ENGINE REBUILD REPORT

Motor Vessel Columbia

for

State of Alaska

Division of Marine Transportation

Department of Public Works

by

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for

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SUMMARY

The Enterprise Engines powering the Motor Vessel Columbia of Alaskan Marine Highway were studied during their state of rebuilding in late January, 1981. Data was examined which had been recorded during the disassembly of the engines prior to rebuilding. Discussions were also held with operating and administrative personnel. Conclusions drawn from analysis of the data lead to performing Non-Destructive Testing (ultrasound and Die-penetration) of the blocks of both engines. Cracks were found to be present in all four blocks of the engines.

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INTRODUCTION

The M/V Columbia was observed on January 21, 1981 and on subsequent days during the rebuilding of its main engines. The engines had been disassembled and many of their components were being refurbished. Some of the cylinder liners on the main car deck appeared to have been honed for replacement. Others showed heavy interior groving and apparently would not be replaced.

Limited measurements of the block and liners confirmed that deformation was producing out-of-round block and cylinders. In both the main and counterbore regions a growth in diameter and a change from circular to oval shape were evident. The counterbore depth of the block was also slightly increased.

No heads were available for inspection, but it was reported that there was a significant problem with the lifetime of the heads. Problems were in the head-to-block sealing and valve guide sealing and life, with excessive carbon residue in the combustion chamber and carbon blow-by into the valve covers.

Non-destructive testing of the block was performed to search for cracks and interstitial failures. Radial cracks outward from the cylinder bore and delamination cracks were found in the blocks of both engines.

Cylinder Bore

Figure 5 shows the data from the December 19, 1980 measurements apparently taken from data recorded on December 3, 1980 (see Figures 1, 2, 3, and 4). In addition to diameter measurements, these figures also show data on the crush measurements for the counterbore. The curve in Figure 5 was added by the investigator to show the average growth in diameter for all cylinders.

The measured values on bore diameter and ovalness (Figures 1, 2, 3, and 4) indicate that the block was experiencing long-term permanent deformation and the effects of creep and fatigue. Because these effects are to be suspected, an exact metallurgical explanation for the microscopic flow phenomena is difficult to make without a thorough examination.

The ovalness of the cylinders, which are greatest in the center of each block, is probably a result of the same combination of effects producing the uniform growth of the cylinder bores. Because growth is seen to be greatest in the middle of the block where temperatures are highest, the cause is probably a creep-temperature relation. At the ends of the block where metal is at room temperature large expanses of metal are resisting this deformation. Because the center of the block is hotter than the metal at the ends, the pattern of growth into non-round cylinders is expected to continue. The cylinder bores are all growing at about the same rate throughout both engines and can be expected to continue at the same or an increasing rate.

	Crush	Counter-bore Depth	Liner Flange Thick	Counter-bore ID	Liner Fl. OD	Block ID	Liner OD	Crush	12-78 Workbook
1	.003	1.5055	1.506	19.523	19.494	19.008	18.995		
3	.0022	1.505	1.506	19.516	19.494	19.008	18.994		.0055
6	.002	1.505	1.506						
9	.0013	1.504	1.503						
12	.005	1.5055	1.505	19.522	19.504	19.009	18.997		
3	.0035	1.504	1.504	19.514	19.495	19.006	18.997		
6	.003	1.504	1.507					.006	.0055
9	.0025	1.504	1.505						
12	.006	1.513	1.506	19.522	19.499	19.010		.0059	
3	.006	1.513	1.505	19.514	19.497	19.004		.0059	.0025
6	.005	1.515	1.505					.0025	.006
9	.006	1.514	1.505					.0025	
12	.003	1.503	1.505	19.518	19.497	19.010	18.998	.0053	
3	.0045	1.5035	1.505	19.509	19.490	19.002	18.995	.0095	.005
6	.002	1.5045	1.506					006	.009
9	.0035	1.503	1.504					.007	
12	.003	1.504	1.504	19.524	19.495	19.012	18.997	.0075	
3	.0027	1.5035	1.503	19.511	19.494	19.003	18.996	.005	.005
6	.002	1.5035	1.5035					.006	.0080
9	.0023	1.504	1.504					.0075	
12	.0025	1.504	1.507	19.525	19.497	19.011	18.995	.0075	
3	.0025	1.505	1.503	19.512	19.496	19.008	18.991	.0072	.005
6	.002	1.5045	1.506					.005	.008
9	.0027	1.505	1.506					.008	
12	.002	1.503	1.506	19.522	19.495	19.008	18.998	.007	.006
3	.0017	1.5045	1.505	19.515	19.494	19.005	18.997	.008	.0085
6	.002	1.505	1.506					.007	
9	.0017	1.5055	1.507					.0075	
12	.001	1.505	1.504	19.521	19.494	19.008	18.997	.004	.0035
3	.0015	1.505	1.504	19.514	19.493	19.006	18.994	.0105	.0105
6	.001	1.5055	1.504					.007	
9	.001	1.506	1.505					.005	

Figure 1

:s	Crush	Counter-bore Depth	Liner Flange Thick	Counter-bore ID	Liner Fl. OD	Block ID	Liner OD	Crush	12-78 Workbo:
12	.004	1.505	1.505	19.520	19.494	19.006	18.997		
3	.0027	1.504	1.505	19.516	19.495	1 .005	18.997		.003
6	.003	1.504	1.505						.0085
9	.0017	1.504	1.505						
12	.0025	1.503	1.505	19.520	19.495	19.008	18.998	.005	
3	.0028	1.502	1.505	19.516	19.494	19.005	18.996		.005
6	.0025	1.5025	1.503					.0065	.008
9	.0025	1.5025	1.503						
12	.005	1.5035	1.504	19.523	19.498	19.009	18.997	.005	
3	.0037	1.5055	1.504	19.512	19.497	19.004	18.998	.006	.0035
6	-.001	1.509	1.504					.0065	.0065
9	.000	1.506	1.505					.006	
12	-.001	1.503	1.505	19.528	19.495	19.013	18.997	.006	
3	-.0025	1.503	1.505	19.512	19.496	19.002	18.997	.0055	.0055
6	-.002	1.502	1.505					.0055	.007
9	-.0018	1.504	1.505					.0055	
12	-.001	1.5065	1.502	19.526	19.493	19.012	18.997	.005	
3	-.0007	1.507	1.503	19.5 2	19.493	19.003	18.997	.005	.004
6	-.002	1.505	1.502					.0075	.008
9	.0007	1.505	1.503					.0071	
12	.002	1.505	1.505	19.525	19.495	19.010	18.999	.0055	
3	.0015	1.507	1.505	19.515	19.493	19.004	18.997		.004
6	.001	1.505	1.505					.004	.0065
9	.001	1.507	1.505					.004	
12	.002	1.505	1.505	19.523	19.495	19.010	18.998	.005	
3	.0025	1.504	1.505	19.515	19.494	19.005	18.997	.0055	.004
6	.002	1.505	1.505					.004	.005
9	.0022	1.505	1.505					.0042	
12	.002	1.505	1.507	19.525	19.496	19.011	18.999	.005	
3	.0017	1.505	1.506	19.516	19.494	19.005	18.997	.006	.0045
6	.001	1.507	1.506					.006	.006
9	.002	1.507	1.506					.0095	

Figure 2

:9	Crush	Counter-bore Depth	Liner Flange Thick	Counter-bore ID	Liner Fl. OD	Block ID	Liner OD	Crush	12-78 Workbee
12	.005	1.502	1.505	19.520	19.499	19.007	19.001		
3	.0045	.504	.503	.517	19.497	.008	18.995		
6	.004	.501	.506					.009	.007
9	.0045	.502	.504						
12	.005	1.503	1.504	19.522	19.501	19.009	13.997		
3	.0035	.500	.504	.514	19.500	.002	18.995		
6	.003	.504	.504					.018	.0055
9	.0045	.504	.504						
12	.004	1.503	1.505	19.526		19.010			
3	.004	.503	.504	.513		.003	18.996		
6	.004	.503	.506					.006	.007
9	.004	.504	.505						
12	.004	1.504	1.506	19.525		19.012	18.997		
3	.0035	.502	.506	.510			18.996		
6	.004	.503	.507			19.001		.006	.0055
9	.004	.503	.506						
12	.004	1.503	1.504	19.520	19.509	19.011	19.006		
3	.005	.503	.503	.509		.002			
6	.004	.501	.504					.021	.045
9	.006	.504	.506						
12	.006	1.501	1.506	19.522	19.498	19.009	19.001		
3	.005	.501	.506	.512	19.443	.003	18.995		
6	.005	.501	.505					.008	.0065
9	.006	.502	.506						
12	.006	1.503	1.506	19.521	19.496	19.009	19.000		
3	.005	.501	.506	.514	19.496	.004	18.999		
6	.006	.502	.506					.001	.005
9	.0055	.503	.506						
12	.006	1.503	1.507	19.519	19.500	19.008	19.002		
3	.006	.501	.503	.516	19.492	.006	18.992		
6	.005	.503	.506					.009	.0055
9	.0055	.503	.506						

Figure 3

?s	Crush	Counter-bore Depth	Liner Flange Thick	Counter-bore ID	Liner Fl. OD	Block ID	Liner OD	Crush	12-78 Workbo
12	.009	1.504	1.506	19.519		19.006			
3	.0075	.502	.506	.516		.006			
6	.010	.503	.507						.006
9	.0095	.502						.0025	.080
12	.005	1.502	1.506	19.523		19.009			
3	.005	.503	.505	.515		.004	18.999		
6	.006	.504						.006	.005
9	.005	.503							
12	.005	1.503	1.506	19.528		19.011			
3	.0045	.503	.506	.513		.001			
6	.003	.505						.007	.005
9	.0035	.502							
12	.004	1.503	1.505	19.526		19.015			
3	.005	.504	.505	.511		.003			
6	.004	.505						.005	.005
9	.004	.504	.506						
12	.004	1.503	1.506	19.526		19.012			
3	.004	.502	.505	.516		.002			
6	.004	.503	.506					.009	.004
9	.004	.502	.505						
12	.004	1.503	1.506	19.528		19.009			
3	.0045	.502	1.504	.516		.001			
6	.004	.504						.006	.004
9	.003	.502	.506						
12	.004	1.503		19.524		19.009			
3	.004	.502		.515		.006			
6	.004	.503						.005	.005
9	.0035	.500	.504						
13	.005	1.504	1.504	19.523		19.007			
-	.0035	.502	.504	.524		.006			
6	.003	.503	.504					.004	.004
9	.0035	.503	.503						

Figure 4

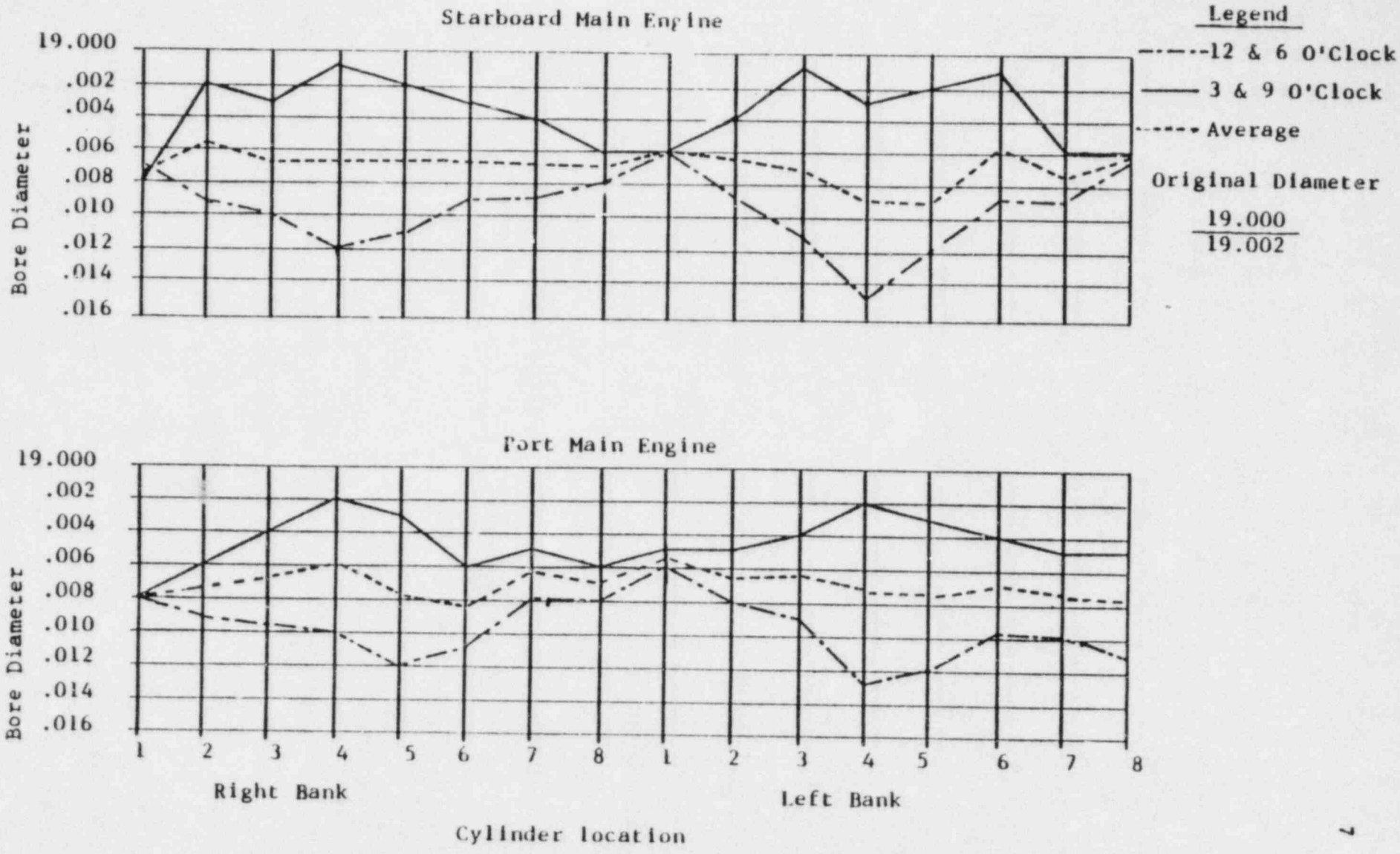

Starboard Main Engine
Legend
12 & 6 O'Clock
3 & 9 O'Clock
Average
Original Diameter
19.000
19.002
Bore Diameter
19.000
.002
.004
.006
.008
.010
.012
.014
.016
Port Main Engine
Bore Diameter
19.000
.002
.004
.006
.008
.010
.012
.014
.016
1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8
Right Bank
Left Bank
Cylinder location

Figure 5

An exaggerated view of this effect shows that the entire block is growing larger, but ballooning out in the center more than at the ends. This permanent strain can be understood by creating a fictitious stress which would be necessary to squeeze the block back to its original outside dimensions to produce circular cylinder bores along its length. This is estimated to be

$$\text{Stress} = \in E = \frac{(.010")}{(10")} \qquad E = 30{,}000 \text{ psi}$$

Thus, an external clamp would have to be put on the engine to squeeze the central intercylinder webs to 30,000 psi to place the bores in symmetry. Continued deformation, caused by both cyclic and thermal stresses, results in fatigue failures. Two observations can be made:

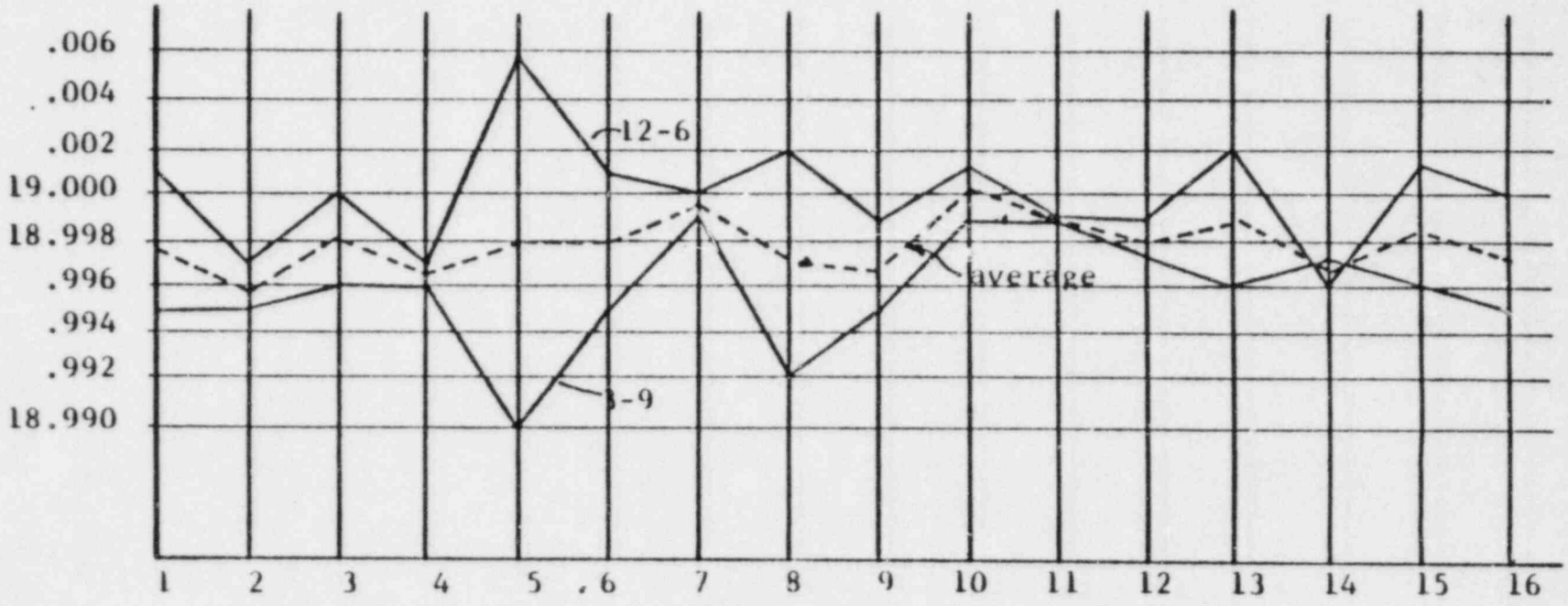
1. The interweb areas are subject to fatigue cracks, and
2. Continued deformation will produce more severe problems from out-of-round cylinders being used with round pistons and rings.

There is danger from failure due to diameter change and increasing ovalness. These effects will continue to aggravate the situation causing shorter lifetime between rebuilds.

Measurements of the cylinder liners show that they are experiencing a similar but smaller effect in dimensional change than the block. This is to be expected as the constraining features of the block will not allow the liners to have a greater change than the block.

The liners do not show as great an oval shape as does the block. The starboard engine liners are plotted in Figure 6. In Figure 7, the average values of liner change are plotted with the average values of block change showing the block to have increased in diameter more than the liner. This difference is plotted in Figure 8.

Perminent Liner Deformation, Bore Diameter



Cylinder No., Clockwise from Right Front

Figure 9

Perminent Deformation of the Cylinder bore and the Liner Bore

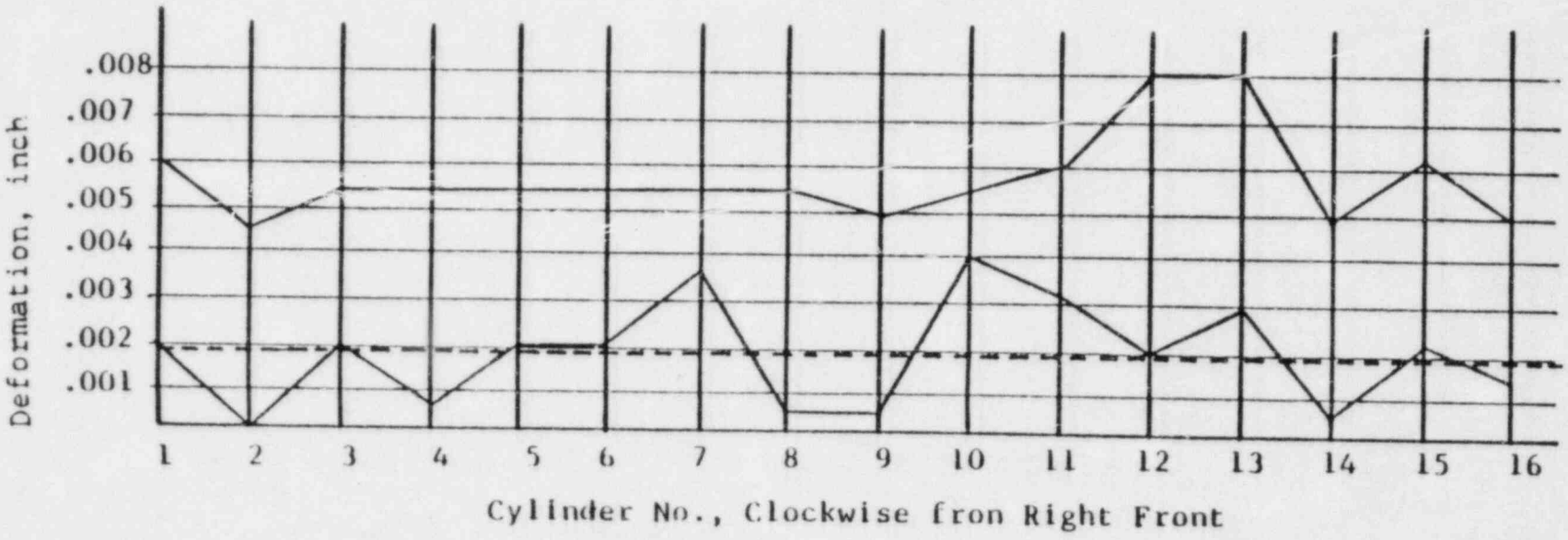
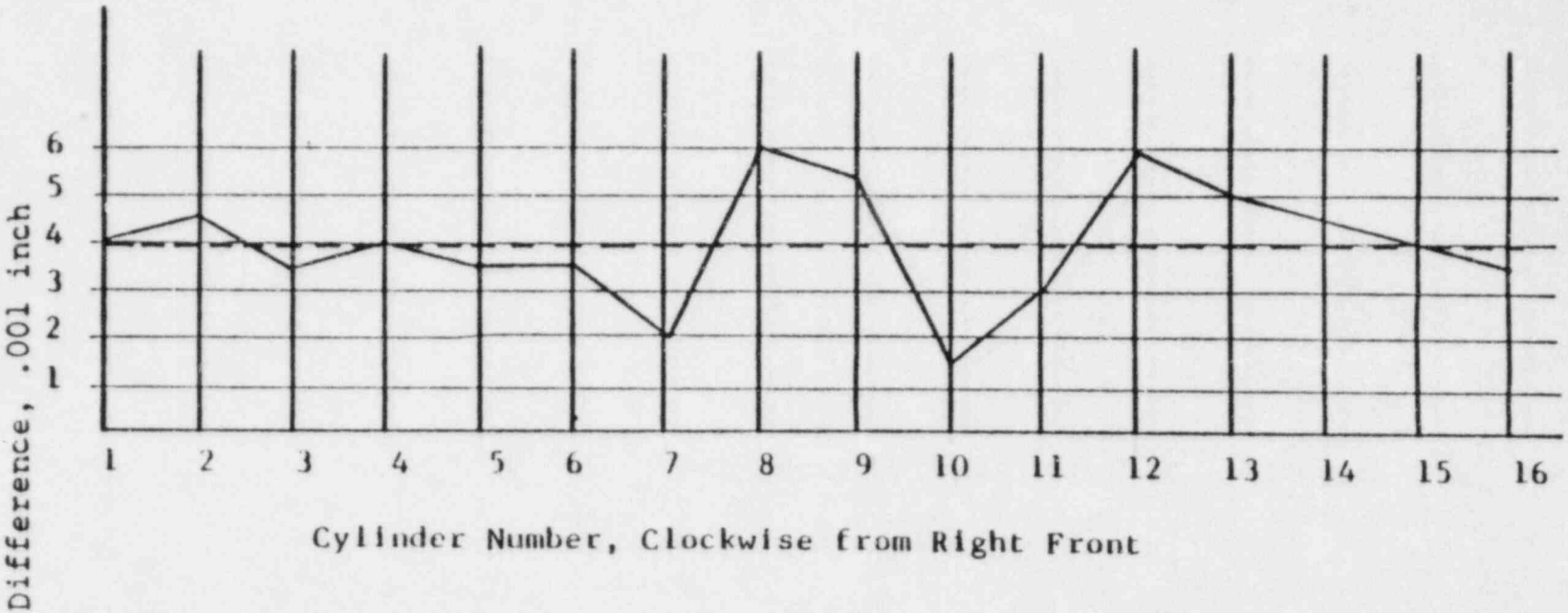


Figure 10

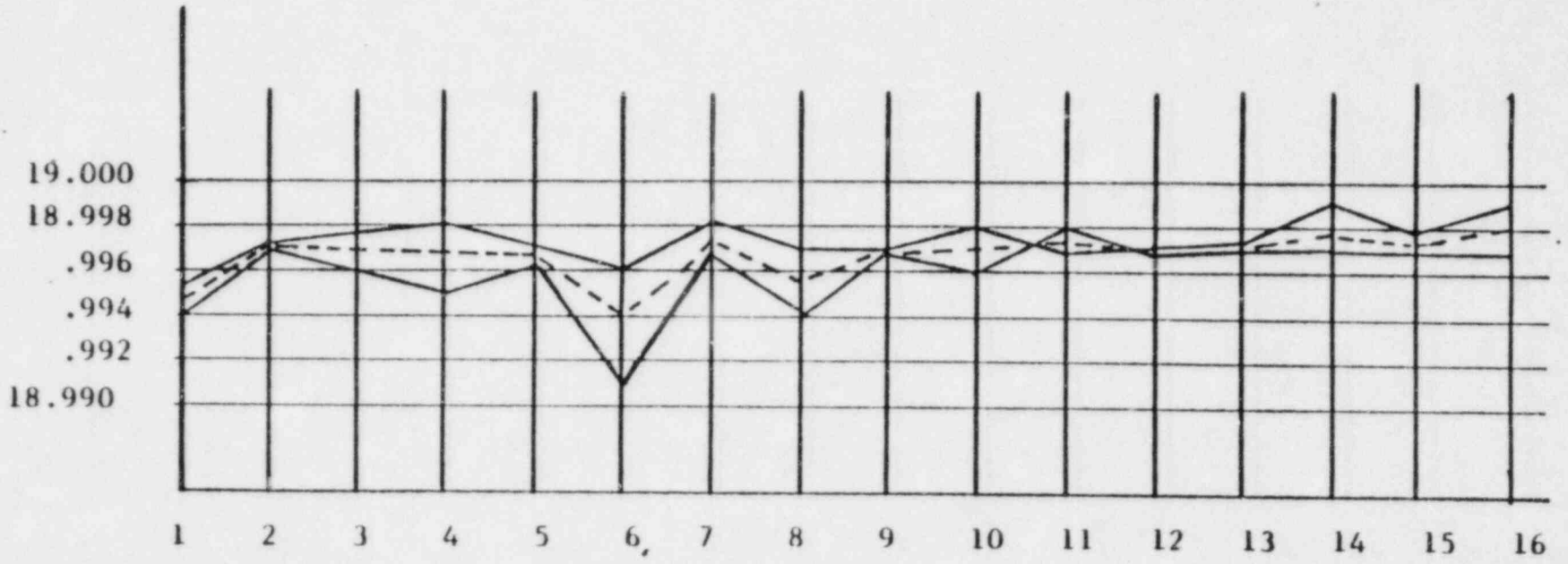
Average Difference between the Block and the Liner Bore Diameter



The average clearance between the liner and the block has increased .005 inch. The clearance difference explains why it was easier to remove the liners when they were cold. Under operating conditions, the effects of internal pressure and temperature gradient from the interior of the cylinder to the water jacket produces liner expansion to where it deforms to follow the shape of the block. Initial calculations indicate that during operation in the firing cycle, the cylinder-to-block compression force will be 27,000 psi.

Non-destructive testing was performed on all cylinders about the circumference of the bore at the top of the block. Figures 10 and 11 show the results of these studies. Radial cracks were found on one or more cylinders in all four blocks. These cracks are a result of the creep and fatigue at the top of the block. These cracks are radial extending outward from the cylinder bore and are generally either between the cylinder bore and a smaller block drilling such as head stud, or water-jacket passage. These openings will have produced local stress concentrations and, hence, the resulting fractures from creep and fatigue stresses.

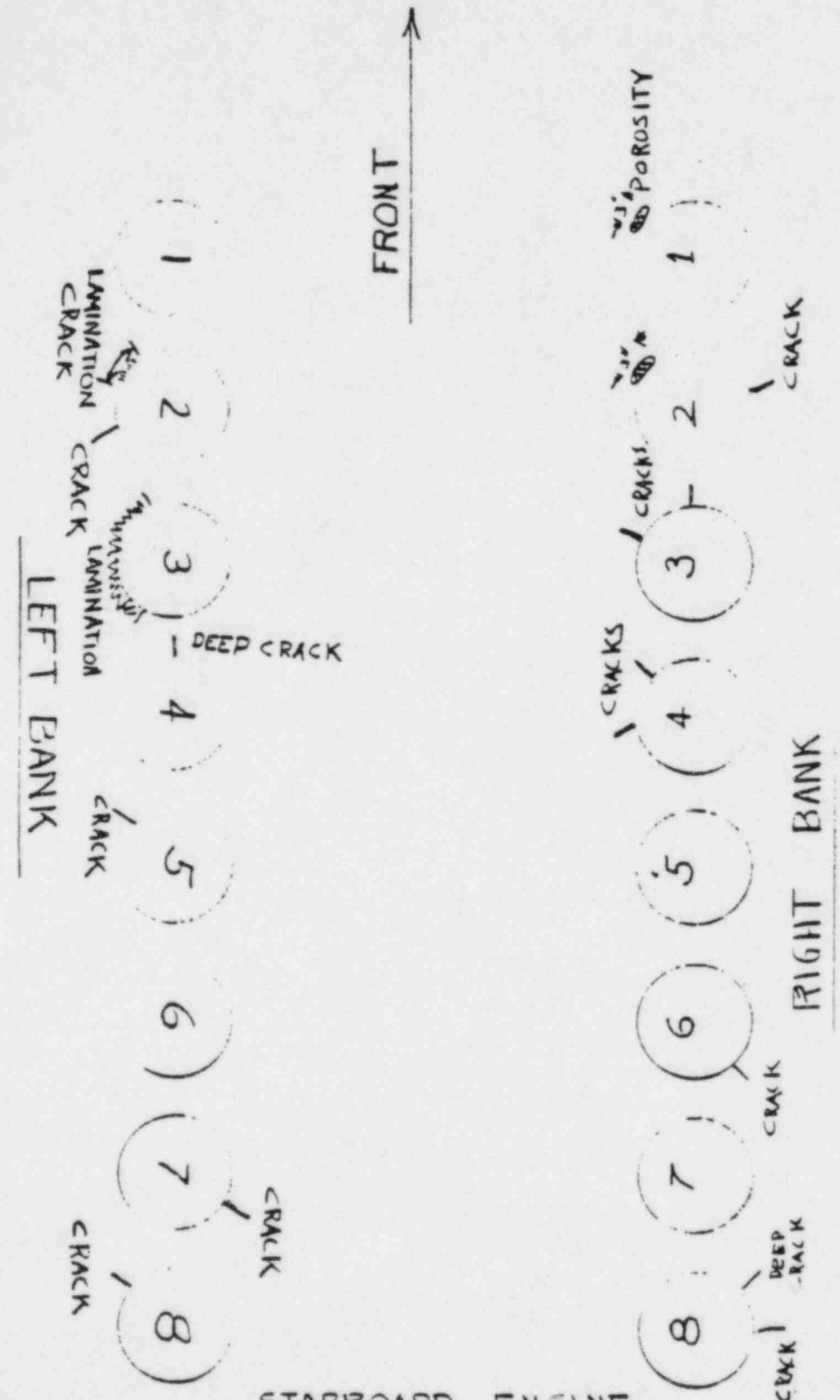
Liner Bore, Port Main Engine



Cylinder Number, Clockwise from Right Front

Figure 15

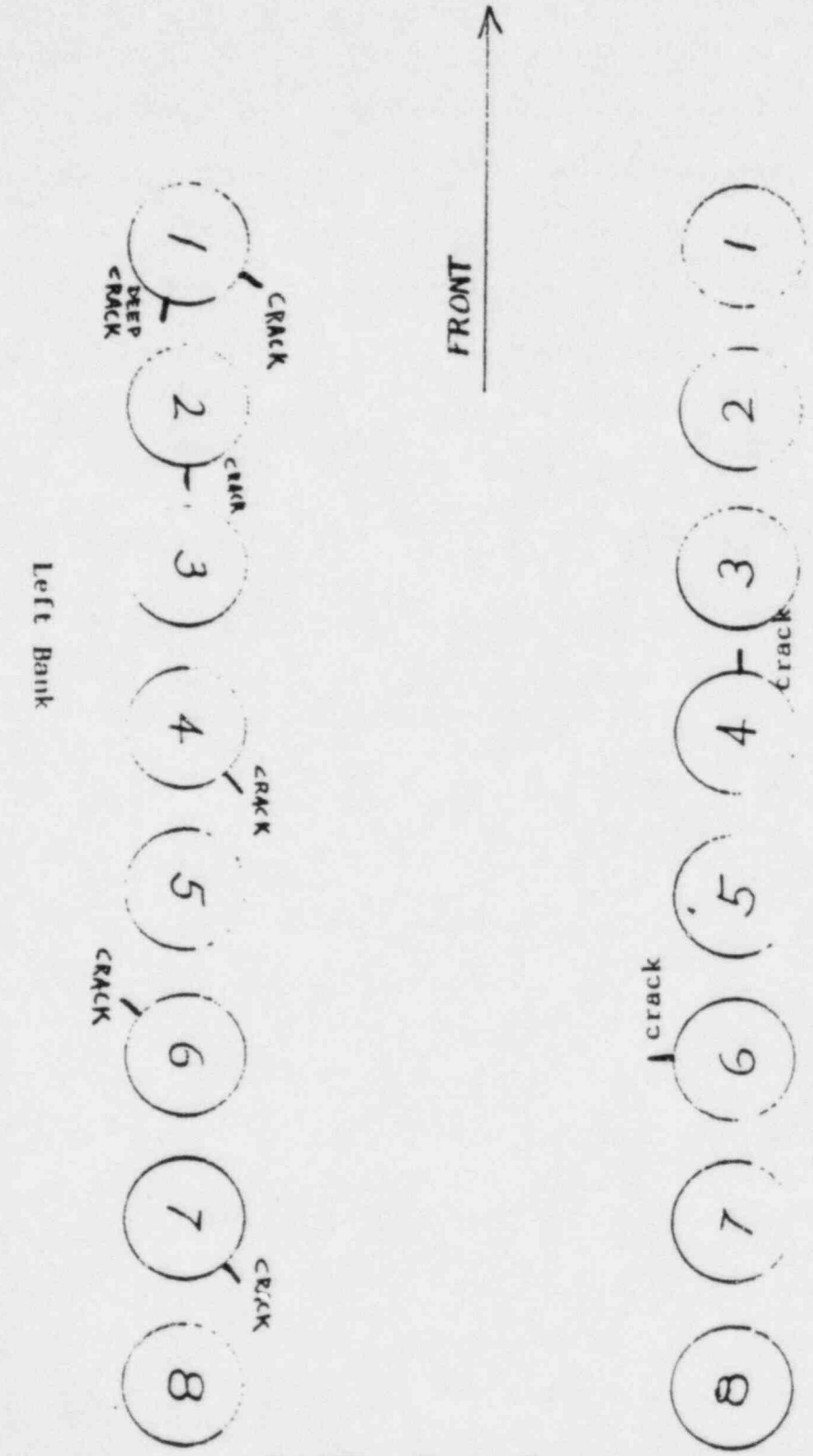
NONDESTRUCTIVE TESTING



STARBOARD ENGINE
ULTRASOUND EXAM

Figure 10

NONDESTRUCTIVE TESTING



PORT ENGINE
ULTRASOUND EXAM

Figure 11

Cylinder Liner Crush

The cylinder liners are by a lip at the top where there is an increase in diameter to form a ridge. This increases the top of the cylinder liner from 19.000 inches to 19.500 inches. The width of the ridge is 1/4 inch and it is 1½ inch deep. This matches a corresponding counterbore in the block. Dimensional differences are such that the cylinder liner extends approximately .004 inch above the top surface of the block. When the head is placed on the engine, it rests on the liner and clamps it into the block when the nuts are torqued to specifications (3600 ft-lb). This size difference and subsequent clamping action is referred to as the "crush."

The data relating to the dimensions of the liner thickness and block counterbore depth are given in Figures 1, 2, 3, and 4. They have been extracted and plotted in Figures 13 and 14. This represents a measured effect in that the counterbore depth of the block is becoming deeper with time while the liners are remaining stable. The apparent growth of the liners has been that they are being delivered with dimensions that are .001 or .002 inch larger than is given in the factory specifications.

The counterbore depth in the blocks has increased .005 inch for the starboard engine (Figure 13) and .005 inch for the port engine (Figure 14).

The explanation for this increase in counterbore depth is that the high forces on the counterbore lip in the block have produced a high state of stress. This state of stress is caused by the preload in the studs holding the head to the block. The preload comes from the torque applied to the nuts during assembly (3600 ft-lbs). The force is all carried by the counterbore lip (¼ inch wide) and results in a compressive stress of 76,200 psi.

Measurements on the block indicate that permanent deformation is taking place to lower the lip in the block. Non-destructive tests showed:

Ultrasonic testing:

Laminar fractures outward from the root of the counterbore in cylinders 3 and 4 of the left bank of the starboard engine (Figure 15).

Die penetration:

Confirmation of the extent of the above fractures by showing their entrance at the metal surface in the roots of the counterbore in cylinders 3 and 4 of the left bank of the starboard engine.

STBD - Crush

	Counterbore	Avg.	Less 1st .5	Liner		Avg. Change -3.75
1 -	9/4	2.25	2.75	18/4	4.5	.75
2 -	11/4	2.75	3.25	16/4	4.0	.25
3 -	13/4	3.25	3.75	20/4	5.0	1.25
4 -	12/4	3.0	3.5	25/4	6.25	2.5
5 -	11/4	2.75	3.25	17/4	4.25	.5
6 -	5/4	1.25	1.75	23/4	5.75	2.0
7	9/4	2.25	2.75	24/4	6.0	2.25
8 -	10/4	2.50	3.0	24/4	6.0	2.25
9 -	11/4	2.75	3.25	20/4	6.25	2.5
10 -	12/4	3.0	3.5	23/4	5.75	2.0
11 -	13/4	3.25	3.75	24/4	6.0	2.25
12 -	16/4	4.0	4.5	23/4	5.5	1.75
13 -	10/4	2.5	3.0	22/4	5.5	1.75
14 -	11/4	2.75	3.25	27/4	6.75	3.0
15 -	8/4	2.0	2.5	23/4	5.75	2.0
16 -	12/4	3.0	3.5	17/4	4.25	.5
		Avg. Value	Avg. Loss =			Avg. Growth
		1.50251	3.01			1.72

Figure 13

Counterbore - Port Main Engine

	Average		Loss (i.e. +.5)	Liner		Growth	Avg. Crush
1 -	19.5/4	4.875	5.375	21/4	5.25	1.5	.375
2 -	17.5/4	4.375	4.875	21/4	5.25	1.5	.875
3 -	5.5/4	13.75	14.25	21/4	5.25	1.5	-8.5
4 -	14/4	3.5	4.0	20/4	5.0	1.25	1.5
5 -	15/4	3.75	4.25	16/4	4.0	.25	.25
6 -	18.5/4	4.625	5.125	22/4	5.5	1.75	.875
7 -	18/4	4.5	5.0	24/4	6.0	2.25	1.5
8 -	21.5/4	5.375	5.875	12/4	4.25	.5	-1.125
9 -	17/4	4.25	4.75	20/4	5.0	1.25	.75
10 -	10/4	2.5	3.0	18/4	4.5	.75	2.0
11 -	24/4	6	6.5	17/4	4.25	.5	-1.75
12 -	12/4	3	3.5	20/4	5.0	1.25	2.0
13	23.5/4	5.875	6.375	10/4	2.5	-1.25	-3.375
14 -	24/4	6	6.5	20/4	5.0	1.25	-1.0
15 -	19/4	4.75	5.25	20/4	5.0	1.25	.25
16 -	24/4	6	6.5	25/4	6.25	2.5	.25
		Avg. Loss (excluding #3)	5.125			Avg. Crush (excluding #3)	.225

Figure 14

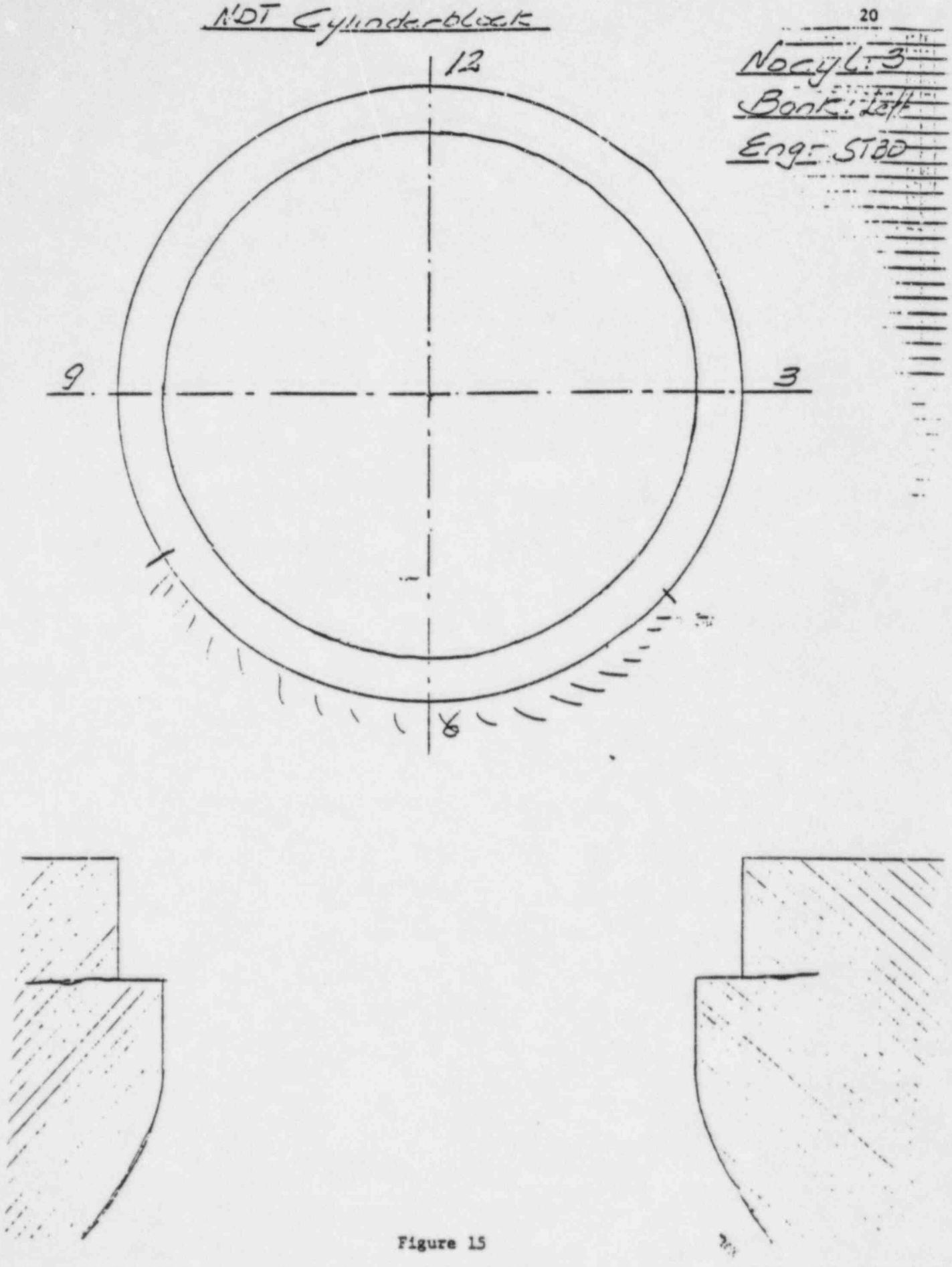


Figure 15

Block Hold-Down Bolts

Discussions with ship personnel indicated that one of the hold-down bolts for the block had broken. The bolt at cylinder B, left bank of starboard engine, had been replaced, and the remaining hold-down bolts had just been retorqued up to 4500 ft-lbs. During retorquing the maintenance personnel had moved in a circular fashion about the periphery of the block, recording the torque value where the nut began to turn.

An analysis was made of the port and starboard engine hold-down forces resulting from the bolt preload to determine the strength of the block-to-base attachment. The forces were calculated using the standard dry-torque coefficient (.20). Hold-down forces for each cylinder were obtained using the four bolts at the corners of each cylinder. The forces generated during maximum operating conditions was taken, using Dcyl - 17 in. and Pmax - 1500 psi. When this force was plotted for the operating condition (see Figure 18), it was seen that the starboard main engine was only marginally operable before retorquing. Two cylinders (R-6 and L-8) were grossly below acceptable limits of block-to-base preload, and cylinders R-4, R-5, R-7, R-8 and most of the left bank were close to separating from the base.

The fracture of the hold-down bolt for the block and the subsequent retorquing of all bolts indicates a need to repeat the retorquing procedure following methods outlined in the engine manual.

Block to Crankcase Bolts
Starboard Main Engine

T=torque (ft-lb)

F= force (lb)

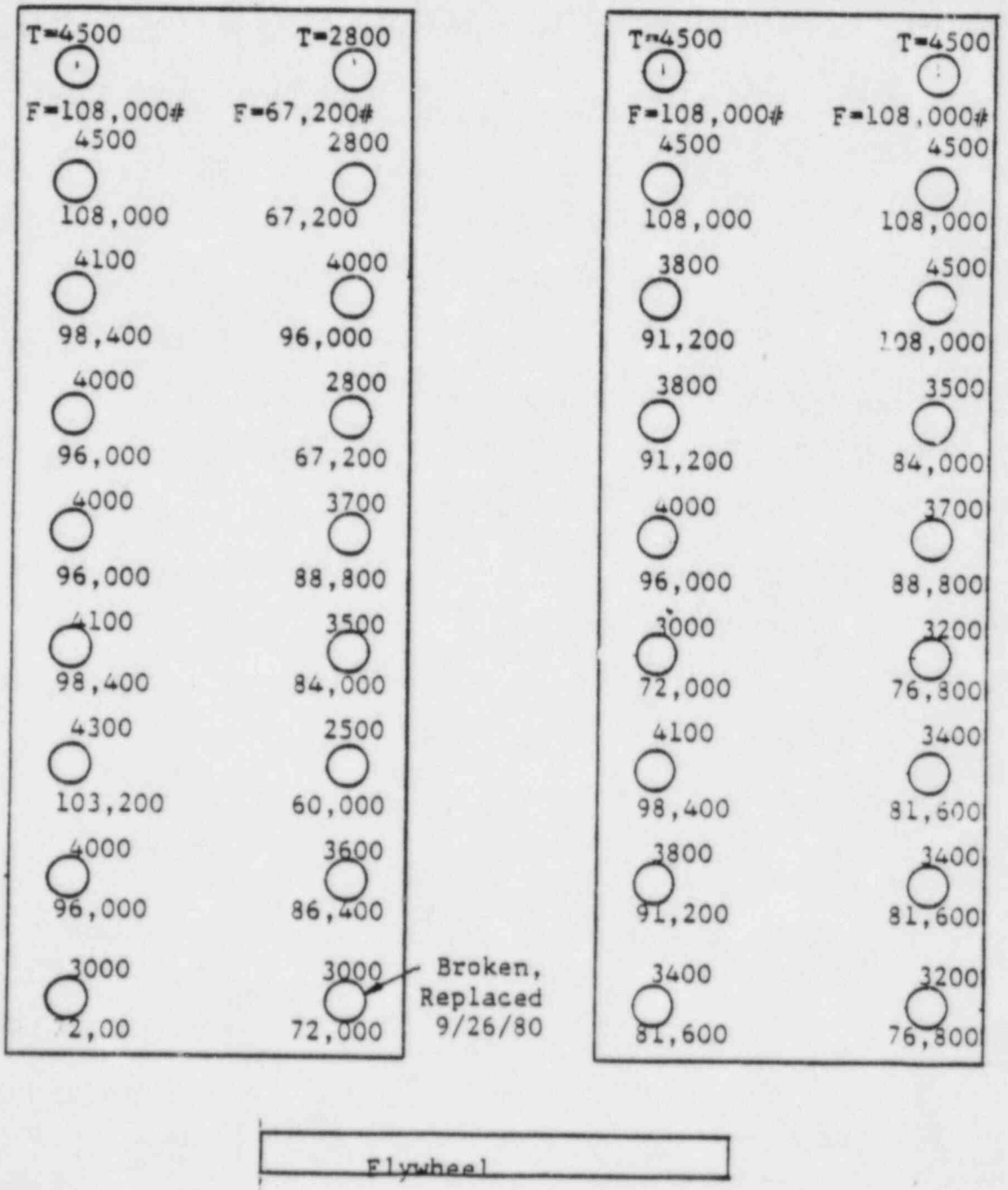


Figure 16

Block to Crankcase Bolts

Dec. 31,1980

Port Main Engine

T= torque (ft-lb)

F= force (lb)

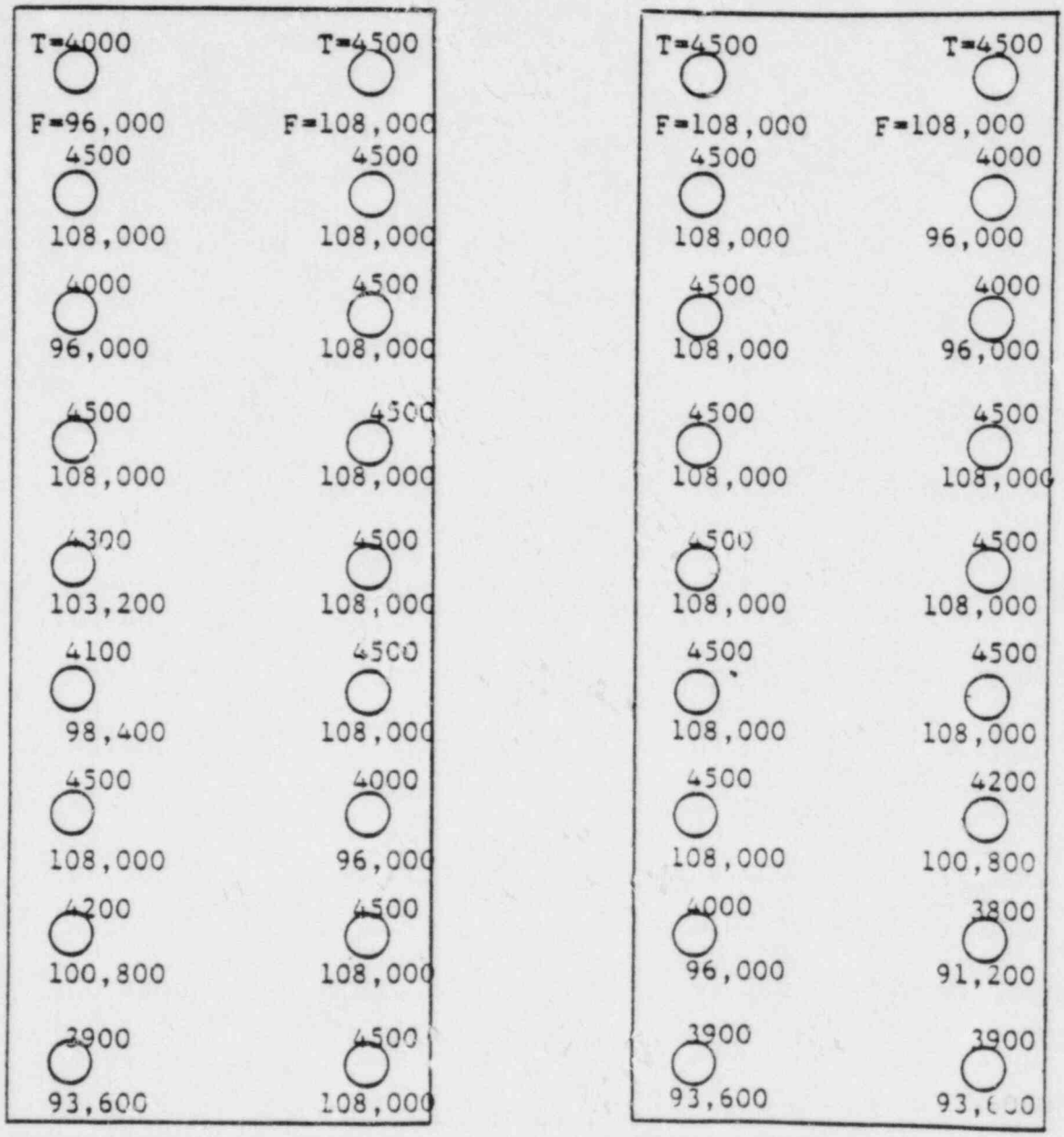
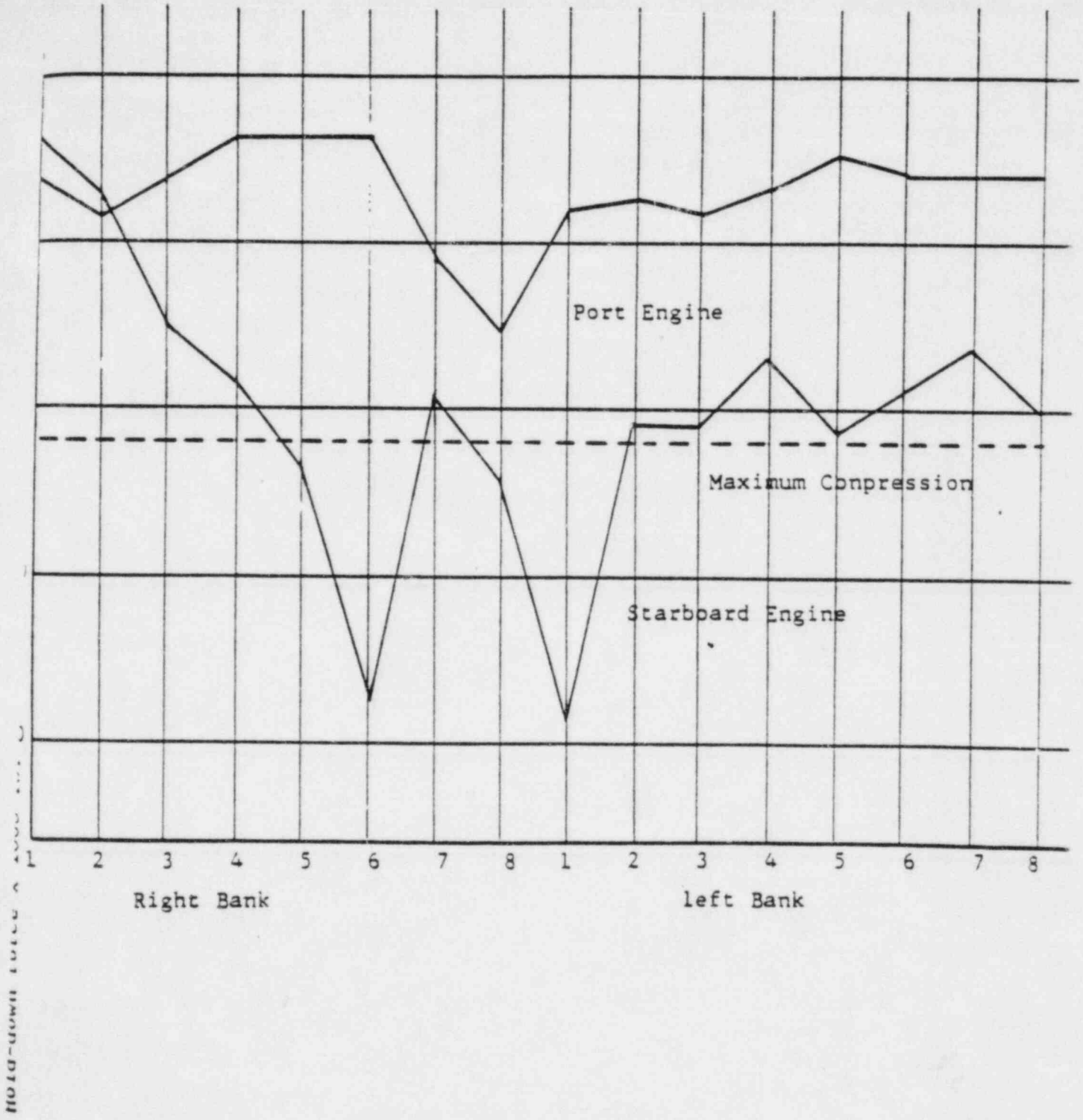


Figure 17

Engine Block to Base hold-down Force



RECOMMENDATIONS

1. That all block-to-base bolts be torqued according to the procedure described in the instruction manual, page 5-6, using the value given in Appendix IV, page 8-5, Torque = 4500 ft-lb. This procedure requires loosening, relubricating, and retorquing to factory specifications. Retorquing is a definite requirement for the starboard engine and highly recommended for the port engine.

2. That some modifications be made to the engine during the rebuilding procedure to bring the engine to a better operating condition. Changes include:

    a. Restore all cylinders to a circular shape.

    b. Reestablish a normal crush at the lip of the liner.

3. That changes be made to the block to include:

    a. Rebore the block at the bore to a circular shape, with the dimensions: $\frac{19.022}{19.020}$

    b. Reestablish the counterbore to a new depth with the dimensions: $\frac{1.515}{1.514}$

4. That metal be added to the liners' bore and counterbor crush surfaces to replace the metal removed in remachining the block. The values are:

    Bore: $\frac{19.017}{19.015}$

    Counterbore crush: $\frac{1.5195}{1.5180}$

5. The laminar fracturing of the left block of the starboard engine has rendered it unserviceable; it or the entire engine must be replaced.

6. Because the remaining three blocks have been shown to have radial cracks about several of the cylinders, this condition must be closely monitored to observe the cylinder diameter growth in an attempt to perform corrective maintenance before major problems occur.

7. Plan to replace the remaining three blocks in the near future.

8. Consider redesign of the upper portion of the block for replacement to alleviate observed block failure.

CONCLUSIONS

Examination of the blocks and cylinder liners for the main engines of the Motor Vessel Columbia indicates that there are specific areas of concern for the future useful life of the engines. The permanent deformation of cylinder bores and counterbore ledge will require major reworking. Laminar fracture of the left block of the starboard engine renders it unserviceable. Rebuilding the existing blocks could be done, but the decisions to do so must give considerable weight to the existing fractures, the inability to arrest continued deformation, and the possibility that the remaining blocks will fail as did the left-starboard bank.

STATE
of ALASKA

MEMORANDUM re M/V COLUMBIA

TO: Ron Lind
Deputy Commissioner
DOT&PF

DATE: June 17, 1981

FILE NO:

TELEPHONE NO:

FROM: Max Zbinden
Assistant Port Engineer
AMH, Seattle

SUBJECT: M/V COLUMBIA; Engine Rebuild Report MARCH 31, 1981 (JACOBSON REPORT)

Subject report was initiated to gain information concerning the cause of unsatisfactory M/V COLUMBIA engine performance and reliability. The report supports many of our prior conclusions. The findings are generally agreed with, however, clarification is deemed necessary in some areas.

The following comments relate to specific elements of subject report and expands on them and the conditions as found upon completion of M/V COLUMBIA main engine rework. The numbered comments pertain to like numbered areas in the attached report.

1. The preliminary report, consisting of 27 pages, is attached as an appendix to the end of this report. (See Section VIII). This portion was developed early in the repair period and prior to the determination that all four engine cylinder blocks required renewal.

2. The one and only breaking of a tie bolt occurred in September (not December) 1980. It was replaced upon vessel's arrival in Seattle. The remaining tie bolts were not properly retorqued at that time because to do so would have required engine disassembly and unacceptable cancelled sailings.

3. This was not a "retorquing procedure" There was concern over whether another tie bolt was broken or if one or more had become loose. It was done as a check and time did not permit a proper retorque procedure. The check did reveal that several bolts were undertorque and necessitated further inspection as soon as the vessel could be removed from service. Because of existing engine blowby and short lube oil filter life problems, this was known to be not too far off.

4. It is assumed that these were properly torqued at the factory at engine assembly. None had ever been disassembled or retorqued by the crew prior to this overhaul period.

5. Normal practice has been to reinstal' the liners back into the same position from which removed. This because the liners take a set in use and mate with the cylinder hole in the block.

One point not noted in the report, which would effect the liners as well as the cylinder heads and blocks, has been the past need to relax and disassemble these items because of continued repair action. The conditions and stresses are disturbed repeatedly and can have a profound effect on the engine itself. A medium speed diesel engine in this H.P. range should just be approaching its first major overhaul interval, based on M/V COLUMBIA operating hours. We have been through 5 major overhauls in the same period.

6. Remachining of the Port Main Engine cylinder block in way of #3 cylinder was accomplished approximately two years ago because of a loss of liner crush. The counterbore depth was increased .013 inch and a .020 inch thick spacer installed. Measurements taken of the same bore this overhaul revealed that some of the liner crush had again been lost.

7. Measurements of liner lip on newly received cylinder liners revealed some to be .002 to .003 inches thicker than specified. This was not programmed for by Transamerica Delaval. When they were made aware of the situation, they agreed to cover local costs for machining the liners to the intended specification. This would have delayed the engine reassembly, was not deemed critical and the new liners were therefore installed as received.

8. Disagree with the statement that "the liners are maintaining their manufactured dimensions during their useful lifetime". That is, unless it is understood that "useful lifetime" may only be one or two seasons. Failure of the liners is not necessarily due to liner material or design. It is caused by other forces within the engine.

9. The cylinder head, cut up for examination, was selected at random. It may not be representative of the general cylinder head problems.

Nine out of sixteen new heads received for use on the starboard main engine were found defective. This due to a casting core shift which seriously blocked off the cooling water outlet passage. Again, time was a factor, so we settled for welding and grinding repair action accomplished locally and paid for by Delaval.

One of the reconditioned cylinder heads cracked through the exhaust valve bridge area by the end of the first trip of the 1981 season. It has been replaced by a vessel spare.

10. This paragraph is misleading to some extent.

The engine was assembled and presumably properly torqued at the factory during assembly. The bolts in question, both crankcase to cylinder block and crankcase to base, had not previously been touched by the owner. Why then did some relax and others not? Why did one fracture? Not as a result of "improper retorquing procedure" since none had previously been checked for torque nor was it required. The damage to the engine had already occurred. A check was made of the crankcase to block tie bolts after the first one broke. This to determine the overall tie bolt condition - not to provide corrective action. This was to be done when the vessel was take off-line and the problem evaluated.

11. The original blocks failed after seven seasons operation. Since the bases are also cracked and the basic engine problem areas remain, it is doubtful that the new blocks will last seven additional seasons.

12. The torque problem has been discussed throughout the report. In several areas the inference is that the owner did not properly retorque the effected bolts which then caused deformation and had an effect on the block failures.

Having access to the same information as the report preparer, it is my contention that the major cause of block failure is the lack of proper block design and structural mass to absorb the loads/stresses applied by these engines developing their rated horsepower of 9200 let alone the 7000 to 7500 horsepower we are actually pulling out of them. Transamerica Delaval blocks on the MALASPINA class vessels are structurally stronger although rated at less than half of COLUMBIA's horsepower. Factors which compound the situation include an apparent cooling or heat transfer problem at the top of the cylinder liner areas and in the cylinder heads themselves. The results are creep and metal fatigue which cause block and cylinder head deformation and fractures in both.

The excessive overloading of the block counterbore lip; the close proximity of cooling water holes; the close proximity of head retaining studs; thread loading point of these studs being in line with the block counterbore, all provide high stress concentration areas. These are the areas that initially fracture as the block expands and distorts.

I contend that the torque problems noted during this overhaul were a direct result of the creep and fatigue phenomenon that the blocks were subjected to. This assumes that the bolts in question were initially properly torqued during engine assembly at the factory. To my knowledge, the owner did not relax, remove or otherwise retorque the bolts since vessel delivery. No such requirement is specifically noted in the maintenance manual. The bolts are for the most part inaccessable except during a major engine tear down. One might expect that these bolts would be checked on a similar engine after 30 to 50 thousand hours of operation. In this case the engines had not reached 24,000 hours of operation. It is logical then to assume that the bolts, or at least some of them, relaxed as a result of the block distortion and deformation. Once relaxed, the surfaces were no longer tight and movement occurred which resulted in the fretting noted on the mating surfaces. Not all the fretting resulted from the relaxed bolts. A portion quite possibly occurred as the result of the movement of the block due to the effects of firing pressures and piston thrusts.

13. It initially appeared that at least the port engine would have to be aligned. Upon installing the new blocks, retorquing of the various components and engine assembly, it was found that the previously noted base and crankshaft distortion had vanished. No engine realignment was therefore required.

14. Conclusion based on internal examination of one head. Condition is considered more serious than the preparer indicates

15. The two cylinder blocks on both main engines were renewed.

All structural bolts were removed, examined reinstalled and wet torqued to specification.

Neither main engine required realignment.

The keeping of operating data is an on going item. We have added periodic checking of structural bolt torque as conditions may present themselves.

STATE
of ALASKA

MEMORANDUM

TO: Ron B Lind
Deputy Commissioner, D.O.T. & P.F.
Pouch Z
Juneau, AK 99811

DATE: November 19, 1981

FILE NO:

TELEPHONE NO:

FROM: Max Zbinden
Assistant Port Engineer
AMH Seattle, WA 98104

SUBJECT: Transamerica Delaval letter of 12 November 1981 with enclosure.

So far Transamerica Delaval has disqualified the operator and equipment used in the Analysts Inc. report. This was addressed in my memo to you of November 9, 1981.

Now we are told that the Jacobson report is also disqualified since it contains inflammatory statements, unsubstantiated data and the author is unqualified. Mr. Jacobson's report apparently hit a nerve to cause such a critical and slanderous reply to be generated.

It would be interesting to hear Mr. Jacobson's comments in this matter. I am hesitant in furnishing him a copy of the report because of the manner in which it was written. The summary on the bottom of the last page could cause a mild eruption, itself. Not being an "expert" in the areas addressed in rebuttal of the Jacobson report, I will not make any comments. Too bad that all the excitement the two reports have generated could not be channeled into the COLUMBIA main engines. Years of correspondence, meetings and modifications have failed to resolve the problems, whatever the cause.

On a new subject, be advised that the two turbochargers on the starboard main engines were inspected by Elliot Turbocharger representative and with Transamerica Delaval personnel present. The Elliot reps preliminary findings revealed no problems were found. They did suggest that the two nozzle rings be sent to the factory to permit a more accurate setting of the blade openings. These were initially set for 41 sqin but several years ago were changed to 39 sqin by Delaval upon instructions from Mr. Trussell. Mr. Trussell later recommended that they be closed down to 37 sqin which we did not agree to. Mr. Trussell recinded that recommendation a year later. Just to make sure we were all in agreement, I requested Elliot to contact Mr. Trussell to varify the desired blade opening. They advised me that Mr. Trussell wants them set at 41 sqin again. This is where we started years ago and will leave the port engine with 39 sqin openings. Elliot will provide us with a complete report of their findings, etc.

Additionally, all the new cylinder heads on the starboard main engine have defective valve springs which must be changed out. Two cylinder heads on the port engine are simularly effected. The change can be made without removing tne cylinder heads by use of a special tool developed by the vessels engineer. Mr. Dave Thompson, the local Transamerica Delaval Customer Service Representative, has been hinting that possibly we should remove a cylinder head or two or more so that their people can look at the cylinders, etc. I'm just as curious as they are. But why pull heads on newly rebuilt engines,

with only 2300 hours, and especially since they (Delaval) have, "hard evidence that future seasons can be successful as well" as the last one? No decision has been made in this respect, todate.

- Regarding the fuel pump calibration issue, it has been concluded that the manner in which Seattle Injector does this work is satisfactory with Bendix.

cc: Hugh McDonald
Port Engineer

Transamerica
Delaval

1840-130th N. E.
P. O. Box 3187
Bellevue, WA 98009
(206) 885-9777

November 12, 1981

Mr. Ron B. Lind
Deputy Commissioner for Administration
State of Alaska
Pouch Z
Juneau, Alaska 99811

Subj: M/V Columbia

Dear Mr. Lind:

We submit our comments to the "Engine Rebuild Report-Motor Vessel COLUMBIA" dated March 31, 1981 by Jon O. Jacobson.

I feel that it is unfortunate that the Jacobson report was submitted to the State of Alaska as it apparently has done much to undermine trust, confidence, and understanding between the Alaska Marine Highway System and Transamerica Delaval.

The attached comments were prepared by our Mr. G. E. Trussell, Mgr. of Engineering, and a recongnized authority on diesel engines. Our comments are critical, very critical, but valid and deserving of your full consideration.

We believe the operation of the Columbia during this past season has substantially improved. There is hard evidence that future seasons can be successful as well. We feel that considerations to repower the vessel are inappropriate. Since these matters are vital to both of us, I would like to ask for a meeting with you, Commissioner Bob Ward and people from our Division at an early date.

Very truly yours,

D. Thomsen

D. Thomsen
District Manager

Enclosure
DT:mg
cc: Mr. Max Zbinden
C. D. Wright
G. E. Trussell
C. S. Mathews

Delaval

Engine and Compressor Division
550 35th Avenue
P.O. Box 2161
Oakland, California 94621

Date: October 27, 1981

To: Dave Thomsen

From: G. E. Trussell

Subject: Alaska Marine Highway
M/V COLUMBIA
Jacobson Rebuild Report

cc: C. S. Mathews
R. J. Pabers
A. C. Barich
R. A. Pratt
C. D. Wright

The "Engine Rebuild Report - Motor Vessel COLUMBIA" dated March 31, 1981 by Jon O. Jacobson presents an inaccurate, distorted, and unsubstantiated picture of the engine. The author does not reflect an understanding of medium-speed engines. Additionally, he demonstrates a lack of knowledge of strength of materials, stress analysis, and failure analysis.

Perhaps the most disturbing thing about the report is that it is filled with inflammatory statements, unsubstantiated by calculation, by measurement, or by other form of analytical model. In summary, it is a subjective report expressing the thoughts of an apparently unqualified author.

For example:

1. The report alleges (Pg. I-9) that the cylinder block liner bores have experienced "creep", and describes this creep as "interstitial flow". The liner bore dimensional data clearly point to wear in the athwartship direction and not "interstitial flow" and "creep". If the liner bores were deformed through creep, as the report says, the increase in athwartship dimension would have been accompanied by a decrease in the longitudinal dimension.

2. The report's contention (Pg. I-9) that "the center webs are heated during operation while the outer ends of the end cylinders remain at room temperature" is totally incorrect. This statement reflects a lack of understanding of the operating temperature of the cylinder blocks and is not supported by any temperature data.

Memo

Transamerica Delaval
Transamerica Delaval Inc.
Engine and Compressor Division
550 85th Avenue
P.O. Box 2161
Oakland, California 94621

Date: October 27, 1981

To: Dave Thomsen

From: G. E. Trussell

Subject: Alaska Marine Highway

3. The report describes (Pg. I-9) "1000 micro inch of strain with a corresponding stress of 30,000 PSI". Cast iron has a modulus of elasticity much, much lower than the 30 x 10^6 PSI assumed by the author. No mention is made of how either the strain value or the stress value were obtained. Errors in such "basic fundamentals" as this cast serious doubt on the author's credentials.

4. The report (Pg. I-10) describes "combined stresses (41,000 PSI)" as "well above design limits for cast iron". The 41,000 PSI number is unsubstantiated by any measurement or calculation and is apparently purely speculation.

5. The report states (Pg- I-10) that "the compression stress on the counterbore lip is in excess of 76,000 PSI". No calculations are shown. If any calculations were made, they ignored the degree to which the stud load is distributed over the cylinder head to block contact surfaces. Also ignored is the transmission of stud load through the outer flexitallic gasket to the cylinder block entablature.

6. The report (Pg. I-10) cites "extremely high stress concentration" without giving any values or calculations. Sketch, Figure 4, (Pg. I-11) is completely misleading. Such subjective comments and misleading sketches lead the reader away from the facts.

7. The report states (Pg. I-12) that the blocks experienced fretting and describes the extent by saying "No measurements were made but the deepest grooves were estimated at a millimeter (0.040 inch)". We seriously doubt that measurement would have supported this claim. We often see minor fretting on these surfaces caused by slight movement between the parts. We have seen this fretting in engines of our design as well as on engines produced by other manufacturers. It does no harm.

Memo

Transamerica Delaval

Transamerica Delaval Inc.
Engine and Compressor Division
550 85th Avenue
P.O. Box 2181
Oakland, California 94621

Date: October 27, 1981

To: Dave Thomsen

From: G. E. Trussell

Subject: Alaska Marine Highway

The contention that fretting occurred because of "reduced preload in the block bolts when the nuts were not fully torqued" is correct. The stated "belief" that a "moment from piston side thrust contributed" is without merit.

8. The report (Pg. II-1) estimates "surface contact pressure of 27,000 PSI at the bore diameter". There is no measurement data or calculation to support this absurdly high number. These statements unfairly portray the engines in an unfavorable light.

9. The report (Pg. II-6) restates the erroneous viewpoint of cylinder head stud forces by saying "the entire force of all bolts is borne by the liner and the head is separated from the block surface". Examination of the cylinder block and cylinder head surfaces shows that the cylinder heads make contact with the cylinder blocks over a wide area. Again (Pg. II-9), the author repeats this error about the liner lip supporting the entire stud load.

10. The report (Pg. III-1) comments that "the cylinder heads...have shown an excessively high failure rate" without indicating what the rate is. The report does not indicate the nature of failure, the cause of failure, or the failure rate. The statement is misleading in the absence of any supporting data, even though many cylinder heads with specific problems have been documented.

11. The report (Pg. III-1) comments on cylinder head repairs as "excessive for a new casting". The standards upon which this comment is based are not included. It is not clear that the author recognizes that the cylinder head is designed as a casting-weldment made from a highly weldable steel casting. Welding plays a major part in the construction of this cylinder head.

Memo

Transamerica Delaval

Engine and Compressor Division
550 85th Avenue
P.O. Box 2181
Oakland, California 94621

Date: October 27, 1981

To: Dave Thomsen

From: G. E. Trussell

Subject: Alaska Marine Highway

12. The report (Pg. IV-1) concludes that "Figure 14 shows the form of the delamination crack where the cylinder lip was separated from the block structure".

    Figure 14 is extremely inaccurate in that it depicts the cracks as parallel to the block upper entablature surface instead of showing them in the actual crack direction, nearly perpendicular to the block upper surface. The word "delamination" is used in the report incorrectly. The definition of "delamination" is "To separate into constituent layers" (Source: Webster's New Collegiate Dictionary - 1977 edition).

    Castings are non-laminar by their very nature. They are homogeneous and are not made up of layers. A casting cannot "delaminate".

    The report indicates that ultrasonic testing was used for detecting the "delamination cracks". At Transamerica Delaval, we regularly use ultrasonics for NDT examination of steel forgings and steel castings. We have in our employ Quality Control inspectors qualified to SNT-CT-IA level 3 and schooled in ultrasonic testing. We have found ultra testing to be completely unsatisfactory for iron casting examination. Mark's Mechanical Engineering Handbook, 8th edition - 1979, does not list cast iron as material recommended for ultrasonic examination.

    On the cylinder blocks in question, we were unable to repeat the report's findings with our ultrasonic equipment. When we cut the blocks apart for further examination, we found some cracks, although in most cases no cracks were found in the locations shown in the report.

    In the absence of other data, the inaccurate sketches and arguments presented in the report make an unbiased conclusion impossible.

Memo

Transamerica Delaval Inc.
Engine and Compressor Division
550 85th Avenue
P.O. Box 2181
Oakland, California 94621

Date: October 27, 1981

To: Dave Thomsen

From: G. E. Trussell

Subject: Alaska Marine Highway

Page 5

The most logical cause of the cracks (overtorque of the cylinder head stud nuts) was given to AMH (Max Zbinden) much earlier this year. The absence of any mention of this key culprit draws the reader away from this most logical explanation of the lip cracks. The actual count of cylinders of this identical liner lip design in service numbers in the thousands, and the M/V COLUMBIA's blocks are the first to have been replaced for this reason.

13. The report contains no meaningful conclusions resulting from the engine alignment - block distortion - base distortion measurements. The author does make one meaningful comment on Page V-17 where he points out the critical importance of maintaining proper torques in the future.

14. The report (Pg. VII) recommendation to replace the blocks was unsupported by any meaningful analysis and should not have been followed! The cracks were not particularly significant structurally and could have been repaired and should have been repaired! The other recommendations on Page VII are excellent and we would encourage their implementation.

In summary, the report appears to be a deliberately biased and misleading effort on the part of an author apparently unskilled in objective investigation and reporting and unskilled in basic engineering sciences.

G. E. Trussell

GET/pn

Memo

02-2138Rev. 10/78

STATE
of ALASKA

MEMORANDUM

TO: Ron Lind
Deputy Commissioner
DOT & PF

DATE: July 29, 1982

FILE NO:

TELEPHONE NO:

FROM: Max Zbinden
APE, Seattle, AMH

SUBJECT: TDI letter dated July 9, 1982
With inspection report attached

The following comments are furnished regarding the subject inspection report. The comments are numbered to match corresponding numbered portions of the inspection report, copy attached.

1. This is the vessel devised leakdown test that TDI originally scoffed at. They now appear interested in the results each time the leakdown test is conducted.

2. Concur that the valve rotator appeared to have failed or was defective. Just what the actual problem was has not yet been confirmed by TDI inspection results.

3. Concur that no appreciable carbon deposits were noted. In this respect, the valves, valve guides and upper deck appeared relatively clean compared to previous inspections.

4. Expect that the majority, if not all, of the cylinder heads will be removed during the next repair period.

   The piston crown cutback remains to be proven. It does permit increased accummulation and buildup of the carbon in the piston crown area before the deposit causes liner damage as it has in the past. It's effectiveness depends upon whether the carbon buildup starts to flake off, before it begins to damage the liners. The water wash system appears to have assisted in reducing the combustion chamber carbon deposits. The possibility exists that a side effect would be de-lubrication of the valve stems resulting in early valve stem and guide renewal. Therefore, the long term effects of the above fixes remain to be seen. The "enhanced air flow" is non-existant.

5. The cylinder head in question was removed for our inspection, not TDI's. They were given the opportunity to visit the vessel and also inspect the cylinder which they did.

6. The "early angular misalignment" is a new phrase. Just what it really is meant to mean is unknown. What was seen was small area on one intake valve where there appears to be less than desirable contact with the seat. TDI suggested that possibly the seat was not concentric with the guide. Possibly this is what they consider

"early angular misalignment". Both reworked and new cylinder heads received form TDI in the past have been notoriously deficient in this respect. Accordingly, each head is specifically checked and the situation corrected prior to installation. For the problem to occur now would suggest that the valve seat has become distorted or that the valve is warped or has become bent. The fact that problems were found with the cylinder head valves was not surprising. The leakdown test suggested same and was the reason the cylinder was opened for inspection and a spare cylinder head installed. This was the fourth head change out since the major engine rework. A fifth head was changed out last week on the SME because of a crack into the cooling water passage which resulted in water leakage out around the fuel injector.

7. I would hope that, "conditions of combustion have improved" since 1979. A major overhaul was completed since then which included four new blocks, 16 new cylinder heads, overhaul of 16 other cylinder heads, reworking of all pistons and installation of new piston ring sets, renewal of the majority of the cylinder liners and reconditioning of the rest, etc. We basically started out with two new engines which should, at least for a short time, provide improved service.

   The incorporation of smaller included angle injector tips was accomplished long before the waterwash system was installed and before the last major engine rebuild.

8. The PME turbochargers were not sent to Elliott. TDI was initially advised that we would only inspect one engines set. In this manner, any resulting improvement in manifold air pressure would be readily apparent by comparison. The inspection of the SME turbochargers by Elliott revealed no basic deficiencies and the only modification made was to change the nozzle ring opening from 29 sqin back to the original setting of 41 sqin. It took 10 weeks to make this change and upon return the nozzle rings would not fit in the housings because they were out of round. Neither TDI or Elliott were of any assistance in resolving that problem. We ground off the nozzle blade tips to permit reinstallation. In the end, it was found that the turbochargers on both main engines provided the same manifold pressure with the engines equally loaded. Inspection and rework of the PME turbocharger is therefore not justified. The manifold air pressure remains deficient and must be a fact that TDI finally accepts. Hence, the push to procure new units.

9. Intercooler cracking has been a problem for years. Approximately 5 years ago, TDI recommended and we installed large support stanchions to resolve the problem. The results were less than satisfactory. The units still crack and are repair welded continously. It is one

of several problem areas on the engines that changes in fuel timing, new turbos, etc., will not correct. In any case, TDI now proposes a fix, the results of which are questionable. We may have developed our own fix by the end of this season. The "epoxy" painting is a new feature and not understood. Possibly intended to provide for a smoother interior surface and reduce the air flow restrictions.

10. The valve spring was provided for TDI's examination along with the apparently defective vlave rotator. It is concernable that the valve spring is deficient and may have contributed to the rotator failure. It should be remembered that we had to change out a number of exhaust valve springs, because of defects, shortly after the last major engine overhaul. This included the 16 new cylinder heads plus a number of our reworked heads. TDI never explained what the defect was. They only furnished replacements with instructions to change them out as soon as possible.

    TDI has not revealed to date the results of the recent valve spring and rotator imspection.

11. I am not so optimistic. Time will tell. Other problem areas still exist.

    It is interesting to note that in January 1980, at a meeting in Oakland, the problem of low manifold air pressure was brought up by the State as well as a suggestion that the engine timing be looked at. TDI was advised that the State might be receptive to derating the engines if reliable operation would result. That this action would be less costly than the alternative of being faced with a repowering project. At that time TDI refused to accept the fact that any problem existed with the low manifold air pressure. They would not even discuss changes in engine timing. Now, 2½ years later, TDI is proposing timing changes (although not what I originally intended) and for the last year or so has made several turbo changeout proposals, the latest of which suggests use of their C-17 unit, whatever it is.

    It should also be noted that during the past nine years every basic engine component has been modified or replaced with a improved item, at least once, with the exception of the crankshaft (which is obsolete and has not been used for years), the engine base, the fuel pumps and the governor. The last two items are not manufactured by TDI.

cc: Hugh McDonald, P/E, AMH
    Bob Snyder, APE, Juneau, AMH

Transamerica Delaval

Transamerica Delaval Inc.
1840-130th N. E.
P. O. Box 3187
Bellevue, WA 98009
(206) 885-9777

July 9, 1982

Mr. Max Zbinden
Assistant Port Engineer
State of Alaska
Division Marine Transportation
Alaska Ferry Terminal
Pier 48
Seattle, Washington 98104

Subj: M/V Columbia

Dear Mr. Zbinden:

I thank you for arranging inspection of # 2 cylinder on port engine and for permitting our Mr. Steve Schumacher to participate in this inspection.

A copy of Steve's inspection report is enclosed. The improved conditions noted during this inspection are encouraging.

Yours very truly,

D. Thomsen
District Manager

cc: Mr. R. Lind, Deputy Commissioner

DT:mg
Enclosures

Transmitted Delaval

MEMO

Inter-Office Correspondence

To R. A. Pratt - Oakland

Date July 9, 1982

From S. G. Schumacher - Oakland

Subject: M/V Columbia S/N 72033 & 34
Trip of 7/8 & 7/9/82

Objective: To inspect the condition of the Port (S/N 72034) # 2 R.B. cylinder.

Personnel Met:

Max Zbinden - Alaska Marine Highway
Chief Bulin - Alaska Marine Highway
Dave Thomsen - TDI
Mike Britt - TDI

Summary:

1) The # 2 R.B. Port Cylinder was pressurized for a leak-down test on 5/25/82 to 46 psig and bled to zero psig in 10 seconds. Other cylinders similarly tested ranged from a high of 117 psig down to 55 psig after 10 seconds, to a low of 62 psig down to 54 psig after 10 seconds. The cylinder was run in this condition until 7/8/82.

2) The # 2 R.B. cylinder head had one leaky exhaust valve (flywheel side, right bank) through a 45° angle. The leak was obvious, but had not guttered the valve or seat. The top of the valve stem exhibited signs of rotator failure. The rotator turned freely when removed from the head. (See form E-267 360-1-1, attached.)

3) The cylinder head, liner, and piston crown appeared to be in very good to excellent condition. No appreciable carbon deposits were visible on these components. (See form E-267 360-1-1 & 315-1-1, attached).

Recommendations:

1) Rebuild the cylinder head removed from # 2 R.B. Port using a new spring and rotator for the aft exhaust valve. Valves and seats should be ground, then lapped after a check and/or replacement of the guides. The rebuilder should expect to remove approximately .003 - .005" max to clean up the valves and seats.

2) Remove two randomly picked cylinder heads from each engine in late Nov. for further inspection. The cylinder inspected had 5000 hrs operation and exhibited signs of good to excellent combustion. The next 3000-5000 hrs. of operation should substantially demonstrate the effects of a) piston crown cutback, b) water wash system, & c) enhanced air flow.

3) Replacement of the Elliott turbos with Delaval C-17's should further enhance the operating characteristics of these engines, particularly at reduced loads where the mass air flow significantly effects the compressor output of the Elliott turbo.

Discussion:

The writer arrived on board the M/V Columbia at 0730 on 7/9/82 and met with the Chief Engr. It was learned that one cylinder head, # 2 RB Port, had been removed for our inspection due to a relatively poor performance on a comparative leakdown test.

The head was inspected and conditions noted on Form E-267 360-1-1, attached. The firedeck was nearly free of carbon buildup (<.001") and the fireseals were in excellent condition, with no signs of combustion leakage. The exhaust valves were then inspected and the aft valve found to be leaking through approx a 45° angle. No guttering of the valve or seat had yet transpired. Intake valves were inspected and found to be sealing very well. The forward intake valve showed signs of early angular misalignment on 180° of the valve circumfrence. The guides were examined and the exhausts found to have minor carbon deposits as noted on the attached form. Overall the head was in very good condition with the exception of the leaky valve apparently caused by the failed exhaust rotator.

The cylinder liner was then inspected and found to be in very good condition, as noted on Form E-267 315-1-1, attached. The cylinder liner had minor scuffing and scratches, but nothing which would reduce efficiency of the burn or increase lube oil consumption. Carbon buildup above the top ring travel was nonexistent on 200° of the liner circumfrence. The other 160° exhibited 4 qty patches of carbon as thick as .015". The piston crown was in excellent condition with very little carbon buildup.

Transamerica
Delaval

It is the writer's opinion that conditions of combustion have improved over a thousand fold since first viewed in December of 1979. The unwarranted 1/4" of sludge in the rocker boxes which used to prevail in every cylinder was non-existent on # 2 R.B., as was the heavy (.150"+) carbon buildup of 1979 and 1980, as well as the deep scoring and scuffing of the cylinder liners reviewed in the past. Intake air passages were clean and exhaust passages were free of unburned oil. These are noticable improvements and are attributed to piston crown cutback, installation of "smaller included angel injector tips", and addition of the waterwash system.

Delaval's files do not indicate whether or not the two turbo charger nozzle rings from port engine were sent to Elliott for checking as was done on starboard engine. We recommend that port nozzle rings be checked, if this has not already been done.

Although combustion appears much improved at this time, the overall efficiency (fuel $) as well as maintenance costs would be significantly improved by the replacement of the Elliott Turbos with Delaval C-17's particularly at reduced loads, but also in the higher ranges.

The writer then reviewed the problem of intercooler adapter cracking. The adapters have the accordian type sides for added rigidity in a single plane. However, the "folds" may not have a flatbar tie across the inside to disallow flexing in another plane. The crack locations are in areas which indicate fatigue due to gas loads rather than mechanical loads. Max agreed to check the inside of the adapters for flatbar ties during the next layup, and the writer promised to assist in a "once and for all" field fix, after which the adapters should be epoxy painted on the interior.

Max was kind enough to volunteer the failed rotator and matching valve spring for my personal examination in Oakland, for which TDI will send new replacements to show our appreciation and cooperation. The writer also promised to send Max a complete set of our Form E-267, Inspection and Maintenance Record.

Delaval

1840-130th N. E.
P. O. Box 3187
Bellevue, WA 98009
(206) 885-9777

Conclusions:

The ship is operating very well and combustion problems, and the enherent increase in maintenance that goes with those problems, is well on its way to becoming a thing of the past.

We should assist the customer wherever possible to change over to Delaval C-17's to complete a total change for the better.

Both Max Zbinden and the ship's engineers have been doing a good job with the engines and warrant our continued support and cooperation.

Respectfully Submitted,

Steve

S. G. Schumacher

cc: C. Mathews
B. Trussell
D. Thomsen

SGS:mg
Enclosures

Transamerica Delaval — Inspection and Maintenance Record

Component Group Title	Parts Group No.	Sheet	Page
CYLINDER LINERS	315	1	1

Customer	Equipment Location
Alaska Marine Highway	#2 E.R. Port Townsend

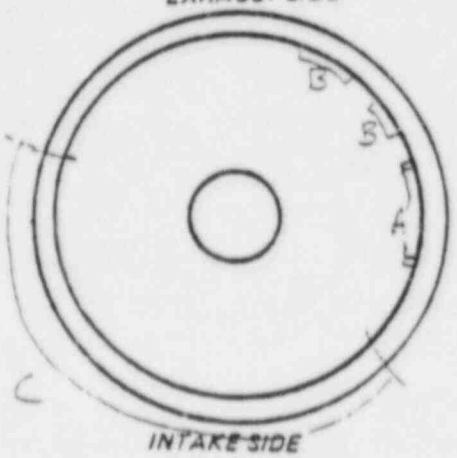
Engine Model	Serial No.	Customer's Designation
DMRV-16-4	72634	

Total Engine Hours	Hours Since Last Inspection	Date This Inspection
No Hourmeter Mast	~ 5000	6-9-82

References	Data Recorded By
Instruction Manual, Section 6, Part C	S G. Schumacher

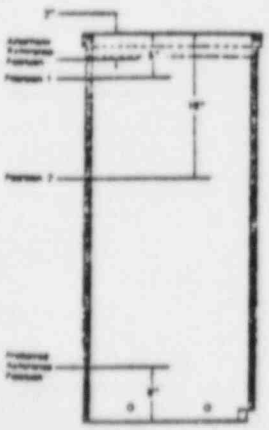
Cylinder No./Bank #2 R.S

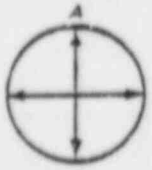
EXHAUST SIDE



INTAKE SIDE

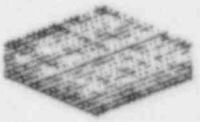
Indicate blemishes on interior surface of cylinder liner as seen from above.



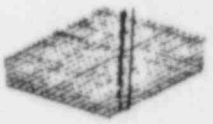


A= Inboard (exhaust) side

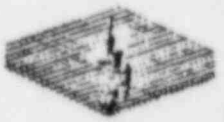
B= Flywheel End



NORMAL CROSSHATCH



SCRATCHES – Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.

A = 

SCUFFING – Caused by piston and/or rings. Can start below oil ring and run up through upper compression ring travel area. Crosshatch pattern cannot be seen.

B = 

BRIGHT SPOT – Bearing through crosshatch. Can appear anywhere. Probable cause: Heavy bearing by buildup above top ring land.

C = Light Carbon above top ring area (<.015"

DIRECTIONS FOR TAKING MICROMETER READINGS:

1. Establish reference measurement and record. If piston is out of liner, or if liner is removed from block, use PREFERRED REFERENCE POSITION. If piston is installed in liner, use ALTERNATE REFERENCE POSITION. Take two readings, 90 degrees apart (A and B)
2. Take readings at Position 1 and record.
3. Take readings at Position 2 and record.

	Before Honing		After Honing	
	A	B	A	B
Ref.				
1				
2				

Method of honing employed (i.e., glaze breaker/grit Sunnen hone/stone grit):

Remarks:

Crosshatch Gone. Cylinder has very little to No Carbon Build up (looks good)

Transamerica Delaval

Inspection and Maintenance Record

Component Group Title	Parts Group No.	Sheet	Page
CYLINDER HEAD – Four Valve	360	1	1

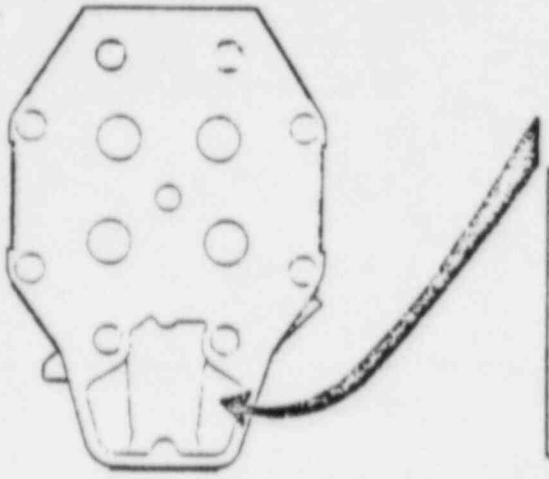
Customer	Equipment Location
Alaska Marine Highway	#2 F.B. Port / South

Engine Model	Serial No.	Customer's Designation
LV-16-4	72034	

Total Engine Hours	Hours Since Last Inspection	Date This Inspection
No Hourmeter Avail	~5000	7-9-82

References	Data Recorded By
Instruction Manual, Section 6, Part B	S.G. Schumacher

Top View of Cylinder Head



Cylinder No./Bank

#2 R.B. Port

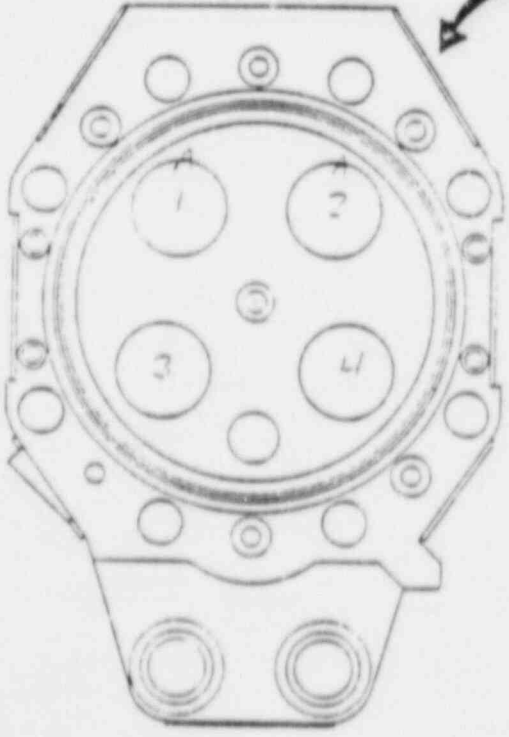
Record all identification numbers and letters appearing in this location.

Identification Numbers

K40 44CD 3-5-79 SRP

Reconditioned + Installed (8-26-81)

Combustion Chamber Side of Cylinder Head



Use diagram at left to sketch any abnormalities appearing on the cylinder head combustion surfaces and valve seats. Record comments relative to condition of cylinder head in spaces below.

Combustion Surfaces

No - little carbon on firedeck < .00

Valve Seat Condition

#2 leaking (inlet) ~60° on seat, 1/4" in w
#3 Ridge contact on valve w/80° contact
Seat shows 1/16" Ridge contact, no dama
Guide shows no unusual wear

Gasket Surfaces

Excellent Firering sealing 100%

Other (specify)

Alight carbon on "A" side of 1+2 in bore of guide.
Valve #2 showed signs of not rotating
Approx #3 Guide or sl. in Bore is tapered slightly

Water Washdeck Previously @ 52 hrs [illegible] Sun Mon July 4, 1752

ENGINE ROOM LOG BO

ALASKA MARINE HIGH

M.V. Columbia

WATCH	ENGINE	LUB OIL PRESS		LUB OIL TEMP		FUEL OIL PRESS	FUEL OIL TEMP	JACKET WATER TEMPERATURES ENGINE			JACKET WATER TEMPERATURES INTER-COOLERS		JACKET WATER TEMPERATURES TURBO CHARGERS		JACKET WATER PRESS	SEA WATER PRESS	MANIFOLD PRESS	MANIFOLD TEMP	CRANK CASE VACUUM	FUEL
		IN ENGINE PUMP	IN ENGINE	OUT ENGINE	IN ENGINE	IN ENGINE	IN ENGINE	IN ENGINE	OUT R BANK	OUT L BANK	OUT RIGHT	OUT LEFT	OUT RIGHT	OUT LEFT						
12 A	PORT		47		172	43			172				22	23		22	14	126	5	3
A M	STBD		48		174	43			165		165		21	31	37	23	16	116	5	3
4 12	PORT		47		173	42			174				22	23		22	125	125	.5	3
A M	STBD		47		176	42			166		166		20	31	37	23	14	118	.5	3
12 A	PORT		47		173	42			172				22	21		22	13.5	126	5	3
P M	STBD		47		175	42			165		165		23	31	37	23	16	116	.5	3
4 12	PORT																			
P M	STBD																			

WATCH	ENGINE	R P M	PROPELLER PITCH	C P PUMP LUB OIL PRESS	C P PUMP LUB OIL LEVEL	C P PUMP SERVO PRESS	C P PUMP EXHAUST PRESS	AUXILIARY ENGINES EXHAUST TEMPERATURES 1 ON	2 ON	3 ON	4 ON	5 ON	6 ON	7 ON	8 ON	9 ON	10 ON	11 ON	12 ON
12 A	PORT	398	5.6																
A M	STBD	11	5.4																
4 12	PORT	11	5.7																
A M	STBD	11	5.4																
12 A	PORT	11	5.8																
P M	STBD	11	5.5																
4 12	PORT																		
P M	STBD																		

START ENG	DEPART	LOCATION	LOCATION	ARRIVE	STOP	HRS RUN P	HRS RUN S
		TOTAL HRS RUN THIS DAY					
PORT			STBD				
		TOTAL HRS RUN THIS MONTH					

	FUEL P & 100	LUBE OIL DIESEL	POTABLE WATER M E LUBE	POTABLE WATER AUX LUBE
ON BOARD MID	186	985	1618	1155
RECEIVED	89	454		
TOTAL	275	5439		
ON BD END DAYS	214	225	1723	1147
CONSUMED	32	417	+457	+8

AUX ENGINES

PORT AUX HRS RUN	
STBD AUX HRS RUN	
TOTAL HRS PORT AUX	
TOTAL HRS STBD AUX	

CENTRIFUGES

FUEL OIL HRS RUN	#	
LUBE OIL HRS RUN		
TOTAL HRS FUEL OIL	#	
TOTAL HRS LUBE OIL		

BOOK Flyracc1 Tooooooooo1
HWAY 9 10 11 12 13 14 15 16

Date Thursday July 8, 1982

RACK	LUBE OIL SUMP SOUND	AIR PRESS SHIPS SERVICE 1	AIR PRESS STARTING 2	NO 1 3	NO 2 4	EXHAUST TEMPERATURES NO 3 5	NO 4 6	NO 5 7	NO 6 8	NO 7 9	NO 8 10	NO 9 11	NO 10 12	NO 11 13	NO 12 14	TURBO R 15	TURBO L 16	REDUCTION GEAR LUB OIL PRESS IN	REDUCTION GEAR LUB OIL TEMP IN	REDUCTION GEAR LUB OIL TEMP OUT
4	1360	880	840	810	850	870	870	830	830	870	850	850	840	870	840	850	840	24		120
7	1360	830	800	830	840	870	860	740	870	810	800	790	820	830	850	850	820	35		118
3	1350	840	850	810	850	870	870	820	830	870	850	850	890	810	850	850	850	74		120
2	1240	820	830	840	850	870	870	800	880	810	800	800	830	830	850	850	820	34		120
5	1330	870	850	820	860	870	880	820	830	870	850	850	890	870	840	850	850	30		100
1	1260	810	800	840	850	820	870	800	880	810	800	800	810	820	820	820	820	35		118

AUX ENG PRESS AND TEMP LUBE OIL PRESS	LUBE OIL TEMP	S W PRESS	J W TEMP	FUEL PRESS	LUBE OIL SUMPS	GENERATOR'S VOLTS	AMPS	CYCLES	K W		BOILER HIGH PRESS	LOW PRESS	HRS RUN OF BOILER		TIME CHECK STEERING GEAR	TIME CHECK REPEATS	NAME OF OILER AND SIGNATURE OF ENGINEER ON EACH WATCH

HOT WATER
3
3
3

REMARKS ADJUSTMENTS ETC

CHIEF ENGINEER

PRINTED BY HARRIS LITHO

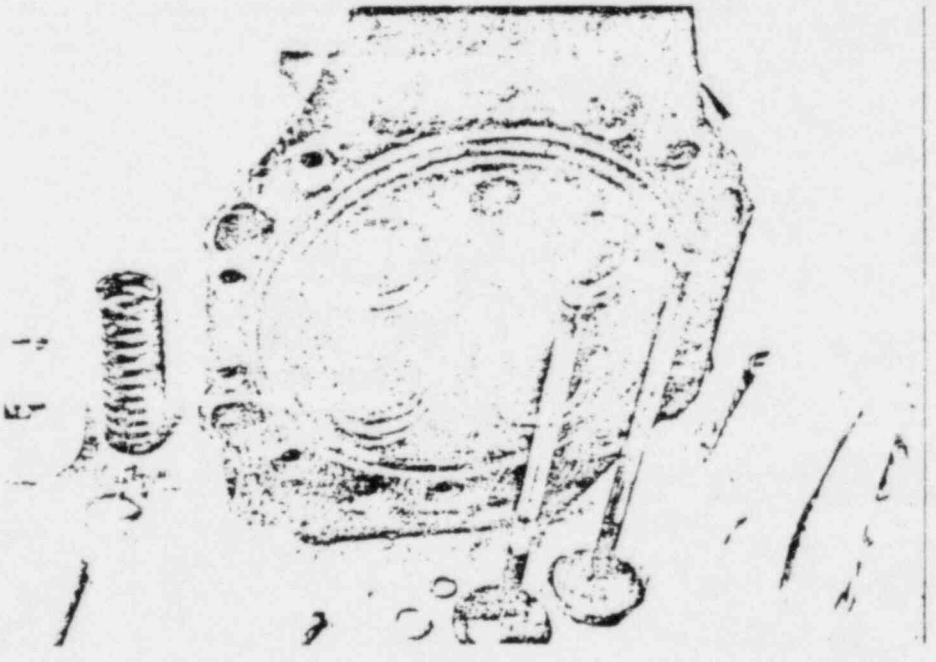
STATIC 5/25

CYL #	Throttle		Power Valve		Manifold	Manifold	
1	102	100	39	36	110	36	
2	104		41		108	38	
3	105		40		108	40	
4	105		37		106	38	
5	60	64	18	14	66	14	LOW COMP
6	80	78	30	30	92	25	
7	58	58	12	12	65	12	LOW COMP
8	54	55	10	11	65	12	LOW COMP
9	84		23		85	22	MED LOW
10	90		25		85	20	MED LOW
11	89		24		112	34	
12	108		42		100	30	
13	96		28		94	38	
14	95		30		117	44	
15	105		35		92	24	
16	115		45		106	34	
PME							
1					68	16	LOW. COMP
2					46 44	0 0	BAD?
3					90	27	
4					90	26	
5					94	21	
6					109	37	
7					76	20	MED LOW
8					82	17	FAST LOSS OF
9					114	46	
10					117	55	
11					103	36	
12					61	[illegible]	LOW

1	53	58	12	12	65	12	COMP
8	54	55	10	11	65	12	LOW COMP
9	84		23		85	22	MED LOW
10	90		25		85	20	MED LOW
11	84		24		112	34	
12	108		42		100	30	
13	96		28		94	38	
14	95		30		117	44	
15	105		35		92	24	
16	115		45		106	34	
PM E							
1					68	16	LOW COMP
2					46 44	0 0	BAD ?
3					90	27	
4					90	26	
5					94	21	
6					109	37	
7					76	20	MED LOW
8					82	17	FAST LOSE OF
9					114	46	
10					117	55	
11					103	36	
12					62	54	LOW COMP
13					85	22	MED LOW
14					102	20	FAST LOSS OF C
15					102	36	
16					97	34	

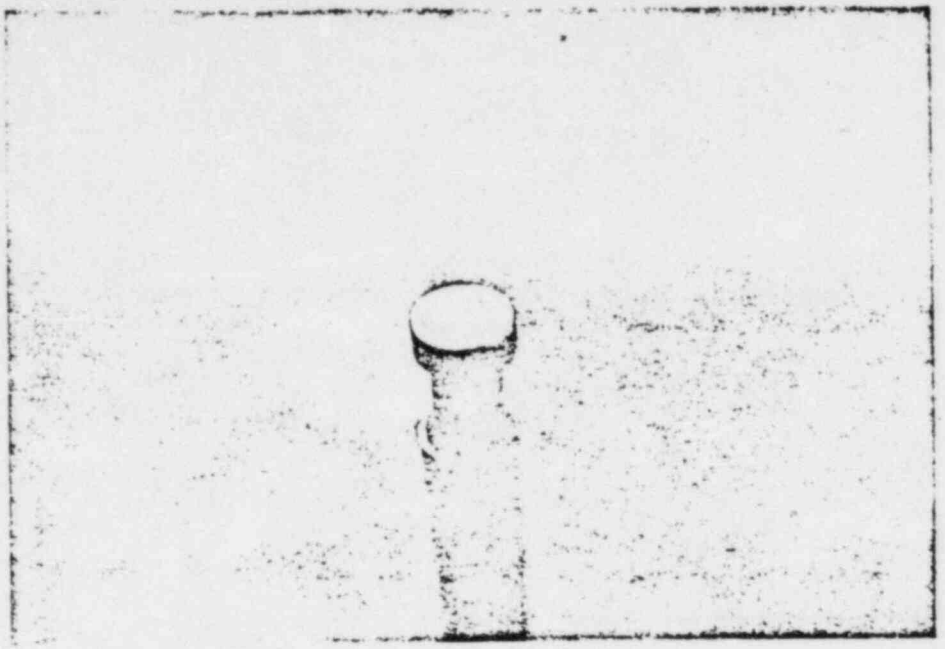
2 RB PORT EXH AFT

NOTE: 45° LACKS PROPER SEATING



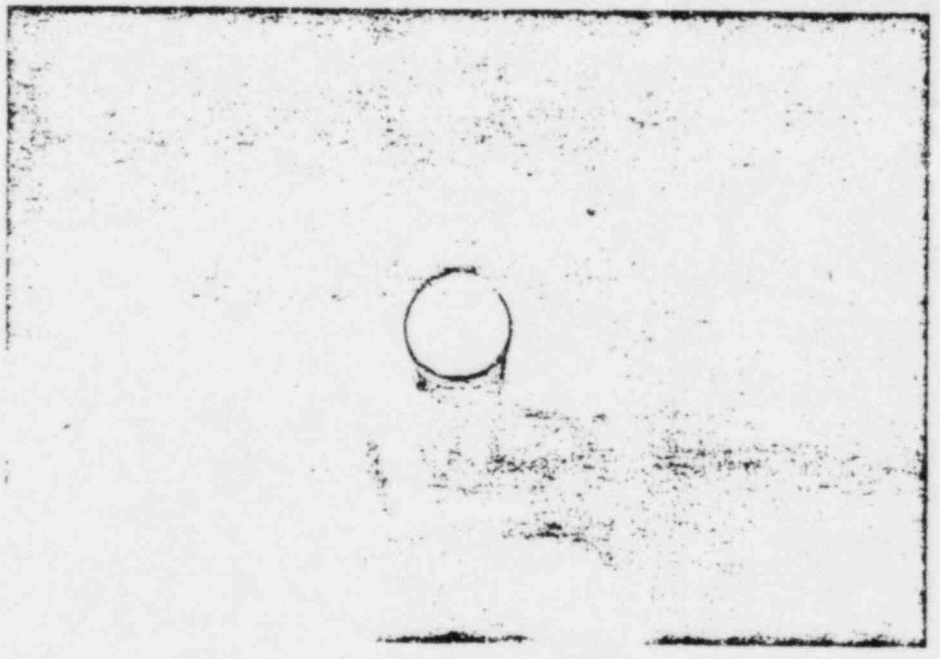
2 RB PORT CYLINDER HEAD

~ 60° OF IMPROPER SEAT CONTACT AS MARKED



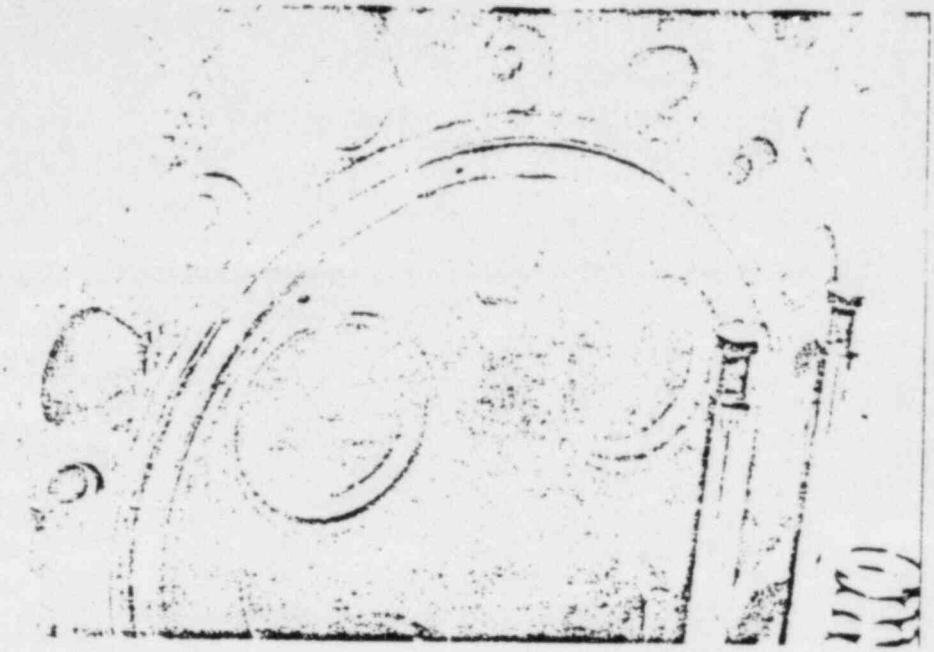
2 RB PORT EXH AFT

NOTE: LINEAR INDICATION ON TOP OF STEM INDICATING ROTATOR FAILURE



2 RB PORT EXH FOREWARD

NOTE: CIRCULAR INDICATIONS ON TOP OF STEM INDICATING FUNCTIONAL ROTATOR



2 RB PORT
NOTE: FIRE RINGS - EXCELLENT
CARBON BUILDUP <.001"

2 RB PORT
NOTE: LACK OF CARBON BUILDUP

#2 RB PORT

SHOWS MINOR SCUFFS AND SCRATCHES

2 RB PORT

VERY MINOR CARBON BUILDUP(.015"max)
ON ~160° OF CIRCUMFRENCE

P 51:

M/V COLUMBIA Date 7/13/82 Time 1100

(ERPM)

Port Main Engine
RPM 398 / 221
Fuel Rack
Propeller Pitch 5.6

JW Temp. Out 167
Manifold Press. 12.5 Manifold Temp. 102
Booster " Fuel Temp.
Servo " Lube Oil Temp. 123

Port Main Eng (mm)		Exhaust Temp.	Firing Pressure	Remarks, Color of Exhaust, Smoke, etc.
Cyl	#1	940	1140	CLEAR
	#2	820	1130	CLEAR
	#3	850	1120	CLEAR
	#4	890	1140	CLEAR
	#5	880	1060	CLEAR
	#6	890	1080	CLEAR
	#7	820	1040	CLEAR
	#8	840	1090	LIGHT HAZE
	#9	920	1060	LIGHT HAZE
	#10	920	1090	LIGHT HAZE
	#11	900	1040	CLEAR
	#12	960	1050	CLEAR
	#13	840	1000	LIGHT HAZE
	#14	890	1040	CLEAR
	#15	910	1040	LIGHT HAZE
	#16	870	1090	CLEAR

(ERPM)

STBD Main Engine
RPM 398 / 221
Fuel Rack
Propeller Pitch 5.6

JW Temp. Out 165
Manifold Press. 12.2 Manifold Temp. 112
Booster " Fuel Temp.
Servo " Lube Oil Temp. 123

STBD Main Engine (mm)		Exhaust Temp.	Firing Pressure	Remarks, Color of Exhaust, Smoke, etc.
Cyl	#1	900	1140	LIGHT HAZE
	#2	850	1140	CLEAR
	#3	870	1130	CLEAR
	#4	890	1120	CLEAR
	#5	940	1100	CLEAR
	#6	900	1090	CLEAR
	#7	830	1140	LIGHT HAZE
	#8	910	1080	LIGHT HAZE
	#9	710	1150	CLEAR
	#10	740	1130	CLEAR
	#11	700	1100	CLEAR
	#12	860	1100	CLEAR
	#13	740	1080	CLEAR
	#14	810	1080	CLEAR
	#15	820	1120	LIGHT HAZE
	#16	820	1210	CLEAR

Valve Gear Examined: Port Starboard

Remarks:

By Jim & Jerry Engineer

[illegible] 1,791

CYLINDER PRESSURE READINGS

M/V [illegible] Date 3/18/80 Time 0800

(SRPM) (ERPM)

Port Main Engine			
RPM	220 - 395	JW Temp. Out	177
Fuel Rack	31mm	Manifold Press.	13.0
Propeller Pitch	4.9	Booster "	
		Servo "	

Manifold Temp. 120
Fuel Temp.
Lube Oil Temp. 170

Port Main Eng.	Exhaust Temp.	Firing Pressure	Remarks, Color of Exhaust, Smoke, etc
Cyl. #1	910	1190	LIGHT HAZE
#2	860	1120	CLEAR
#3	850	1190	CLEAR
#4	870	1120	CLEAR
#5	880	1170	LIGHT HAZE
#6	800	1110	CLEAR
#7	830	1110	CLEAR
#8	890	1170	LIGHT HAZE
#9	900	1120	LIGHT HAZE
#10	890	1140	LIGHT HAZE
#11	820	1090	CLEAR
#12	920	1090	CLEAR
#13	840	1080	LIGHT HAZE
#14	890	1020	LIGHT HAZE
#15	890	1100	LIGHT HAZE
#16	820	1100	CLEAR

STBD. Main Engine			
RPM	220-395	JW Temp. Out	164
Fuel Rack	30mm	Manifold Press.	13.5
Propeller Pitch	5.1	Booster "	
		Servo "	

Manifold Temp. [illegible]
Fuel Temp.
Lube Oil Temp. 17[illegible]

STBD. Main Enge.	Exhaust Temp.	Firing Pressure	Remarks, Color of Exhaust, Smoke, etc
Cyl #1	880	1120	CLEAR
#2	820	1190	CLEAR
#3	8[illegible]	1130	CLEAR
#4	860	1160	LIGHT HAZE
#5	[illegible]	1130	CLEAR
#6	880	1100	CLEAR
#7	810	1200	LIGHT HAZE
#8	820	1120	LIGHT HAZE
#9	[illegible]	1230	CLEAR
#10	730	1180	CLEAR
#11	[illegible]	1130	CLEAR
#12	800	[illegible]	LIGHT HAZE
#13	[illegible]	[illegible]	CLEAR
#14	[illegible]	[illegible]	CLEAR
[illegible]	8[illegible]	[illegible]	[illegible]

Valve Gear Examined: Port Starboard

Remarks: [illegible] [illegible] Clear

By [signature] Engine

STATE OF ALASKA

DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

JAY S. HAMMOND, GOVERNOR

PHONE: 206 623-6850

Division of Marine Highway
Systems
Pier 48
Seattle, WA 98104

Transamerica Delaval Inc.
Engine and Compressor Division
550 85th Avenue
P.O. Box 2161
Oakland, CA 94621

Attention: Robert Johnston; Engineer, Customer Service

Subject: Cylinder Head Valve Springs

Reference: (a) TDI Telex of October 14, 1981 concerning Engine SN 72033/34, M/V COLUMBIA.
(b) TDI Letter of October 30, 1981, same
(c) TDI Telex of December 22, 1981, same
(d) AMH Telex of December 22, 1981, same

The 72 replacement valve springs were received as per references (a) and (b).

A total of 64 "potentially defective" valve springs were found and changed out on M/V VOLUMBIA's Port and Starboard Main Engines. That left eight (8) valve springs unaccounted for.

Your sales orders B-22166, B-22167 and C-22161 covered the furnishing of the 16 new cylinder head assemblies procured on our D.O. #590247. One of these cylinder head assemblies was returned to your facility, under warranty, for finish machining of the injector bore. This cylinder head was repaired and returned to us on your sales order W-24594. Since it presumably had the same valve springs installed when initially furnished as it did after warranty repair, it would account for four (4) of the eight (8) missing valve springs.

We have been unable to locate the four remaining valve springs associated with your sales order C-20872. They are not on any of the installed or spare cylinder heads nor in our stock of spare parts. Accordingly, we are returning a total of only 64 of the "potentially defective" valve springs. These springs will be returned in one box on RMR-5731-72 and marked to the attention of Mr. L. Mills. This shipment will be accompanied by a second box, similarly marked, but which contains the eight (8) unused replacement valve springs.

Sincerely,

Max E. Zbinden A.P.E., AMH

cc: Ron Lind, Deputy Commissioner, DOT & PF
J. Eide, Director, AMH
Hugh McDonald, P/E, AMH
C/E M/V COLUMBIA
Dave Thomsen, TDI, Seattle

28A-T2LH

DELIVERY ORDER

STATE OF ALASKA

△ VEND

SEND INVOICES TO: Dept. of Transportation & Public Fac.
Pouch Z--Supply Section
Juneau, Alaska 99811

DELIVERY ORDER NUMBER
DO 70757

Dept. of Transportation & Public Fac.	DATE DELIVERY REQUIRED: "See Specification	DATE OF ORDER: 10-15-82
Alaska Marine Highway Systems M/V Columbia--Engine	F.O.B. POINT: Seattle	REQUISITION NO.
Pier 48 Seattle, Washington 98104	SHIPPING INSTRUCTIONS	

TO: Transamerica De Laval
Engine and Compressor Division
550 Eighty Fifth Ave. P.O. 2161
Oakland, California 94621

1. SEND ALL INVOICES IN DUPLICATE BY AIR MAIL TO ADDRESS SHOWN IN BOX ABOVE
2. ORDER NUMBER AND RECEIVING DEPARTMENT NAME SHOWN ABOVE MUST APPEAR ON ALL DOCUMENTS RELATING TO THIS DELIVERY ORDER
3. A SEPARATE TAX FREE INVOICE MUST BE SUBMITTED FOR EACH DELIVERY ORDER
4. DO NOT OVERSHIP OR SUBSTITUTE

The State of Alaska, Department of Transportation and Public Facilities (Owner) hereby enters into an agreement with Transamerica Delaval Inc. (Contractor) to furnish materials, parts, engineering and labor to perform the work described in this order.

1.1 SCOPE OF WORK

a. Remove existing turbochargers and install new Transamerica Delaval Model C-17 turbochargers on both main engines of the State of Alaska's M/V Columbia. Turbochargers are to be complete with foundations, supports and related components as necessary to provide for a complete installation ready for operation. This shall include modification necessary to accommodate the new installation such as air and exhaust side connections, relocation and size reduction of the four air intake filter/silencer units, removal, relocation or reinstallation of all interferences as required. This further includes additional air blower assembly, modifications to the J.W. system, etc., a spare turbo rotating assembly and spare bearings and a complete set of as-built drawings.

b. The Contractor will furnish a representative to supervise the installation.

c. Trabon exhaust valve lubricating system shall be installed on 38 or less Owner furnished cylinder heads. The Owner will make modifications to the cylinder covers as per instructions and materials to be furnished by Contractor.

d. In conjunction with the installation of the Trabon lubricating system, Contractor will recondition 38 or less cylinder heads. Reconditioning will consist of, but not be limited to, disassembly, hot tank clean, hot pressure test for cracks, repair as necessary and completely rebuilt the heads to place in condition to conform with present factory specifications.

e. The Contrator will furnish 4 copies of revised and updated main engine maintenance, operation and spare parts manuals.

DO 707573 Cont.

f The turbochargers shall be furnished with the air seal system including an additional Paxton Blower assembly with associated air control equipment and electrical power service.

g A spare turbocharger rotating assembly and one (1) set of spare bearings shall be furnished in suitable storage container and be properly preserved.

h The turbochargers shall be fitted with tachometer systems with separate digital readout provisions in the Control Booth.

SILENCE OF SPECIFICATIONS:

The apparent silence of this specification and supplemental specifications as to any detail, or the apparent omission from it of a detailed description concerning any point, shall be regarded as meaning that only materials and workmanship of first quality are to be used in compliance with requirements of all regulatory bodies and that only the best marine practice is to prevail.

9 INTENT

9.1 Turbochargers:

a. It is intended to derate the existing engines from 9200 HP each at 450 RPM to meet the following agreed upon ratings:

Minimum Idle Speed	300 RPM
Design Service Ratings	384 RPM @ 5248 BHP
Maximum Continuous Rating	403 RPM @ 6164 BHP
10% Overload Rating	403 RPM @ 6791 BHP

b. Engine BMEP will be reduced from present 213 to approximately 158 BMEP.

c. The new C-17 turbochargers must be properly matched to the engine revised performance ratings.

d. Turbochargers response time from 40% to 100% load shall be within 6-7 seconds. Turbocharger response during rapid de-pitching from steady state operation shall be at least as fast as that presently provided by the Elliott G-90 units.

e. The turbocharger installation shall include such modifications as necessary to maintain the waste heat recovery systems at present output level.

f. The installations will be in accordance with good marine practice and shall meet CG and ABS requirements.

g All components of the various systems requiring ABS and/or CG approval will be so certified upon delivery or will be furnished with such documentation necessary for the Owner to secure same. Should any component fail to receive such certification, corrective action required, will be furnished by the Contractor at no additional cost.

DO 707573 Cont.

h. All equipment removed from the vessel, and originally the property of the Owner, shall remain the property of the Owner. Care shall be taken to prevent damage of such equipment during removal.

3. GUARANTEES:

Contractor guarantees for a period of one operating year or 5500 operating hours, whichever occurs first, that the above modifications will achieve the following results without any additional cost to the Owner:

a. Provide the new derated and agreed upon operating conditions and reduced BMEP described under "intent".

b. Turbocharger response shall be as described under "intent", throughout the period.

c. Engine performance and the C-17 turbochargers shall basically meet the curves furnished by Contractor graph of 11/17/82, Appendix A.

d. Reduction of:

A. Smoke level.
B. Combustion chamber carbon deposits.
C. Lube Oil Contamination.
D. Cylinder Liner Wear.
E. Exhaust valve/guide blowby.

CONDITIONS:

The Owner will use their crew for miscellaneous repairs and maintenance work. The Contractor acknowledges that this work will continue without Contractor employee interference during the period contract work is being accomplished.

The Owner may have several equipment representatives on board during the period to supervise, or be actively engaged in equipment repairs or inspection. The Contractor acknowledges that this work or inspection will be carried out without interference.

The Contractor shall indemnify and hold and save the Owner, its officer, agents, and employees harmless from liability of any nature or kind, including costs and expenses for, or on account of, any and all legal actions or claims of any char .ter whatsoever resulting from any injury or damage sustained by person or persons or property as a result of any error, omission or negligent act of the Contractor or its Subcontractors or relating to its performance of this order.

Before performing work under item 5 of "PRICING" on page 5, evidence of the following coverages will be provided:

Comprehensive General Liability With Coverage Limits Per Contract Schedule.

a. Premises Operations.
b. Independent Contractors.

DO 707573 Cont.

Comprehensive General Liability With Coverage Limits Per Contract Schedule (Cont).

c. Products/Completed Operations
(Maintained for two years after contract).
d. Blanket Contractual.
e. Personal Injury.

Ships Repairers' Legal Liability.

The Contractor shall maintain Ships Repairers' Legal Liability to cover Owner's property while in the care, custody, and control of the Contractor.

Limits Required As Per Schedule.

Workers' Compensation Insurance: The Contractor shall provide and maintain for all employees of the Contractor engaged in work under this contract, Workers' Compensation Insurance as required by AS 23.30.045. The Contractor shall be responsible for Workers' Compensation Insurance for any subcontractor who directly or indirectly provides services under this contract. This insurance shall include the following coverages:

a. Statutory coverage for states in which employees are engaging in work.

b. Employer's Liability Protection in the amount of $500,000 per person/$500,000 per occurance.

c. Broad Form All State's Endorsement.

d. United States Longshoremen's and Harbor Worker's Act.

e. Jones Act and Other Federal Acts (if applicable).

Contract Schedule

Limits For All Insurance Are $5,000,000 per accurance/annual aggregate:

The Contractor shall protect the vessel and her Owners against any and all liability or damage or action upon the part of any Federal, State, or Municipal authorities caused by any pollution of any waters of any bay, harbor, river, or tributary by oil or refuse from the vessel during the course of repairs arising from the fault or negligence of the Contractor or any subcontractor.

Contractor shall make good at the Contractor's expense any and all damage of every nature and description to the vessel or vessel's equipment, or its stores, which shall occur at any time after the vessel's delivery to the Contractor until its redelivery to the Owner after the completion of work; or any time while work is being performed on the vessel if such damage shall result from any default or neglect of the Contractor, any subcontractor, or any of the agents or employees of the Contractor or any subcontractor; or if such damage could have been prevented by the exercise of reasonable care.

DO 707573 Cont.

In case any of the vessel's machinery, equipment, or fittings are used by the Contractor for any purposes whatsoever, he shall be held responsible for their reconditioning, if necessary, and shall make good any damage resulting from such use.

The Contractor shall keep the vessel clean and free of debris during the course of repairs; and he shall also moor the vessel at a safe and protected berth with no other vessel alongside.

1.	Turbochargers, brackets, seal air compressor		$467,680
2.	Trabon Lube System, Price Per Head		1,000
3.	Recondition Cylinder Heads, Price Per Head		5,500
4.	Preliminary Engineering for Turbo Installation		16,295
5.	Cost to provide labor and materials to install turbochargers:		
	Labor	$610,918	
	Engineering	22,656	
	Materials	132,919	766,493
6.	Turbocharger Tachometer, qty (4)		12,147
7.	Turbocharger spare rotor, spare bearing set		52,873
8.	Instruction and parts manual sets, qty (4)		3,500
9.	Customer Service Representative		17,000

Should the cost of item 5 above exceed $766,493.00 the Owner will not be liable for additional cost until such cost exceed $800,000.00 computed by figuring the Subcontractor cost to Contractor of labor, engineering and materials plus 18% overhead and then the owner will only be liable for 50% of those costs in excess of $800,000.00.

EXTRA WORK:

Should the Owner direct the Contractor to perform additional installation work not covered in this order the rates will be as follows:

Labor:	Straight time	$37.00/man hour
	Overtime	61.00/man hour

Materials and outside services - Cost plus 33%

DO 707573 Cont.

PAYMENT:

1. Payment for items 1, 2 and 7 under "PRICING" will be made as follows:

   50% upon delivery of components to the shipyard.

   50% upon successful completion of one operating season, not to exceed November 30, 1983.

2. Payment for item 4 under "PRICING" will be 100% net 30 days from submittal of invoice.

3. Payment for item 5 under "PRICING" will be 100% net 30 days upon demonstration that the engine operates in basic compliance with the graph, "Air Flow vs. Engine Speed M/V Columbia", dated 11/17/82, attached, and within the other parameters identified in this contract. Such demonstration shall be during sea trials. If for any reason not related to the work performed under this contract sea trials are not possible by March 15, 1983 the State of Alaska will, starting April 15, 1983, pay interest at 10.5% per annum on the unpaid amount until such trials or other tests are held.

4. Payment for items 3, 6, 8 and 9 under "PRICING" will be 100% net 30 days upon deliver to Pier 48 Seattle, Washington.

WARRANTY:

1. Contractor's Standard Warranty insofar as it is not superceded by guarantees made herein, shall apply to all items listed as 1, 2, 3, 6, 7 and 8 in the "PRICING" section. Standard Warranty is explained in Appendix B.

2. New cylinder heads or heads reconditioned by Contractor and turbochargers shall be covered by the above warranty for two operating season, not to exceed November 30, 1984.

TIMING:

1. Turbochargers and mounting brackets will be shipped by December 31, 1982. All other miscellaneous Contractor furnished items related to the turbo-charger will be shipped by January 14.

2. Installation shall be completed and materials delivered to allow completion of sea trails by March 15, 1983.

It is understood that the Contractor or its Subcontractor will require 45 working days, straight time, to complete installation.

By acceptance of this order Transamerica Delaval Inc. agrees to furnish all labor, equipment and materials and perform the work described above for the amount stated above in strict accordance with the specifications and conditions contained within this order.

STATE OF ALASKA

By _____

_____
(Official Title)

CONTRACTOR

Transamerica Delaval Inc.

By _____
(Type or Print Name and Signature)

_____
(Title)

APPENDIX A

Delaval
P. O. Box 3167
Bellevue, WA 98009
(206) 885-9777

November 29, 1982

State of Alaska
Division Marine Transportation
Alaska Ferry Terminal
Pier 48
Seattle, Washington 98104

Attn: Mr. Max Zbinden

Subj: M/V Columbia
Turbocharger Retrofit
Your P.O. 707573

Dear Mr. Zbinden:

I attach to your copy or this letter one each of TDI's Drawing # LE-2997 and 102549 Rev. A.

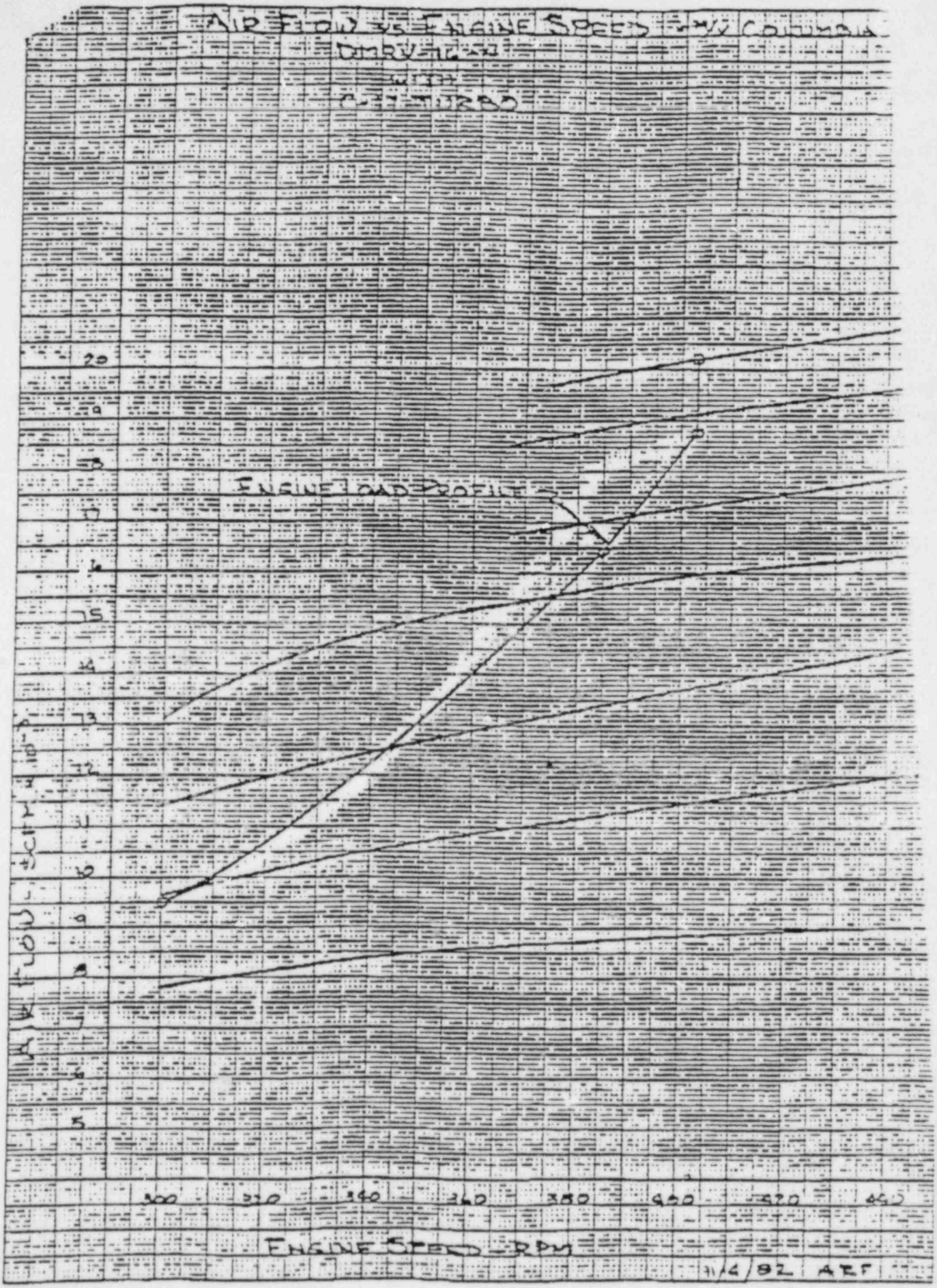
I also attach revised issue of curve showing air flow versus engine speed on the M/V Columbia with the C-17 turbocharger. This curve replaces similar curve submitted with our Mr. Bob Bailey's letter dated November 9, 1982 addressed to the attention of Mr. R. B. Lind. It was recently noted that on the original curve the 385 RPM point was misplotted on 380 RPM.

Very truly yours,

D. Thomsen
District Manager

DT:mg

cc: Mr. R. Lind
Mr. K. Gehring
Mr. R. Bailey
Mr. C. D. Wright


AIR FLOW VS ENGINE SPEED FWD COLUMBIA
DOHC VTEC
W/ CAT
NA
ENGINE LOAD PROFILE
AIR FLOW - LB/MIN
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
300
340
380
420
460
500
540
580
620
ENGINE SPEED - RPM
11/4/92 AEF

APPENDIX B

DOMESTIC
STANDARD CONDITIONS OF SALE

TRANSAMERICA DELAVAL INC. (hereinafter referred to as "Transamerica Delaval") proposes to furnish the Purchaser the apparatus, machinery, or materials (hereinafter termed "Machinery") subject to the following terms and conditions.

1. DELIVERY: Unless otherwise agreed, Transamerica Delaval will furnish the Machinery f.o.b. cars, its factory. Delivery to the transporting carrier shall constitute delivery to the Purchaser, and shall constitute transfer of title to the Purchaser, subject to the provisions of paragraph 2, below.

If shipment or any other act or condition affecting payment for Machinery shall be delayed on account of Purchaser, payment shall become due when Purchaser is notified that the Machinery is ready for shipment, and the Machinery shall thereafter be held at Purchaser's risk and expense. If partial shipments are made, proportionate payments shall become due and payable on the partial shipments.

The specified shipment, or erection if specified, is subject to any delay on the part of the Purchaser in supplying Transamerica Delaval with necessary data or approved drawings as may be required or any changes therein at the Purchaser's instance, and to delays due to causes beyond Transamerica Delaval's reasonable control, including but not limited to, acts of God, or acts of Purchaser, fires, floods, strikes, accidents, wrecks, delays in transportation, embargoes, car shortages, acts of civil or military authority, compliance with priority orders or preferred ratings issued by the U.S. Government, delay by suppliers of material, shortages of material, unusually severe weather, or an inability to obtain necessary labor, materials or manufacturing facilities due to any such causes, and in the event of delay due to any such cause, the time specified for shipment or completion shall be extended during the continuation of such delay and a reasonable time thereafter to allow for shipment or completion. If changes in specifications or drawings are made at the instance of the Purchaser, and accepted by Transamerica Delaval, Transamerica Delaval shall be entitled to an equitable adjustment in the price, delivery date or both.

Delivery dates are approximate. Delivery dates and prices are based on prompt receipt by Transamerica Delaval of orders and all information necessary to permit Transamerica Delaval to proceed with work immediately and without interruption, and satisfactory assurance of compliance with the terms of payment agreed upon. Prices will be subject to adjustment in accordance with the provisions of the annexed price adjustment clause, if any.

2. TITLE: Without relieving the Purchaser from obligation to make payment as provided for and without reference to the form of invoice that may be used, it is agreed that title to the extent of a security interest in the Machinery furnished, is reserved in Transamerica Delaval until the purchase price (including any extensions of payment whether evidenced by note or otherwise) shall have been fully paid in cash, and the Machinery shall remain personal property, whatever may be the mode of its attachment to realty or other property until fully paid for in cash, and the Purchaser agrees to perform all acts which may be necessary to perfect and assure retention of title in Transamerica Delaval as aforesaid. In case of failure by the Purchaser to make any payments when due, it is expressly understood that it shall be optional with Transamerica Delaval to take exclusive possession of the Machinery wherever found and remove same without legal process at all the expense of the Purchaser. In the event of default by Purchaser, the amount of damage to Transamerica Delaval being undetermined and difficult or impossible to ascertain, it is hereby agreed that any payments which may have been made to Transamerica Delaval shall be retained by it as liquidated damages without prejudice to its right of recovery for further damage it may suffer from any cause arising out of such default.

3. STANDARD WARRANTY: Transamerica Delaval warrants that the Machinery will be free from defects in title and so far as of its own manufacture, will conform, in the manner provided in the applicable specifications which are made a part hereof, and will be free from defects in material and workmanship, and should any part of it be found, when properly installed, maintained and used under specified service conditions, within one year after date of notification of completion or, at Transamerica Delaval's option, of shipment by Transamerica Delaval, whichever is the earlier, to have been defective or nonconforming with the specifications, Transamerica Delaval will repair or replace said part f.o.b. its factory, provided the original part is returned to its factory transportation prepaid and Transamerica Delaval's inspection reveals it to have been defective or nonconforming within the terms of this warranty. No device or part shall be returned without giving prompt notice of nonconformance or defect to Transamerica Delaval and obtaining its prior written authorization. Transamerica Delaval shall in no event be held liable for damage or delay caused by nonconformance or a defect in material or workmanship, and no allowances will be made for repairs or alterations unless made with its written approval. Purchaser or any user claiming through Purchaser assumes all liability for the consequences of the use or misuse hereof by itself or its employees, or by others. Equipment and accessories not of our manufacture are warranted only to the extent of the warranty of the original manufacturer. Transamerica Delaval shall not be liable for damage of any kind resulting from erosive, corrosive or other harmful action of any gases, liquids or any other substance handled by the Machinery. The foregoing is in lieu of all other warranties by, and obligations or liabilities of Transamerica Delaval, or its representatives, whether express, implied or statutory, and SINCE THE MACHINERY IS THE SUBJECT OF SPECIFICATIONS, AS AFORESAID, NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE IS APPLICABLE.

Transamerica Delaval assumes no responsibility for damages due to deterioration during periods of storage by the Purchaser prior to installation and operation, if provided for in the proposal, or for an extra charge Transamerica Delaval will, if notified prior to shipment that the Machinery is to be stored, apply preservatives to minimize the deterioration.

4. INSURANCE: Fire and extended coverage insurance in an amount sufficient to protect Transamerica Delaval's interest in the Machinery is to be taken from and maintained with an insurer satisfactory to Transamerica Delaval by and at the expense of the Purchaser from the time of delivery until the Machinery may have been fully paid for in cash. The Purchaser shall assume all losses resulting from any cause that may not be covered by insurance.

5. TAXES: The Purchaser shall pay to Transamerica Delaval in addition to the purchase price, the amount of any excise, sales, privilege, use or any other tax, local, state or federal, which is payable by Transamerica Delaval because of the acceptance of an order, or sale, delivery, installation or use of the Machinery covered hereby.

6. INSTALLATION: The Machinery shall be installed by and at the expense of the Purchaser unless otherwise expressly agreed. Upon request, Transamerica Delaval will provide a competent technical representative to supply technical advice and assistance in the setting up and/or starting of the Machinery. The Purchaser shall pay Transamerica Delaval for the service of said technical representative at stipulated rates plus the traveling and other proper expenses. The technical representative shall be considered an employee of Transamerica Delaval, but Transamerica Delaval shall not be liable for injury to persons or damage to property occurring in the course of, or as a result, of the technical representative's presence upon the premises of the Purchaser. Transamerica Delaval accepts no responsibility for material and equipment, or for the acts of personnel, furnished by the Purchaser, nor has it any responsibility for the performance of Machinery not set up or started under the technical advice and assistance of its technical representative unless deficient performance is caused solely by inherent defects in material or workmanship.

7. SPECIFICATIONS: Any specifications referred to herein or annexed hereto are a standard form covering machinery of Transamerica Delaval of substantially identical type and character and there may be variations therefrom in the details of design and construction of any particular machine. Transamerica Delaval reserves the right to make such changes in details of design and construction as shall, in its judgment, constitute an improvement over such former practice as may be shown or described in the specifications. Transamerica Delaval does not supply detailed or shop working drawings of its Machinery.

8. PATENTS: Transamerica Delaval shall indemnify the Purchaser for any liability the Purchaser may incur because of claims of infringement of United States apparatus patents by the Machinery or parts manufactured by Transamerica Delaval. The Purchaser shall indemnify Transamerica Delaval for any liability Transamerica Delaval may incur because of claims of infringement of United States process patents in the use of the Machinery and parts furnished hereunder.

9. CANCELLATION: Should the order be terminated for any such cause the Purchaser shall pay Transamerica Delaval for all costs and expenses incurred and commitments made in connection with the performance of the order, plus a reasonable profit thereon.

10. EMERGENCIES: For contracts or orders with a price of $200,000 or more and/or for development contracts of a special nature, where Transamerica Delaval's performance or completion of such contracts or orders is delayed or suspended for a protracted period, directly or indirectly, as the result of war, national emergency, Federal or state statute or government rules or regulations, priority controls, defense efforts, or any like cause (as distinguished from the normal delays in manufacturing caused by factors beyond the control of the manufacturer, such as strikes, fires, labor embargoes, etc.), either Transamerica Delaval or the Purchaser, at any time after the end of 180 days following the start of such delay or suspension, may terminate the contract or order upon 10 days written notice to the other, and upon the giving of such notice the Purchaser shall pay Transamerica Delaval for all costs and expenses incurred and commitments made in connection with performance to the date of such suspension, plus a reasonable profit thereon. Title to all material paid for by Purchaser shall thereupon vest in the Purchaser and shall thereafter be held at Purchaser's risk and expense. In the event that the contract or order has not been so terminated, Transamerica Delaval will, promptly after the cessation of the cause for such delay or suspension, notify the Purchaser of the revised shipping schedule and proceed with performance in accordance therewith.

11. LAWS AND REGULATIONS: The Machinery to be produced by Transamerica Delaval and delivered hereunder will be produced in compliance with the Fair Labor Standards Act of 1938, as amended, when applicable. Transamerica Delaval will comply with Federal, state and local laws, orders and regulations applicable to it as of the date of its quotation. Transamerica Delaval shall be responsible for compliance with the requirements and standards of OSHA, or any similar law, only to the extent that they apply to the Machinery itself and are sufficiently specifically identified in the order to Transamerica Delaval's satisfaction and accepted by it in writing. Price and delivery shall be subject to adjustment to compensate for compliance by Transamerica Delaval with any other laws, orders, regulations or requirements.

12. LIMITS OF LIABILITY: In no circumstances shall Transamerica Delaval be liable for special, consequential or exemplary damages, including, but not limited to, loss of use of the Machinery or associated equipment, damage to associated equipment, loss of profit or revenues, capital costs, cost of substitute machinery, facilities or equipment, facilities or services, cost of replacement power, down time costs, or claims of Purchaser's customers or others for any such damages. The complete liability of Transamerica Delaval to Purchaser, whether based upon breach of contract, warranty, tort (including negligence), or otherwise, is limited to that stated herein, and Purchaser shall and all successors in interest to the limitation of Transamerica Delaval's liability contained herein.

13. ATOMIC ENERGY USE: The Purchaser represents that the Machinery being supplied hereunder is to be used for a purpose other than in, or in any way related to, the creation, handling, or use of atomic energy or any activity associated therewith, and Transamerica Delaval shall not be responsible to the Purchaser or any third party should the Machinery be used, used otherwise than as represented, in which event the Purchaser shall indemnify and hold Transamerica Delaval free and harmless of any and all costs and damages. If, upon notice to Transamerica Delaval, the Machinery is to be used for the purpose of or in any way related to the creation, handling or use of atomic energy or any activity associated therewith, Purchaser agrees to comply with, and be bound by, all the terms, provisions and conditions of Transamerica Delaval's applicable Nuclear Indemnification Clause, a copy of which will be supplied upon request.

14. MANUFACTURE: The Machinery contemplated to be furnished hereunder, other than those items normally purchased from others, may be manufactured by any of Transamerica Delaval's Divisions, Affiliates or Subsidiaries.

15. GENERAL: All of the above provisions, together with those set forth in the Transamerica Delaval form to which this is annexed, and such others as may be accepted by Transamerica Delaval in writing, all of which are accepted by Purchaser and supersede Purchaser's order form, if any, shall be and constitute the entire agreement for the sale of the Machinery. Any terms and conditions in any writing pertaining to the sale of the Machinery, irrespective of its wording or all when received by Transamerica Delaval, which are inconsistent with, or add to the terms and conditions hereof, will not be acceptable or become a part of the contract without Transamerica Delaval's written consent signed by its duly authorized representative. Commencement of performance or shipping shall not constitute acceptance of any such inconsistent or added terms and conditions. Any representation, promise, course of dealing or trade usage not contained or referenced herein, will not be binding on Transamerica Delaval. No modification, amendment, rescission, waiver or other change shall be binding on Transamerica Delaval unless agreed to in writing by Transamerica Delaval. The rights and obligations of the parties shall be governed in all respects by the laws of the State in which the order is accepted and entered by Transamerica Delaval.

ALL ORDERS ARE SUBJECT TO ACCEPTANCE BY TRANSAMERICA DELAVAL AT ITS HOME OFFICE AND NO ORDER SHALL BE BINDING UPON TRANSAMERICA DELAVAL UNTIL SO ACCEPTED.

STATE OF ALASKA

MEMORANDUM

TO: Transamerica Delaval Inc.
Oakland, CA

Attn: Bob Bailey

DATE: March 7, 1983

FILE NO:

TELEPHONE NO:

FROM: Max Zbinden
Alaska Marine Highway
Seattle, WA 98104-2599

SUBJECT: M/V COLUMBIA Main Engine Cylinder Heads

In regards to my letter of March 1, 1983, please be advised that the 33 cylinder heads, noted as being returned to the vessel, only covered reconditioned units. It did not include the 3 scrapped heads.

Confirming our phone conversation of March 4, 1983, we have received the following shipments of cylinder heads:

1 shipment of 14 reconditioned heads
1 shipment of 15 reconditioned heads
1 shipment of 3 reconditioned heads
1 shipment of 1 reconditioned head
1 shipment of 3 junked heads

Please advise if the one cylinder head that was to be replaced with an exchange unit, under DO #745942, could actually be repaired. During a recent phone conversation, I believe you indicated that the head was subsequently found beyond repair. If such be the case, that portion of DO #745942 will be cancelled and a new replacement ordered. The head, if unrepairable shall be returned to Pier 48 marked "SCRAP".

In my letter of March 1, 1983, reference was made to several cylinder heads that were neither new or any of those sent to your facility for rework. Closer inspection revealed that the three in question are infact heads that we had sent for rework. For this I must apoligize. However, these 3 heads were so badly damaged during the reconditioning that we concluded they could not of been ours. Two of these three heads are unfit for use. The third one may last the season. I would recommend that someone from your facility inspect the general condition of the reconditioned cylinder heads as being returned to the vessel.

The three new cylinder heads, which are on order have not been received to date. Request status of same. Additionally request status of the cylinder head, damaged in transit and returned for repair or replacement with new head assembly, on RMR-5675-34 and our DO #746326.

cc: Dan Casey, Commissioner, DOT & PF
Ron Lind, Deputy Commissioner, DOT & PF
Hugh McDonald, Port Engineer, AMH
Dave Thomsen, TDI
Chief Engineer, M/V COLUMBIA
Bob Snyder, APE, Juneau

STATE OF ALASKA

BILL SHEFFIELD, GOVERNOR

DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
MAINTENANCE AND OPERATIONS
DIVISION OF MARINE HIGHWAY SYSTEMS

PHONE: 623-6850

March 1, 1983

Transamerica Delaval Inc.
550 85th. Ave.
Oakland, CA 94621

Attn: Bob Bailey
Project Manager

Subject: M/V COLUMBIA Turbocharger
Retrofit Project

In accordance with the provisions of D.O. #707573, a total of 38 cylinder heads were to be shipped to your facility for Trabon modifications and reconditioning. A total of 37 cylinder heads were actually shipped.

Early on, one cylinder head was reported to be in need of extensive repair. Such repairs could not be accomplished in time and it was therefore suggested we utilize a rebuilt exchange unit. This was agreed to. Three additional cylinder heads were later reported to be badley cracked and beyond repair. Two new replacement cylinder heads were ordered. This would leave us with a total of 36 cylinder heads.

A total of 33 cylinder heads have been returned to the vessel todate. One of these received damage in transit and was returned to your facility for repair or replacement with a new cylinder head. Inspection of the remaining 32 reconditioned cylinder heads reveals much poor workmanship and an apparent lack of proper shop inspection during rework and prior to shipment. The heads contain welding slag and other debris. Pits and blow holes are evident in the valve seat surfaces. Excess exhaust valve insert weldments exist which were either not finish machined or only partially accomplished on several heads. Several heads contained rust on the machined surfaces, some had frozen or stuck valve rotators while others had springs missing from the valve seals.

Several of the returned cylinder heads are neither those sent from the vessel for rework or are they new replacements. They appear to be well used cylinder heads from some other engine or engines. Two of these are unfit for use. One has internal cracks and damaged gasket faces, the other has a tap broken off in a flange bolt hole whose threads are also damaged and its fire deck is not flat.

The remaining 30 cylinder heads will be installed. There ability to survive a full season is questionable. This currently leaves us short two servicable heads which are overdue and necessary in order to reassemble the engines. Additionally, at least two spare servicable cylinder heads will be required to be on board on or before 25 March 1983.

The cylinder head problems, including warranty responsibility will have to be resolved at a meeting to be conducted after the vessel returns to service.

Sincerely,

Max E. Zoinden
Assistant Port Engineer

MEZ:clp
cc: Dan Casey, Commissioner, DOT & PF
Ron Lind, Deputy Commissioner, DOT & PF
Hugh McDonald, Port Engineer, AMH
Dave Thomsen, TDI
Chief Engineer, M/V COLUMBIA
Bob Snyder, APE, Juneau

From: M. Zbinden
Alaska Marine Highway System
Seattle

To: B. Bailey
TDI, Oakland

15 each M/V COLUMBIA main engine departing Seattle 12/2/82 via ETMF due Oakland 12/6/82.

RMR 9479 Applies.

All 15 cylinder Heads to receive trabon mods. charged against D.O. 707573, Project #4

14 of the cylinder heads to additionally receive complete overall (spare head excluded) including disassembly, hot tank cleaning, hot press test, rebuild and/or rework as found necessary and reassemble ready for reinstallation charged against D.O. 707573, project #5.

Expect remaining cylinder heads to be shipped early week of 12/6/82.

Port Main Engine
Installed during 82-83 O/H

SERIAL #'s

R-89 409F Recon 1-17-83

O-14 558E Recon 1-27-83

J-33 141T Recon 12-1-83

3-19 558R Recon 1-17-83
Pin Holes in intake valve seats

D-18 425J Recon 1-18-83
Head was Rusty

=-48 856P Recon 1-19-83

=-60 9-27-P Recon 2-3-83

1-28 136-T Recon 2-3-83

F-42 821-P Recon 2-3-83

B-14 939-T Recon 1-25-83

F-83 242-R Recon 12-10-82

7 52 754-T Recon 12-6-83

4-11 24LT Recon 2-8-83

A-45 743T Recon 12-7-83

E-~~2~~ 72 ~~T-6-J~~ 18W Recon 1-3-83

B-5 671J Recon No Date

SERIAL #'S

SCBD Main Engine
Installed during 82-83 O/H

R-77	379 F	Recon	1-25-83
P-53	865 E	Recon	1-24-83
		Rotators Froze	
R-9	226 F	Recon	1-13-83
		Rotators Froze	
R-20	453 F	Recon	2-1-83
R-97	425 F	Recon	2-4-83
N-64	435 E	Recon	1-27-83
O-89	731 E	Recon	1-21-83
D-6	754 E	Recon	1-28-83
R-36	276 F	Recon	1-19-83
M-92	183 E	Recon	1-19-83
R-53	370 F	Recon	2-7-83
		Rotators Froze	
O-87	731 E	Recon	1-20-83
R-39	244 F	Recon	1-26-83
		Pits in valve seats	
H-32	357	Recon	2-2-83
		NG	
B-6	671 J	Recon	2-10-83
		Was spare	
F-29	748 J	Recon	2-4-83
		NG	

of-ALASKA

TO: Hugh McDonald
Port Engineer, AMH

DATE: March 9, 1983

FILE NO:

TELEPHONE NO:

FROM: Max Linden
APE/Seattle, AMH

SUBJECT: M/V COLUMBIA; Main Engine Turbo Retrofit status report #6

In accordance with the provisions of DO. 707573, relating to subject work, the project was to be completed in 45 working days. Work commenced on December 16, 1982 and should therefore have been completed on February 18, 1983. As of this date, the project is still incomplete. Todd Pacific Shipyards, under contract to Transamerica Delaval Inc., has yet to complete fabrication, field fitting and installation of the air intake elbows to each of the four new turbochargers. Additionally, the exhaust lines remain to be insulated, various pipe joints to be made up, small tubing runs to be completed, various pipe, tubing and electrical cable supports installed, etc.

Since the major portion of the hot work has been accomplished, it has been possible to clean up the machinery space to the point that the main engines could be opened up. Cleaning of the engines themselves, reinstallation of the cylinder liners and piston-rod assemblies has commenced. We are still at least one week behind schedule at this writing.

Confusion that resulted over the new Muskegan piston rings has been resolved with TDI. To our knowledge, none of the 37 cylinder heads shipped to TDI for rework and Trabon modifications, were cracked. Four of these cylinder heads have thus far been returned as junk. Three of these now have internal cracks which are beyond repair. It is assumed that the cracks occurred during the exhaust valve seat renewal process. Three new cylinder heads have been ordered at $20,209.00 each plus freight to replace in part those now junked. This should leave us with a total of 36 heads, 32 of which will be installed and the remaining four carried as spares.

Thus far 33 reconditioned cylinder heads have been returned to the vessel by TDI. One of these was damaged in transit, was returned to TDI for repair and is still outstanding. Three other of the remaining 32 heads were received badly butchered. One has internal cracks, one has a tap broken off in a threaded hole, several have damaged flange faces and/or dented fire decks. Two of these cannot be used without repair action. Because of the time frame, the crew will attempt to remove the broken tap and install a helicoil to restore the damaged threads on one unit. Those heads with damaged flange faces will be built up with plastic steel and dressed to provide the necessary gasket sealing surface. TDI advised this date that the head with the internal cracks can be used with no problem. It will therefore be installed along with the head that has the damaged fire deck. This action will reduce the probability of any further delay.

The TDI representative visiting COLUMBIA this date expressed concern over the appearance of several cylinder liners. He has recommended that these be changed out and/or honed. Unfortunately we have no time to accomplish same at this date.

His recommendation is directly opposite the information contained in the TDI report of liner condition, made at our request and expense, when the cylinder heads were first pulled. The TDI report stated that the liners were basically in excellant condition with many thousand of operating hours still left. The vessel's Chief Engineer and I disagreed with the TDI findings and stated that based on our inspection and past history, the liners should be able to only last this coming season after which the engine would have to be pulled down for major rework. Our argument did not stand up against the TDI experts at that time. What TDI now seems to be concerned about is what we have been seeing for years and repeatedly bitched about. In each case we were told that what we object to are normal conditions with respect to the engine. One must wonder if TDI is becoming a bit concerned over the wording in DO 707573 concerning full payment for the work envolved. It requires that the engine operate for one season without problems. TDI may be looking at the liner conditions a bit more realistically in light of this.

MEZ:clp

cc: Daniel Casey, Commissioner, DOT & PF
Ron Lind, Deputy Commissioner, DOT & PF
Martin Nusbaum, Acting Director, AMH
Bob Snyder, APE Juneau, AMH
Ken Beselin, C/E M/V COLUMBIA