

# IN-LINE INTER- AFTERCONDENSER

Installation, Operation, Maintenance and Manual

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## **TABLE OF CONTENTS**

<b>SECTION I - INTRODUCTION.....</b>	<b>3</b>
<b>SECTION II - REMOVING AND REPLACING DEFECTIVE STRAIGHT TUBES.....</b>	<b>3</b>
<b>SECTION III - REPAIR AND REPLACEMENT ORDERS.....</b>	<b>9</b>

## SECTION I - INTRODUCTION

The in-line inter-aftercondensers are utilized as the heat exchangers for the vacuum producing equipment serving surface condensers.

The package units generally consist of one of three styles (refer to drawings S-3942, S-3943 or S-3944). The inter-aftercondenser internals are basically identical except for the shell diameter, number of tubes and tube passes.

For general instructions for installation, operation and maintenance of shell and tube heat exchangers, refer to OMI-II-90.

## SECTION II - REMOVING AND REPLACING DEFECTIVE STRAIGHT TUBES

The suggested procedure listed below should be used for units with tubes expanded at both tubesheets and at the shell division plate. When removing tubes, the tube metal must be completely loosened from each tubesheet and then the tube will pass easily out through the tubesheet holes, division plate and baffle/support plates. Any attempt to drive the tube out before it is properly loosened will result in the possible swelling of the tubes so that it will not pass through the holes in the baffles and/or support plates. It is preferred to pull the tubes from the aftercondenser end of the unit (the return or outlet end).

**Note:** Tube removal tools and expanders may be purchased if not included with order.

### A. Removing Tubes

**Method A** - Manual Method (not intended for large retubing jobs)

- 1) Remove bonnets or waterboxes at both ends of unit.
- 2) Clean all dirt and obstructions from the inside ends of tubes to be removed.
- 3) If tube protrudes past the face of the tubesheet on inlet end, trim flush with the use of any commercial tube end facing tool or tube trimmer.

At the opposite end of unit (return or outlet end), thread the manual puller mandrel into the other end of tube, until at least five (5) teeth are engaged. Slip on spacer(s) as required. Next, screw nut onto mandrel and seat on spacer. Simultaneously, while this nut is being torqued down at this end, the tube at other end (end in which tubes were trimmed) should be lightly tapped with a tube knock-out tool. Once the tube is loosened, it is fairly easy to completely remove with the use of additional spacers at pulling end. Since the tubes were expanded in the shell division plate, a certain amount of drag will be present in removing tube. Be extremely careful that the tube hole is not scratched or gouged. All holes should be carefully examined for surface condition, and, if necessary, a reamer of slightly larger diameter should be used to remove imperfections (check expanding tolerances before reaming the tube holes).

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### **Method B - Hydraulic Tube Puller Method**

- 1) Refer to Steps 1 and 2 of Method A.
- 2) Thread the tube "spear" into the adapter. Be sure the proper size is used which is based upon the tube OD and gauge (BWG).
- 3) By hand or using an impact wrench, turn the spear into the tube until it bites in firmly.
- 4) Place the hydraulic tube puller over the spear and attach. Keep cylinder end square against the face of tubesheet and clear of other tube ends.
- 5) Place the horseshoe lock into the adapter groove.
- 6) Apply light pressure with the pump (snug up) and, at the same time, break the expanded joint between tube and tubesheet at the other end by using a tube knock-out tool. If tube protrudes, trim flush with face of tubesheet (see paragraph A.3).
- 7) When seal is broken and tube is completely loosened from both tubesheets, the hydraulic unit can be used to finish removing the tube (as a slide hammer). Since the tubes were expanded in the shell division plate, a certain amount of drag will be present in removing tube.
- 8) Care should be taken to not scratch the tube holes in the tubesheet. All holes should be carefully examined for surface condition and, if necessary, a reamer of slightly larger diameter should be used to remove imperfections (check expanding tolerances before reaming the tube holes).

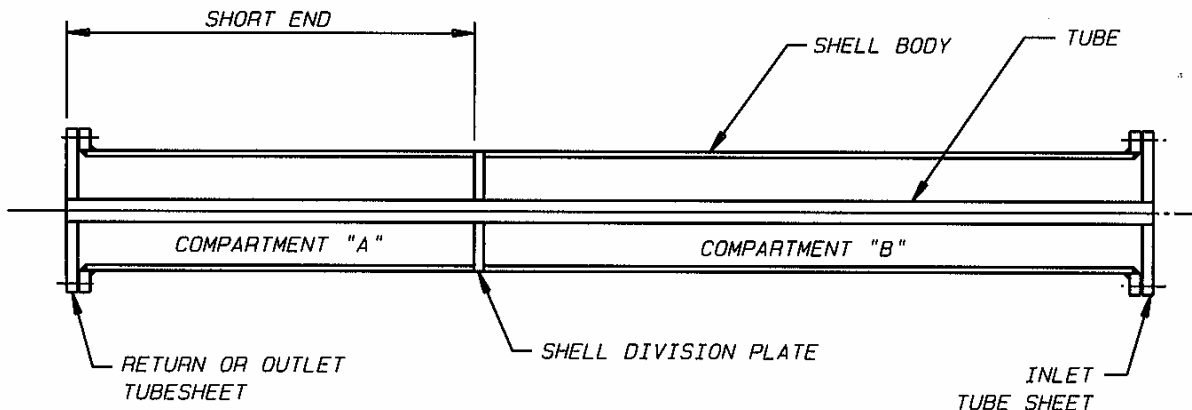
### **B. Replacing Tubes**

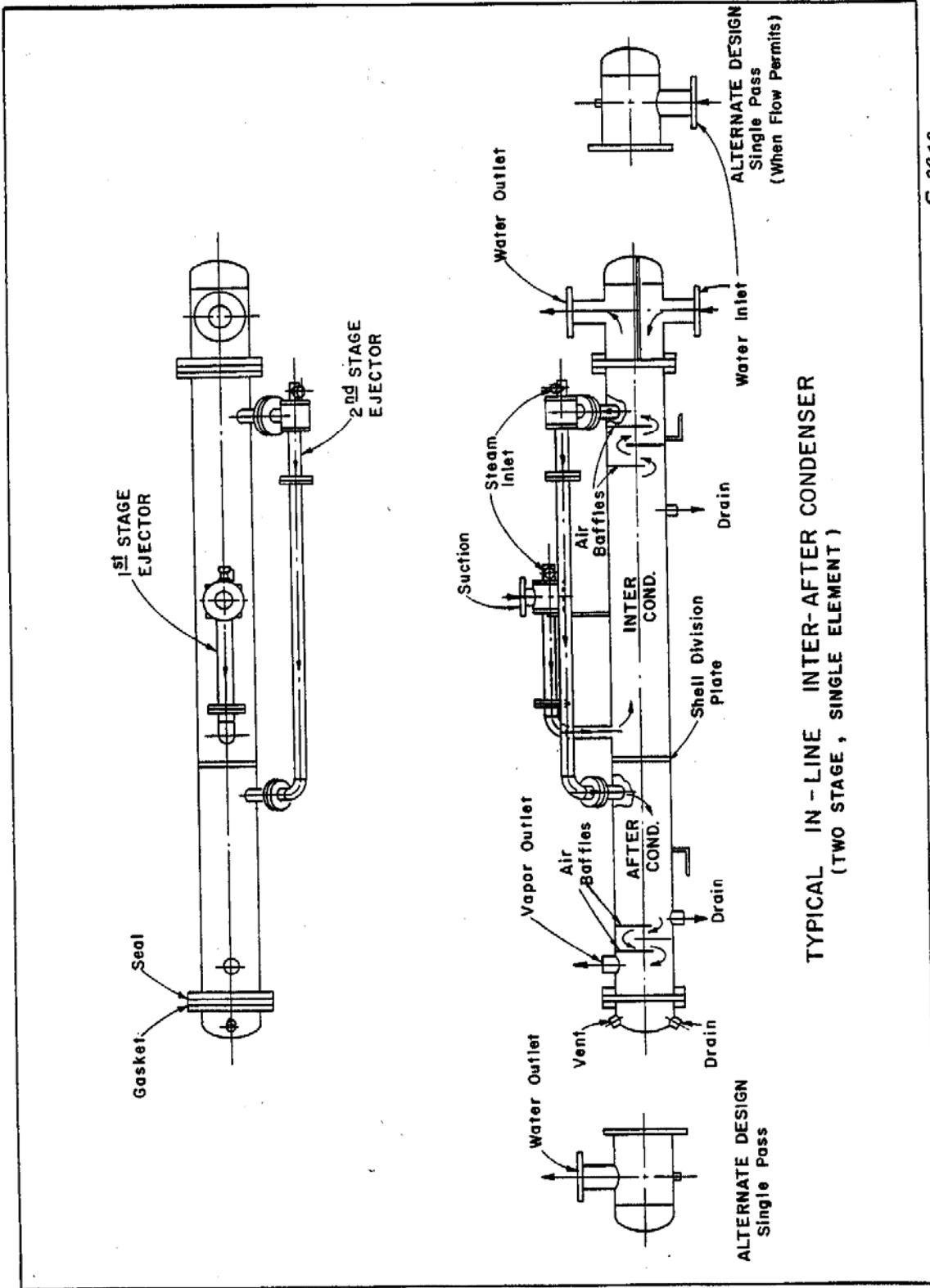
- 1) Twist the new tube as it is being pushed forward through the tubesheets and baffles for ease of insertion. The use of a tube guide speeds the assembly operation and prevents tube end damage. (If tube guides are used, be very careful that they do not fall out of tube and into unit. Follow manufacturer's instructions carefully.) **Note: Refer to Sketch "A".**
- 2) Expand all tubes replaced in the return or outlet tubesheet (at short end of unit) with a short nosed expander.
- 3) From the same end (short end), use a special extra long reach expander to seal center shell division plate. Note: Care must be taken to set rollers to the proper depth.

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- 4) Hydrostatically pressure test short end (compartment A). Refer to the outline drawing or the nameplate for the correct test pressure to be applied to the shell side of unit.
- 5) Expand the tubes at the inlet tubesheet and hydrostatically test this compartment B to the pressure shown on outline drawing or per the nameplate.
- 6) Reassemble bonnet and/or channels using new gaskets and hydrostatically test the tube side to the test pressure shown on outline drawing or per the nameplate.

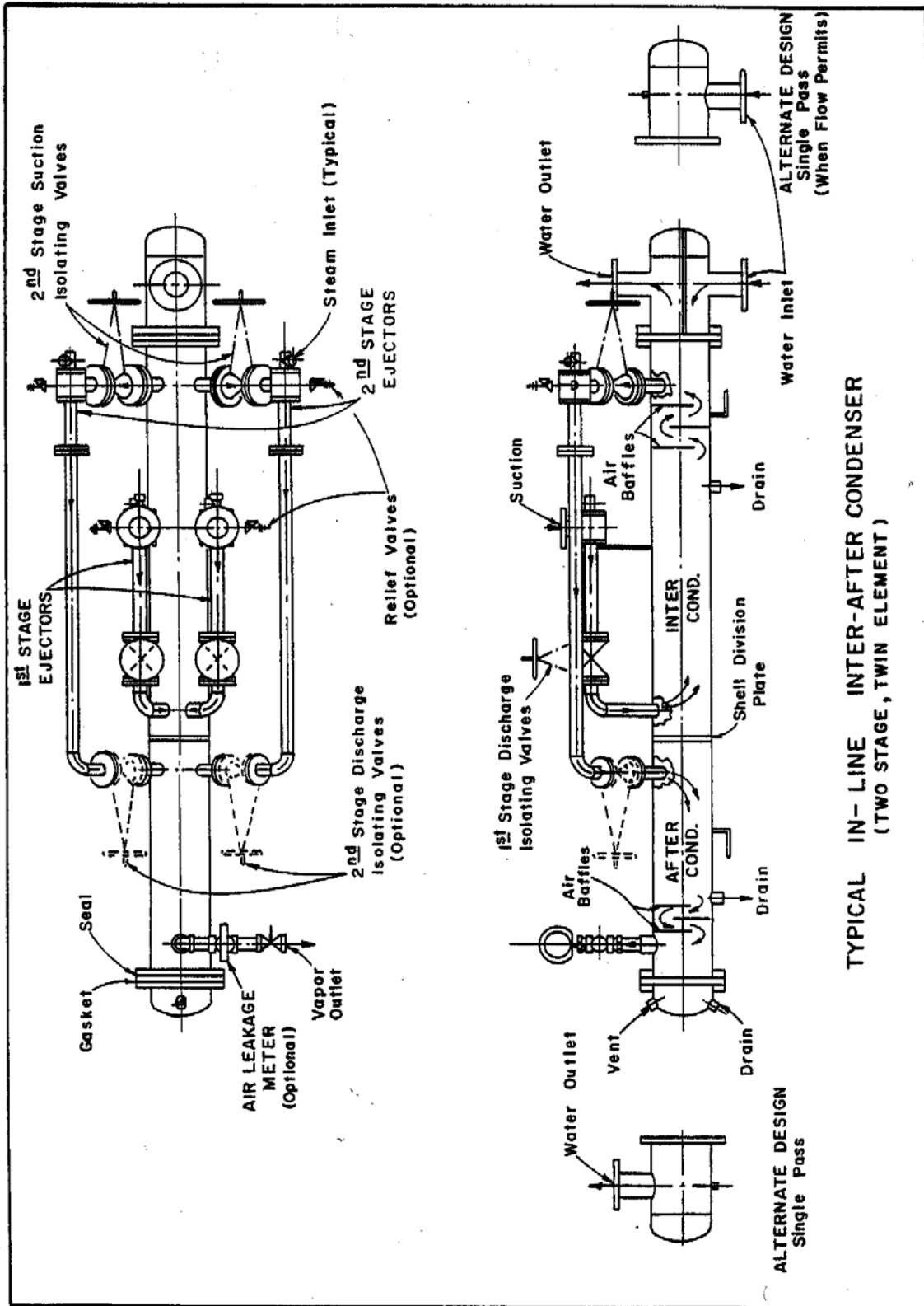
**SKETCH "A"**





S-3942

S-3942

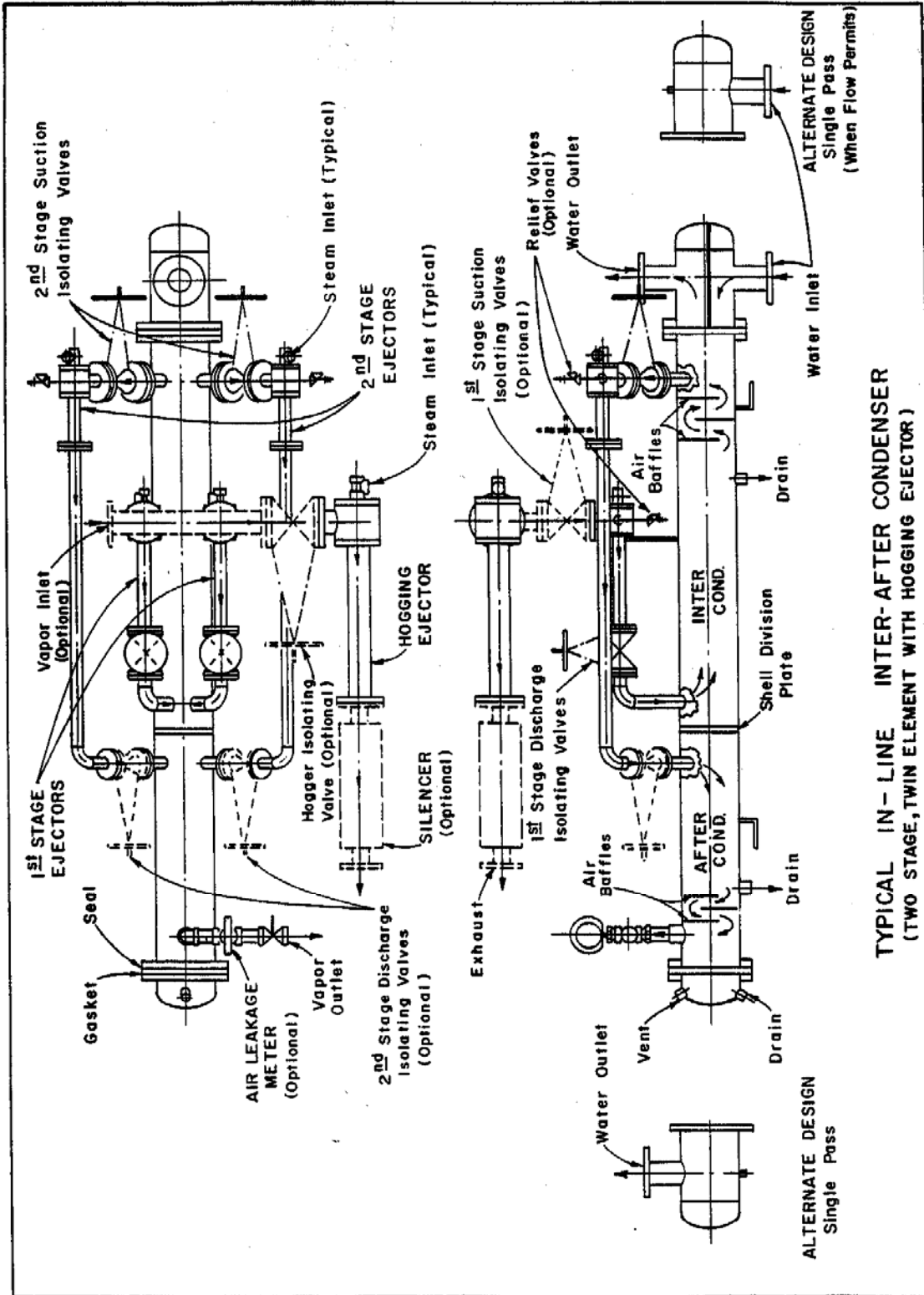


TYPICAL IN-LINE INTER-AFTER CONDENSER  
(TWO STAGE, TWIN ELEMENT)

ALTERNATE DESIGN  
Single Pass

5-3943

5-3943



TYPICAL IN-LINE INTER-AFTER CONDENSER  
(TWO STAGE, TWIN ELEMENT WITH HOGGING EJECTOR)

S-3944

S-3944



### **SECTION III - REPAIR AND REPLACEMENT ORDERS**

When it is necessary to obtain spare parts, please address your communication to:

GRAHAM CORPORATION  
20 Florence Avenue  
Batavia, New York 14020

Telephone: 585 / 343-2216  
Spare Parts: 800 / 828-8150  
Fax: 585 / 343-1097  
E-MAIL: spares@graham-mfg.com  
WEBSITE: <http://www.graham-mfg.com>

**IMPORTANT** - The following information should be given in order to identify the spare parts required:

1. Serial number of unit (stamped on nameplate),
2. Name or description of part required,
3. Method of shipment (i.e. freight, express, etc.).

*Graham Corporation presents the information in this manual as good engineering practice. We cannot be held responsible for any damage to equipment that may result from mal-operation nor for any personal injuries should they occur during normal or abnormal operation.*