

MANUAL
ON
INSTALLATION OF REFINERY INSTRUMENTS
AND CONTROL SYSTEMS

PART III—FIRED HEATERS AND INERT GAS GENERATORS

SECOND EDITION
1977

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FOREWORD

This recommended practice is based on the accumulated knowledge and experience of engineers in the petroleum industry. Its purpose is to aid in the installation of the more generally used measuring, control, and analytical instruments; transmission systems; and related accessories in order to achieve safe, continuous, accurate, and efficient operation with minimum maintenance. Although the information contained herein has been prepared primarily for petroleum refineries, much of it is applicable without change in chemical plants, gasoline plants, and similar installations.

Successful instrumentation depends upon a workable arrangement that incorporates the simplest systems and devices that will satisfy specified requirements. Sufficient schedules, drawings, sketches, and other data should be provided to enable the constructor to install the equipment in the desired manner. The various industry codes and standards, and laws and rulings of regulating bodies should be followed where applicable. The information contained in this publication does not constitute, and should not be construed to be, a code of rules or regulations. Furthermore, it does not grant the right, by implication or otherwise, for manufacture, sale, or use in connection with any method, apparatus, or product covered by letters patent; nor does it ensure anyone against liability for infringement of letters patent.

For maximum plant personnel safety, transmission systems are employed to eliminate the piping of hydrocarbons, acids, and other hazardous or noxious materials to instruments in control rooms. Proper installation is essential in order to utilize the full capabilities which are built into the instrument or transmission system.

In the installation of an instrument, the various components must be accessible for efficient maintenance and certain of these elements must be readable for good operation. Orifices, control valves, transmitters, thermocouples, level gages, and local controllers, as well as analyzer sample points, generally should be readily accessible from grade, permanent platforms, or fixed ladders. In this manual, special consideration is given to the location, accessibility, and readability of the elements.

Users of the various sections of this manual are reminded that in the rapidly advancing field of instrumentation no publication of this type can be complete, nor can any written document be substituted for qualified engineering analysis.

Certain systems are not covered herein because of their very specialized nature and limited use. When one of these systems gains general usage and installation reaches a fair degree of standardization, this section will be revised to incorporate such additional information.

Acknowledgment is made of the work of all the engineers and operating and maintenance personnel who, through years of study, observation, invention, and sometimes trial and error, have contributed to the technology of instrumentation.

Suggested revisions are invited and should be submitted to the director of the Refining Department, American Petroleum Institute, 2101 L Street, N.W., Washington, D.C. 20037.

PREFACE

This section is one of a series which make up RP 550, *Manual on Installation of Refinery Instruments and Control Systems*. RP 550 is composed of four parts:

- Part I—Process Instrumentation and Control
- Part II—Process Stream Analyzers
- Part III—Fired Heaters and Inert Gas Generators
- Part IV—Steam Generators

Part I assays the installation of the more commonly used measuring and control instruments, as well as protective devices and related accessories; Part II presents a detailed discussion of process stream analyzers; Part III covers installation requirements for instruments for fired heaters and inert gas generators; and Part IV covers installation requirements for instruments for steam generators. These discussions are supported by detailed information and illustrations to facilitate application of the recommendations.

The format of RP 550, Part I has been changed to facilitate continuity of presentation, convenience of reference, and flexibility of revision. Each section is now being published individually as follows:

- Section 1—Flow
- Section 2—Level
- Section 3—Temperature
- Section 4—Pressure
- Section 5—Automatic Controllers
- Section 6—Control Valves and Accessories
- Section 7—Transmission Systems
- Section 8—Seals, Purges, and Winterizing
- Section 9—Air Supply Systems
- Section 10—Hydraulic Systems
- Section 11—Electrical Power Supply
- Section 12—Control Centers
- Section 13—Alarms and Protective Devices

In the preparation of these documents, it was necessary to decide on a logical method of presentation: should each point be explained as fully as possible, or should extensive cross-referencing be done between sections?

The final documents contain a combination of these methods of presentation. An attempt has been made to make each section as complete as possible, with cross-referencing done only where very extensive repetition would have been required.

Users of this recommended practice are cautioned to obtain a complete set of sections in order to efficiently accomplish any cross-referencing that is required for a full understanding of the subject matter.

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PART III—FIRED HEATERS AND INERT GAS GENERATORS

SECTION 1—FIRED HEATERS

1.1 Scope

This section covers instrumentation for three types of tubular fired heaters:

1. Heaters with natural draft
2. Heaters with forced or induced draft fan(s), or both
3. Heaters with forced and induced draft fans with a combustion air preheater.

These heaters are comprised of heating coils, usually arranged in a refractory setting to provide radiant and convection heating sections. The heaters are usually fired with gas, oil, or a combination of both. The flow of material through the coils is generally countercurrent to the flow of combustion gases in order to achieve good thermal efficiency over a reasonably wide range of heat loads.

1.2 General

Heaters may be divided into two general types, horizontal tube and vertical tube. They may be updraft or

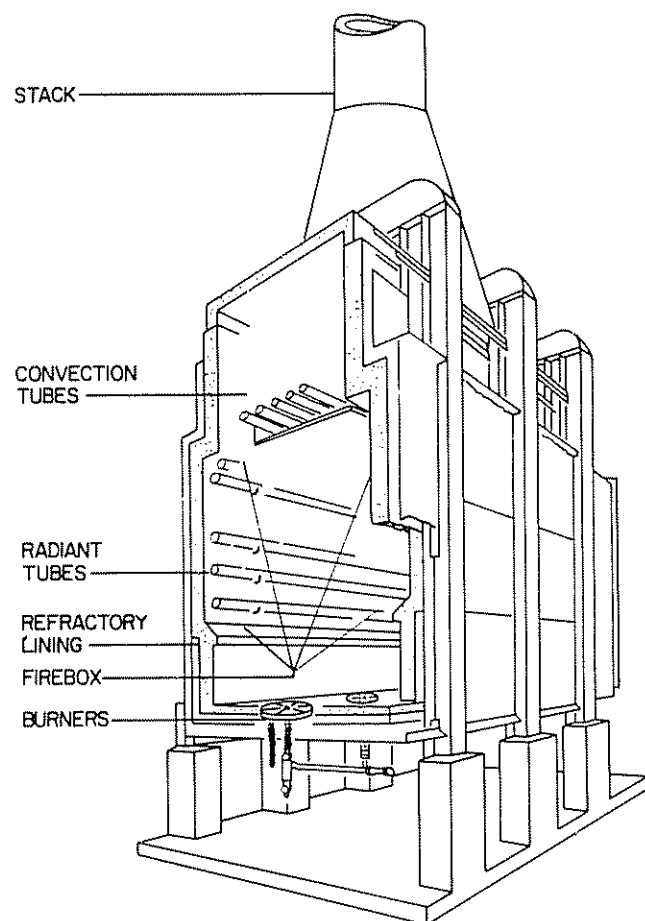


Figure 1-1—Typical Horizontal Tube Heater

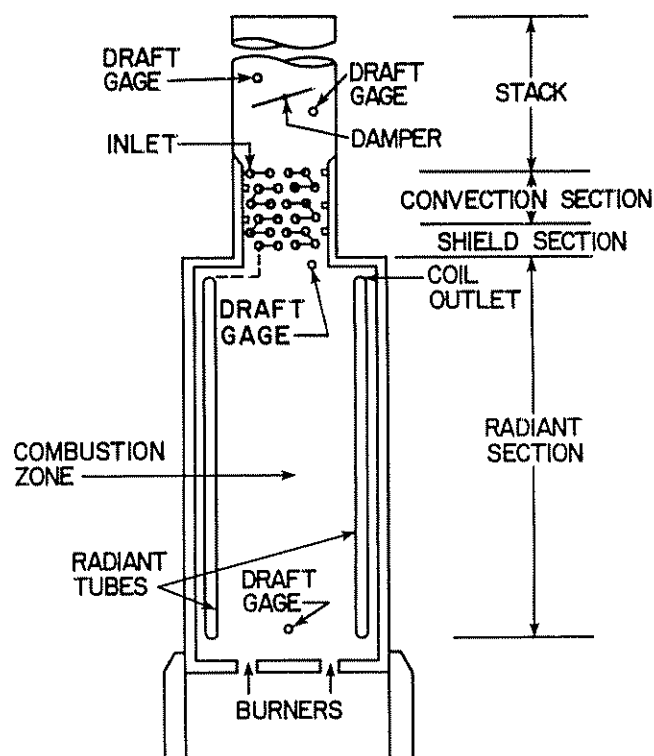


Figure 1-2—Typical Vertical Tube Heater

downdraft with gas or oil fired burners located in the end or side walls, floor, roof, or any combination thereof.

Fired heaters usually incorporate locations or zones where the primary mode of heat transfer is by radiation and other locations or zones where the primary mode of heat transfer is by convection from combustion gases. The location or zone which is directly exposed to flame radiation is termed the radiant section. The location or zone which does not "see" the flame is termed the convection section. Some areas of fired heaters may incorporate a heating surface where a combination of these heat transfer modes occur.

The sizes and arrangement of tubes in a heater are determined by process requirements (crude oil distillation, cracking, and so forth), the amount of heating surface required, the metal temperature, the allowable flow rate through the tubes, and the pressure drop. A typical horizontal heater is shown in Figure 1-1.

Vertical tube heaters may have either a circular or a rectangular cross section. The burners are usually located in the floor and the radiant tubes are vertical. Figure 1-2 shows a typical vertical heater.