabin.

Pressurization of the aircraft was considered, but Grumman believes that the use of the aircraft does not justify the extra weight and cost to install the system. Air conditioning is being considered as an option for the 174-kt. cruise speed amphibian.

Bladders in the wing, rather than integral fuel tanks, will hold the 250 gal. of fuel the aircraft is expected to carry. The bladder was chosen to cut down on possible fuel leaks. Amphibian operator input also dictated that Grumman attempt to incorporate the knowledge that operators had acquired concerning the most efficient use of passenger and cargo access on land and water.

To do this, Grumman designed the 711 with a water loading door on the left side of the aircraft. The Dutch style cargo door is on the right side of the aircraft so the pilot can observe the loading, if need be. The 40 × 50-in. cargo door was sized to accommodate oil drums and spare engines.

Design 711 Specifications, Performance

Dimensions:		
Length		39 ft.
Height		16 ft.
Span		54 ft.
Powerplant options:		
Teledyne Continental Motors		GTSIO520
Garrett AiResearch		TPE331
Avco Lycoming		LTP101
Pratt & Whitney of Canada		PT6A-10
Weight:		
Takeoff gross weight		8,000 lb.
Load Capacities:		
Personnel:	One pilot and nine passengers	
Cargo:	Volume: 275 cu. ft.	
	Side cargo door: 40 by 50 in.	
	Front loading hatch: 36 by 18 in.	
	Baggage inside: 50 by 36 by 50 in.	
Fuel:	1,500 lb.	
Performance Criteria:		
Stall speed		61 kt.
Takeoff distance—land		1,000 ft.
Takeoff distance—water		1,500 ft.
Rate of climb, sea level		1,200 fpm.
Cruise speed at 10,000 ft.		174 kt.
Range		800-900 stat. mi.

Hatch Loading

The right windshield opens to become a hatch. Numerous pipes or pieces of timber 20 ft. long can be loaded through the hatch and it is conveniently located for mooring the aircraft while on water.

The nine-passenger interior has been designed for quick conversion to a cargo configuration. The passenger seats would collapse and fit into the cabin's deep center trough. The seat backs could be used as cabin flooring, which would allow conversion to and from the passenger configuration at any off-station location.

In keeping with trying to make the Design 711 an adaptable aircraft for all land and water operations, the once fixed floats have been designed so that they are individually retractable for berthing alongside a dock. The floats retract and become end plates on the wing, thus increasing the wing's area, span and aspect ratio. The same consideration for berthing caused Grumman to drop the idea of a twin tail for the aircraft in favor of the single tail.

Grumman's earlier amphibian design had embedded nose gear that could function as a bumper. This concept was rejected in favor of an individually retractable nose gear contained in the hull of the aircraft. The aft folding gear's tire would be the same size as the main gear to facilitate beach operations.

Grumman expects the incorporation of a slightly convex, single-glass windshield to make cockpit visibility excellent, an important feature for water operations.

The amphibian is not meant to be avionics intensive, but Grumman would offer an instrument flying avionics package as an option on the single piloted aircraft. Dual controls, deicing equipment and a water rudder also would be listed as optional equipment.

Grumman, while conducting its market survey in Alaska, found that the banks did not balk at the retail financing of the aircraft. The future of an amphibian as an investment aircraft and the steady growth of aviation in Alaska were given by the banks as reasons for their willingness to finance retail sales.

The retail selling price of the amphibian has not been determined. Grumman is aware it would be entering a price sensitive market where operating and maintenance costs are important factors. Although there are no hard figures, Grumman is looking for an aircraft that would have a breakeven point at 40% load factor.

Grumman sees a market for the 10-place amphibian in areas where tourism is on the increase, such as the Caribbean and the Pacific. The operations would be applicable to some of the smaller islands that do not have adequate airport facilities, but are seeing an increased demand from people trying to get away from the larger commercial centers.

Alaska is believed to be a good market for expanded operations in replacing the Goose and the Mallard. Canada is a less certain market because of the increasing number of airstrips and roads being built.

"We do not kid ourselves about a huge market for the Design 711 type of amphib-

ian. If we should go ahead with the program, we see a low-quantity monthly production of the aircraft built over a long period of time," one Grumman official said.

Another amphibian manufacturer said, "There is no amphibian in the 10-place market, and there are many operators who would pay anything, within reason, for an aircraft to replace the Goose."

Less Optimistic

An aircraft float manufacturer was less optimistic: "The main problem with an amphibian, or with a float aircraft for that matter, is that the market is too limited. I do not know what a new 10-place amphibian would cost, but if it is in the $1-million range, it would make my eyes roll."

Grumman is providing manufacturing support for the Trident Aircraft, Ltd., of Canada's Trigull, a six-place, single-engine amphibian. Grumman is assisting in the Trigull's production and start-up activities.

Wind tunnel tests in late October were conducted with a 1/7-scale model of the Design 711 to examine lift, drag and moment characteristics of the baseline configuration.

The initial wind tunnel testing was completed with what one Grumman official termed, "Results better than given on paper with all design points met."