Frakes Aviation

Grumman Mallard Owners Association

Joint Submission to

The National Transportation Safety Board

regarding the

Chalk's Ocean Airlines
Miami, Florida
December 19, 2005

Accident Investigation

Submitted by
The Grumman Mallard Owners Association
and
Frakes Aviation

October 12, 2006

Introduction

In accordance NTSB rules, this report on the investigation of the accident involving a Chalk's Ocean Airline seaplane on December 19, 2005 is a joint submission by the Grumman Mallard Owners' Association (GMOA) and by the holder of Grumman Mallard G73 and G73T Type Certificates, Frakes Aviation.

Members of the Grumman Mallard Owners Association include both private and commercial owners and operators. Our eighteen Grumman G73 Mallard and G73T Turbine Mallard seaplanes represent more than two-thirds of the Mallard fleet. The content of this submission is based on factual information gathered during the NTSB investigation, on more than one hundred years of combined operational experience of G73 Mallards and G73T Turbine Mallards, and on publicly available information.

Frakes Aviation operated Grumman seaplanes in commercial passenger service from 1947 to 1984 in Alaska. In 1970 Frakes developed the G73T Turbine Mallard and currently holds the type certificate for the G73 Mallard and G73T Turbine Mallard.

In its August 30 *Party Recommendations as to Findings, Recommendations and Probable Cause,* the GMOA noted that the NTSB investigation focused on the operator's questionable repairs and on the terminal structural failures that preceded the accident. The investigation does not address the cause of the structural deterioration that developed over years, and which eventually failed the wing.

This report includes information gathered from observation and off-the-record interviews. Lacking the authority to obtain the operational and regulatory information known to exist, and which is necessary for the correct determination of the underlying causes of the accident, the GMOA has requested that the NTSB seek validation of this information. This submission contains photographs and discussion that may appear to digress from a strict focus on the accident. However, they are included to promote understanding of the environment in which the accident aircraft operated. Such an understanding is necessary to correctly determine the cause of the accident and to formulate effective recommendations than can prevent the occurrence of a similar ocean airline accident in the future.

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Summary

On December 19, 2005, shortly after takeoff from Governor's Cut channel in Miami, Florida, a Grumman G73T Turbine Mallard amphibious flying boat was destroyed by impact forces after a wing separated from the fuselage. All twenty souls on board were fatally injured in the accident.

This seaplane had operated from the ocean as a scheduled commercial passenger transport for more than 20 years. It had almost 40,000 cycles, mostly ocean take-offs and landings, and had accumulated severe corrosion and widespread cracking of the wing structure, some of which had been improperly repaired. The investigation showed large cracks and repairs of both lower wing skins, fractures of all six lower wing z-stringers, and stress fractures of both lower spar caps.

Noting that this aircraft had gathered 31,226 airframe hours over almost sixty years, the media and some government agencies proclaimed that this was another example of an aging aircraft flown beyond its lifespan, and the FAA announced that an unsafe condition exists for this model aircraft.

These conclusions appeared reasonable at first, but the facts presented in this report and the NTSB staff report show that the causes of the accident were more complex, and that the initial assumptions and conclusions are in error. An FAA-mandated inspection of the Mallard fleet shows no correlation between airframe age and corrosion or center section cracking. In contrast, corrosion and cracking correlates 100% with a history of ocean operation. Also, the Mallard has demonstrated that it is an exceptionally rugged aircraft able to fly even after the destruction of most of its structural strength.

Inadequate regulation and oversight of flight operations allowed this model aircraft to be operated in conditions for which it was neither intended nor designed, and which exceeded the Mallard's flight manual limitations. While the exceptional strength and damage tolerance of the Mallard enabled it to withstand the corrosion and extreme stresses of ocean operation for more than twenty years, the accident aircraft's fate was sealed by improper repair and continued ocean operations while it was virtually screaming for attention to its accumulated corrosion and structural damage.

Regulatory agencies' institutional focus on conventional landplane conditions, operations and failures is a major contributing factor to the conditions that led to the accident, and this focus continues to be detrimental to an understanding of the special requirements of ocean operations. Unless the conditions of ocean operation are understood and addressed, a risk of similar accidents will remain. While it is unlikely that Mallards will again be operated by ocean airlines, any one of a number of available modern seaplanes could take its place in the ocean. If this accident is incorrectly reported as an "aging aircraft" issue, newer aircraft without Grumman's legendary strength could be destroyed as the result of ocean operations more quickly and with less warning than that given by the Mallard.

The Grumman Mallard Owners Association has recommended practical regulations and procedures that, if they had been in place, would have prevented the accident. The GMOA has also requested that the NTSB investigate the operations of the ocean airline to verify the root causes of this accident. Understanding the rodeo-like conditions of an ocean environment is necessary if the NTSB recommendations are to help close the holes in the aviation system that made this accident possible, if not inevitable. We respectfully urge the Board to give this request serious consideration.

Ocean Seaplane Operations

Unlike land runways, the ocean landing and take-off environment has both fixed and moving obstructions, and is subject to large changes in shape and surface. Wind-driven waves, ocean swells, boat wakes and other marine traffic can quickly turn otherwise suitable landing areas into hazardous traps. From time to time, seaplane airlines that operate through all seasons will encounter conditions beyond the capabilities of both pilots and aircraft. The extent to which air transport seaplanes press into rough water conditions has not been part of this investigation and historic information would be difficult to quantify. However, a wealth of information is available from numerous sources including US and Bahamian marine operators, Search and Rescue agencies, the US Coast Guard, and seaplane transport pilots who have flown Caribbean routes. These sources, coupled with the evidence of severely damaged seaplanes that operated in ocean environments, clearly indicate a cause-effect relationship between the accident and use beyond the published limitations of the Mallard aircraft. The GMOA has suggested lines of investigation that would facilitate understanding of ocean seaplane operations and the stresses imposed on the airframe of the accident aircraft.

As reported by Franklin T. Kurt, Grumman's chief engineer and test pilot, in his book *Water Flying*, hull-mounted accelerometers have recorded G-forces of six or more during ocean operations. The mass of a wave increases as the square of its height. Doubling wave height would logically square the impact force, but risk of damage is actually much higher when the wave length exceeds the hull length. As shown in data from the Woods Hole Oceanographic Institution, winds of only 15 knots produce waves of five feet, or twice the Mallard's 2½ foot limitation. Even in sheltered channels, incoming swells and large boat wakes can exceed the limitations of small seaplanes such as the Mallard.

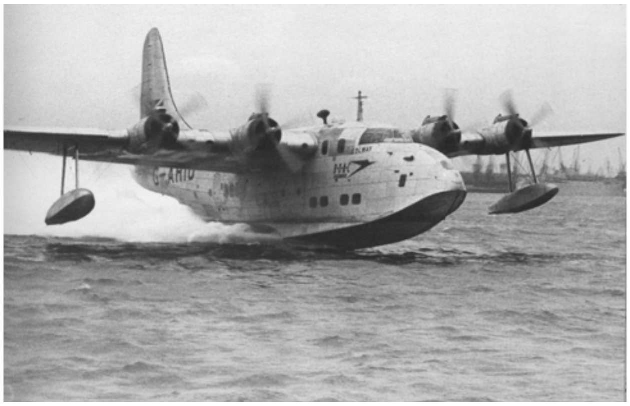
When wave height doubles from 2½ feet to 5 feet, the distance between waves increases from 50 feet to more than 100 feet. With a boat hull length of 34 ft, Mallards will fall into wave troughs and slam into, instead of slicing through the top of each swell. Race-boat operators report that this action, called "stuffing", can cause boat hulls to split in two. When the Mallard hull is abruptly decelerated, the momentum of the wing, engines, fuel and accessories is focused on Wing Station 34—the point where the accident aircraft's wing skins, z-stringers and spar cap cracked.

Flying Boats

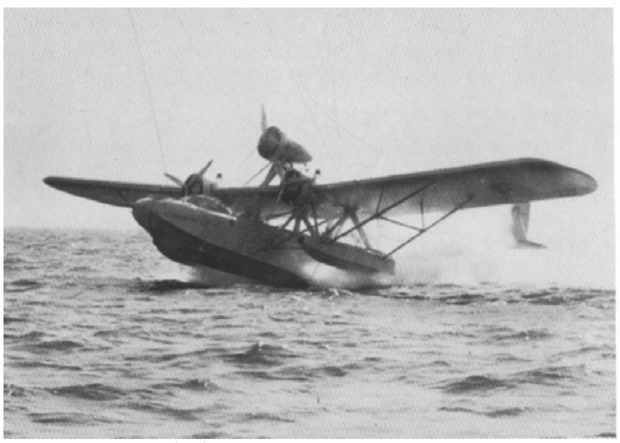
Flying boats, as are naval carrier-based aircraft, are built to be more rugged and tolerant of damage than conventional aircraft. Not coincidentally, the "Grumman Iron Works" was the leading manufacturer of both categories of aircraft. However, for a boat to fly, it has to be much lighter, and consequently more fragile, than boats that remain on the water. Most seaplane damage is related to water operations, with rough water operations causing "popped" rivets, cracked ribs and bottom skins, separated floats, etc.

"Rough water" is relative to the size of the seaplane. Eight foot waves are tolerated by the 140,000 pound, 127 foot Convair P5Y, whereas the 31,385 pound Grumman Albatross is limited to six foot waves. The much smaller 14,000 pound Turbine Mallard is pounded by waves at its limit of only 2½ feet.

For this reason, Franklin T. Kurt states that: *"Marine airplanes were designed to fly from one relatively sheltered body of water to another. Landings in open rough-water areas are just as much emergencies as landing large landplanes in unprepared pastures." " Small airplanes --- have no business, or probable need, to be there."* He continues*: "Operations in the open sea should be confined to only the largest amphibians or seaplanes with highly skilled water pilots and should be attempted only for emergency or rescue purposes. The gross weight should be kept to a minimum in order to reduce the impact forces and speeds."* Apparently Grumman determined that the information contained in Kurt's book was so important and valuable that the company issued an abbreviated version of this book to Mallard owners, emphasizing the emergency nature of open-sea operations.


Short Solent, Length 89 ft, Gross weight 78,000 lbs


Dornier Do.24. Length 72 feet. Gross weight 35,715 lbs

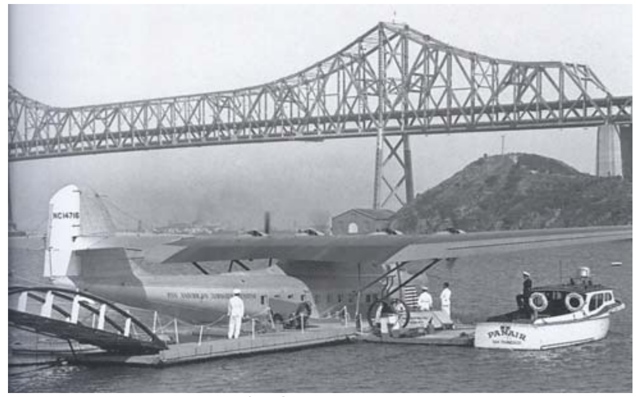

Martin P3M. L.63 ft, Gross weight 15,797 lbs


Shin Meiwa PS-1. Length 110 ft., Gross weight 99,208 lbs


Consolidated PB2Y. Length 79 ft., Gross weight 68,000lbs

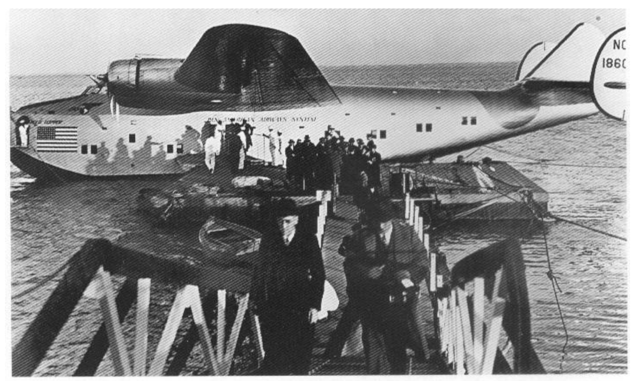

Boeing 314. Length 106 ft, Gross weight 84,000 lbs

Dornier Do.24. Length 72 feet. Gross weight 35,715 lbs



Martin M130. Length 91 ft., Gross weight 52,252 lbs

Dornier Do.24 TT. Length 72 feet. Gross 34,100 lbs



Boeing 314. Length 106 ft, Gross weight 84,000 lbs

Convair P5Y Length128 ft, Gross weight 140,374 lbs

Grumman G73 Mallard. Length 48 ft, Gross Wt 12,750 lbs

The Grumman Mallard

Grumman introduced the G73 Mallard in 1946. Mallards were sold to corporations, heads of state and to private individuals. While it was certified under the CAR 4a air transport category, no Mallards were sold for airline use. Every one of the 59 aircraft built was delivered with a ten-passenger executive cabin. Mallards were, and most still are, personal aircraft used for business and recreation. Approximately one cycle in ten is a water landing, and is almost always in fresh water. Some Mallards have never landed in the ocean. As corporate and private owners moved to the Mallard's successor, the Grumman Gulfstream, and to other aircraft, numerous Mallards were put into commercial service, some to be later restored for private use.

Mallards in ocean airline service were usually fitted with 17-passenger interiors and turboprop engines. Unlike airliner flying boats built by Boeing, Sikorsky, Shorts, Dornier and others, the Mallard was neither designed nor intended to be a heavy-water boat. While the Mallard operation manual limits take-offs and landings to a 2½ feet wave height, commercial transport pilots report Mallard operations in seas higher than four feet, with repeated take-off attempts into swells or boat wakes so large that take-offs had to be aborted. Mallards operated in the ocean have been destroyed by corrosion, structural damage, hurricanes and accidents. Mallards cracked and corroded by ocean operations were commonly scrapped or retired to bone-yards, where they can be seen today.

Mallard Fleet Inspection.

After AD 2006 01 51 grounded all U.S. Mallards, the FAA, the GMOA and the TC holder, Frakes Aviation, developed an inspection program as part of an Alternate Method of Compliance (AMOC).

a. a review of flight operation logbooks to determine type of operation, especially salt-water or ocean operation, and airframe hours and a review of airframe logbooks and other maintenance records for entries indicating previous repairs to the center section wing area due to incidents, corrosion, or damage.

b. a comprehensive inspection of the center section and adjacent structures for visible signs of corrosion, fuel leaks, skin deformation or cracking, missing or loose fasteners, mis-shaped skin over extruded members, with particular attention to evidence of previous repairs.

c. eddy-current inspection of z-stringer slosh holes and/or eddy-current plus ultrasound inspection of lower wing skins for invisible cracking.

To date, inspections have been performed on six G73 Mallards and one G73T Turbine Mallard. In the process of developing the AMOC, four of these aircraft were also inspected by an FAA Designated Engineering Representative with certification in damage tolerance.
Information about four other G73 Turbine Mallards that operated as ocean airliners has been extracted from the NTSB Structural Group Chairman's Factual Report.

Findings:

The NTSB Structural Group Chairman's Factual Report of June 2, 2006 DCA 06MA010 details inspection of four Grumman Mallards, serial numbers J27, J30, J32 and J42. All of these aircraft had been operated in the ocean, and all had more than 25,000 cycles. All had significant corrosion. All had cracking of the center section z-stringers. Three of the four aircraft had cracking of the lower wing skins, while the fourth aircraft's wing skin had been removed.

Mallards J2 (14,883 hours), J8 (6,227 hrs), J35 (7,100 hours) and J57 (11,655 hours) were never operated in the ocean. None of these Mallards have any signs of center section corrosion, cracking or other structural deterioration.

J13 (6,000 hours) and J56 (18,040 hours) were operated in the ocean. J50 (15,985 hours) was operated in brackish bayous. The wing center sections of these aircraft required rebuilding. These Mallards are no longer operated in the ocean and are free of cracks and corrosion.

Correlation of Structural Damage to Ocean Operation:
In summary, significant corrosion was found in each of seven aircraft (J27, J30, J32, J42, J13, J56, and J50) that had been operated in the ocean, with documented cracking in six of these. In contrast, none of the aircraft that were not operated in the ocean (J2, J8, J35 and 57), have any signs of corrosion, cracking or structural deterioration. Attached detailed photographs show that Mallards not operated in the ocean have no signs of aging, and are amongst the soundest and best maintained of all General Aviation aircraft.

The table of Mallard inspection results (below) clearly demonstrates the adverse airframe impacts caused by ocean operation.

Frakes Aviation

Grumman Mallard Owners Association

Inspection Results: G73 and G73T Mallards

Aircraft Designation	Flight Hours	Ocean Ops	Inspection Results		Rebuilt Center Section	Inspection Type & Notes
			Center Section Cracks	Corrosion		
Mallard J2	14,833	**No**	**No**	**No**	No	AMOC inspection. Eddy-current and ultrasound NDI
Mallard J8	6,227	**No**	**No**	**No**	No	AMOC inspection
Mallard J13	6,000	**Yes**	**Unknown** Prior to Center Section Rebuild	**Yes** Prior to Center Section Rebuild	**Yes**	Annual inspection. No post-rebuild cracks, corrosion or other deterioration
Mallard J27	31,226	**Yes**	**Yes**	**Yes**	No	NTSB report
Mallard J30	27,182	**Yes**	**Yes**	**Yes**	No	NTSB report
Mallard J32	16,000	**Yes**	**Yes**	**Yes**	No	NTSB report
Mallard J35	7,100	**No**	**No**	**No**	No	AMOC inspection
Mallard J42	34,878	**Yes**	**Yes**	**Yes**	No	NTSB report
Mallard J50	15,985	brackish bayous	**Unknown** Prior to Center Section Rebuild	**Yes** Prior to Center Section Rebuild	**Yes**	AMOC insp. Eddy-current and u/sound NDI. No post-rebuild cracks, corrosion or other deterioration
Mallard J56	18,040	**Yes**	**Yes** Prior to Center Section Rebuild	**Yes** Prior to Center Section Rebuild	**Yes**	Normal inspection. No post-rebuild cracks, corrosion or other deterioration
Mallard J57	11,655	**No**	**No**	**No**	No	AMOC inspection. Eddy-current and ultrasound NDI

Aging Aircraft

It is accepted that repeated stresses degrade aircraft structures to a variable extent, and that a small number of aircraft models have had failures resulting even from proper, legal and foreseeable use within the design limits of the aircraft. However, current high interest in the nascent industry of damage tolerance engineering has made the issue of aging aircraft into a *cause célèbre*. In the enthusiasm to identify examples of age-caused structural deterioration, conclusions have preceded proper investigation and analysis.

After the Chalk's accident and the NTSB release of pictures of an aircraft that resembled an undersea wreck from World War II, members of the aviation engineering community, of government agencies, and also of the media, promptly attributed the accident to aircraft age. Having never seen a "normal" Mallard, some concluded that this deterioration was the result of high airframe hours, and that it followed that other Mallards with similar hours would be in similar condition.

Also, even though the Mallard's ability to fly with severe damage to primary support structures clearly demonstrated extraordinary structural redundancy, the FAA stated, and still maintains, that "an unsafe condition exists for this model aircraft". Without any evidence that the structural deterioration seen in the accident aircraft is related to aircraft age or airframe hours, and despite its demonstrated survivability in the face of damage and disrepair, the Mallard has become a poster child for aging aircraft.

On July 25, 2006, the NTSB issued a Safety Recommendation to the FAA calling for further implementation of the aging aircraft inspections called for by Congress. While an aging aircraft inspection program or, better still, an inspection and maintenance program appropriate to ocean operation, would have identified the damage to the accident aircraft, the timing of this recommendation reinforces the erroneous conclusion that the accident was caused by aircraft age. Ironically, the NTSB recommendations did correctly identify a void in aging aircraft inspection, but did not address the larger and more significant hole in the system of regulation and oversight through which the certification, operation and maintenance of ocean airlines had fallen.

Conclusion:
While a few more Mallards are yet to be inspected, there is no correlation of visually- or NDI-observable structural deterioration with airframe age or cycles. However, there is a 100% correlation between severe cracking and corrosion with commercial ocean operation. The overwhelming evidence of this data makes it patently evident that the "aging aircraft" conclusion is erroneous in this instance, and that such a conclusion may well result in a serious risk assessment error for future ocean airline operations.

Inadequate Regulation of Ocean Airlines

When land-based airliners became available, the focus of air transport regulatory activity shifted away from seaplanes. The special needs and conditions of land-based airliners, agricultural applicators, fire-bombers, naval carrier aircraft, home-built and aerobatic aircraft, etc. were recognized and addressed by appropriate regulations. However, the corrosion and high airframe stresses of commercial ocean operations appear not to have been quantified or made part of official thinking, and the more demanding conditions of ocean airline service were overlooked.

While safety regulations applying to land operations developed over the decades, structural, maintenance and operating requirements mandated for land-based airlines were not required of the few airlines that continued to use flying boats. For example, airlines are required to show that aircraft are suitable for intended routes and runways, but as large ocean flying-boats were retired, seaplane operators could freely turn to smaller flying boats and floatplanes that were built for inland and sheltered waters. Small flying boats such as the Grumman G21 Goose and G73 Mallard, intended to be flown from one sheltered area of water to another, were allowed to operate on routes where rough water ocean conditions prevailed.

For land-based air carriers, runway surface requirements are precisely defined, and conditions under which runways can be used are highly detailed. Hard landings, rejected take-offs and other anomalies must be reported. Few similar regulations exist for ocean operations. Without enforcement of the Mallard's 2½ foot maximum wave height, the primary limitation of a rough-water operation is concern whether the aircraft might break during that particular take-off or landing. The effect of accumulated over-stresses on the airframe is seldom mentioned as a consideration. Today, what may be the most hazardous airline operating environment is also the least regulated. Until the accident, it also received the least attention.

Accident Cause

The investigation has focused on maintenance, repairs and on the terminal structural failures that preceded the accident. It has not yet investigated the operation of this seaplane, which Mallard owners believe to be the underlying cause of the structural deterioration that developed over years and that eventually failed the wing.

On August 30, 2006 the GMOA asked the NTSB for further investigation of the ocean operation of the accident aircraft. On the September 12, 2006 Technical Review Meeting, the GMOA provided a written list of questions for further investigation. In the report of the meeting (Agenda item D "Additional Investigation Discussion"), this was to be distributed and tasked to appropriate group chairmen. The GMOA has received no further information resulting from progress of this investigation. Without adequate information about the operating conditions of the accident aircraft, none of the parties has sufficient information to make a sound and verifiable attribution of the causes of the accident.

Further investigation will validate that the accident is the result of structural failure caused by multiple airframe stress loads that exceeded the design limits of the aircraft. Contributing causes were structural deterioration from severe corrosion, failure to properly repair long-standing structural failures that developed over years of ocean operation, failure to retire or rebuild the aircraft prior to its reaching an unairworthy status, failure to properly monitor operation and maintenance, and lack of sufficient regulatory oversight of maintenance and operation.

Ultimately, the multiple causes of this accident are attributable to a failure to recognize, understand and appropriately respond to the special conditions of ocean seaplane operation. Lack of appropriate regulation allowed a model of small flying-boats to be used for scheduled air transport in conditions that exceeded its limitations. Lack of appropriate operating limitations, and lack of oversight of the inadequate limitations that do exist, allowed these aircraft to be slowly destroyed for more than twenty years in conditions for which they were not designed or certified.

Attribution of the accident cause to an unsafe condition for this model airplane is not supported by the findings. While all aircraft deteriorate to some extent over time, thorough visual and NDI inspection indicates that the Mallards with more than 15,000 hours of operation within certified limits show no detectable structural deterioration. The Mallard demonstrates the extraordinary structural redundancy typical of Grumman aircraft, as evidenced by the fact that the accident Mallard continued to fly with severe corrosion, fractured wing skins and stringers (a loss of 70% of wing strength), spar cap stress cracks and other damage.

Attributing the accident to aircraft age would also be detrimental to safety because, without addressing the role of high wave loads in accelerating structural deterioration, commercial ocean

seaplane operations could resume with new model aircraft that have less tolerance for shock loads than the Mallard. A modern aircraft without the Grumman's legendary strength, subjected to similar operating conditions, would likely have failed sooner, and with less warning.

Further Investigation:

The high airframe stresses encountered in commercial ocean operations appear not to have been quantified or considered. Consequently, the role of nearly 40,000 take-offs and landings, a proportion of which can be shown to be in waves far larger than the aircraft was designed to withstand, has not yet been considered or evaluated in determining the cause of this accident.

Without understanding and considering the conditions under which commercial ocean seaplanes operate, the NTSB cannot determine the full cause of the accident or make useful recommendations regarding the type of equipment, operating limitations and maintenance program necessary for the safe future operation of commercial passenger aircraft in ocean conditions.

If the cause of the accident is to be understood, further investigation is necessary to determine why <u>every</u> Mallard that operated in the ocean, and <u>only</u> Mallards that operated in the ocean, developed the same pattern of accelerated and severe corrosion and structural damage that resulted in the failure of the accident aircraft. This information would be readily available to the NTSB by investigating operational issues with the same methods and thoroughness that was evident from the comprehensive report of the repairs and terminal structural failure of the accident aircraft.

These avenues of investigation will provide information about the operation of the accident aircraft:

1. <u>Operational history of the accident aircraft.</u>
   The conditions that this Mallard operated in are well known to the commercial seaplane industry. Flight crews and staff, and other qualified observers such as US and Bahamian military, SAR and Coast Guard personnel, have detailed knowledge about these commercial seaplane operations, including wave heights, wind speeds, incidents and accidents, and other conditions that have been encountered. While there will be reluctance to provide information about operations that were unsafe or outside of aircraft certification limitations, the information exists. The list appended below suggests preliminary avenues of investigation that could provide information about commercial ocean operation, including information necessary to determine the relationship between actual loads and design loads produced by ocean waves. Sources of background information include Franklin Kurt's "Water Flying", the Grumman certification data for the Mallard and Albatross, and research data from the NACA Langley Field Laboratory.

2. <u>Stress loading.</u>
   From information gathered about wave heights and wind speeds, it should be determined if calculated loads exceeded the design loads for which the aircraft was certified, and if the loads are consistent with the observed structural failures.

3. <u>Damage History.</u>
   Examine airframes and maintenance/repair records of Mallards operated in the ocean for evidence of damage related to rough water operations.

Frakes Aviation

Grumman Mallard Owners Association

Grumman G111 Albatross. Length 62 ft, Gross wt 31,365 lbs

Recommendations:

1. Seaplanes should be limited to a wave height that will not produce loads that exceed the maximum certified for the airframe.
2. Commercial passenger seaplane operations should require an FAA approved operation, inspection and maintenance program that:
    a) requires that the seaplanes utilized are not limited to wave heights below those foreseeable in the operating conditions. Aircraft suitable for this purpose, for example the 31,385 gross weight Grumman G111 Albatross and others exist.
    b) prohibits seaplane take-offs and landings in waves beyond the aircraft limitations.
    c) requires inspections of extent and frequency appropriate to the high stresses and accelerated fatigue associated with ocean operations.
    d) requires maintenance personnel to be specifically trained and knowledgeable in the prevention, recognition and disposition of seaplane structural deterioration caused by overstress and corrosion.
    e) requires all seaplanes that operate in the open ocean to be fitted with recording accelerometers that detect and record stress loads beyond a safe limit.
3. FAA oversight and auditing of scheduled commercial seaplane passenger operations (both maintenance and operations functions) should be increased to meet the demands of ocean operating environments.
4. DERs designing and/or engineering major repairs should consider the effects of corrosion and previous repairs when evaluating the effect of an individual repair on the general health of the structure.
5. The Coast Guard should be made aware of wave height and other seaplane operating limitations in order to monitor safety of water operations under their jurisdiction.

Respectfully Submitted for the *Grumman Mallard Owners Association*

Loel Fenwick
Vice President & NTSB Coordinator

Reid W. Dennis
President

Respectfully Submitted for Frakes Aviation

Joe Frakes
Owner

Appendix

Re. : NTSB No. : DCA06MA010

Attachment to GMOA Letter of August 30, 2006:
Party Recommendation as to Findings, Recommendations and Probable Cause

Avenues for further investigation of accident.

1. Water Operations

Company policies and limits regarding operations in winds, locations and sea states.
Company policies regarding reporting hard landings, aborted take-offs, fuel leaks, hull leaks, aircraft damage and passenger/crew injuries.
Compliance with these policies.
Frequency of operation in waves greater than 30”, and estimation of wave size.
Stalls, “stuffing” (crashing into wave face), immersion of wings, engines, cockpit.
Encounters with boat wakes.
Aborted take-offs due to high waves.
Details of structural damage incurred during operation.
Details of injuries to crew or passengers.
Collisions with rocks, shore structures, bridges, etc.

2. Airframe evidence of overstress

Frequency and extent of repairs to hull skins, hull ribs and stringers, loose rivets, hull leaks, fuel leaks, fuselage skin cracks, gear well cracks, wing cracks, control surface and hinge cracks.

3. Corrosion prevention procedure

Metal protective coating used. Frequency of application.
Frequency of airframe flushing to remove salt water.
Fuel leaks, hull leaks

The Grumman Mallard

There is no greater contrast within an aircraft fleet than that between Grumman Mallards that have been operated in the ocean and Mallards that are still operated as personal or corporate aircraft. While workhorse Mallards operated in the ocean were exposed to salt water corrosion and waves beyond the height for which they were certified, Mallards that escaped ocean service have been operated well within their limits and have received superb care and maintenance. All are hangared and none are used in salt water. Treasured as the finest seaplane, and possibly the most capable, comfortable and rugged personal aircraft ever built, Mallards seldom change ownership.

Attachment to GMOA/ Frakes Joint Submission to the NTSB

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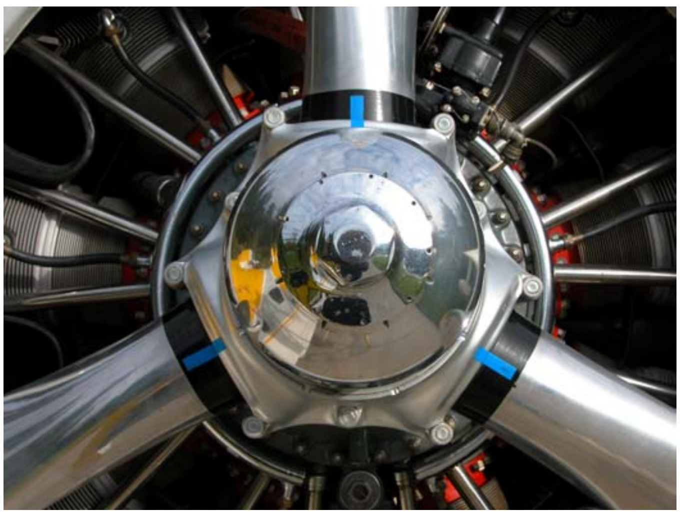
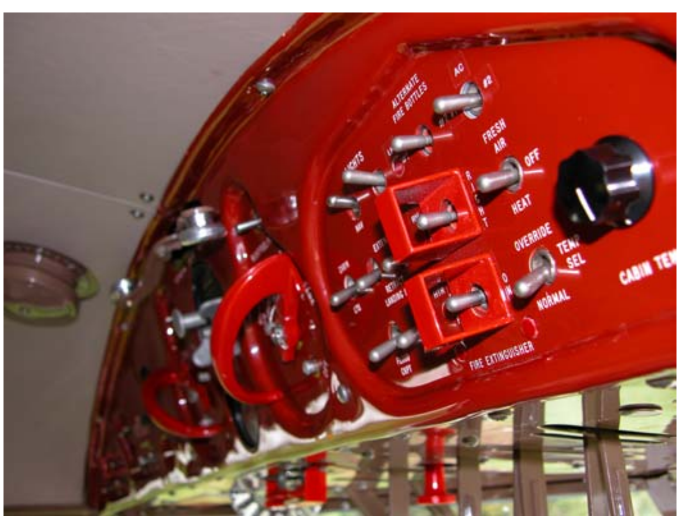
Grumman

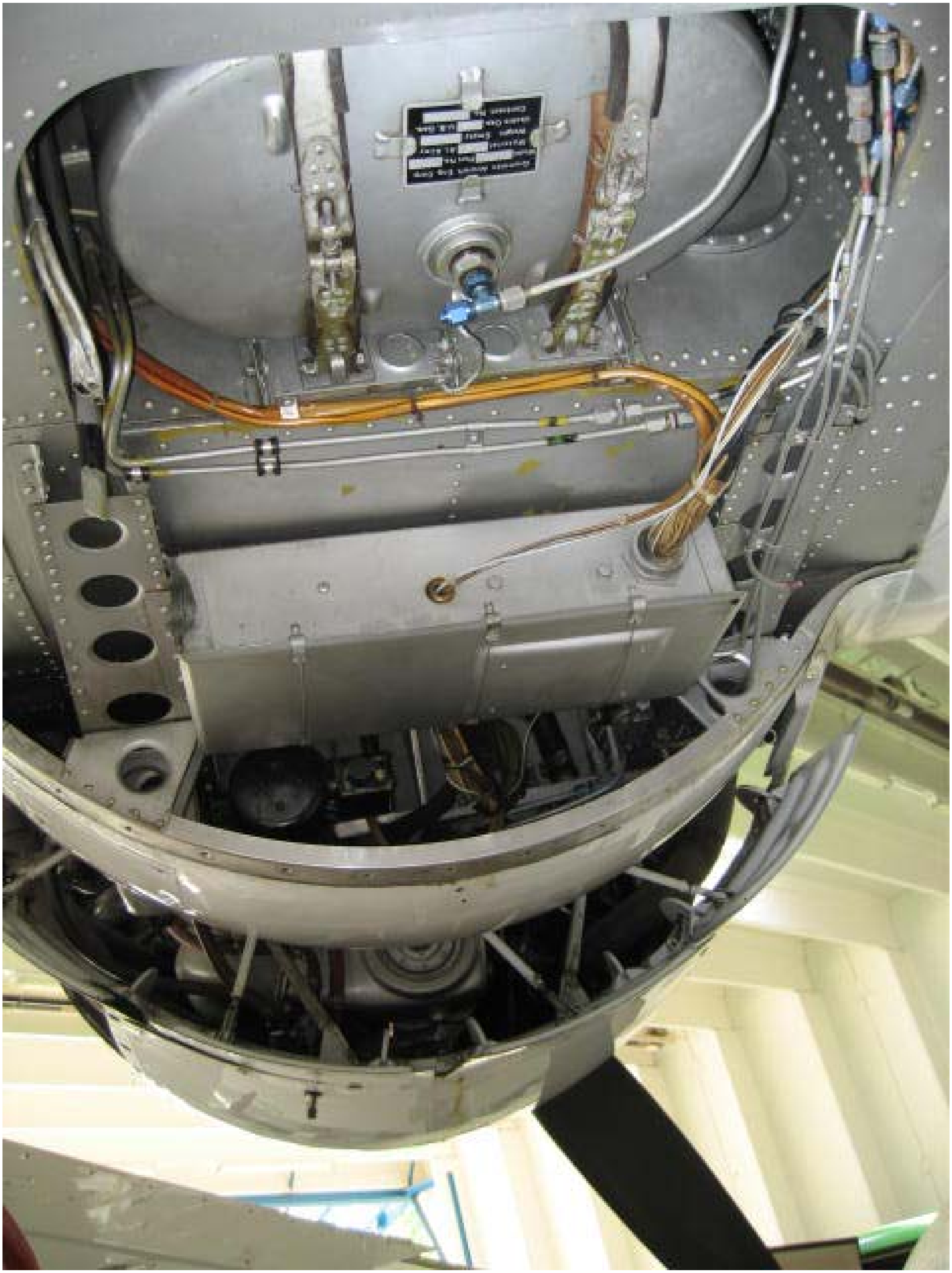


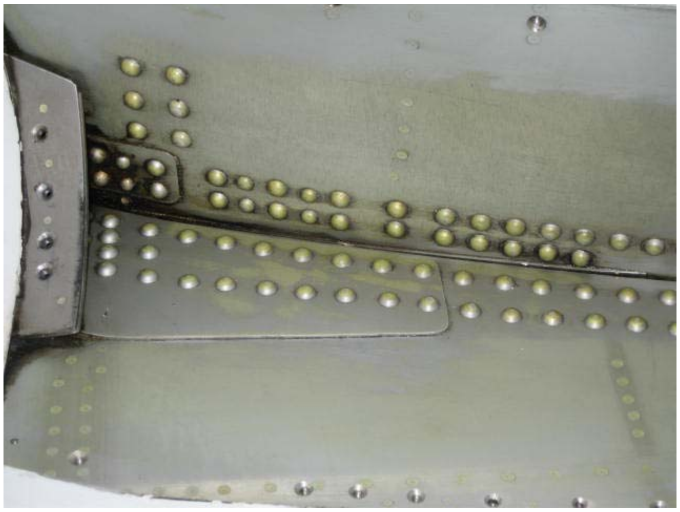

DOWN
NOSE WHEEL
UP

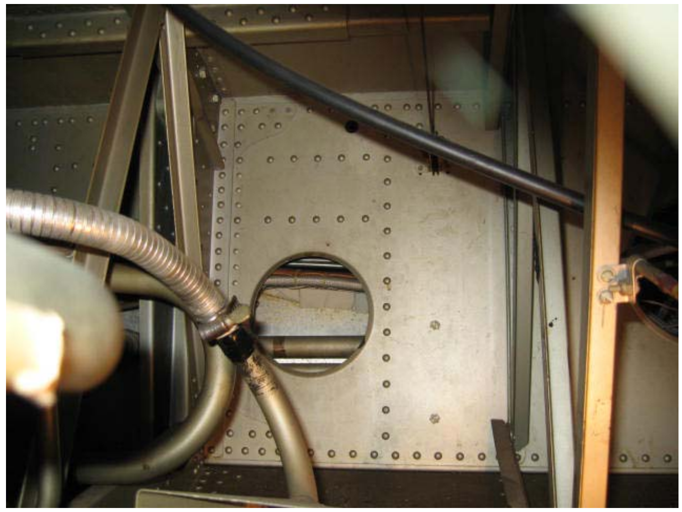


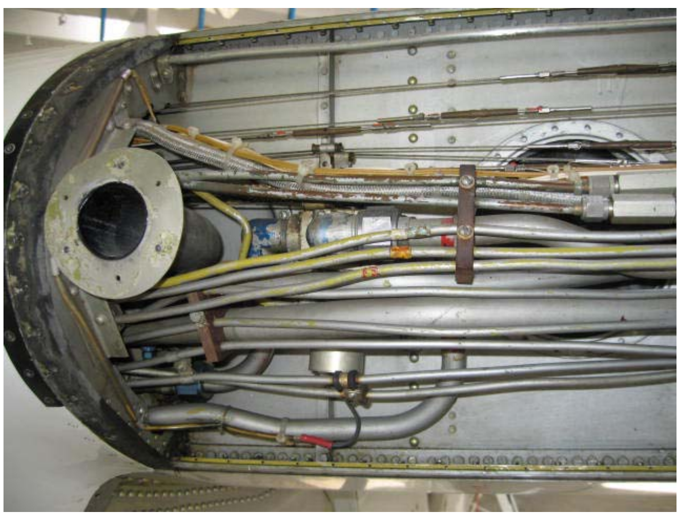
Attachment to GMOA/ Frakes Joint Submission to the NTSB

J13 2002 Oshkosh Antique/Classic Grand Champion









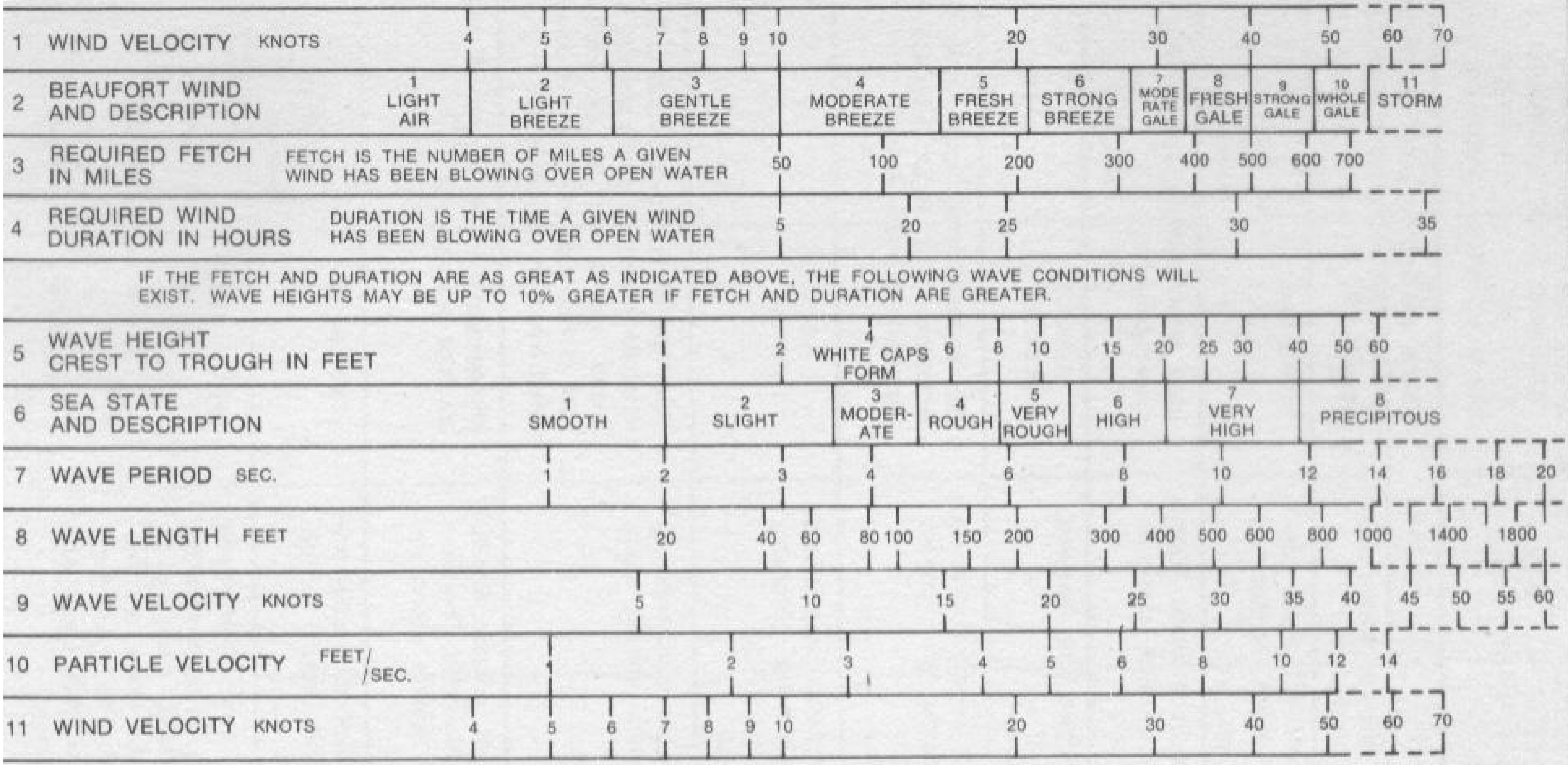
Grumman G73 Mallard Serial # J57.

Built 1951 Aircraft Total time: 11,655.4 hours

Estimated land landings	:	7631
Estimated water landings	:	1141
Estimated open ocean landings	:	0
Estimated Total landings	:	8772

Zero corrosion or structural deterioration--.
Typical of private/corporate Mallards operated within certified limits.

Figure 8—Wind Waves at Sea



This table applies only to waves generated by the local wind and does not apply to swell originating elsewhere.

WARNING: Presence of swell makes accurate wave observations exceedingly difficult.

NOTE: *(a) The height of waves is arbitrarily chosen as the height of the highest 1/3 of the waves. Occasional waves caused by interference between waves or between waves and swell may be considerably larger.*

(b) Only lines 7, 8, and 9 are applicable to swell as well as waves.

(c) The above values are only approximate due both to lack of precise data and to the difficulty in expressing it in a single easy way.

(d) Below the surface the wave motion decreases by 1/2 for every 1/9 of a wave length of depth increase.

(e) Observations and comments leading to increased accuracy and usefulness are desired.

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