



Technical Bulletin TB-027

Air-Cooled Heat Exchanger Freeze Damage

Revision 0, 1/05/2018, Matt Reed & Ross Putvin

Freeze damage is often **UNREPAIRABLE**. Avoid freeze damage with a proper concentration of glycol.



Illustration 1: Air-Cooled Heat Exchanger

Freeze Damaged Tubes

Leaks are an indication of tube damage. Determining the type of damage will dictate whether the damage is repairable.

Freeze damage is NOT warranted by Dry Coolers and often results in a total loss of the coil.

FREEZE-DAMAGE AT TUBE-SHEET ENDS

Freeze-damage is caused by insufficient concentration of anti-freeze in the water. As water approaches the freeze point, it begins to crystalize and expand. This expansion creates a substantial amount of internal pressure and will lead to ruptured tubes. Most freeze-damage occurs at the U-bends at the tube-sheet face and will appear as buldging and split tubes (Illustration 2). Most successful repairs have been done by cutting off the U-bend and brazing the tube shut. Unfortunately, this leaves a “dead” circuit in the coil that will not transfer heat. As a result, you can expect a certain amount of loss in heat transfer performance and increase in pressure drop. Be aware that fixing one leak may lead to another leak in the next weakest location/joint. This will likely be an iterative process. Fix, test, fix, test....



Illustration 2: Buldging and Split Tubes Caused by Freeze Damage

FREEZE-DAMAGE INTERNAL TO THE COIL

Sometimes freeze-damage will occur inside the tube bundle. Internal leaks are not always located where the unit drips. Fluid can travel in channels and pathways within the unit and drips can form on the opposite end from the actual leak. This can make them difficult to pinpoint. Internal leaks are almost impossible to repair as they cannot be accessed.

JOINT FAILURE

Failures at soldered/brazed connections can occur as a result of undue stress or vibration at the connection from mating pipes that are not supported independent from the system. They can also occur by an improperly brazed joint.

CORROSION

External corrosion can be caused by different environmental factors.

Salt-Air - Aluminum fin-damage can occur near the ocean shorelines. Distances of up to 1 mile from seawater can experience issues. A protective fin-coating should be requested for these locations.

Trace Ammonia or H₂S - Copper is susceptible to corrosion damage in the presense of Ammonia or H₂S. A coated coil or all stainless steel coil is recommended for these environments.

SERVICING A DAMAGED COIL

Heat exchanger coils have similar construction as condenser coils (thin-walled copper tubes and aluminum fins). Repairing a coil is a delicate operation and should be discussed with Dry Coolers first. Sometimes, we may request a local refrigeration specialist to evaluate the coil and attempt repairs.

RELATED BULLETINS:

- Technical Bulletin TB-002: Glycol Freeze and Burst Protection
- Technical Bulletin TB-009: Air Cooled Heat Exchanger Maintenance
- Technical Bulletin TB-028: Air Cooled Heat Exchanger Fin Combing

REVISION LEVEL:

- Rev 0: 1/05/2018, Matt Reed & Ross Putvin