FAILURE MODE ANALYSIS OF HVAC (HEATING VENTILATION AIR CONDITIONING) SYSTEM

A Comprehensive Guide for Investigation and root cause assessment

FEBRUARY 12, 2013

PALASH CHANDRA DAS
M.Pharm

ABOUT AUTHOR

Palash Chandra Das

M. Pharma

LinkedIn Link

Pharmaceutical Chemistry

Core Technical Area: Qualification & Validation , Sterility Assurance, QMS, Investigation, Risk Management

Palash Chandra Das is the Technical Writer focuses on technical writing including investigative reports and operating procedures. His passion for writing is displayed in the many writing sessions he hosts via his Blogs at https://pres.net.in.

Mr. Palash Chandra Das is recognized as an expert in the field of aseptic manufacturing of parenteral products, and is a frequent presenter at several web conferences and technical training for Sterile Drug Manufacturing.

He earned his Master's for Pharmaceutical chemistry from the University of West Bengal University of technology in India.

Since 2011 Palash has associated with installation, qualification and operation of several production-lines in standard Clean room Technology as well as in Isolator Technology at major regulatory facility across India.

Fish-Bone on Failure Mode analysis of HVAC (Heating Ventilation Air Conditioning) System

Material	Machine	Man	Method	Measurement	Mother Earth
Duct	Server configuration	Operator Controls	System Control	Field Instrument	Protection
Insulation of duct	Processor type	Supervisory, Control and Data Acquisition (SCADA)	Audit trial	DPT across filter	Products and personnel
Duct sheet thickness	RAM	Programmable Logic Controllers (PLC)	Password control	DPT across Fan	Air filtration
Duct leak test	Hard disk Drive	Energy Management System (EMS)	Recipe management	Duct type T & RH sensor - Supply Air and Return Air	Unidirectional airflow
Air Handling unit	Processor speed	Data gathering panels (DGP)	Data backup	Temperature sensor for CHILLED water manifold return	Infiltration
Chamber intactness	Network Interface Adaptors	Operator control and monitoring	Software backup	Ambient T & RH sensor	Cross-contamination
Door gasket	Redundant server	Time programs	Time & Date setting	Dew Point Sensor	Temperature and relative humidity
Filter replacement	Operating Software	Alarm handling	Primicess/Facility Design	CO2 Sensors (PPM)	Dust control
Filter cleaning	Parameter/set point	Event control	Building finishes and structure	Differential pressure transmitters for room	Protection of the environment
Filter size	Printer	Reporting	Air filtration	Room mounted temperature & relative humidity sensor	Dust in exhaust air
Filter arrangement	Faulty cable connection	Incident reporting	Air change rate or flushing rate	DPT for Rooms (VAV)	Fume removal
Filter Damage		Breakdown handling	Room pressure	Pressure gauges	HVAC systems and components
Chilled water & Hot Water coil		Operator physical parameter	Location of air terminals and directional airflow	Hygrometer	Air distribution
Capacity optimization		Operator Behaviour	Temperature		Re-circulation system
Temperature not maintained		Hygiene	Humidity		Full fresh air systems
Leakage in coil		Area Cleaning /Moping	Material flow		Other
Manual control		Fogging	Personnel flow		Power failure
Auto valve set point		Spillage in the area	Equipment movement		UPS back up
Dehumidifier		Water leakage	Process being carried out (open or closed system)		Dynamic/Static Pass box
Chiller header temperature		Improper closer of door /damage	Outside air conditions		Adverse weather conditions
		Door interlock	Occupancy		
			Type of product		
			Qualification test		
			Particle count test		
			Air pressure difference		
			Airflow volume		
			Airflow velocity		
			Filter leakage tests		
			Containment leakage		
			Recovery		
			Airflow visualization		

By : Palash Ch Das. M.Pharm

Fish-Bone on Failure Mode analysis of HVAC (Heating Ventilation Air Conditioning) System

PRES — A complete Pharma Solutions

Method

Building finishes and structure
Air filtration
Air change rate or flushing rate
Room pressure
Location of air terminals and directional airflow
Temperature
Humidity
Primicess/Facility Design

Material flow
Personnel flow
Equipment movement
Process being carried out (open or closed system)
Outside air conditions
Occupancy
Type of product

Audit trial
Password control

System Control
Recipe management
Data backup
Software backup
Time & Date setting

Airflow visualization
Recovery
Containment leakage
Filter leakage tests
Airflow velocity
Airflow volume
Air pressure difference
Particle count test
Qualification test

Man

Supervisory, Control and Data Acquisition (SCADA)
Programmable Logic Controllers (PLC)
Energy Management System (EMS)
Data gathering panels (DGP)
Operator control and monitoring
Time programs
Alarm handling
Event control
Operator Controls

Reporting
Incident reporting
Breakdown handling

Material

Chiller header temperature
Dehumidifier
Auto valve set point
Manual control
Leakage in coil
Temperature not maintained
Capacity optimization
Chilled water & Hot Water coil

Fogging
Area Cleaning /Moping
Hygiene
Operator Behaviour
Operator physical parameter

Filter Damage
Filter arrangement
Filter size
Filter cleaning
Filter replacement
Door gasket
Chamber intactness
Air Handling unit

Products and personnel
Air filtration
Unidirectional airflow
Infiltration
Cross-contamination

Spillage in the area
Water leakage

Duct leak test
Duct sheet thickness
Insulation of duct
Duct

Protection

Failure Mode analysis of HVAC System (Heating Ventilation Air Conditioning)

Power failure
UPS back up
Dynamic/Static Pass box
Adverse weather conditions

Mother Earth

Air distribution
Re-circulation system
Full fresh air systems

Other

Protection of the environment

Dust in exhaust air
Fume removal

HVAC systems and components

Temperature and relative humidity
Dust control

DPT across filter
DPT across Fan
Duct type T & RH sensor - Supply Air and Return Air
Temperature sensor for CHILLED water manifold return
Ambient T & RH sensor
Dew Point Sensor
CO2 Sensors (PPM)
Differential pressure transmitters for room
Room mounted temperature & relative humidity sensor
DPT for Rooms (VAV)
Pressure gauges
Hygrometer

Measurement

Processor type
RAM
Hard disk Drive

Processor speed
Network Interface Adaptors
Redundant server
Operating Software
Parameter/set point
Printer
Faulty cable connection

Machine

By- Palash Ch Das, M.Pharm