ASSETSTAGE
DATA STAGING & QUALITY PLATFORM

ISO 14224 Implementation Cheat Sheet

A Practical Reference Guide for Reliability & Maintenance Engineers

Who This Guide Is For

- Reliability engineers implementing failure tracking
- CMMS administrators setting up code tables
- Data migration teams preparing for Maximo/SAP upgrades
- Maintenance managers standardizing across sites

What ISO 14224 Actually Does

ISO 14224:2016 standardizes how you collect, structure, and exchange reliability and maintenance data for industrial equipment. It gives you:

- **A common taxonomy** - 9 levels from industry down to part
- **Standard failure codes** - Failure modes, mechanisms, causes
- **Equipment boundaries** - What counts as "one asset"
- **Data collection requirements** - What to record for each failure

What it doesn't do: Tell you how to organize your CMMS. You adapt ISO 14224 to your system, not the other way around.

The 9-Level Taxonomy

This is the backbone of ISO 14224. Every piece of equipment fits somewhere in this hierarchy.

Level	Name	Description	Example (Seawater Lift Pump)	Typical CMMS Field
1	Industry	Broad industry sector	Petroleum	Business Unit
2	Business Category	Type of operation	Upstream	Facility Type
3	Installation	Physical facility	Offshore Platform Alpha	Site
4	Plant/Unit	Process unit	Water Injection System	Functional Location L1
5	Section/System	Sub-process	Seawater Lift	Functional Location L2
6	Equipment Unit	Maintainable item	Seawater Lift Pump P-4501A	Equipment/Asset
7	Subunit	Major assembly	Pump Assembly	Component Group
8	Maintainable Item	Replaceable component	Mechanical Seal	Component
9	Part	Individual part	O-Ring	Spare Part

Key decision: Most CMMS implementations track to Level 6 (Equipment Unit) or Level 8 (Maintainable Item). Going deeper adds data entry burden without proportional analysis value.

Equipment Classes (Annex A Reference)

ISO 14224 defines standard equipment classes. Use these codes consistently across all sites.

Rotating Equipment

Code	Equipment Class	Typical Subunits	Key Attributes
1.1	Centrifugal Pump	Impeller, Mechanical Seal, Bearings, Coupling	Flow rate (m^3/h), Head (m), Power (kW), RPM
1.2	Reciprocating Pump	Plunger/Piston, Valves, Packing, Crankshaft	Flow rate, Pressure (bar), Stroke, Power
1.3	Rotary Pump	Rotor, Timing Gears, Bearings, Seals	Flow rate, Pressure, Viscosity range
2.1	Centrifugal Compressor	Impeller, Seals, Bearings, Lube System	Capacity (m^3/h), Discharge P (bar), Power
2.2	Reciprocating Compressor	Piston, Valves, Packing, Crankshaft	Capacity, Pressure ratio, Stages
2.3	Screw Compressor	Rotors, Bearings, Seals, Oil System	Capacity, Pressure, Oil injection rate
3.1	Gas Turbine	Compressor Section, Combustor, Power Turbine	Power (MW), Heat rate, Fuel type
3.2	Steam Turbine	Rotor, Blades, Bearings, Governor	Power, Inlet P/T, Exhaust P
3.3	Electric Motor	Stator, Rotor, Bearings, Cooling	Power (kW), Voltage, RPM, Frame size
3.4	Diesel/Gas Engine	Cylinder, Pistons, Fuel System, Turbocharger	Power, Cylinders, Fuel consumption
4.1	Generator	Rotor, Stator, Exciter, AVR	Power (MVA), Voltage, Power factor

Static Equipment

Code	Equipment Class	Typical Subunits	Key Attributes
5.1	Shell & Tube HX	Tubes, Shell, Gaskets, Baffles	Duty (kW), Area (m^2), Design P/T
5.2	Plate Heat Exchanger	Plates, Gaskets, Frame	Duty, Plates, Design P/T
5.3	Air Cooled HX	Tubes, Fins, Headers, Fans	Duty, Face area, Fan power
6.1	Pressure Vessel	Shell, Heads, Nozzles, Internals	Volume (m^3), Design P/T, Material
6.2	Atmospheric Tank	Shell, Roof, Floor, Nozzles	Capacity (m^3), Diameter, Height
6.3	Column/Tower	Shell, Trays/Packing, Distributors	Height, Diameter, Stages/HETP
7.1	Piping	Pipe, Fittings, Supports	Diameter, Schedule, Material, Length

Valves

Code	Equipment Class	Typical Subunits	Key Attributes
8.1	Gate Valve	Body, Gate, Stem, Packing	Size, Pressure class, Material
8.2	Globe Valve	Body, Plug, Stem, Packing	Size, Cv, Pressure class
8.3	Ball Valve	Body, Ball, Seats, Stem	Size, Port (full/reduced), Pressure class
8.4	Butterfly Valve	Body, Disc, Shaft, Seat	Size, Pressure class, Liner material
8.5	Check Valve	Body, Disc/Ball, Seat	Size, Type (swing/lift/dual), Pressure class
8.6	Control Valve	Body, Trim, Actuator, Positioner	Size, Cv, Characteristic, Actuator type
8.7	Safety/Relief Valve	Body, Disc, Spring, Bonnet	Size, Set pressure, Capacity

Electrical & Instrumentation

Code	Equipment Class	Typical Subunits	Key Attributes
9.1	Transformer	Core, Windings, Bushings, Cooling	Rating (MVA), Voltage ratio, Cooling type
9.2	Switchgear	Breaker, Bus, CT/PT, Protection	Voltage, Current rating, Breaking capacity
9.3	UPS	Rectifier, Inverter, Batteries, Static switch	Capacity (kVA), Autonomy, Battery type
10.1	Transmitter	Sensor, Electronics, Housing	Measurement type, Range, Output signal
10.2	Analyzer	Sensor, Sample system, Electronics	Measurement type, Range, Sample handling
10.3	Control System	I/O, Processor, Power supply, HMI	I/O count, Redundancy, Protocol

Failure Mode Codes

Use these codes on EVERY failure record. No free text. No "Other" unless genuinely novel.

Primary Failure Modes (Equipment Level)

Code	Failure Mode	Definition	Use When...
AIR	Abnormal instrument reading	Instrument shows incorrect value	Transmitter drift, gauge error
BRD	Breakdown	Complete loss of function requiring major repair	Catastrophic failure

ELP	External leakage - Loss of containment to environment	Process fluid leaking externally	Flange leak, seal leak, casing crack
ELU	External leakage - Utility	Utility fluid leaking externally	Cooling water leak, steam leak
ERO	Erratic output	Irregular, fluctuating, or intermittent output	Unstable flow, fluctuating pressure
FTC	Fail to close	Does not close on demand	Valve stuck open
FTO	Fail to open	Does not open on demand	Valve stuck closed
FTR	Fail to regulate	Does not control to setpoint	Control valve hunting
FTS	Fail to start on demand	Does not start when commanded	Motor won't start, pump won't prime
FTF	Fail to function on demand	General failure to perform function	Safety device doesn't trip
HIO	High output	Output above acceptable operating range	Overpressure, overtemperature
ILP	Internal leakage - Process	Internal process leakage	Valve passing, tube leak
ILU	Internal leakage - Utility	Internal utility leakage	Internal cooling water bypass
LOO	Low output	Output below acceptable operating range	Low flow, low pressure
NOI	Noise	Abnormal noise	Cavitation, bearing noise
OHE	Overheating	Temperature above acceptable	Hot bearing, motor overheating
PDE	Parameter deviation	Gradual drift outside acceptable limits	Vibration trending up

PLU	Plugged/Choked	Flow restriction or blockage	Strainer blocked, line fouled
SER	Minor in-service problems	Degraded but functional	Requiring adjustment
SET	Spurious trip/activation	Trips or activates without demand	Nuisance trip
STP	Structural deficiency	Mechanical damage or deformation	Cracked casing, bent shaft
UST	Spurious stop	Stops without command	Random shutdown
VIB	Vibration	Abnormal vibration	Imbalance, misalignment
OTH	Other	Not covered above	Document details in comments
UNK	Unknown	Cannot determine	Use sparingly - investigate!

Failure Mechanism Codes

Record WHY it failed, not just HOW it failed.

Mechanical Mechanisms

Code	Mechanism	Definition	Common Causes
1.1	Wear - General	Material loss from relative motion	Normal service, inadequate lubrication
1.2	Wear - Abrasive	Material removal by hard particles	Contaminated fluid, sand ingress
1.3	Wear - Erosive	Material removal by fluid/particle impact	High velocity flow, cavitation

1.4	Corrosion - External	Chemical attack from external environment	Atmospheric, CUI, soil
1.5	Corrosion - Internal	Chemical attack from process fluid	CO2, H2S, acids, chlorides
1.6	Erosion-Corrosion	Combined erosion and corrosion	High velocity corrosive flow
1.7	Fatigue	Cyclic stress failure	Vibration, pressure cycling
1.8	Overload	Stress beyond design limits	Surge, water hammer, overpressure
1.9	Fracture - Brittle	Sudden crack propagation	Low temperature, hydrogen embrittlement
1.10	Fracture - Ductile	Crack with plastic deformation	Overload, creep
1.11	Deformation	Permanent shape change	Overload, thermal expansion
1.12	Looseness	Loss of fastener integrity	Vibration, thermal cycling
1.13	Seizure/Galling	Binding of moving parts	Lack of lubrication, contamination
1.14	Clearance/Alignment	Out of tolerance	Wear, installation error, settlement

Electrical Mechanisms

Code	Mechanism	Definition	Common Causes
2.1	Short circuit	Insulation breakdown	Moisture, overheating, age
2.2	Open circuit	Loss of continuity	Wire break, connector failure
2.3	Earth/Ground fault	Unintended ground connection	Insulation failure, contamination

2.4	Electrical overheating	Thermal damage	Overload, poor connection
2.5	Insulation failure	Loss of dielectric integrity	Age, contamination, overvoltage

Instrument/Control Mechanisms

Code	Mechanism	Definition	Common Causes
3.1	Out of calibration	Drift beyond tolerance	Time, temperature, vibration
3.2	Software fault	Logic or code error	Bug, configuration error
3.3	Signal interference	Electrical noise	EMI, grounding issues
3.4	Sensor fouling	Contamination of sensing element	Process deposits

External Mechanisms

Code	Mechanism	Definition	Common Causes
4.1	Foreign object damage	FOD ingress	Debris, dropped objects
4.2	Contamination	Unwanted material in system	Process upset, ingress
4.3	Environmental	Weather, temperature extremes	Flooding, freezing, heat
4.4	External impact	Physical damage from outside	Collision, dropped load

Other

Code	Mechanism	Definition	Common Causes
5.1	Material defect	Manufacturing flaw	Poor QC, casting defect

5.2	Design error	Inadequate design	Wrong material, undersized
5.3	Fabrication error	Construction/installation defect	Weld defect, wrong gasket
5.4	Operating error	Incorrect operation	Wrong procedure, operator error
5.5	Maintenance error	Incorrect maintenance	Reassembly error, wrong parts
5.9	Combined causes	Multiple mechanisms	Document all in comments
5.0	Unknown	Cannot determine	Investigate further

Failure Cause Codes

The ROOT CAUSE - what initiated the failure chain.

Code	Cause Category	Examples
1	Design-related	Inadequate capacity, wrong material selection, poor design margins
2	Fabrication/Installation	Weld defects, assembly errors, wrong components installed
3	Operations-related	Operating outside design envelope, operator error, process upset
4	Maintenance-related	PM not performed, incorrect procedure, wrong parts, reassembly error
5	Management-related	Inadequate procedures, insufficient training, poor spare parts management
6	Miscellaneous	Unknown, combination, not applicable

Detection Method Codes

How was the failure discovered?

Code	Detection Method	Description
PER	Periodic maintenance	Found during scheduled PM
INS	Periodic inspection	Found during scheduled inspection
TST	Functional testing	Found during proof test
PRM	Production/Process demand	Demand revealed the failure
OBS	Casual observation	Found by chance during other work
CPM	Condition monitoring	Vibration, oil analysis, thermography
ALM	Process alarm	SCADA/DCS alarm triggered
OTH	Other	Document in comments

Maintenance Activity Codes

What did you DO about it?

Code	Activity	Description
REP	Repair	Restore to function without full replacement
RPL	Replace	Replace with new/reconditioned item
MOD	Modify	Change design or configuration
ADJ	Adjust	Realign, retorque, recalibrate
CHK	Check/Inspect	Inspect with no action needed

REC	Recondition	Refurbish to like-new condition
TST	Test	Functional test with no deficiency
CMB	Combination	Multiple activities - document all

Complete Worked Example

Scenario

Seawater lift pump on offshore platform fails with external seal leak during normal operation.

Equipment Data Record

Field	Value
Hierarchy	
Industry	Petroleum
Business Category	Upstream - Offshore
Installation	Platform Alpha
Plant/Unit	Water Injection
Section	Seawater Lift
Equipment	
Equipment ID	P-4501A
Equipment Class	1.1 - Centrifugal Pump
Description	Seawater Lift Pump A
Manufacturer	Sulzer

Model	MSD-D 80-200
Serial Number	SZ-2019-45678
Design Data	
Flow Rate	450 m^3/h
Head	85 m
Power	160 kW
Speed	2980 RPM
Seal Type	Double mechanical (API Plan 53B)
Material - Casing	Super Duplex SS
Material - Impeller	Super Duplex SS
Operating Context	
Installation Date	2019-03-15
Operating Hours at Failure	32,456
Criticality	A - Production Critical
Safety Class	Non safety-critical

Failure Data Record

Field	Value
Failure Date	2024-11-15
Failure Time	14:32
Operating Hours	32,456
Failure Classification	

Failure Mode	ELP - External leakage - process
Subunit Failed	Mechanical Seal Assembly
Maintainable Item	Outboard Mechanical Seal
Part Failed	Stationary face
Root Cause Analysis	
Failure Mechanism	1.1 - Wear - General
Failure Cause	4 - Maintenance-related (seal faces not replaced at last overhaul)
Detection Method	OBS - Casual observation (operator noticed dripping)
Impact	
Severity	Degraded - Reduced capacity required
Downtime	18 hours
Production Loss	1,200 m^3 water injection capacity

Maintenance Data Record

Field	Value
Work Order	WO-2024-8934
Activity Date	2024-11-15 to 2024-11-16
Work Performed	
Activity Type	RPL - Replace
Description	Replace outboard mechanical seal cartridge
Resources	
Labor Hours	24 (2 techs × 12 hours)

Parts Used	1× Seal cartridge P/N SZ-MSD-SEAL-OB
Parts Cost	£4,200
Timing	
Active Repair Time	8 hours
Waiting Time	6 hours (parts from store)
Admin/Logistics	4 hours

Lessons Learned

- Seal faces should be replaced at every major overhaul regardless of condition
- Update PM procedure PMP-4501 to mandate seal face replacement
- Consider upgrading to Silicon Carbide faces for longer life

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CMMS Field Mapping Quick Reference

Maximo Mapping

ISO 14224 Concept	Maximo Object	Maximo Field
Equipment Unit	ASSET	ASSETNUM, DESCRIPTION
Equipment Class	CLASSSTRUCTURE	CLASSSTRUCTUREID
Hierarchy Level 1-5	LOCATIONS	LOCATION (hierarchy)
Equipment Attributes	ASSETSPEC	ALNVALUE, NUMVALUE
Failure Mode	FAILURECODE	FAILURECODE
Failure Mechanism	PROBLEMCODE	PROBLEMCODE
Failure Cause	CAUSECODE	CAUSECODE

Maintenance Activity	WORKORDER	WORKTYPE
Downtime	DOWNTIME	DOWNTIME object
Operating Hours	METER	METERNAME, LASTREADING

SAP PM Mapping

ISO 14224 Concept	SAP Object	SAP Field
Equipment Unit	Equipment Master	EQUNR, EQKTX
Equipment Class	Classification	CLASS, KLART
Hierarchy Level 1-5	Functional Location	TPLNR (hierarchy)
Equipment Attributes	Characteristics	ATNAM, ATWRT
Failure Mode	Damage Code	FECOD (catalog type C)
Failure Mechanism	Cause Code	URSACH (catalog type 5)
Failure Cause	Root Cause	Custom catalog
Maintenance Activity	Order Type	AUART
Downtime	Breakdown indicator	MSAUS
Operating Hours	Measuring Point	POINT, READG

Implementation Decision Tree

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START: What industry are you in?
│
├─► Oil & Gas (Upstream/Downstream)
│   └─► Use ISO 14224 as primary standard
│       └─► Implement full 9-level taxonomy
│       └─► Use all failure code tables as-is
│
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├─► Power Generation
│   └─► Use KKS or RDS-PP for hierarchy structure
│   └─► Adopt ISO 14224 failure modes & mechanisms
│   └─► Map KKS equipment classes to ISO 14224 Annex A
│
├─► Maritime/Shipping
│   └─► Use SFI Group System for hierarchy
│   └─► Adopt ISO 14224 failure codes
│   └─► See our Maritime CMMS Guide for integration
│
├─► Manufacturing/Process Industries
│   └─► Create custom hierarchy (Site→Area→Line→Equipment)
│   └─► Adopt ISO 14224 equipment classes where applicable
│   └─► Use ISO 14224 failure modes & mechanisms
│   └─► Customize equipment classes for industry-specific assets
│
└─► Facilities/Commercial
    └─► Create location-based hierarchy (Building→Floor→Zone→Asset)
    └─► Adopt simplified ISO 14224 failure codes
    └─► Focus on equipment classes relevant to HVAC, electrical, plumbing
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Common Mistakes & How to Fix Them

Mistake	Why It's Wrong	How to Fix
Recording "Pump failed"	Too vague for analysis	Require specific failure mode code (ELP, LOO, FTS, etc.)
Using UNK/Other for >10% of failures	Destroys analytical value	Train technicians, require supervisor review, investigate
Free-text failure descriptions	Can't aggregate or trend	Lock fields to dropdowns, add comments field for details
Inconsistent equipment boundaries	Corrupts rollup reporting	Document boundary definitions with diagrams
Not recording operating hours	Can't calculate MTBF	Install hour meters, enforce meter readings on failures
Skipping mechanism/cause	Lose root cause data	Make fields mandatory, won't close WO without them

Too many failure codes	Users confused, inconsistent selection	Limit to 20-30 codes per equipment class, retire unused codes
Too few failure codes	Lose detail, everything is "Other"	Review annually, add codes for top recurring issues

30-Point Implementation Checklist

Setup (Do First)

- [ ] Download ISO 14224:2016 standard (or access via corporate subscription)
- [ ] Identify pilot equipment group (10-20 critical assets)
- [ ] Map existing CMMS hierarchy to ISO 14224 9-level structure
- [ ] Document equipment boundary definitions with diagrams
- [ ] Create equipment class crosswalk (your codes → ISO 14224)

Code Tables

- [ ] Load failure mode codes into CMMS (from this guide)
- [ ] Load failure mechanism codes into CMMS
- [ ] Load failure cause codes into CMMS
- [ ] Load detection method codes into CMMS
- [ ] Load maintenance activity codes into CMMS
- [ ] Configure code relationships (which mechanisms valid for which modes)
- [ ] Set up code table governance (who can add/modify)

Data Collection

- [ ] Create failure report template/form
- [ ] Define mandatory fields for failure records
- [ ] Configure CMMS validation rules (can't close WO without codes)
- [ ] Install/verify hour meters on rotating equipment
- [ ] Create work order templates that prompt for ISO 14224 data

Training

- [ ] Train reliability engineers on code selection
- [ ] Train technicians on failure data collection
- [ ] Train supervisors on data quality review
- [ ] Create quick reference cards for field use
- [ ] Document 5-10 example failure records as training reference

Governance

- [ ] Assign data quality owner
- [ ] Set up monthly data quality review
- [ ] Create KPI dashboard (% complete, % with codes, UNK rate)
- [ ] Establish quarterly code table review process
- [ ] Document lessons learned process

Data Quality KPIs to Track

Metric	Target	Formula
Failure records with valid failure mode	>95%	Records with FM ≠ blank or UNK / Total failure records
Failure records with mechanism	>90%	Records with mechanism / Total failure records
Failure records with cause	>85%	Records with cause / Total failure records
"Unknown" failure mode rate	<5%	Records with FM = UNK / Total failure records
"Other" failure mode rate	<10%	Records with FM = OTH / Total failure records
Operating hours recorded	>95%	Failures with hours / Total failures on metered equipment
Average time to close failure record	<7 days	Mean days from failure to WO close

Quick Reference: Top 10 Equipment Classes

For quick code selection in the field:

If the asset is a...	Use class...	Common failure modes
Centrifugal pump	1.1	ELP, LOO, VIB, FTS, NOI
Reciprocating pump	1.2	ELP, LOO, VIB, NOI
Electric motor	3.3	FTS, OHE, VIB, ELP (bearing)
Centrifugal compressor	2.1	VIB, STP, OHE, ELP
Control valve	8.6	FTR, ELP, ILP, STP
Manual valve	8.1-8.5	ELP, ILP, FTO, FTC
Safety valve	8.7	FTO, SET, ELP, ILP
Heat exchanger	5.1	ILP (tube leak), PLU, LOO
Instrument/Transmitter	10.1	AIR, PDE, FTF
Transformer	9.1	OHE, ELP (oil), STP

Need help implementing ISO 14224 in your CMMS? AssetStage provides data staging, validation, and clean import to any CMMS platform. Contact us at sales@assetstage.io

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