

Fig. 25 . . . Typical Air-Water Induction Units

their following numbers on Fig. 25 are: primary air plenum (2), balancing damper (not shown), nozzles (3), secondary coil (8), mixing chamber (6), cabinet or enclosure (7).

Plenum. The conditioned primary air is introduced to the plenum which insures good air distribution to the nozzles. The plenum is baffled and lined with sound absorbing material to help attenuate the noise generated in the high-velocity duct system.

Balancing Damper. A damper (external or integrated with the unit) is used to adjust the primary air quantity to the unit.

Nozzles. The nozzle is an outlet for the primary air which provides the motivating force to induce flow of the secondary air through the unit coil.

Secondary Coil. Room temperature is controlled by modulating the flow of hot or cold water through the unit coil. Equipment is also available for maintaining desired room temperatures by bypassing air around the secondary coil as room conditions dictate.

Mixing Chamber. This chamber serves as a mixer for the primary and secondary air. It also provides the stack effect required for gravity heating.

Enclosure. The enclosure can be a factory furnished cabinet or furring to suit on the job. It must be designed to allow proper flow of secondary air through the coil and an unobstructed discharge.

Unit Selection Criteria

Four factors govern the selection of air-and-water induction units:

1. The unit must have sufficient capacity to satisfy maximum room sensible cooling requirements.
2. The unit must provide sufficient primary air at a dew point that will satisfy latent load requirements.
3. The unit primary air quantity must include sufficient outdoor air for ventilation purposes.
4. The unit must satisfy the room heating requirements. These can be met by providing the proper quantity of heated primary air to each room. (See Unit Selection Procedure for discussion of A/T ratio) or by supplying warm water to the unit coil. The ratio A/T is the ratio of primary air (cfm) to the heat transmission per degree of space being conditioned.

Range of Available Equipment

The following summary shows the available general range of sizes, air quantity, heating and cooling capacities, and pressure drops of current equipment.

Air-Water Induction Unit Summary

Number of available sizes	= 5
Cabinet dimensions	length = 20 to 62 in. width = 8 to 12 in. height = 12 to 26 in.
Air quantities	= 20 to 150 cfm
Nozzle pressure	= 1.0 to 3.5 in. of water
Water flow rate	= 1.0-2.0 gpm
Cooling capacity at 52 F entering water	= 2000-13,000 Btuh

Gravity heating
at 180 F entering water = 2600-9500 Btuh

Unit Application

Units can be mounted either vertically or horizontally in recesses or in cabinets. The preferred arrangement in the northern climates (when outdoor design temperature is below 20 F) is vertically underneath windows to minimize downdraft. There are, few limitations in unit location in very temperate climates other than the convenience of physical layout and economics. Units are available for free standing, wall hung, or ceiling hung applications.

Standard units are suitable for average window sill heights or all glass buildings.

In addition to dimensional differences, units are available in varying induction ratios (ratios of secondary coil air to primary air capacities). The wide selection is required due to the wide variation in sensible load that exists. For example, all-glass office buildings with high lighting loads require units with very high induction ratio; existing hotels with small windows and very light internal loads require a unit with low induction ratio.

System Description

The air-water induction unit system differs from the all-air system in that both fluids are capable of heating or cooling. By supplementing each other during the cooling season, the air quantity required can be greatly reduced.

Outdoor air for ventilation is drawn into the central primary air apparatus where it is conditioned and filtered. In summer and intermediate seasons, the dehumidifier chilled water coil removes excess moisture from the air. During intermediate seasons, a reheater warms the air sufficiently to offset balancing losses.

During the summer most of the cooling load, and in intermediate seasons all of the cooling, is accomplished by circulating cold secondary water through the induction unit coil to cool the secondary air.

This type of operation may continue through the heating season or the system can be changed over to operate with cool primary air and warm water for heating during cold winter weather. In either case, in freezing weather the preheater will temper the air so that it has the capacity to absorb moisture when passing through the humidifier sprays.

Nonchangeover systems can be applied on any building, but are normally confined to the following circumstances.

1. In areas which have a mild winter climate where periods of cold weather are of short duration and are comparatively mild, as for example, Florida, Texas and California.
2. In buildings where a changeover system would increase the primary air quantity above ventilation and cooling load requirements. In a severe winter climate where temperatures of 0 F or below are prevalent for weeks at a time, there is no reason why this prohibits operation on the winter cycle during these periods.

Chilled water from a central refrigeration plant is circulated through coils in the central dehumidifier. A secondary water pump circulates warm or cold water to the coils of the induction units. A high pressure centrifugal fan delivers the conditioned air through high velocity air conduits to the induction units. A sound absorber reduces the noise level as the air leaves the fan.

The basic system components are the central station conditioning equipment, the air transmission system, primary chilled water piping, secondary water piping, control system, and room induction units. Fig. 26 is a schematic diagram of the system showing the various components which are discussed in the following sections.

Central Station Apparatus

The central station air-conditioning equipment is conventional in design as generally described in Chapter 1. However, there are certain qualifications which should be made.

This apparatus can be designed to supply air of one temperature to every unit in a building. The supply air temperature in this case is coordinated with the outdoor temperature. A reheater as well as a preheater is required to achieve this control. The reheater should be sized for approximately 25 percent excess capacity to allow for duct heat losses and building pickup requirements.

In cases of low calculated changeover temperatures and where it is desired to shut off the refrigeration machine at higher temperatures, the primary air dehumidifier can be used to provide a source of cooling from outdoor air for the secondary water during intermediate seasons. If the capacity of the dehumidifier for this service is not adequate, supplementary cooling may usually be obtained from the interior zone dehumidifier.

In those instances where the refrigeration machine must be operated to obtain the secondary water cooling, steps must be taken to make the cooling tower suitable for winter operation.

If zoning is required with a single apparatus it may be accomplished by providing a reheater for each zone on the discharge side of the fan. If the size of the building is such that multiple conditioning stations are required, it may be desirable to arrange these stations as different zones.

Air Transmission Systems

The air transmission system should be designed for high velocity and high pressure, and therefore, sound absorbers are normally required on the discharge side of the fan. The duct layout should be as symmetrical as possible and ducts should be sized by static regain methods. This minimizes the pressure variation between units, reduces fan horsepower and keeps balancing time at a minimum.

Piping

Conventional piping practices as discussed in Chapters 8 and 74 will apply to the air-and-water induction unit system. However, there are certain qualifications:

Balancing. The use of a reverse return system generally eliminates the need for balancing. In new buildings it usually costs no more to design a complete reverse return system. In

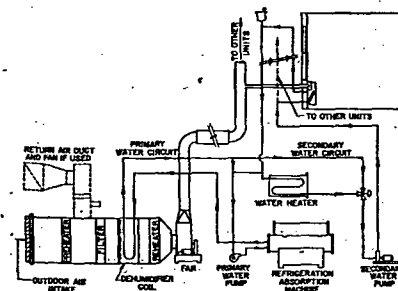


Fig. 26 . . . Typical Air-Water Induction Unit System

existing buildings, where this may be difficult the system can be designed with reverse return headers. Properly designed direct return risers result in only minor penalties.

Zoning. Usually with systems including automatic room control, zoning is not necessary except where it is desired to change over only part of the building from summer to winter operation and vice versa (a discussion of change-over is included under controls). Also zoning is not recommended for designs using manual room control if such buildings are located in metropolitan areas where shadows from adjacent structures materially influence the room load. Since it is impossible to zone effectively for these conditions, there is little to be gained by incurring the added expense. If the buildings are located where a good delineation of zones results then room regulation of temperature can be improved for manual room control applications by use of judicious zoning. This permits such control of zone water temperature that a minimum of adjustment is required at the room valve.

Diversity. When more than one exposure is served by a common secondary water circuit and automatic valves are used to control water flow, both the headers and the pump may be designed for lower flow rates because of diversity of load. A brief analysis of peak and coincidental off-peak loads (sun load is the major variable) indicate the magnitude of reductions that can be made. Note, however, that no diversity should be used when an air bypass control is used on the room induction unit secondary coil.

Flushing. It is desirable to provide a shut-off valve on both the supply and return run-outs between the riser and the induction unit or group of units, to permit servicing. If this is done, it will be possible to drain a single unit or a separate group of units to service an induction unit coil.

Flushing a new installation is imperative. Since the secondary coil is received in a clean condition, it is desirable to flush the piping system without flushing through the coil.

Accessories. Particular attention should be paid to design of air venting, dirt legs, expansion tank, shut-off, and drains.

Secondary Water Pump Selection. Pumps should be selected for continuous operation. The flow through the secondary pump is subject to considerable reduction, because of the throttling action of valves at the units. It is desirable to select these pumps on a flat part of the head vs flow curve, so excessive pressures do not result during throttling. In extensive systems where pump head requirements are high, it may be necessary to relieve the excess pressure across the control valves during throttled conditions to avoid loss of control, noise, and chattering valves. A differential pressure controller may be used as a sensing device to operate a pump bypass or the main throttling valves.

New piping results in less friction than indicated by current data. Hence, in a new installation the pump usually operates at greater than design flow and brake horsepower. Thus, in selecting a centrifugal pump, the addition of a safety factor to the calculated pump head increases the possibility of motor overload. It is recommended, therefore, that pump and pump motor selection be made from manufacturers' data, to insure that motor overload does not occur under any normal operating condition.

Condensate Drains from Induction Units. Condensate drain piping may be omitted with proper system design: If the secondary water temperature is maintained at no more than 3 F deg below the room dew point, dry secondary coil operation results. Usually this can be accomplished by designing the system with a 48 F apparatus dew point and 53 to 55 F secondary water temperature. If there is any question, a check of the final room dew point should be made.

Office buildings where abnormal conditions seldom occur are