cause
unloading valve not working properly
excessive wear in pump
relief valve set too high
discharge valve throttled or closed
leak in suction pipe
packing or seal worn
lift too great
discharge line blocked or choked up filter
suction pipe too long
insufficient head. suction valve shut
too much air in the system
pump and motor out of alignment. bent shaft. cavitation. recirculation. unusual wear
some rotating element broken off, causing an unbalanced condition

cavitation from lack of net positive suction head or turbulence from sharp pipe bends immediately upstream of the pump. suction pressure lower than the corresponding saturation temperature
recirculation due to blocked or narrowed discharge line
obstruction lodged in one side of the impeller
lack of lubricant or over-lubrication
pump not turned regularly when sitting idle
incorrect installation
wrong direction of rotation
discharge line blocked
discharge valve closed
impeller mounted incorrectly
mechanical defects, such as worn rings, damaged impeller, or a defective casing gasket
clogged filters
required differential head or pressure lower than rated
improper alignment

piping misalignment
bent shaft
poor lubrication
over-greasing
poor foundations
improperly fitted bearings
bearing substitute used and never replaced with original specification model
air leaks in suction line or stuffing box
wear rings worn or damaged
foot valve too small
speed too high
specific gravity or viscosity too high
bent shaft
rotating element binds

stuffing boxes too tight
wearing rings worn
wrong type of grease or oil causing breakdown of the lubricant
low oil level
loss of oil through the seal
housing overpacked with grease, causing excessive churning of the lubricant
inadequate internal clearance from using a substitute bearing
housing bore out of round
housing warped
rotating seals rubbing against stationary parts
blocked oil return holes
unbalanced load
housing bore too large
incorrect oil level causing insufficient oil to reach the bearing

wrong type of lubricant, which has broken down and lost its lubricating properties
foreign matter such as dirt, sand, and carbon entering the bearing housing
brinnelling
static electrical arcing in the bearings
corrosive agents entering the bearing
failure to remove foreign matter from the bearing housing before assembling the bearing unit
a flat on a ball or a roller due to skidding
incorrectly mounted bearing
bearing hammered onto the shaft or into the housing
interference of other movable parts of the machine
unbalanced load
housing bore too large
bearing exposed to resonance-caused vibration while the machine is idle
distortion of shaft and inner ring

distortion of the housing and outer ring, causing pinching of the bearing
rotating seals rubbing against stationary parts
incorrectly mounted bearing as indicated by hammer blow signs on the bearing
inadequate support in the housing, causing the outer ring to cock
general vibration of the machine
shaft and housing shoulders and face of the locking nut not square with the bearing seat
shaft diameter too small or adapter not tight enough
knurling and center punching of the bearing seat on the shaft, causing the high spots to be flattened when the load is applied
loose fitting shaft
inadequate shoulder support in the housing causing bending of the shaft
distortion of the bearing seals
bearing seat diameter machined oversize, causing excessive expansion of the shaft and bearing inner ring, thus reducing the clearance in the bearing
incorrect linear or angular alignment of two or more coupled shafts with two or more bearings
distortion of the housing and the outer ring causing pinching of the bearing

incorrect linear or angular alignment of two or more coupled shafts with two or more bearings
distortion of the housing and the outer ring causing pinching of the bearing
unequal load distribution on the bearing
air flowing over the bearings, for example, a forced draft fan with air inlet over the bearings
oil leakage at the housing split causing excessive loss of lubricant
failure to remove debris from the bearing housing before assembling the bearing unit
packing too loose
packing reached the end of its useful life
insufficient number of turns of packing
packing ring butts all in line
valve stem badly scored
wrong grade packing material
cocked gland follower
gasket beyond the 60% crush factor

wrong type of gasket material
hammer-cut gasket and fibers destroyed
wrong gasket material
gasket landing surfaces dirty
gasket landing grooved by wire-drawing
scored body or bonnet seal faces
body/or bonnet bolts improperly tightened
gasket too old and pressure blown
packing gland too tight
too many turns of packing installed
piping misalignment
bent valve stem
wrong size handwheel or motor operator
stem threads or nut damaged

thermal binding of valve closed
piping misaligned
valve internals out of alignment due to body stresses caused when piping to valve is misaligned
valve being used to throttle flow
piping distortion due to loading or temperature distortion
partially open valve
natural vibration frequency being excited by some other natural or induced vibration frequency
rising stem valve in confined space restricting full opening
stem lock nut on yoke loose
erosion across the seat face
reface the disc and seat, and lap to ensure good contact all around the faces
seat contact surface area too wide
incorrect valve in the system
incorrect valve in the system (continued)

disc cocking due to bent valve stem
disc sticking due to slightly off-center misalignment of bonnet stem threads
stem attached to the disc nut is too tight, restricting the disc from self-centering in the seat
valve back-seated too tightly
missing lock screw or tab
bonnet lock nut not torqued to specified setpoints
bolts improperly tightened
reusing old gasket, causing old gasket material to stick to the flange surface
wrongly set flexible gasket
improper setting
valve-disc-to-seat contact area too large, causing valve simmering to take place
cracked or broken compression spring
bent valve stem
improper loading of pipe hangers

resonance
water hammer
valve may be installed in the wrong direction
piping misalignment with valve
neoprene valve seat and gasket
thread damage
shaft bent
valve body twisted
piping misaligned to valve body
bonnet stem nut out of alignment with valve seat
gland packing too tight
gland packing badly installed
incorrect tension
insufficient lubrication

worn drive
misalignment of sprockets
loose casing or bearings
pitch too large
chain worn
insufficient tension
material in tooth pockets
chains & sprockets fit poorly
insufficient chain wrap
excessive chain slack
running too fast
insufficient lubrication
chain operating too fast for bath lubrication
chain immersed too deeply in oil bath in bath-lubricated drive

worn sprocket teeth
material buildup on driver sprocket tooth pockets
sticky lubricant
insufficient tension
stiff chain joints
excessive chain slack
high pulsating loads
nonuniform chain wear
misalignment of drive
worn and corroded chain
inadequate lubrication
corrosion on the chain
excessive overload
material buildup in joints

peening edges of side plate metal
misalignment of the drive chain
chain speed too high for the pitch and sprocket size
material buildup in sprocket tooth pockets
heavy shock or suddenly applied loads
nan
inadequate lubrication
poorly fitted sprockets
chain or sprocket corrosion
chain tension too low
chain speed too slow
obstruction
heavy or tacky lubricants
sprockets with too few teeth, causing a large amount of chordal action

eccentricity
obstruction striking the cotter pins
excessive shock loads, especially with small, cast-iron sprockets
obstructions striking the cotter pins
cotter pins not installed properly, not spread apart and drawn back snugly against the side plates
bent or damaged flights, attachments, or links
obstruction in throughways or casings
improper timing
misalignment
faulty lubrication
excessive tension on the belts or the chain
worn parts
overloading
incorrect lubricant

incorrect amount of lubricant
overloading
obstructed air flow
too much oil in the unit
clogged air breather
loose bolts and nuts in jointed areas
vibration from fluctuating loads or misalignment
open drain-back valve from pressure line to return line
pump relief valve or system pressure control valve set low
oil leak(s) in the system
system pressure control valve set too high or not functioning properly
plugged flow nozzle(s)
system pressure control valve not functioning properly
air being drawn into the system and pumped with the oil

dirty filter
high differential pressure across the filter
operating pump not running
mercoid switches incorrectly set
increased demand for oil from the system due to an oil leak
oil temperature too high
low fluid level
system pressure too high
variable-volume or pressure-compensated pump adjusted for too much flow
intake leaking
pump speed too high
motor and pump not aligned
restricted intake
worn pump

cavitation caused by lack of net positive suction head (npsh) or turbulence from sharp pipe bends immediately upstream of the pump suction
suction pressure lower than the corresponding saturation temperature
recirculation of fluid at the impeller vane exit area
not enough tension
drive overloaded
contaminants on belts or sheaves
heavy starting load
not enough arc of contact
broken cords from prying belts on and off sheaves
not enough tension
shock loads
broken cords from running or prying belts on and off sheaves
foreign objects falling into the sheaves
worn sheave grooves

sheave diameter too small
misalignment
drive overloaded
belts rubbing
contaminated environment
excessive heat
drive centers too long
tensioner idler sheave out of adjustment
inadequate bearing lubrication
too much bearing lubricant
drive belts too tight
not a matched set of drive belts
belts broken internally because of poor installation practices
improper amount of take-up since the initial belt installation

overload on the drive belt
internal breaks in the belt
not a matching set of belts
unequal coefficient of friction
nonparallel shafts
internal and non-visible breaks in belts
broken belt cords
worn grooves in sheaves
small sheaves
excessive belt tension
belt obstruction
turned over or twisted belt
rubber solvent or oil on the belt
abrasive condition, worn sheaves, improper sheave angle, slip, exposed to chemical fumes, obstructions, or high heat

rubber solvent or oil on the belt
exposure to severe heat and/or chemical fumes
total resistance on system higher than expected
dampers closed or partially closed
speed too slow
dampers or variable inlet vanes incorrectly set
poor fan inlet conditions, such as choked filters
atmospheric air induction through ducting leaks
fan rotation wrong
wheel mounted backward on the shaft
unbalance due to dirt buildup on fan blades
poor foundations or warped baseplate
misalignment
soft-foot conditions

no zero cold-spring of ductwork at the fan connection
belt drive misalignment
bad lubrication
nan
nan
misaligned belt drives
worn coupling
resonance effect from another machine(s)
fan rotating in the wrong direction
partial offset restriction on inlet side of fan, causing it to unload
overlubrication of bearing
misalignment
unbalance
bent shaft

over-tensioned belts
abnormal axial thrusting caused by misaligned belts
sheaves that have eccentric bores due to poor machining practices or cast with boss off-center
no prime, bucket, or traps because trap not primed when originally installed
no prime, bucket, or traps because trap not primed after cleaned
bypass valve open or leaking
sudden pressure drop
valve mechanism not closing because scale or dirt lodged in orifice
worn or defective valve or disc mechanism
ruptured bellows (thermostatic traps)
back pressure too high in a thermodynamic trap because worn or defective parts
back pressure too high in a thermodynamic trap because trap stuck open
back pressure too high in a thermodynamic trap because undersized condensate return line or pig tank
back pressure too high in a thermodynamic trap because blowing flash steam caused by flash steam forming when the condensate is released to a lower or atmospheric pressure

pressure too high because trap rating too low
pressure too high because orifice enlarged by normal wear
pressure too high because pressure-reducing valve set too high or broken
pressure too high because system pressure raised
condensate not reaching the trap because strainer clogged
condensate not reaching the trap because obstruction in the line to the trap
condensate not reaching the trap because bypass valve opening or leaking
condensate not reaching the trap because steam supply line shut off
condensate not reaching the trap because trap clogged with foreign matter
condensate not reaching the trap because trap held closed by a defective mechanism
condensate not reaching the trap because high vacuum in the condensate return line
no pressure differential across the trap because blocked or restricted condensate return line
no pressure differential across the trap because incorrect pressure change assembly
trap too small and undersized for the capacity being handled

trap pressure rating too high
trap clogged
strainer plugged
bellows overstressed in a thermostatic trap
loss of the prime
failure of valve to seat due to worn valve and seat
scale and dirt deposits under the valve and in the orifice
worn guide pins and lever
capacity margin in trap for heavy starting loads
insufficient air handling capacity on bucket traps
short circuiting by using group traps
inadequate steam supply due to pressure valve change
steam pressure-reducing valve setting off
condensate return line too small

other traps blowing steam into header
pig tank vent line plugged
obstruction in return line
excess vacuum in return line
blown fuses
overload trips
improper current supply
improper line connections
open circuit in the winding or the starting switch
mechanical failure
short-circuited stator
poor stator coil connection
defective rotor
overloaded motor

one phase of three-phase motor open
short-circuited stator
worn or sticking brushes on repulsion induction motors
wrong application
overloaded motor
low motor voltage
open circuit due to blown fuses
incorrect control resistance of wound motor
power failure
motor not properly sized for designed load of the system
voltage too low at motor terminals due to line drop
improper control operation of the secondary resistance of the wound motor
starting load too high
broken rotor bars

open primary circuit
excess loading
poor circuit
defective squirrel-cage rotor
applied voltage too low
wrong sequence of phases
overload
wrong blowers or air shields that may be clogged with dirt, preventing the proper ventilation of the motor
one phase of motor open
grounded coil
unbalanced terminal voltage
shorted stator coil
high resistance
high voltage

low voltage
rotor rubbing against the stator bore
motor misaligned
weak foundations
coupling out of balance
driven equipment out of balance
bearings not in line
defective ball bearing
balancing weights shifted
wound rotor coils replaced
poly-phase motor running single-phase
excessive end play
unequal terminal volts
single-phase operation

poor rotor contacts in control wound rotor resistance
brushes not in the proper position on the wound rotor
fan striking the insulation
fan rubbing against air shield
motor loose on the bedplate
air gap not uniform
rotor unbalanced
bent or sprung shaft
excessive belt pull
pulley too far from bearing
pulley diameter too small
misalignment
oil grooving in the bearing obstructed by dirt
oil viscosity too high

oil viscosity too low
too much end thrust
badly worn bearing
insufficient lubricant
excess lubricant
deterioration of the grease or contaminated lubricant
overloaded bearing
broken ball or rough races
higher than design speeds
belts rubbing hard against some projection
poor lubrication
density of gas too high
wrong rotational direction
bent shaft

misalignment
motor phases wrongly wired
stator to air gap restricted
broken or cracked rotor bars
rough commutator surface
low bar on commutator
high bar on commutator
high mica
brushes too short
insufficient brush tension
weak brush springs
brushes sticking in holders
dirt or oil on commutator
shortened armature winding

open armature winding
misalignment
overheating due to loose soldered connections that might cause future trouble
usually a line problem
load too heavy. disconnect motor to see if it starts without load
uneven air gap. measure with feeler gauge
unbalanced rotor or bent shaft
foreign matter in the air gap
misalignment. magnetic center out of location
extreme motor vibration
vibration sources
misalignment
vibration in driven machine. run motor disconnected for check
rotor out of balance

overload
dirt in motor
rotor rubbing on stator
shorted stator windings
ground
misalignment
too much tension in chain or belt drive
excessive end thrust
too much grease (ball or roller bearings)
sticking oil slinger ring
insufficient lubricant
incorrect grade of brushes
excessive brush pressure
load current too high

loose connections
overtravel and/or contact force too low
copper oxide or foreign matter collected on the contact faces
load on in excess of 8 hours
ambient temperature too high
line and/or load cables too small
overtravel and/or contact force too low
contact bouncing on closing
poor contact alignment
jogging duty too severe
excessive inrush current
vibration in the starter mounting
low contact force
contact bouncing on opening or closing

abrasive dust on the contacts
load current too high
jogging cycle too severe
oil-immersed contactor being used instead of an air breaker contactor
excessive current
terminals improperly torqued to the base of the breaker
cable improperly torqued in terminal
improper wire size
ambient temperature too high
trip unit improperly torqued to base
high inrush current from the motor
breaker tested with incorrect type of field testing
high peak current on y~delta starter transfer during open transition
high humidity

corrosive environment
attachments not functioning correctly
low frequency, high voltage, core clamps slackened off during shipment or handling
high-input voltage
low frequency, high-input voltage
low frequency, high-input voltage
very high core temperature due to high-input voltage or low frequency
insulation failure
lightning surge
broken terminals, taps, or arresters
excessive dirt buildup or dust on the coils
clogged air ducts
insulation failure