BRAINERD
• COMPRESSOR INC. •

IDENTIFYING FAILURE MODES

1. Liquid Slugging - Liquid, either refrigerant or oil, in the compressor cylinders.
    (a) Broken reeds
    (b) Loose discharge valve bolts
    (c) Blown gaskets
    (d) Broken rods
    (e) Broken crankshafts

2. Liquid Washout - Washing the oil off of loaded surfaces.
    (a) Worn pistons
    (b) Worn rings
    (c) Worn cylinders
    (d) Scored wrist pins
    (e) Scored rods
    (f) Worn bearings
    (g) Scored crankshafts

3. Liquid Dilution - Liquid refrigerant diluting the oil.
    (a) Dragging rotor
    (b) Worn bearings
    (c) Scored and/or broken rods
    (d) Scored crankshafts

4. High Discharge Temperatures - Temperatures thinning the oil.
    (a) Discolored valve plate
    (b) Overheated or burned reeds
    (c) Worn rings and pistons
    (d) Worn cylinders
    (e) Scored rods, bearings, and crankshafts

5. Lack of Lubrication - Lack of oil or indeterminate.
    (a) Scored bearings
    (b) Broken rods
    (c) Scored crankshafts

6. Motors
    (a) General burn - entire windings burned
    (b) Single phase - two phases burned
    (c) Half winding single phase - one half of each two windings
    (d) Spot burn - localized burn
    (e) Start winding burn - only start winding burned
    (f) Leads shorted
    (g) Primary single phase

The first three modes are results of varying amounts of liquid in the compressor.

1 Liquid Slugging

This is a result of trying to compress liquid in the cylinders. That liquid may be either refrigerant or oil or more likely a combination of both. In the case of air-cooled compressor, any liquid being returned to the compressor comes directly into the cylinders. On a suction-cooled compressor, slugging is a result primarily of refrigerant migration into the oil on the off cycle. Upon start up the lowering of crankcase pressure causes a violent explosion that carries quantities of refrigerant and oil into the cylinders. The results in either case are:

    (a) Broken reeds - either or both
    (b) Loose discharge valve bolts - stretching or stripping threads
    (c) Blown gaskets - head or valve plate gaskets
    (d) Broken rods - depending on the quantity of liquid in cylinders
    (e) Broken crankshaft - particularly on MR or 9R

2. Liquid Washout

This is a result of refrigerant washing oil off wearing surfaces. On air-cooled compressors, this is usually saturated refrigerant being returned during the running cycle directly to the cylinders and washing the oil off the pistons and cylinders. This is also a possibility on suction cooled compressors, but off cycle migration is more likely the cause. When the compressor starts up with refrigerant in the crankcase, the

refrigerant washes the oil off of the pistons and cylinders. Slugging is really just an extreme result of migration.

The results are:

(a) Worn pistons
(b) Worn rings if they are used
(c) Worn cylinders - hard to determine
(d) Scored wrist pins
(e) Scored and broken rods
(f) Worn bearings
(g) Scored crankshaft

3. Liquid Dilution

This is a result of liquid refrigerant being returned to a suction-cooled compressor during the running cycle. If the liquid refrigerant is returned in great enough quantity, and a for long enough period of time to cool the motor, it will be returned to the crankcase through the oil check valve. The heat of the oil will vaporize some of the refrigerant, but as the oil cools, it will become so diluted that it cannot properly lubricate. The diluted mixture may be adequate for the oil pump and cover bearing, but as it progresses down the crankshaft, there will not be enough oil left to properly lube the main bearings.

The results are:

(a) Dragging rotor
(b) Worn bearings, particularly the center and rear
(c) Scored and/or broken rods - Scoring first
(d) Scored crankshaft

4. High Discharge Temperatures

This is a result of temperatures in the compressor head and cylinder becoming so hot that the oil looses its ability to lubricate. High compression ratios and inadequate compressor cooling cause this. High compression ratios are the result of operation with too low a suction pressure, too high a discharge pressure or a combination of both. It is important that the system operate with as high a suction pressure and as low a head pressure as possible. Proper selection of equipment and proper setting of pressure switches will help assure this. The temperature of the suction gas returning to the compressor should be as low as practical without having flood back.

The results are:

(a) Discolored valve plates - color cannot be rubbed off

(b) Overheated or burned reeds.
(c) Worn rings, pistons and wrist pins.
(d) Worn cylinders.
(e) Scored rods, bearings, and crankshafts.
(f) Stator spot burned due to debris.

5. Lack of Lubrication

This is a result of lack of enough oil in the crankcase to properly lubricate the load bearing parts. This may be caused by improper piping, oil trapping, inadequate defrosts, loss of charge, short cycling, or low load conditions. Oil must return to the compressor as fast as it is pumped out in order to maintain proper lubrication.
The results are:

(a) Scored bearings
(b) Broken rods
(c) Scored crankshafts

6. Motors

Many motors fail as a result of lubrication related failure. But many also fail without evidence of mechanical problems.
Examples of this are:

(a) General Burn - The entire windings are overheated or burned. This may be a result of voltage problems, inadequate motor cooling, or unknowns.
(b) Single Phase Burn - Two phases of a three-phase motor are overheated or burned. This is a result of not having current through the unburned phase and overloading the other two phases.
(c) Half Winding Single Phase Burn - This occurs on a part winding, two-contactor system when one half of the motor has a single phasing condition. This is usually a contactor problem.
(d) Spot Burn - This is a short either between windings, between wires, within a winding or to ground. The damage is confined to a small area. Reason unknown.
(e) Start Winding Burn - Only the start winding is burned in a single-phase motor. Excessive current has flowed through the start winding from a failure of starting components, miswiring or overloading the motor.
(f) Leads Shorted - Terminals grounded or lead abrasion.
(g) Primary Single Phase - As a result of losing a phase in the primary of a Δ to Y or Y to Δ transformer. This shows as one phase burned.