#3A
Industrial Coils

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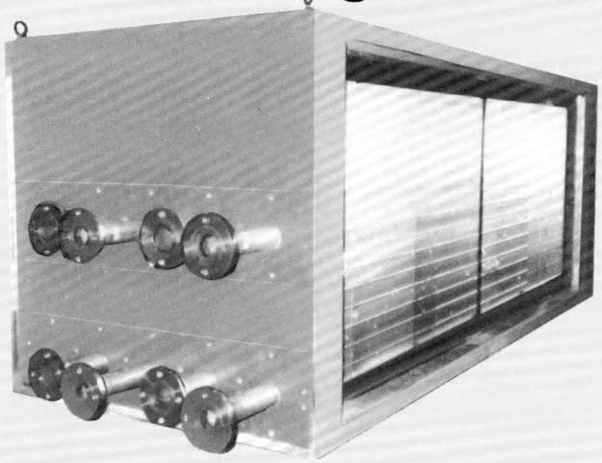
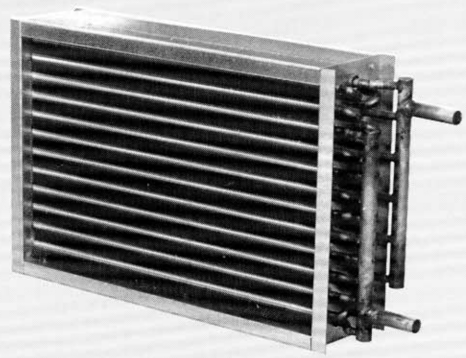
1 Construction & Emergency Shipping

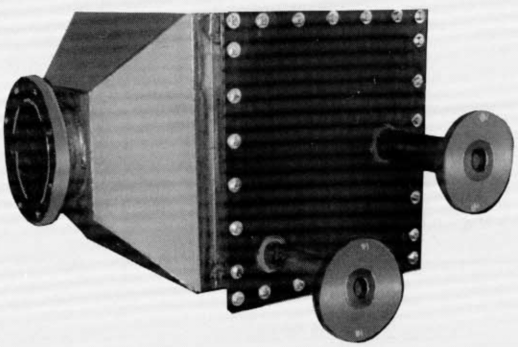
The widest range of Industrial Coils in the Industry.



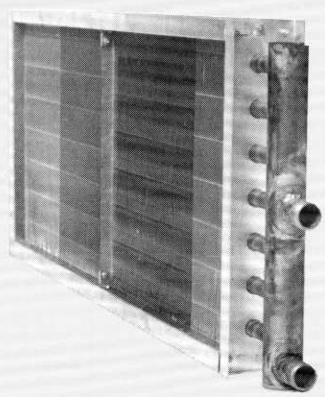
Multiple Coils arranged in banks. Coils either stacked high or deep, depending on the application. Special flanged connections are available on request. Coils can be arranged in a common casing.



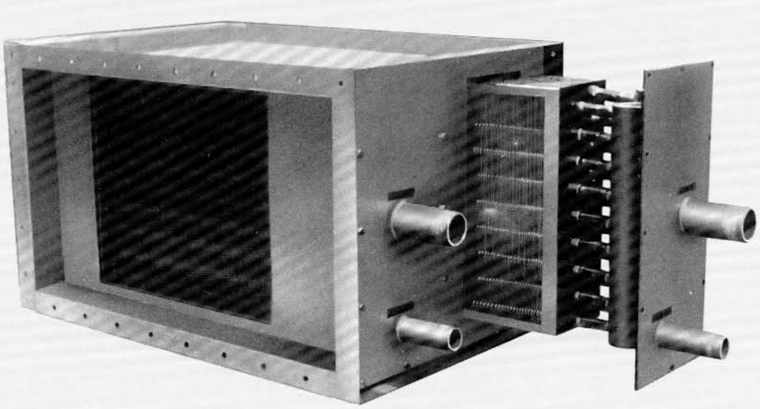
Hot Water or Chilled Water Cooling Coils - available in same or opposite end designs with a multitude of circuitry available. Coils constructed of 3/8", 1/2" and 5/8" O.D. tubes with aluminum or copper fins and galvanized or stainless steel casings.



High pressure coil design with coils installed in round to square transitions. Casing designed for pressures up to 100 P.S.I.G.



Steam Distributing Heating Coil - available in 5/8" O.D. or 1" O.D. design. All coils have inner distributing tube in conjunction with outer condensate tube making them perfect for below freezing air or modulation steam applications.



Industrial Heating, Cooling and Process Coils - in all types of arrangements and construction to meet your exacting requirements. Included are cleanable tubes, fabricated headers, removeable cores and air tight casings.

USA Coil & Air specializes in emergency shipments!

Three shipment programs are available for you to choose from:

1. STANDARD SHIPMENT: Most coils ship in 4 to 5 weeks under this program. Coils made from very special materials that require a high degree of welding and other labor sometimes take 6 to 7 weeks to build.

2. SPECIAL 10 WORK DAY SHIPMENTS: USA can build the vast majority of H.V.A.C. and process coils in 10 working days for a premium of 25%. More than 1/4 of all coils that USA manufactures ship under this program. (10 working days equals 2 weeks.)

3. SPECIAL 5 WORK DAY SHIPMENTS: USA can also build most H.V.A.C. and process coils in 5 working days for a premium of 50%. About 1/5 of all coils that USA manufactures ship under this program. (5 work days equals one week.)

In addition, USA offers many expedited delivery methods. These include; special air freight, special motor freight, UPS or RPS, when available. There are, of course, extra charges for these quicker methods of delivery. It is important to remember that USA specializes in quick shipment. We are the best in the industry when it comes to arranging economical, fast delivery for an emergency job!

Materials of Construction*

TUBE MATERIALS	DIAMETER	THICKNESS
COPPER	1/2" O.D.	.017" , .025"
COPPER	5/8" O.D.	.020" , .025" , .035" , .049" , .065"
COPPER	5/8" O.D. NON-FREEZE STEAM	.025" , .035"
COPPER	7/8" O.D.	.035" , .049" , .065" , .109"
COPPER	1" O.D. NON-FREEZE	.035" , .049"
90/10 CUPRO-NICKLE	5/8" O.D.	.035" , .049" , .065"
90/10 CUPRO-NICKLE	7/8" O.D.	.035 , .049" , .065"
BRASS (RED/ADM.)	5/8" O.D.	.035" , .049" , .065"
CARBON STEEL	5/8" O.D.	.035" , .049" , .065"
CARBON STEEL	7/8" O.D.	.049" , .065" , .109"
304/316 STAINLESS	5/8" O.D.	.035" , .049" , .065"
304/316 STAINLESS	7/8" O.D.	.049" , .065" , .109"
ALUMINUM	5/8" O.D.	.049" , .065"

FIN MATERIALS	THICKNESS
ALUMINUM	.006", .008", .010" .016", .030"
COPPER	.006", .008", .010"
CARBON STEEL	.012"
304/316 STAINLESS	.010"
90/10 CUPRO-NICKLE	.010"

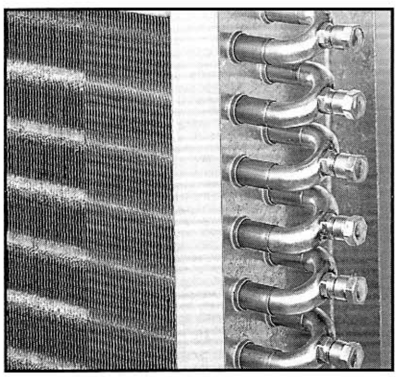
CASING MATERIALS	THICKNESS
GALV. STEEL 304/316 STAINLESS ALUMINUM	16 GA., 14 GA., 12 GA., 10 GA., 8 GA., AVAILABLE FOR ALL

CONNECTIONS	CONNECTION TYPES
COPPER STEEL 90/10 CUPRO-NICKLE BRASS ALUMINUM	M.P.T. F.P.T. SWEAT FLANGED

* USA Coil & Air has the tooling in place to build coils from all the materials and thicknesses in the above charts. Please keep in mind that some of these materials are very expensive and occasionally the commercial availability is not very good. Please check with USA prior to specifying or promising materials that are hard to get or exotic in any way.

Stop freeze damage with USA Coil & Air SENTRY GUARD Coils.

The first coil designed to protect itself from the cold; and its only available from USA Coil & Air.
Freeze damage. The leading cause of coil failure. It happens every winter when water or condensate freezes and expands causing internal pressure to reach dangerous levels. And if cold air is delivered across coil surfaces by a fan, freezing can happen fast, resulting in damage occurring within minutes. Until now freeze damage or bursting often lead to one repair solution – expensive and time consuming coil replacement.
Developed by USA Coil & Air, Sentry-Guard addresses the need for freeze protection by providing internal pressure relief well before catastrophic damage occurs. No other product offers this breakthrough freeze protection technology that is built into every Sentry-Guard coil.



Sentry-Guard coil with patent pending freeze relief plugs.

Sentry-Guard makes freeze protection easy, reliable, and very cost-efficient.
No other approach to coil freeze protection offers the operating and maintenance benefits of Sentry-Guard technology. The unique design incorporates easily removable pressure relief inserts into every coil return bend of a Sentry-Guard coil. As pressure approaches design limits, a specially designed plate ruptures, releasing pressure when and where required, protecting critical coil components from damage – simply, effectively, and reliably.
Freeze severity determines how many Sentry-Guard relief inserts rupture. In all cases repair is easy. Simply unscrew the top flange and set in a replacement insert. Hand tightening is all that's needed. Replacement Sentry-Guard inserts can easily be stored on or near each coil for quick, convenient servicing.
While Sentry-Guard does not eliminate the need to winterize coils by draining or adding glycol, it offers the security of straightforward, dependable freeze damage protection unequalled in the industry today.

Protection for all coil applications – hot or cold. All backed by a 30 Month Warranty.
Heating coils, especially for comfort applications, operate at peak levels during winter months, and can be exposed to the dangers of freezing ambient temperatures. Boiler breakdown, power failure, or improperly operating freezestats and controls are some factors which lead to freeze damage to any type of coil, regardless of location. Sentry-Guard coils are available to meet most requirements served by conventional coils – in a wide range of sizes, types, and for heating, cooling and reheating.

Patent pending freeze relief plug.

For additional information on the Sentry-Guard burst-proof coil call USA Coil & Air at 1-800-872-2645.

2 Steam Coil Construction

Selection of a coil for temperature and pressure is fairly simple if the proper rule is always applied. Longevity should increase as the service factor is increased. By this, we mean that the maximum temperature/pressure rating versus operating rating ratio is increased. Selection of a coil at or near its maximum limitations can cause problems.

An example is as follows:

GIVEN:	Steam coil operating at 200 PSIG working pressure. 90/10 cupro-nickel construction alternative for materials with 5/8" tubes. (See table below.)
SELECTION POSSIBILITES:	1. 90/10 cupro-nickel tubes (.035 OR .049) 230 ÷ 200 = 1.15 ratio
	2. Carbon steel tubes (.049) w/steel header 250 ÷ 200 = 1.25 ratio
	3. Carbon steel tubes (.083) W/Sch. 40 HDR. 400 ÷ 200 = 2.00 ratio
SELECTION:	#1 Okay but has lowest ratio – probably lowest cost
	#2 Good with satisfactory ratio – slightly more expensive
	#3 Excellent with best ratio – moderately more expensive

TABLE 1

STEAM HEATING COILS PRESSURE LIMIT TABLE

TUBE DIA.	TUBE MATERIAL	HEADER MATERIAL	MAX. RECOMD. STEAM PSIG	TEST PSIG	FIN MATERIAL	CASE MATERIAL
.625	.025 COPPER	TYPE K COPPER	100	400	SELECT FROM GROUP A	SELECT FROM GROUP F
	.049 COPPER	TYPE K COPPER	100	400		
		.083 MIN. WALL STEEL	150	400		
.875	.032 COPPER	TYPE K COPPER	120	400		
	.045 COPPER	TYPE K COPPER	120	400		
		.083 MIN. WALL STEEL	230	400		
.625	.035 90/10 CUPRO NICKEL	90/10 CUPRO NICKEL	230	400	SELECT FROM GROUP B	
		3/16" THK. FORMED 304 S.S.	230	400		
	.049 90/10 CUPRO NICKEL	90/10 CUPRO NICKEL	230	400		
		3/16" THK. FORMED 304 S.S.	230	400		
.875	.035 90/10 CUPRO NICKEL	90/10 CUPRO NICKEL	230	400		
		3/16" THK. FORMED 304 S.S.	230	400		
	.035 90/10 CUPRO NICKEL	90/10 CUPRO NICKEL	230	400		
		3/16" THK. FORMED 304 S.S.	230	400		
.625	.049 ALUM.	SCH 40 ALUM PIPE	120	400	.010 ALUM	12 GA. ALUM
.875	.058 ALUM.	SCH 40 ALUM PIPE	120	400	.016 ALUM	12 GA. ALUM
.625	.049 STEEL	.083 MIN. WALL STEEL	250	600	SELECT FROM GROUP C	SELECT FROM GROUP F
	.065 STEEL	SCH 40 STEEL PIPE	400	600		
.875	.049 STEEL	.083 MIN. WALL STEEL	250	600		
	.083 STEEL	SCH 40 STEEL PIPE	400	600		
.625	.035 304 L.S.S.	.083 MIN. WALL 304 L.S.S.	250	400	SELECT FROM GROUP D	
	.049 304 L.S.S.	.083 MIN. WALL 304 L.S.S.	250	400		
		SCH 40 304 L.S.S. PIPE	400	600		
.875	.035 304 L.S.S.	.083 MIN. WALL 304 L.S.S.	250	400		
	.049 304 L.S.S.	.083 MIN. WALL 304 L.S.S.	250	400		
	.065 304 L.S.S.	SCH 40 304 L.S.S. PIPE	400	600		
.625	.035 316 L.S.S.	.083 MIN. WALL 316 L.S.S.	250	400	GROUP E	

FIN SELECTION:

GROUP A	ALUMINUM, COPPER
GROUP B	ALUMINUM, COPPER, 90/10 CUPRO NICKEL
GROUP C	ALUMINUM, STEEL
GROUP D	ALUMINUM, COPPER, 90/10 CUPRO NICKEL, 304 S.S.
GROUP E	316 S.S.

CASE SELECTION

GROUP F	COPPER, STEEL, GALVANIZED STEEL, 304 S.S., OR ALUMINUM

INTRODUCTION

For all practical purposes, corrosion can be defined as an electrochemical process where an electrical current causes, or is caused by, chemical reactions in the metal and its environment. Thus, the control of corrosion becomes a matter of altering chemical reactions or reducing current flow. In many coil applications, particularly those involved in comfort heating or cooling, the medium (usually water or steam) can be treated to reduce corrosion rates. The treatment usually consists of removing dissolved gases (such as oxygen and carbon dioxide) and the addition of inhibitors. With proper treatment, copper tube/aluminum fin coils are the usual material selection, resulting in the lowest initial coil cost. In many coil applications, treatment programs may not be practical or even possible. In these applications, other materials will have to be utilized.

The discussion on the following pages is limited to those materials most frequently used in coil construction. Those materials are: copper, admiralty brass, red brass, 90/10 cupro nickel, 70/30 cupro nickel, aluminum, carbon steel, 304 and 304L stainless steel and 316 and 316L stainless steel. Other materials such as titanium, Hastelloys*, Monel** and numerous other alloys may be more suitable in some applications. These materials are costly and generally avoided, unless operating conditions are very severe.

*registered Trademark of Cabot Corporation

**registered Trademark of Huntington Alloys

SERVICE RELATED FACTORS

EFFECTS OF VELOCITY. The effect of velocity on corrosion depends on the metals involved and the environments to which the metal is exposed. In most environments, such as sea water, the effect of velocity depends on the characteristics of the films that a given metal develops. Those metals capable of developing very tough films with a relatively low resistance to fouling will fare better with high velocities. In the same environment, metals that develop films with good antifouling characteristics may be velocities sensitive. These metals will perform better with low velocities. Some general guidelines are listed below.

	FRESHWATER	SEAWATER
Copper & Red Brass	1-6 FPS	1-2 FPS
Admiralty Brass	1-6 FPS	1-6 FPS
90/10 Cupro Nickel	1-8 FPS	4-8 FPS
70/30 Cupro Nickel	1-12 FPS	5-12 FPS
Steel	1-10 FPS	Not Recd.
Stainless Steel	1-15 FPS	5-15 FPS
Aluminum	1-4FPS	Not Recd.

Velocity related corrosion problems usually occur within several inches of the tube to header joints or in the return bends becausethese areas are subject to increased turbulence. The failures normally show up as pinhole leaks on the outer tube surfaces. The corresponding inner tube surfaces are usually rough and pitted. In severe cases, the pitting may be horseshoe shaped.

EFFECTS OF TEMPERATURE. Increasing temperature increases corrosion activity in nearly all cases. In some instances, temperature increases can dramatically increase corrosion rates.Temperature increases of less than 60°F, for example, can double corrosion rates in waters containing oxygen and carbon dioxide (two common contaminants in water and steam systems). As a consequence, the effects of temperature in a given application must be carefully considered in selecting materials. This is particularly true when operating temperatures are in excess of 120°F.

EFFECTS OF STRESS

CORROSION FATIGUE. Corrosion Fatigue is a combined action of corrosion and cyclic stresses which cause failure that would not occur with either factor separately. Failure in such instances results in cracking, usually in or near the tube/header joint. In most cases, the cyclic stresses are a result of temperature changes causing expansion and contraction of the tube and/or header. The magnitude of cyclic stresses required to initiate fatigue corrosion depends on the intensity of the corrosive activity as well as the frequency of the cyclic stresses.

In typical comfort heatlng/cooling coil applicatons, steam coils exposed to outside air temperatures are more susceptible to this type of failure than water or refrigerant coils. All coils, however, regardless of materials or design, are susceptible to this type of failure given the proper environment. When conditions are present for corrosion fatigue failures, coil design with formed headers tying multiple rows of tubes together should be avoided. In terms of materials, with all other factors being equal, carbon steel has a lower coefficient of expansion and would be more desirable as the tube header material.

STRESS CORROSION CRACKING. Stress corrosion cracking is a corrosion failure resulting from the combined effects of corrosion and tensile stresses. Stresses are present due to processes of manufacturing coils and also operational consideraflons, most notably, temperature changes causing dimensional changes in the tube. Of the materials most common to coil construction, (i.e., copper, copper alloys, aluminum, steel, and stainless steel), copper alloys containing more than 15% zinc and stainless steels are the most susceptible to attack. Pure metals, such as copper and 1100 aluminum, are nearly immune to stress corrosion cracking.

As a rule, the causes of stress corrosion cracking are not well understood. Environments that cause stress corrosion cracking, however, are relatively well defined. Copper alloys are subject to stress corrosion cracking in environments containing ammonia and ammines, either in solution or moist atmospheres, and also in the presence of moist S02, Stainless steels are subject to stress corrosion containing acidic chlorides and fluorides.

Temperature, contaminate concentraflons and the magnitude of the stresses will, in a complicated manner, determine the susceptibility of a given material to stress corrosion cracking. However, increasing any of these factors will increase the severity and rate of the attack. At high temperatures, over 200°F, stress corrosion cracking can occur with very small concentratons of contaminates. Usually this form of corrosion occurs in or around the tube/header joint or other welded areas. The small cracks that develop as a result of stress corrosion cracking must be confirmed through microscopic examination.

MISCELLANEOUS INFLUENCES ON CORROSION

GALVANIC CORROSION. Galvanic corrosion occurs when dissimilar metals are in electrical contact with an electrolyte. In such instances, active metals are sacrificed (corroded) to passive metals. In galvanic corrosion of coils, the conductivity of the electrolyte (liquid) is important. Salt water, for example, is much more conductive than distilled water and as a result, promotes galvanic corrosion. Generally, coils handling fresh waters do not ordinarily pose severe galvanic corrosion problems. In such systems, copper tubes/steel headers are used sucessfully. In more conductive mediums, however, the joining of unlike metals may initiate galvanic corrosion problems.

In some cases, atmospheres can also initiate galvanic corrosion problems. As with the medium in the tubes as discussed above, the conductivity of the electrolyte is important. Condensation from sea air may galvanically corrode unlike material combinations; such as aluminum fins on copper tubes or copper tubes with steel headers.

In the galvanic series below, metals that are active relative to another metal would be corroded. In practice, copper and copper alloys can usually be mixed without causing galvanic corrosion problems.

GALVANIC SERIES IN SEA WATER

ACTIVE END
Galvanized Steel
Aluminum
Carbon Steel
304 and 316 Stainless Steel (Active)
Hastelloy B*
Admiralty Brass
Red Brass
Copper
90/10 Cupro Nickel
70/30 Cupro Nickel
304 and 316 Stainless Steel (Passive)
Titanium
PASSIVE END

*Trademark of Cabot Corporation

CREVICE CORROSION. Crevice corrosion is responsible for many if not most, premature corrosion failures of coils. This form of corrosion causes deep, localized pitting on the tube surfaces, often leaving the metal surrounding the pitting virtually uncorroded. Once started, the corrosive activity in the pits can be hundreds of times faster than the general rates of corrosion, and penetration through the tube wall can occur in very short periods of time.

Crevice corrosion is usually caused by variations in oxygen concentrations or by soluble contaminates such as sulfur, chlorine, or fluorine in contact with the tube surfaces. Variations of oxygen often occur when scale, sand, dirt, marine organisms or other solid matter is deposited on the tube surfaces causing a restricted access of oxygen to those surfaces.

With crevice corrosion, tube side velocities can play an important role. Moderate to high velocities tend to reduce the incidence of this form of corrosion since solid matter is more likely to be suspended in the liquid and not deposited on tube surfaces, and also because higher velocities tend to provide more uniform access of oxygen to the tube surfaces. Low velocities or stagnate conditions increase the incidence of crevice corrosion for the opposite reasons. Consequently crevice corrosion often occurs during coil shutdowns or other occasions when coils are taken out of service and left with fluid in them.

When conditions likely to cause crevice corrosion are known to exist, cleanable tube coils should be considered along with a scheduled cleaning of the coil.

FRESH WATERS

Water dissolves rock, soil, gases and other materials with which it comes in contact. As a result, depending on its source, fresh water can contain a variety of minerals, dissolved gases and pollutants that will ultimately determine its corrositivity to a given metal. Thus, material selection is a local problem in many cases. Some general guidelines are as follows:

STEEL. Steel tube coils generally offer excellent service life in fresh waters free of dissolved oxygen. If carbonate minerals are present, corrosion rates are reduced even further due to the formation of a protective layer on the tube surfaces, In the presence of oxygen, corrosion rates can become excessive.

COPPER AND COPPER ALLOYS. Copper and copper alloys exhibit excellent resistance to most fresh waters. Ordinarily, minerals react with dissolved gases, oxygen and carbon dioxide, to form protective films on the tube surfaces. Corrosion rates generally range between, l-5 mills/year. Corrosion rates between copper and various copper alloys do not vary significantly in most cases. however, there are exceptions. Admiralty brass, for example, tends to perform better in polluted waters than other copper alloys.

ALUMINUM. Aluminum has excellent resistance to most fresh waters, distilled waters and de-ironized waters with Ph values between 5-8. As a rule, aluminum performs better than copper, copper alloys and steel in waters containing oxygen and carbon dioxide, but may be severly corroded by waters containing chlorides, bicarbonates and heavy metal compounds.

304, 304L, 316 AND 316L STAINLESS STEEL. 304, 304L, 316 and 316L stainless steels offer superior corrosion resistance to waters free of chlorides and other halide ions than copper, copper alloys, aluminum and steel. The high corrosion resistance of the stainless steel depends on the presence of oxygen (or other oxidizing media) to assist in the formation of thin, but highly protective films on the metal surface. In the presence of chlorides or other halide salts, these films are destroyed and oxygen can act to accelerate the corrosion process.

SEA WATER

Unlike fresh waters, sea waters do not vary significantly from one locale to another, unless a specific pollutant is involved. Therefore, material selection for sea water service is relatively straightforward.

STEEL. Steel is subject to excessive corrosion rates and severe pitting. Its use should be avoided.

COPPER AND COPPER ALLOYS. Taking all factors into consideration, 90/1 0 cupro-nickel, and to greater extent 70/30 cupro-nickel alloys offer better corrosion resistance than copper, other copper alloys, stainless steel and aluminum. The cupro-nickel's excellent resistance to sea water is due, in large part, to the formation of protective films that tolerate relatively high velocities. Cupro-nickel also exhibits fairly good fouling characteristics and is less subject to pitting than other metals in slow moving sea water, Corrosion rates of cupro-nickel generally range between 1-5 mills/ year at velocities between 4-8 FPS.

Admiralty brass, although not as resistant as cupro-nickel, also offers excellent resistance to sea waters flowing at velocities less than 6 FPS. Copper and red brass are significantly less resistant than other copper alloys and are generally not recommended for use in sea water service.

ALUMINUM. Aluminum is subject to severe pitting in slow moving sea water and exhibits poor resistance to fouling.Aluminum is not recommended for use in sea water service.

304 AND 316 STAINLESS STEEL. 304 and 316 stainless steels, as a group, are much more susceptible to localized corrosion than copper and copper alloys. 304, and to a greater extent, 316 stainless steel have been used successfully, however. Their success depends on minimizing deposits of sand, scale, or other foreign matter as well as preventing the attachment of marine organisms to the tube surfaces. Because higher velocities tend to limit deposit formatons, stainless steel performs best when velocities are maintained at 5 FPS to 10 FPS. In general, the use of stainless steel in sea water is limited to applicaflons where pollutants in the water would corrode copper alloys.

ATMOSPHERES

The presence of moisture and contaminates in the atmosphere will, to a large extent, determine corrosion rates of a given metal. Moisture, acting as an electrolyte in the electrochemical process is a necessary ingredient.

When moisture is not present on coil surfaces, corrosion rates are generally very low. This is ordinarily the situation with all (air) heating coils or (air) cooling coils with very dry air or air below 32°F It should be assumed, however, that the vast majority of cooling coils will condense moisture on its surfaces and be subject to corrosion depending on the contaminates in the air and the metal involved.

For convenience, atmospheres are divided into three categories: rural, industrial and marine.

RURAL ATMOSPHERES. Rural atmospheres are not as corrosive as either industrial or marine atmospheres due to the absence of particulate matter and contaminates. In such atmospheres, all materials exhibit good resistance ranging from .001 mills/year (aluminum), .023 (copper), to .042 (zinc coated steel)*,

*H. E Boyer, (Ed.), Metals Handook - Volume 4 - Fdilure Analysis and Prevention, 8th edition, American Society for Metals Metals Park, Ohio. 1975. pg. 191.

INDUSTRIAL ATMOSPHERES. Industrial atmospheres contain dust as the primary contaminate. The dust particles are generally made up of carbon, metal salts, sulfates, chlorides and sulfuric acid. In combination with moisture, industrial atmospheres can be corrosive depending on the specific contaminates and concentration involved. In a general classification, however, copper, copper alloys, aluminum, galvanized steel and stainless steel are not excessively corroded by industrial atmospheres, although the specific contaminates involved at a given location may render any of these materials unsuitable.

MARINE ATMOSPHERES. Marine atmospheres can cause crevice corrosion or possible stress corrosion cracking in aluminum and stainless steels. Copper and copper alloys (notably the cupro nickels) are preferred in most applications involving marine environments. Hot dip galvanized, phenolic or fluorocarbon coatings can also provide good corrosion resistance to marine environments. Sacrificial coatings such as hot dip galvanized are preferred over other coatings in highly conductive electrolytes such as moist sea air. Corrosion is also an important consideration in marine environments.

STEAM AND STEAM CONDENSATES

Steam is generally not corrosive to most materials involved in coil construction. Steam condensates, however, may be corrosive depending on the steam quality. Well treated steam (steam void of oxygen, carbon dioxide and ammonia) does not generally produce condensates that are corrosive to copper, copper alloys, alumnimun, steel or stainless steel, However, condensates containing dissolved gases, for example oxygen and to a greater extent carbon dioxide, are corrosive to copper, all copper alloys and carbon steel. In such applications, steel is corroded to a greater extent than copper. Corrosion rates of copper and copper alloys have been measured at 7-14 mills/year in condensates containing 4.6 ppm 02; 14 PPM C02; a pH of 5.5 and a temperature 154°F.* Condensates containing ammonia are corrosive to copper and copper alloys. Although 70/30 cupro nickel has shown moderate resistance, all copper alloys should be avoided in applications where ammonia is present. When oxygen, carbon dioxide or ammonia are present in steam condensates, it is recommended that aluminum or stainless steel should be used as the tube and header material.

*T, Lyman (Ed.), Metals Handbook-Volume 1 -Prooerties and Selection of Metals. Metals Park Ohio. 1961. pg. 985.

GLYCOL SOLUTIONS (PROPYLENE OR ETHYLENE)

Untreated glycol solutions are corrosive to copper, copper alloys and steel. In most instances, however, glycols are treated and are not particularly corrosive. Glycol solutions are used extensively in copper tube coils.

BRINE SOLUTIONS

Untreated calcium chloride brine is corrosive to copper alloys, aluminum, steel and stainless steel. At room temperature or below, neutral calcium chloride brine can be used successfully with aluminum, steel and copper. Untreated sodium chloride brine is corrosive to copper, most copper alloys, steel and stainless steel. Inhibited sodium chloride brine can be used successfully with copper, cupro-nickel and aluminum.

REFRIGERANTS

Halocarbon refrigerants R-12, R-22 and R-502 are not corrosive to copper, copper alloys, steel, aluminum and stainless steel.

Ammonia refrigerants (R-717) are corrosive to copper and all copper alloys. Carbon steel, stainless steel and aluminum are the tube materials used in ammonia coils. Usually when steel tubing is used, steel fins are also used and the entire coil is hot dip galvanized after fabrication for atmospheric protection. Aluminum tube coils are ordinarily supplied with aluminum fins and need no additional atmospheric protection.

COATINGS

Coatings can be effective in increasing the serviceable life of coils. The most effective coatings are designed to "exclude" the corrosive factors from the metal. Chips, scratches, holidays in the coating or cracks caused from thermal expansion and contraction of the coil however, can lead to failure in a corrosive environment. Consequently, the bare metals should be at least moderately resistant to the environment to which the coil is to be subjected and the coatings should be considered as a means to extend the serviceable coil life rather than complete protection. Coatings in this category are either baked phenolic or fluoropolymer (FEP).

The other type of coating frequently used is a hot dip galvanizing. Unlike the phenolic or FEP coatings, galvanizing is a sacrificial coating and small voids or holidays will not affect the overall performance of the coating. Unfortunately, galvanizing (zinc) is not particularly corrosion resistant to most chemicals and its use is limited.

Fluoropolymer coatings (Teflon*) are chemically inert to most substances, and, as a result, offer excellent corrosion resistance to nearly all environments. In addition to its exceptional corrosion resistance. FEP coatings exhibit excellent non-stick properties. These properhes are useful in dirty environments since contaminates in the air steam are less likely to lodge on the coil surfaces and also because contaminates that do lodge on the coil surfaces are much easier to clean off. FEP coatings can be applied to all metal surfaces and are suitable for operating temperatures up to 400°F.

Baked phenolic coatings (Heresite, Plasite, Libcote and others) are the most widely used of the available coatings. This coating offers good corrosion resistance to most weak acid or alkaline solutions and most organic solvents. For maximum chemical resistance, this coating should not be used at temperatures above 150° to 200°F. Baked phenolic coatings can be applied to all metal surfaces and are suitable for maximum operating temperatures to 400°F.

Hot dip galvanized coafings are used primarily to protect steel tube/steel fin coils from corroding in ordinary outdoor exposures. This coating is not particularly protective against chemical attack. Hot dip galvanized coatings can be used to a maximum temperature of 500°F

*Teflon is a registered Trademark of DuPont.

OTHER ENVIRONMENTS (See Following Tables)

CAUTION: Corrosion problems are often complex and may involve numerous factors that will ultimately determine the suitability of a given material to a given environment. In applications where safety, product loss, costly down time or other critical considerations are involved, it is necessary to solicit the services of qualified corrosion engineers.