twin reducing station in the plant yard. Each of the two reducing valves can handle enough gas at 35 psi to carry top station load. An 18-in. header in the boiler room feeds individual units through 10-in. plug cocks, followed by two emergency shutoff cocks with an automatic vent between them and a manual or automatic gas-control valve operated from the boiler board. This control valve reduces gas pressure to 1 to 5 psi, depending on burner load.

On first starting up with gas, this user took the precaution of blowing the 22-in. main feed line from the gas company's reducing station to the yard reducing station and atmosphere for 7 minutes. Then he purged the line from there to the individual burners, using nitrogen. Considerable foreign material was picked up from the new gas main — enough in one case to cut out the internals of the yard-reducing-station valve.

Gas-System Piping. It can be seen that the basic problem is to install a correct gas-piping system and to operate it properly. To help industrial gas users in this connection, the American Gas Assn formed the Industrial Gas Practices Committee in April 1952. This committee is to prepare a detailed statement of standard requirements for industrial consumers' gas piping.

It is hoped that the committee's work will serve as the basis for an American Standards Assn recommendation for all gas-piping carrying pressures above 0.5 psig. The committee's present thinking was summarized in a paper by E L Spanagel, Rochester Gas & Electric Corp, at the 1953 Fall Meeting of ASME. Much of the material in this paper (*Installation of Fuel-Gas Piping*) is presented on these pages, headed: "Recommended Practices for Industrial Gas Piping."

Standby Provisions. Many industrial-gas consumers take advantage of the lowest rates offered by the supplier, which often are for service of the interruptible type — that is, service may be cut off without notice and restored as the supplier's situation dictates. Plants using interruptible service usually make standby provisions of one kind or another. Often standby fuel is oil.

In many plants, although gas is not used as a boiler fuel, it is used in manufacturing operations, as in printing machinery, heat treating, etc. For such use any standby fuel should be gaseous and should have nearly the same properties as the fuel usually burned so a minimum of adjustments are needed.

Propane, butane and combinations of them (usually referred to as LPG, for liquefied petroleum gases) are finding increasingly wide use for standby service as well as regular fuel in areas where natural gas isn't available. In the typical standby setup, storage tanks of horizontal cylindrical design are used, with relief valves and extra-heavy pipe and fittings.

An external mixer proportions gas and air to match the physical properties and burning characteristics of the natural-gas supply. Most mixers permit a wide turndown rate, as much as 15 to 1, so load swings should cause no trouble. A vaporizer unit insures that the liquefied gas is properly conditioned for mixing. With such a setup, no changes in settings and burner adjustments are needed. Nor does the gas raise any problems of sludge or gas deposits in the orifices or burners.

RECOMMENDATIONS FOR INDUSTRIAL GAS PIPING, contd

Take branch connections, when needed, off the top or sides of main horizontal pipes rather than off the bottom. This helps to avoid pickup of condensate, scale, rust.

Equip branch connections with suitable manual shutoff valves or plug cocks, placed in the closed position. Close outlets with threaded caps, plugs or flanges until ready to use.

Main shutoff valves on lines to individual buildings should be outside the building to permit cutting off in emergencies. Location should be plainly marked and posted, and provisions made to prevent operation except when authorized.

Gas shutoffs should be gate valves or full-opening plug cocks. Lubricated plug cocks are usually recommended for pipe sizes over 2 in. Where gas pressure runs above 5 psig, tamperproof cocks are a good safety measure.

■ **TESTING PROCEDURE.** Subject the piping system to a test pressure at least 1.5 times maximum working pressure, but never less than 3 psig. System should hold bottled-up pressure for at least 10 min, without drop in pressure after test gas has had time to arrive at ambient temperature. Unusually long piping systems should be tested for longer periods—up to 24 hr.

As test medium, use air or inert gas, such as carbon dioxide, nitrogen or combustion products. Never use oxygen, water or any other liquid.

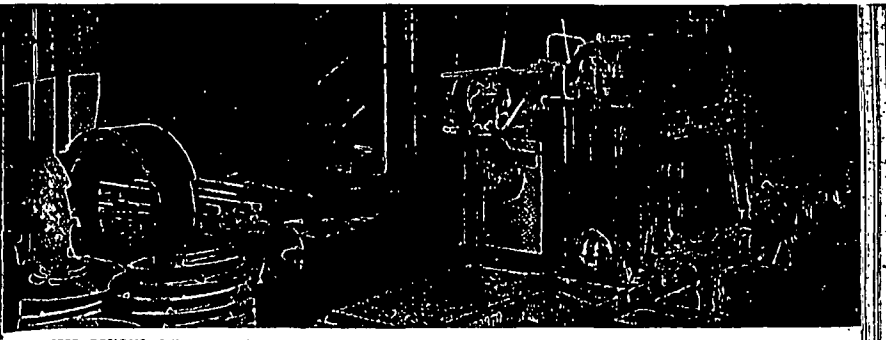
Purge piping after test and after gas meter has been set. Do the purging at the most distant point from the meter, by hose or temporary pipeline leading outside the building. Similarly purge each major branch line.

Make a final check after purging and filling up the gas lines. Test dial on gas meter can be used for over-all leak checks. Observe for 5 min; if there's no movement, consider system tight. If there is, shut gas off at meter and look for open fittings, open ends, open shutoff valves, bad joints.

■ **SAFETY PRECAUTIONS.** Never use gas piping for electrical grounding and never employ piping, control casings, panels or other metal parts in place of wiring. This doesn't apply to the gas combustion system's own low-voltage control and ignition circuits, nor to electronic flame-detection circuits.

Install a backpressure valve wherever air is used for the combustion system at a pressure higher than normal gas pressure. It might possibly back up into the gas lines. Also, put in an automatically operated gas valve with manual reset in the gas-supply line to serve as an interlock between air supply and gas supply. This will prevent flow of gas without accompanying flow of air necessary for combustion.

A second manually reset, automatically operated gas valve should be put in the gas-supply line to close tight at a preset low-pressure limit. Where gas compressors or other devices are installed to raise consumer's gas pressure above that normally supplied, install a similar low-pressure gas cutoff valve with manual reset.



FIELD-TESTED DESIGNS, fully automatic operation, make packaged watertube boilers ideal if they get good water treatment

Packaged Watertube Boiler Treatment

Compact, factory-assembled, packaged watertube boilers feature concentrated water-circulation paths, economy of metal, close tolerances. So steam and water passages must be kept free of scale and corrosion

By PAUL BRINDISI,
Chemical Engineer, Calco Laboratories

▶ WIDE ACCEPTANCE of the packaged firetube boiler set off a strong interest in developing its counterpart — the packaged watertube boiler. Current designs reflect this interest quite markedly. You'll find these new units a sharp departure from the long-established low-head watertube boilers. But because of these design differences they require special considerations for proper water treatment, *much as do the packaged* firetube designs, covered in POWER, June, p 76.

Design. For years, boiler manufacturers have been making their single- and 2-drum, bent-tube designs more and more compact. Today, they have reached the ultimate. These boilers now leave the manufacturer completely shop-assembled and nearly ready for operation on delivery, photo above. At this early stage of packaged watertube boiler development, units are available for steam capacities ranging from 4000 to 33,000 lb per hr and for operating pressures as high as 400 psi.

The watertube package wholly encases the boiler proper within an insulated sectional-steel jacket, suitable for either indoor or outdoor installation. It requires no special or costly foundation and occupies comparatively little floor space, with low headroom. One or two burners may be employed, firing oil or gas, either alone or in combination. In the single-drum boiler the burner goes in just beneath the steam drum, while in the 2-drum unit you'll find it to the side of the drums, drawings, top of p 101. The integral furnace is entirely watercooled with bare wall-tubes. However, the single-drum unit has longitudinal sidewall headers on either side of the burner, while the 2-drum unit has none.

Waterwall tubes of the 2-drum design connect directly from the steam drum to the mud drum. In some designs both drums have identical diameters, while in others the lower drum runs slightly smaller than the upper. These two drums extend the full length of the boiler, but are not always on the same vertical centers. The steam drum of either design generally carries steam-purifying baffle plates or internal separators. In addition, there's usually one blowdown connection from the bottom of the mud drum, about a quarter of the way in from the cooler end. The single-drum design, incidentally, makes blowdown connections to the rear of each of its sidewall headers.

Either forced or induced draft may be provided, although the last named is the more common. Superheat is available, and an external economizer or air preheater can be attached to these units when desired. Installation on the user's premises requires only a simple foundation and the tying of fuel, gas duct, electrical, steam and water connections to ready these boilers for operation.

Gas Travel. The single-drum design has a single, but split, gas pass in which the combustion products return *to the front dual-exits by way of side* corridors through the waterwalls, right-hand drawing, p 101. Tubes, comprising the cooling bank in front of the rear target wall, are quite widely separated and are staggered with respect to each other. Those forming the side waterwalls are also four or five rows deep, but more closely spaced.

The 2-drum design may have one, two or three gas passes, left-hand drawing, p 101, depending on the unit's size. Designers take advantage of the extra length of larger boilers and use only one large gas pass, with no convection baffling whatever. The combustion products leave by way of the front, top corner, away from the burner. Except for the few somewhat widely staggered tubes at the gas entrance, the drum-connecting tubes go in on fairly close and equal centers.

Medium-size 2-drum boilers have a 2-pass, U-shaped travel with the gases escaping through the rear, top corner,