

# APPENDIX A TYPICAL SPECIFICATION FOR STEAM SURFACE CONDENSERS

## A1.0 GENERAL COMMENTS

**A1.1** This Appendix is intended solely as a guide to assist in writing specifications for steam surface condensers. It is for the convenience of Purchasers who wish to incorporate parts or all of it in their own specifications.

**A1.2** In the procurement of condensers, it is very important that the Purchaser set forth the conditions to be met by the unit so that:

1. The equipment is of the proper capacity, type, and quality to perform successfully the functions for which it is specified
2. The performance characteristics are proper to meet the Purchaser's specific service conditions

3. The accessories to be included are adequate to meet the requirements of service for which the unit is specified
4. The highest degree of safety in operation and continuity of service is obtained

**A1.3** The design and construction of air removal equipment shall conform to the latest *Heat Exchange Institute Standards for Steam Jet Vacuum Systems and Performance Standards for Liquid Ring Vacuum Pumps*.

**A1.4** The design capacity of air removal equipment shall conform to the latest *Heat Exchange Institute Standards for Steam Surface Condensers*.

## A2.0 CONDENSER DESCRIPTION

**A2.1 Type and Arrangement** – The condenser shall be of the horizontal tube surface type. Materials of construction should be in accordance with those referenced by the latest *Heat Exchange Institute Standards for Steam Surface Condensers*.

**A2.2 Shell** – The design shall be adequate for the condition under which the unit shall be operated and shall remain tight under any operating vacuum. The shell shall be hydrostatically tested in accordance with *Heat Exchange Institute Standards for Steam Surface Condensers*. Suitable supporting feet shall be provided. There shall be openings for admission or removal of steam, air, vents, and returns as specified. Where impingement on the tubes may cause erosion, internal protection shall be provided. Suitable means shall be incorporated in the design to provide for the differences in thermal expansion between shell and tubes.

**A2.3 Water Boxes** – Water inlets and outlets and other openings shall be sized and located in accordance with good engineering practice and plant layout. The water boxes and cover plates if required shall have provisions for lifting. A sufficient number of openings shall be provided of suitable size and location to provide access for maintenance and inspection. Water boxes shall be designed for the specified pressure and hydrostatically tested in accordance with *Heat Exchange Institute Standards for Steam Surface Condensers*.

**A2.4 Tube Support Plates** – The tube support plates shall be of sufficient number and proper spacing as indicated by the *Heat Exchange Institute Standards*

*for Steam Surface Condensers* to provide adequate support for the tubes. Holes for the tubes shall be drilled in accordance with paragraph 8.2.9.1.

**A2.5 Tubesheets** – The tubesheets shall be drilled and prepared to receive the tubes in accordance with paragraph 8.2.9.2.

**A2.6 Hotwell** – The hotwell, with capacity as specified, of the same material as the shell, may be furnished as an integral part of or connected to the bottom of the condenser shell.

**A2.7 Miscellaneous** – The Manufacturer shall provide connections on the condenser for all instruments as specified.

**A2.8 Transition** – The arrangement shall be adequate to provide a smooth transition between the turbine exhaust and the condenser tube bundles. Provisions shall be provided for feedwater heaters, boiler feed pump turbine exhausts, turbine by-pass piping or other devices as specified. Materials of construction shall be of the same material as the shell.

**A2.9 Tubes** – Tube material and gauge is as specified by the Purchaser. Tubes shall be shop (field) installed.

**A2.10 Steam Inlet Expansion Joint** – The preferred type expansion joint is (Stainless steel, Rubber belt, Rubber U, other) as specified.

### A3.0 SPECIFICATION CONTENT

**A3.1** In view of the complexity of most specifications it is important that sufficient time (a minimum of four weeks) be allowed for preparation of designs at the proposal stage. Proposals shall be submitted on or before \_\_\_\_\_ in hard copy or electronic format and addressed to:

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**A3.2** The intent of this specification is to state the requirements and conditions for the furnishing and delivery of steam surface condensers as hereinafter specified.

**A3.3** The design and construction of the condenser shall conform to the latest standards of the *Heat Exchange Institute Standards for Steam Surface Condensers*.

**A3.4** The Manufacturer shall submit, with his proposal, drawings with approximate dimensions and weights, as well as descriptive material and data sheets which adequately describe the proposed design.

**A3.5** The materials and workmanship used in the construction of all apparatus shall be of industry standard quality.

**A3.6** Purchaser shall be responsible for supply of the following:

- Concrete foundations
- Anchor bolts, washers, sole plates and grouting
- All necessary building openings through which equipment is to be passed, as well as shoring of floors and items of similar building alteration which may be necessary because of the size and weight of the condenser equipment
- Labor and material for unloading, handling, and installation of equipment
- All piping, valves, and fittings, including those between condenser and auxiliaries
- All electrical wiring and motor controls
- All instruments and gauges
- All supplies and operating personnel necessary for condenser startup
- Circulating water chemistry with material selection
- Turbine allowable loads

**A3.7** The equipment shall be installed at:  
plant name: \_\_\_\_\_

Unit number: \_\_\_\_\_

Turbine capability: \_\_\_\_\_ mw \_\_\_\_\_  
Plant truck delivery  
address:

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Plant rail delivery address:  
\_\_\_\_\_

Delivering railroads:  
\_\_\_\_\_

A railroad siding does (does not) extend into the building and is (is not) under the station crane. The equipment must be moved \_\_\_\_\_ feet (miles) from the railroad cars to the \_\_\_\_\_ foundation. The method of unloading and movement of the condenser components is as follows:

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**A3.8** Shipping Terms shall be: \_\_\_\_\_  
(Incoterms 2000 or other).....

(i.e. Ex Works, FCA Delivered, FAS Port of Export, DDU, etc.) **A3.9** After order award, the Manufacturer shall provide the Purchaser with outline drawings of the condenser for approval. Also, the Purchaser will provide copies of power plant reference drawings to the Manufacturer for use in the design and fabrication of the condenser. These will include drawings such as: foundations, turbine exhaust details, circulating water piping, turbine bypass pipe, etc.

## A4.0 CONDENSER THERMAL DATA

Number of shells / Number of exhaust openings	/	
Pressure - (Single) (multiple)		
Steam condensed - design		lb/hr
Steam condensed - maximum		lb/hr
Heat rejected to circulating water (design total)		Btu/hr
Turbine bypass conditions at condenser connection		
HP:		lb/hr, Btu, °F, psia
LP:		lb/hr, Btu, °F, psia
Condenser pressure (absolute)		in HgA
Inlet circulating water temperature (design)		°F
Inlet circulating water temperature (range)	/	°F / °F
Circulating water flow - design		gpm
Circulating water nozzle size		in
Circulating water velocity in tubes - design		ft/sec
Circulating water source:		
(River) (Cooling tower) (Ocean) (Well) (Other)		
Circulating water chemistry		
Tube side pressure drop		psi
Cleanliness factor		%
Oxygen in condensate (maximum) (42) (14) (7)		ppb
Condenser surface		ft <sup>2</sup>
Number of water passes - (one) (two) (other)		
Tubes: Furnished by (Purchaser) (Manufacturer)		
Outside Diameter		in
Length - effective / total	/	ft / ft
Direction of tube withdrawal		
Tube end preparation (rolled) (welded)		
Tubes material / wall thickness:		
Gas Cooler	/	/BWG
Main Bank	/	/BWG
Periphery	/	/BWG
Additional requirements		

## A5.0 CONDENSER MECHANICAL DATA

Tube sheet material		
Shell material		
Water box type (divided) (non-divided)		
Water box material		
Water box internal coating (epoxy) (neoprene) (none) (other)		
Water box pressure design / test	/	psig
For a siphon arrangement of the circulating water system:		
Minimum elevation of discharge water level		ft
Hotwell arrangement (divided) (non-divided)		
Hotwell capacity		gal
Hotwell retention time		min
Hotwell special requirements		
Condensate outlets - quantity / size	/	# / in
List of all service connections including: size, quantity, material, flow, pressure		
enthalpy, temperature, frequency		
LP Turbine information:		
Exhaust connection (flanged) (welded)		
Turbine exhaust dimensions	x	ft
Allowable exhaust load X / Y / Z	/ /	lbs
Movement - lateral / axial	/	in / in
Condenser tube axis referred to turbine shaft axis:		
(parallel) (perpendicular)		
Elevation and dimensional information:		
Turbine room floor elevation		ft
Turbine exhaust connection elevation		ft
Basement floor or condenser pit elevation		ft
Turbine foundation beam depth		ft
Condenser top tube elevation (maximum)		ft
Condenser bottom tube elevation (minimum)		ft
Condenser Width (maximum allowable)		ft
Condenser Height (maximum allowable)		ft
Condenser Length (maximum allowable)		ft
Additional special requirements		

## **A6.0 ASSOCIATED EQUIPMENT**

### **A6.1 LP Turbine / condenser expansion provisions:**

(Spring supported) (expansion joint) (solid mounted)

### **A6.2 Turbine / condenser expansion joint:**

(rubber) (stainless steel)

### **A6.3 Provisions for feed water heaters located in transition section:**

Number / Diameter: \_\_\_\_\_ / \_\_\_\_\_

(Supports) (Closing plates) (Lagging)

### **A6.4 LP Turbine extraction:**

Pipes: number / size \_\_\_\_\_ / \_\_\_\_\_

(Lagging) (Supports) (Expansion joints)

### **A6.5 Air removal equipment:**

(vacuum pumps) (steam jet air ejectors) (hybrid pump / ejector system)

### **A6.6 Pressure relief device:**

(rupture disc) (atmospheric relief valve)

### **A6.7 Vacuum breaker valve**

Actuated (manual) (electric motor) (pneumatic)

### **A6.8 Instrumentation, provide a complete list**

### **A6.9 Water box accessories:**

Circulating water expansion joints (rubber arch type)

Gauge glasses

Cathodic protection

Continuous tube cleaning system

Priming system

Air release valves

### **A6.10 Additional equipment or accessories:**