DCH Marine, Inc.

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Venice, Fl. 34293
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U.S. Surveyors Association Member #40208H
www.dchmarine.com

June 13, 2003

This *Damage Survey* has been prepared exclusively for the client listed below or on their behalf by request of their insurance company under the terms of their insurance policy. The purpose of this report is to examine the damaged vessel, equipment or cargo to:

1) identify and document the vessel/equipment/cargo,
2) ascertain the probable cause of the damage,
3) estimate the cost to either repair or replace the item in question,
4) develop an outline for repairs, and
5) provide a current market value of the subject vessel/equipment/cargo.

This survey only covers a specific area of concern, as noted in the first paragraph below, and in no way should be considered a statement of this vessels usable condition or that it meets current minimum safety standards.

Nationwide Insurance Co.
ATTN:
12651 Mc Gregor Blvd.
Suite 401
Ft. Myers, Fl. 33919

Re: Your Insured, Robert
Claim #
DOL 4/26/2003

Our File # 03-113

Dear ,

Thank you for the assignment to document the above referenced claim for damage to the engine on Mr. vessel, allegedly from overheating caused by a restricted water inlet.

The Stated Facts of the Loss:

I interviewed the insured by phone on June 14th, 2003 while en route to Cape Coral to examine his vessel. The insured stated that while underway in the Caloosahatchee River and making way to the main channel, he felt the boat hit something in the water and the engine stalled. He stated the depth of the water was fluctuating between 4 to 6 feet, according to his depth finder and that he noticed sand/mud had been stirred up by the propeller. He then re-started the engine and began to make his way back to his residence, a 45-minute ride due to low speed zones. During his ride back to his house, he stated the engine began running worse and worse until it got to the point of stalling when allowed to run under 1,100 RPM's. The insured stated he was able to limp the boat all the way home and did not call Sea Tow, even though he is a member and a tow would have been free. During the trip he noticed the temperature gauge was running slightly higher than normal if he tried to run the engine very fast, so he kept the speed to the minimum amount possible without stalling.
At some later point, the insured had Sea Tow move the vessel to a repair facility at no charge. The repair facility did their preliminary check and disassembly of the engine and revealed a hole in the number 2 piston. After hearing the quote for repairs, the insured filed an insurance claim citing engine damage from overheating and water ingestion due to sand disabling the cooling system caused by vessel grounding.

The Insured Vessel:

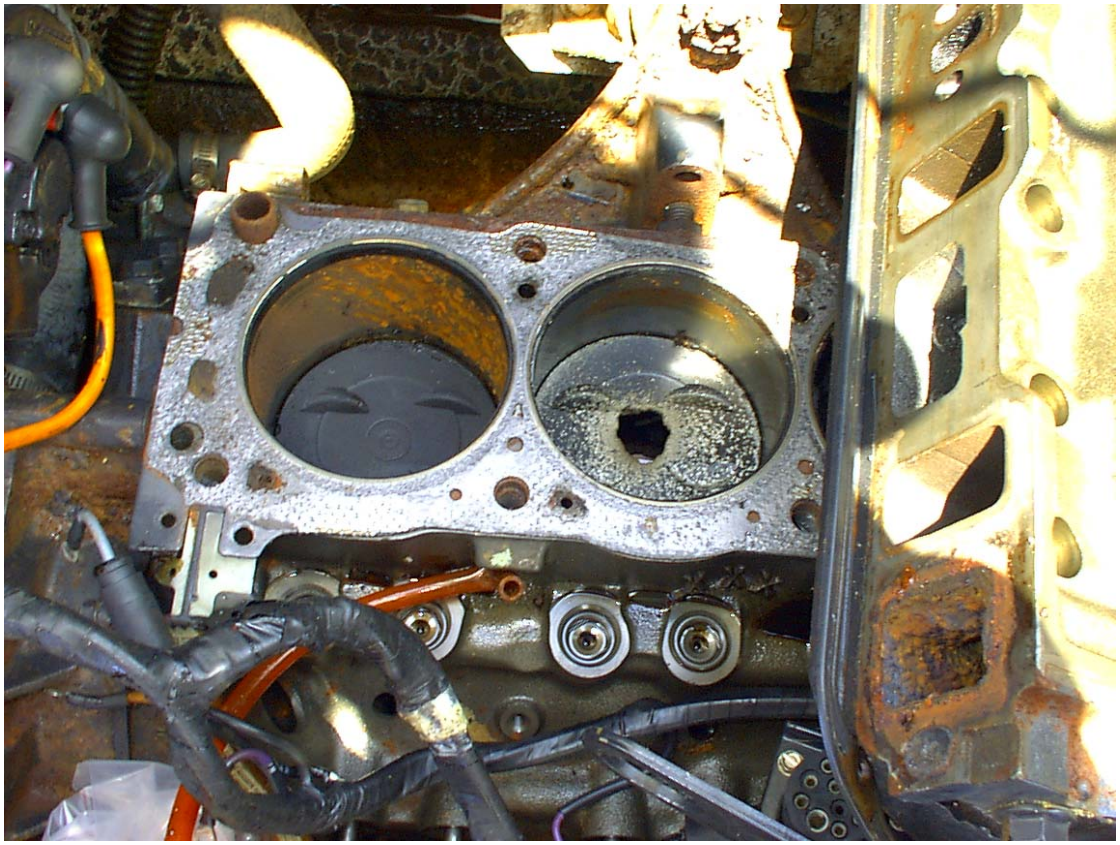
The insured vessel is a 1996 Hurricane Deck Boat, manufactured by Godfrey Marine. It is 24 feet in length and bears hull ID# GDY and Florida state registration # FL .
The vessel is powered by a single stern drive or inboard/outboard unit manufactured by Volvo-Penta Marine Group. The base engine is a Ford, 302 cubic inch, 5 liter, automotive engine which has been converted for marine use by Volvo-Penta Marine. The engine hour meter currently reads 447.0 running hours. The outdrive unit is manufactured by Volvo-Penta directly. It is a model # SX-C1 and bears serial number 4112017665. It has a 1.65:1 gear ratio. The engine is mounted in the vessel in the standard layout fashion, that being located all the way at the stern and it is covered by a sound deadening, lift-up type engine hatch. The engine is raw water cooled, meaning the engine uses water from the body of water in which it is operated in, for cooling purposes. The insured has owned the vessel since new and it was purchased at the facility, which is currently doing the repairs. The insured performs most of his own maintenance, according to the repair facility manager. The insured does not have a trailer for the vessel so the repair facility hauled and blocked the vessel in their repair yard when Sea Tow brought it in. The following photos show the cosmetic condition and layout of the vessel. The hull is badly weathered and chalked and the cushions are sun rotted. The insured stated he has ordered new interior cushions. The engine has recently had the spark plug wires changed and the exhaust manifolds and risers replaced. All of this work was performed by the insured.

Our Findings:

I inspected the vessel and the disassembled engine at Marine, , Cape Coral, Fl. I met with the service department manager, . He would not offer any information or insight into the probable cause of the damage due to liability concerns, only that the engine had a hole in one piston and the fact that Ford 302 engines are no longer available new. He said he gave the insured a price to repair the vessel of around $7500.00. This price is for a complete engine replacement with a new, Chevrolet, base engine complete with all the bolt on accessories.

This price also included the costs associated with modifying the engine mounting bed to fit the Chevrolet engine. I told him I knew of a source for remanufactured Ford engines and he told me he wouldn't be interested unless the supplier offered a parts and labor guarantee. He only wants to install engines which have such a warranty. I told him I didn't think the vessel's overall condition required that type of repair, as it would not be cost effective. I will give you a value analysis later in this report. Mr. did state the insured had fallen on some hard times and had done most of the repairs himself for the past few years in order to save money.

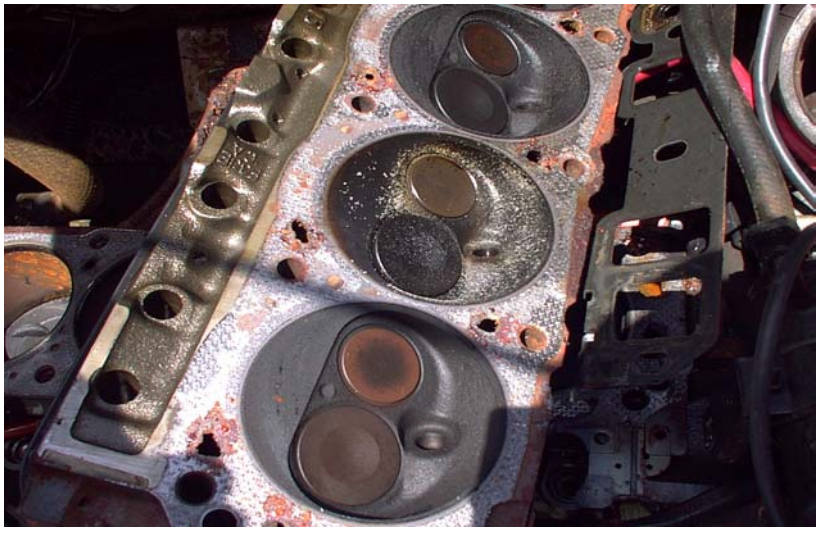
I started the inspection expecting to see an engine which had overheated to the point of blowing a head gasket or possibly cracking the cylinder head thus allowing water into the affected cylinder. That scenario sometimes causes a piston top to become very clean, almost looking brand new from the cold water being sprayed into a hot combustion chamber and loosening all the carbon which has built up over the years and expelling it out the exhaust. This engine was partially disassembled and I could find nothing visibly wrong with the head gasket on the right engine bank, no visible cracks in the cylinder head, no rust stains in the intake manifold for the affected cylinder, virtually no signs of water ingestion anywhere. The affected cylinder is the #2 cylinder, which is the second cylinder from the front of the engine on the right side, as viewed from the rear. The following photo shows the damage. In this photo, front is to the left.



As you can see there is a good size hole in the piston and the aluminum has gotten hot enough to spatter and stick to the rest of the piston and to the cylinder head. This usually does not happen from water getting in the cylinder. Engines usually do not get overheated enough to cause this

type of damage, they will usually seize up first from the oil being burned off of all the moving parts from the heat. By this point I had ruled out overheating as the cause of damage. I also examined the propeller and outdrive and noticed there was no "new" damage. There was a lot of old damage, but no recent evidence of grounding. See the following photos and notice the condition of the outdrive. The corrosion damage is fairly extensive.

While examining the cylinder head I noticed the spattered aluminum had migrated past the intake valve upstream towards the intake manifold. This is unusual because usually the melted aluminum, which doesn't stick to other engine parts, usually exits the engine through the exhaust. I never seen the melted aluminum remain hot enough, through the pistons remaining 3 strokes, to get up past the intake valve in the head. There is some time during the running cycle when both valves are open. This period is known as "valve overlap" however, on a marinized engine, this time is greatly reduced in order to keep sea water from being pulled back into the cylinder during the overlap period. This fact made me look elsewhere for the cause of the melted aluminum up in the intake channel of the head. Notice in the following photo how there is still carbon on the head surface, a sure sign there was no water in there. The silver is all spattered aluminum, melted from piston.

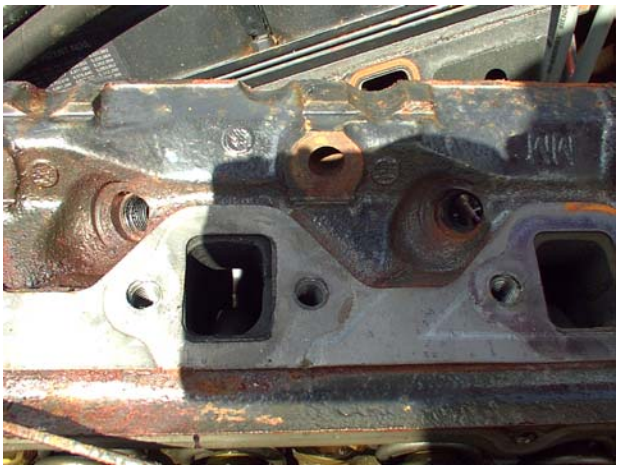


OK, at this point we have an engine which did not overheat and there is a hole in one piston not caused by water intrusion. That only leaves severe detonation (pinging) as the cause but only on one cylinder. Usually detonation is caused by too low of an octane rating on the fuel used for the compression ratio of an engine or the ignition timing is too far advanced.

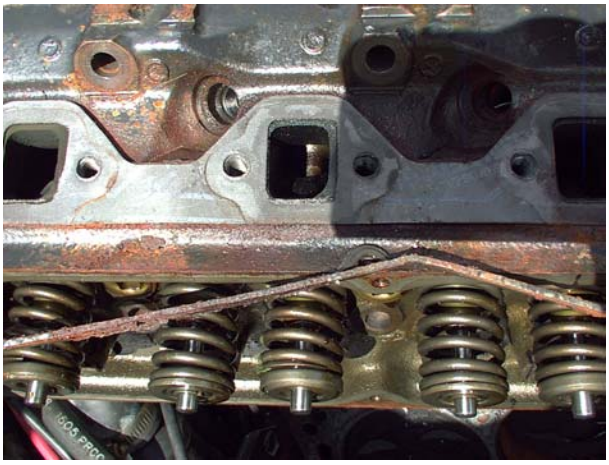
What I'm talking about here with ignition timing is this. Fuel and air is compressed in a cylinder by a piston moving up the bore and compressing the mixture against the cylinder head. There is an optimum time for the spark plug to ignite this compressed mixture to get the most "push" on the piston, forcing it back down in the bore and turning the crankshaft. This optimum time for plug firing is known as ignition timing and it varies depending on RPM (crankshaft revolutions per minute). At idle, which is about 600 RPM, the timing should be let's say about 8° before top dead center for most V-8 engines. This means the spark plug is timed to spark when the crankshaft is rotated to a point 8° before the piston reaches it's highest point in the cylinder. At 600 rpm, this amount of timing gives the compressed fuel/air mixture in the cylinder a chance to begin burning before the piston reaches it's optimum position for the oncoming explosion to force it back down the bore.

This amount of timing is fine for an idling engine, but as RPM's increase, timing must be advanced because the burn rate of the fuel is a constant. Therefore an engine running at 3600 RPM may have the timing advanced to lets say 40° for optimum performance. This adjustment is performed automatically by the distributor after base timing is locked in manually by the mechanic. Obviously, 40° of timing would not work at idle because the fuel/air mixture would explode in the cylinder before the piston got to the top of the bore and be forced backward, however if an engine had a slight mis-adjustment of the base setting, lets say to 12° rather than the specified 8°, the engine would still run, but because the fuel/air mixture was burning too soon, the engine would have a loss of performance, run hotter because it's working harder and the early explosion in the cylinder would cause a knocking sound from the backlash of the piston trying to be forced against the direction of travel. This "knocking" sound is commonly known as "pinging". Using too low an octane rated fuel can also cause pinging. The lower the octane rating, the faster the burn rate, so the less timing needed. It is possible for pinging (more profesionally known as detonation) in severe cases, to destroy an engine by overheating piston tops to the point of making holes in them. This information is all great except it usually affects all cylinders just about uniformly. In this claim only one piston shows detonation failure. That puts me in a quandry.

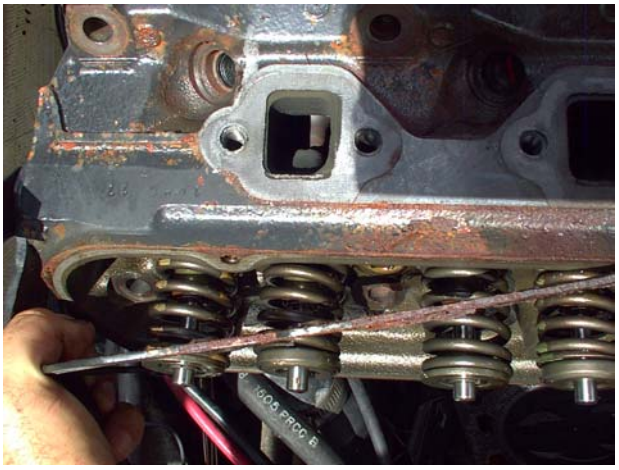
As I examined the exhaust ports on the right side cylinder head, I noticed the two center cyliniders appeared to not have been firing correctly for some time based on the wet residue around the valve stems caused by unburned fuel being exhausted past them. The two outermost exhaust ports had dry residue, consistent with a properly (or at least more normally) burned fuel/air mixture. I tried to capture how different these pors look in the following four photos, but it doesn't photograph easily. Basically, this means the two center cylinders were not firing properly on the right bank of this engine prior to disassembly. The spark plugs had been discarded, so I was unable to view them. One of these malfunctioning cylinders was #2, the one with the hole in it, as you might expect. The other malfunctioning cylinder was the one next to it, #3. We'll number the photos below from left to right starting at the top. Photos numbered 2 and 3 best show the difference in the residue in the exhaust ports. Photo #5 shows the new riser reportedly installed by the insured.



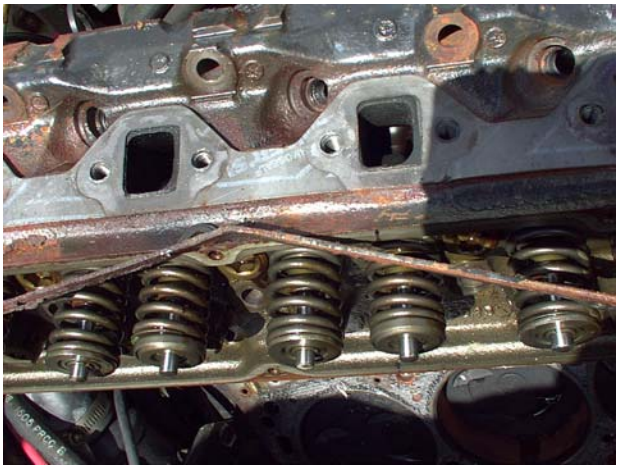
1



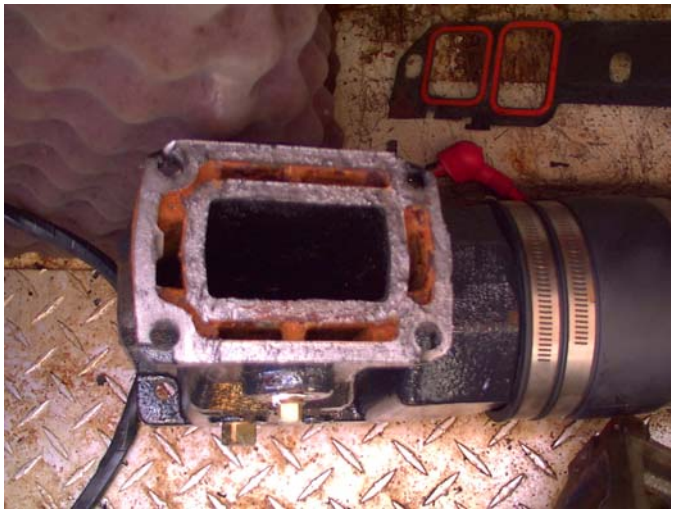
2



3



4



5

Continuing to work backwards in time from the time of damage, I noticed the insured had recently installed new exhaust manifolds and risers sometime prior to the loss. This in itself is a good thing, as these parts are one of the leading causes of premature marine engine failure. I didn't think these parts being installed had anything to do with the damaged piston. It was when I dug through the pile of removed parts from the disassembled that I realized what had happened to this engine. There were new plug wires in the pile. They looked as if they had been installed about the same time as the exhaust manifolds, which would make sense, as they have to be removed to take the manifolds off the engine. At this point I realized what caused the number 2 piston to detonate to the point of failure while the number 3 piston next to it wasn't burning all the fuel supplied to it. The person who installed the new plug wires mixed up the two cylinders. They put the wire intended for number 3 on the number 2 plug and vice-versa. It can happen very easily because of the extent that everything is disassembled to change the manifolds.

I asked the service manager, if he could put aside his liability concerns long enough to look up the cylinder firing order for this particular year and model engine. He did. Every engine has a specific order in which the cylinders fire in order to minimize vibration and reduce undue stress on the crankshaft. Now stay with me here! This particular engine fires in the following order: 1,3,7,2,6,5,4,8. Ford engines' cylinders are numbered 1,2,3,4 on the right bank and 5,6,7,8 on the left bank. This claim involves a hole in the #2 cylinder and the unburned fuel residue in the cylinder next to it, #3. Let's say you swap these two plug wires, what would happen? According

to the firing order #2 would fire in place of #3, a full 2 positions early. How early is that? Well, there are 360° in a full crankshaft revolution. This is an 8 cylinder engine, so 8 ÷360° = 45°. That means there is a piston firing at every 45° of crankshaft rotation. Now take one cylinder and move it up two places in the firing order. That cylinder is now firing approximately 90° before top dead center, and thats at idle!! That means it could be as much as 130° before TDC at 3000 rpm!! The engine would still run because the other cylinders would carry the load, but when the #2 cylinder fires, the tendency would be for the crankshaft force to be slowed at that point. This would cause really poor performance and severe detonation on one cylinder. As RPM increases, the problem gets worse. This explains how the melted aluminum got up inside the intake valve port. At some point, the RPM actuated advance is enough to cause the burned fuel to be forced back up the intake port because the intake valve is still open to allow the fuel to get into the cylinder! Now, the #3 cylinder has the #2 wire on it, so in this scenario, that cylinder is firing about 90° after it should. This condition is not as dramatic as the other cylinder, but is does cause the fuel/air mixture in the cylinder to be expelled through the exhaust before it is fully burned, so this cylinder is not putting out it's full potential and it is leaving a wet residue in the exhaust port. How long does it take to do all this damage? Well the insured stated it is about a 45-minute trip to get to where the engine trouble started. This was mostly at low speed. The engine hatch is somewhat soundproofed, so he may not have heard 1 cylinder pinging. About the only sign he would have had would have been poor performance and higher than normal operating temperature, both of which he mentioned in his statement. He said the boat acted like it was overheating, but the gauge only read a little over normal, certainly consistent with the scenario set forth above. So, round trip, 90 minutes with one cylinder running at an average timing advance of 90°, that's long enough to melt a piston for sure.

In Summary:

Unfortunately, this looks like a case where an attempt to save money is going to end up costing quite a bit. Obviously, the insured has some amount of mechanical ability, how much is unknown. This problem was caused by a simple mistake of replacing two plug wires in improper positions. This lead to one of the cylinders' ignition timing to be advanced so far, it detonated a hole in the piston. I asked the service manager at Marine if they would consider removing the engine, replacing the piston and performing a valve job to clean up the heads. This is the most cost-effective means of repair for this engine and it is very feasible because it was not overheated and there was no salt-water ingestion. There is also very little wear on the cylinder walls. The manager agreed it could be repaired this way but said there would be no warranty on the work. I don't think that is going to be a problem as there was no warranty on a vessel which is 7 years old and has 447 hours on the engine anyway, and this repair method will put the insured almost exactly back to pre-loss condition.

As I stated earlier, Ford no longer makes new 302 or 351 engines, so rebuilds are all that is available, and they are getting harder to find. The marina will not guaranty the labor should one of these engines I've mentioned, fail while under warranty from the rebuilder, and most rebuilders won't pay labor to swap an engine that's failed. The marina wants to convert the vessel to Chevrolet power, which means the insured gets all new pumps, manifolds, carburetor,

etc. The boat is just not worth that much expense. I'm sure that $7,500.00 quote plus tax is at least 70% of what the vessel is actually worth. This vessel is over insured by about $10,000.00.

The following pages contain an estimate of repairs needed to remove the engine and outdrive, replace the affected piston and rings and perform a valve job. There is also a current market value statement based on comparable listings, recent sales and published price guides.

This report is designed to help the insurance company representative settle this claim once liability has been established. This report, shall not be considered a commitment of liability on the insurance company's behalf. As always, the insurance company representative should apply the guidelines of their policy to this report and any other supporting documents and statements and settle accordingly.

This vessel **was not** inspected for safety and/or compliance with any governing codes or agencies as it is a damage survey only and only addressed the damage arising from the insurance claim stated above.

The preceding examination was made using visual, non-destructive means only. There was no removal of machinery, linings, bulkheads or decking unless specifically noted in this report. The vessel was judged for safety and compliance based on standards set forth by the NFPA code 302, ABYC, US Coast Guard, UL, and the US Code of Federal Regulations titles 33 and 46. The accuracy of this report is limited to the scope of the inspection.

This marine survey has been prepared and submitted in good faith and without prejudice. It is a visual description of said vessel in the opinion of DCH Marine, Inc., Captain Don Hunter, Master Marine Surveyor, as then found and to the best of his ability. The surveyor assumes no responsibility for any defects, errors or omissions and shall be held harmless for any subsequent condition which may arise. This survey does not guarantee either expressed or implied, the condition of this vessel. Our opinion is derived after inspection of said vessel, any pertinent documents or statements provided by the vessel owner/client and the performance of all systems tested. This survey will only be considered complete and usable when full payment is received from owner/client, signed by the attending surveyor and the company seal embossed on this page. Payment for and or use of this report constitutes this agreement.

Thank you for your business and the trust you have placed in us.

Sincerely,

Captain Donald C. Hunter, MMS
President, DCH Marine, Inc.
U.S. Surveyors Association Member #40208H

Value Assessment:

1996 Godfrey Hurricane 24' Deck boat w/210 HP Volvo I/O……$11,500.00 (rough)

No trailer.

This value has been derived by consulting published regional price guides, recent comparable sales and comparable vessels currently on the market. This average price is then adjusted accordingly for condition, options and wear and tear.

The following page contains an estimate to repair the vessel to its pre-loss condition. I have reviewed this estimate with at the repair facility and reached an agreed price with them. Although they agreed to the price, I explained they have to have approval from the vessel owner before any further repairs can take place as he will be the one to expect payment from.

The estimate provided herein is for your convenience only and should not be considered a judgment by this company as to whether this is a covered loss or not or to what extent Nationwide is liable. Please apply the guidelines of your policy and adjust as necessary.

There is the possibility a supplement will be needed. During the course of performing a valve job, the machine shop may find that some of the valves and/or valve guides may need to be changed. There is also the issue of all the corrosion due to saltwater operation hindering the removal of the outdrive and engine mounts. I added a provision in the estimate for dealing with the corrosion in the form of additional labor time, but there is the chance a part will be damaged during the process. These items may have to be dealt with at a later date, should an issue arise.

ITEM DESCRIPTION	UNIT PRICE	QTY	TOTAL	HRS.	% ADJ	OWNER	INS. CO.
Remove and Re-install outdrive				3.0			
Additional labor adjustment for excessive corrosion				2.0			
Remove and Re-install engine assembly incl alignment				5.0			
8 cylinder Ford 302 valve job (basic machine work)	250.00	1	250.00				250.00
Remove and re-install cylinder heads				9.0			
Marine head gasket set, Napa # HS3530VM	215.98	1	215.98				215.98
Replace # 2 Piston, Napa # 2241916	14.92	1	14.92	2.0			14.92
Press piston onto rod (machine shop)	15.00	1	15.00				15.00
Single piston rod bearing, std. Napa # CB634P	4.30	1	4.30	incl			4.30
Piston Ring set, std. Napa # 50564	40.40	1	40.40	incl			40.40
Oil Pan gasket set Napa # 0S30531	20.89	1	20.89	incl			20.89
Oil filter	6.95	1	6.95	incl			6.95
6 Qts Oil	2.00	6	12.00	incl			12.00
8 spark plugs	1.95	8	15.60	incl			15.60
Haul, block and launch	5.00	24	120.00				120.00
SUB TOTALS			$716.04	21.0			$716.04
TOTAL LABOR HOURS	21.00	@	$60.00	PR.HR		= $1,260.00	
TOTAL PARTS						= $716.04	
SUB TOTAL						$1,976.04	
TAX			6%			= $118.56	
TOTAL FROM PAGE 2							
CLAIM TOTAL						$2,094.60	
CUSTOMER TOTAL		+	DED	$500	=	$500.00	
INSURANCE TOTAL						$1,594.60	