NOTES FROM THE SEA

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Air-conditioning Unit Compressor—Use with Five Effective Pistons

The following is extracted from a report received by the Fleet Technical Staff from a 'Leander' *Class frigate.*

During an AMP in Hong Kong, the port air-conditioning unit was found to be hot gassing continuously, An investigation revealed that the capillary of the BA 10 valve in the capacity control system was broken. A new valve was fitted on the day the ship sailed.

During the passage to Singapore, several attempts were made to set the plant to work using the procedure given in BR 3404, chapter 3. On two occasions, after a short period of running the plant cut out through the operation of the lubricating oil differential switch. At this time, it was noted that the compressor suction and discharge pressures were both above normal.

Adjustments were made to reduce the suction pressure and the plant was restarted. On this occasion, after a short period the plant stopped because the fuses in the motor circuit blew. The overload settings were checked and the plant was restarted; tong testers were used to determine the load current. It was found that the starting current was correct but, after a short delay, the running current rose quickly towards the overload condition. On this occasion a chattering noise was heard coming from the compressor.

When the compressor head was removed, three of the suction plate-valves were found to be broken. The compressor was turned by hand and each cylinder was examined with its piston at top dead centre, As far as could be seen, there were no pieces of plate-valve jammed between the pistons and centre walls and the rings appeared to be undamaged. Three of the liners were scored.

On arrival in Singapore, the Commander Fleet Maintenance provided assistance to lift each piston in turn to the point where the top rings were fully visible. All rings were in good condition. However, during this inspection, the small-end bush of the after piston in the outboard bank was found to be seized onto its gudgeon pin. The hole in the piston was elongated and the casting in way of the bush was cracked. The surface of the piston round the hole for the small-end bush was also cracked and some pieces had broken away. The other pistons were all free.

The ship's allowance of spares does not include a piston, and no piston was available at Singapore. The ship was programmed for a weapon training period the following week on one of the occasions when there were to be three ships in company. At this stage, the alternatives were:

(*a*) to remain in harbour to await the arrival of the parts that had been demanded from the U.K.;

(*b*) to sail with only one air-conditioning unit available;

(*c*) to remove the damaged piston and run on five cylinders.

Because of the limited 'in-company' time programmed for the ship before leaving the Far East, option (*a*) was discarded. Option (*b*) meant that some of the fighting equipment could not be used and also that living conditions on the messdecks would become intolerable. After taking into account the relatively short crankshaft in these compressors and that the connecting rod for the damaged piston was the centre rod of three on that particular throw, the decision was taken in favour of option (*c*).

The drawings indicated that there was an oil restrictor in the connecting rod. To limit the loss of oil pressure and to ensure that the big ends were located axially, the connecting rod was cut as closely as possible to the big-end bearing housing so as to allow the housing to act as a spacer.

The machining was undertaken by Sambawang Shipyard who also renewed the plate valves and evacuated the compressor before setting the plant to work. When the plant was restarted, the vibration level was noticeably greater than that of the starboard compressor; it was not, however, excessive and was considered to be acceptable for a limited period. The following day, the plant stopped because of low lubricating oil pressure. It was found that the pressure could be restored by operating the lubricating oil strainer, so an attempt was made to blow through the strainer but nothing of significance was found. A routine was instituted to operate the strainer at more frequent intervals and the plant ran satisfactorily for the remainder of the week.

On return to Singapore, the contractors opened up the compressor and examined a representative sample of big and small end bearings. No defects were found. As the required spares had not arrived in time to be fitted before the ship was due to sail, it was necessary to make a decision whether to continue to run the plant with five pistons. As the ship's programme included time

in company with other ships and considering the condition of the bearings that had been examined, it was decided to continue to run with five pistons.

When the ship returned to Singapore after two weeks, the contractor fitted a new piston, liner, and connecting rod. The contractor also examined all the big-end bearings and the small-end bushes in the throw with the damaged piston; time did not permit an examination of the remaining small-end bushes. The big-end bearings were unmarked, but there were chatter marks on one of the small-end bushes. It was found that the locating pin for the bush had sheared allowing the bush to rotate. The remaining bushes showed no signs of wear.

At this stage, it was noticed that the two pistons which had been removed were badly scored. As no additional spares were available, the pistons were lightly dressed and replaced. The compressor was boxed up and ran successfully without vibration.

Because of the limited amount of 'in-company' time programmed for the ship, it is considered that the decision to run this air-conditioned unit with only five pistons was justified.

The compressor was examined at the time when the new piston was fitted. No defects were found which could be attributed to the 440 hours that the machine ran out of balance, but the inspection was necessarily a rather cursory one.

The vibration level with five pistons connected was inevitably higher than normal but was considered to be acceptable for a limited period.

The two additional scored pistons and liners were not removed because spares were not available.

Ship Department Comment

While not encouraging the indiscriminate running of machinery outside its designed conditions, the ship's staff and the Commander Fleet Maintenance are to be congratulated on the successful use of their initiative and engineering knowledge. It is heartening to realize that these compressors are sufficiently robust to be able to take for a limited time the additional stresses imposed by running on five out of the six cylinders.