ASSETSTAGE
DATA STAGING & QUALITY PLATFORM

ISO 14224 for Non-Oil & Gas Industries

Applying Proven Reliability Standards to Manufacturing, Utilities, and Beyond

Why Use ISO 14224 Outside Oil & Gas?

ISO 14224 was developed for petroleum and petrochemical industries, but its core concepts apply universally:

- **Consistent equipment taxonomy** - Works for any rotating/static equipment
- **Standardized failure codes** - Pumps fail the same way in any industry
- **Data collection framework** - Structured reliability data benefits everyone
- **Industry benchmarking** - Some data is transferable across industries

What You Get from ISO 14224

Benefit	Value for Non-O&G
Equipment classification	Organize any industrial asset
Failure mode codes	Standardize failure recording
Failure mechanism codes	Understand why things fail
Data collection requirements	Know what to record
Boundary definitions	Clear scope for analysis

What You Need to Adapt

ISO 14224 Element	Adaptation Needed
Industry/Business Category (Levels 1-2)	Replace with your industry structure
Installation/Plant (Levels 3-4)	Map to your facility structure
Equipment classes	Use applicable classes, add custom
Failure codes	Use as-is, excellent universal fit
Data fields	Use relevant fields, skip O&G-specific

Part 1: Equipment Classes for Other Industries

Manufacturing

Applicable ISO 14224 Classes:

ISO 14224 Class	Manufacturing Application
1.1 Centrifugal Pump	Process pumps, cooling pumps
1.2 Reciprocating Pump	Hydraulic units, dosing pumps
2.1 Centrifugal Compressor	Process air, pneumatics
2.2 Reciprocating Compressor	Air compressors
3.3 Electric Motor	Main drives, auxiliary motors
3.4 Diesel/Gas Engine	Emergency generators, mobile equipment
5.1 Heat Exchanger	Process cooling, HVAC
6.1 Pressure Vessel	Process vessels, accumulators

7.1 Piping	Process piping
8.1-8.5 Valves	Process valves
8.6 Control Valve	Process control
9.1 Transformer	Power distribution
10.1 Transmitter	Process instruments

Additional Classes Needed:

Custom Class	Description	Based On
MFG-1	Conveyor	N/A - custom
MFG-2	Robot/Manipulator	N/A - custom
MFG-3	CNC Machine	N/A - custom
MFG-4	Packaging Machine	N/A - custom
MFG-5	Press/Forming	N/A - custom
MFG-6	Oven/Furnace	Similar to 5.x heat transfer
MFG-7	Mixer/Agitator	N/A - custom

Water/Wastewater Utilities

Applicable ISO 14224 Classes:

ISO 14224 Class	Water Utility Application
1.1 Centrifugal Pump	Raw water, distribution, lift stations
1.2 Reciprocating Pump	Chemical dosing, sludge
1.3 Rotary Pump	Progressive cavity sludge pumps
2.1 Centrifugal Blower	Aeration blowers

3.3 Electric Motor	Pump drives, blower drives
5.1 Heat Exchanger	Digester heating
6.1 Vessel	Chlorine tanks, chemical storage
6.2 Tank	Clarifiers, basins (as static equipment)
8.1-8.5 Valves	Distribution valves, process valves
8.6 Control Valve	Flow control
10.1 Transmitter	Flow, level, pressure, quality

Additional Classes Needed:

Custom Class	Description
WTR-1	UV Disinfection System
WTR-2	Membrane System (RO/UF/MF)
WTR-3	Clarifier/Settler
WTR-4	Aerator (surface/diffused)
WTR-5	Screen/Bar Screen
WTR-6	Dewatering Equipment

Food & Beverage

Applicable ISO 14224 Classes:

ISO 14224 Class	F&B Application
1.1 Centrifugal Pump	CIP, product transfer
1.3 Rotary Pump	Positive displacement for viscous products
2.1 Compressor	Refrigeration, CO2

3.3 Electric Motor	Drives throughout
5.1 Heat Exchanger	Pasteurizers, coolers
6.1 Vessel	Process vessels, CIP tanks
8.1-8.6 Valves	Sanitary valves, control valves

Additional Classes Needed:

Custom Class	Description
FB-1	Filler/Packager
FB-2	Labeler
FB-3	Palletizer
FB-4	Refrigeration Unit
FB-5	CIP System
FB-6	Homogenizer
FB-7	Pasteurizer (as system)

Pharmaceutical/Life Sciences

Applicable ISO 14224 Classes:

ISO 14224 Class	Pharma Application
1.1 Centrifugal Pump	WFI, process
2.1 Compressor	HVAC, process gas
3.3 Electric Motor	Drives
5.1 Heat Exchanger	Process heating/cooling
6.1 Vessel	Reactors, tanks

8.6 Control Valve	Process control
10.1 Transmitter	Critical instruments

Additional Classes Needed:

Custom Class	Description
PH-1	Lyophilizer (Freeze Dryer)
PH-2	Autoclave/Sterilizer
PH-3	Clean Room HVAC
PH-4	WFI Generation
PH-5	Tablet Press
PH-6	Filling/Packaging (GMP)

Data Centers

Applicable ISO 14224 Classes:

ISO 14224 Class	Data Center Application
2.1 Compressor	Chiller compressors
3.3 Electric Motor	Pump motors, fan motors
4.1 Generator	Emergency power
5.1 Heat Exchanger	Cooling systems
9.1 Transformer	Power distribution
9.2 Switchgear	MV/LV distribution
9.3 UPS	Critical power

Additional Classes Needed:

Custom Class	Description
DC-1	CRAC/CRAH Unit
DC-2	Chiller
DC-3	Cooling Tower
DC-4	PDU
DC-5	Battery System
DC-6	ATS/STS

Facilities Management

Applicable ISO 14224 Classes:

ISO 14224 Class	FM Application
1.1 Centrifugal Pump	HVAC pumps, fire pumps
2.1 Compressor	HVAC compressors
3.3 Electric Motor	Fan motors, pump motors
5.1 Heat Exchanger	HVAC coils, plate HX
9.1 Transformer	Building power
9.2 Switchgear	Distribution

Additional Classes Needed:

Custom Class	Description
FM-1	AHU

FM-2	RTU/Package Unit
FM-3	Boiler
FM-4	Chiller
FM-5	Elevator
FM-6	Escalator
FM-7	Fire Suppression System

Part 2: Failure Codes - Universal Application

ISO 14224 failure codes work across all industries. A pump leaks the same way whether it's pumping crude oil or milk.

Failure Modes (Use As-Is)

Code	Mode	Universal Application
AIR	Abnormal instrument reading	Any instrumented equipment
BRD	Breakdown	Any equipment - catastrophic failure
ELP	External leakage - process	Any sealed/pressurized equipment
ELU	External leakage - utility	Cooling water, steam, air
ERO	Erratic output	Any controlled output
FTC	Fail to close	Valves, dampers, doors
FTO	Fail to open	Valves, dampers, doors
FTR	Fail to regulate	Control valves, regulators
FTS	Fail to start	Motors, engines, drives

FTF	Fail to function	Safety devices, interlocks
HIO	High output	Overpressure, overtemperature, overspeed
ILP	Internal leakage - process	Valves, heat exchangers, seals
LOO	Low output	Low flow, low pressure, low power
NOI	Noise	Rotating equipment, hydraulics
OHE	Overheating	Motors, bearings, electrical
PDE	Parameter deviation	Gradual drift from setpoint
PLU	Plugged/Choked	Filters, strainers, piping
SER	Service problems	Degraded operation
SET	Spurious operation	Trips, activations without cause
STP	Structural deficiency	Mechanical damage
UST	Spurious stop	Unexpected shutdowns
VIB	Vibration	Rotating equipment
OTH	Other	Documented in comments
UNK	Unknown	Minimize use

Failure Mechanisms (Use As-Is)

The mechanisms (WHY it failed) are completely universal:

Mechanical:

- Wear (1.1) - Universal
- Erosion (1.2) - Universal
- Corrosion (1.4-1.6) - Universal
- Fatigue (1.7) - Universal
- Overload (1.8) - Universal

Electrical:

- Short circuit (2.1) - Universal
- Open circuit (2.2) - Universal
- Insulation failure (2.5) - Universal

Instrument/Control:

- Out of calibration (3.1) - Universal
- Software fault (3.2) - Universal

External:

- Contamination (4.2) - Universal
- Environmental (4.3) - Universal

Failure Causes (Adapt Slightly)

Causes may need slight adaptation:

ISO 14224 Cause	Universal Version
Design-related	Design-related (same)
Fabrication/Installation	Fabrication/Installation (same)
Operations-related	Operations-related (same)
Maintenance-related	Maintenance-related (same)
Management-related	Management-related (same)

Part 3: Adapting the Hierarchy

Original ISO 14224 (9 Levels)

```
1. Industry
```

```
2. Business Category

3. Installation

4. Plant/Unit

5. Section/System

6. Equipment Unit

7. Subunit

8. Maintainable Item

9. Part
```

Manufacturing Adaptation (6-7 Levels)

```
1. Company/Division

2. Site/Plant

3. Production Area / Building

4. Production Line / System

5. Equipment

6. Component / Assembly

7. Part (optional)

Example:
ACME Manufacturing
└── Cleveland Plant
    └── Building A - Assembly
        └── Line 1 - Final Assembly
            └── ROB-001 Welding Robot
                └── Servo Drive Axis 1
                    └── Motor encoder
```

Utilities Adaptation (6-7 Levels)

```
1. Utility Company
```

```
2. Service Area / District

3. Facility (Plant / Station)

4. Process Area / System

5. Equipment

6. Component

7. Part (optional)

Example:
Metro Water Authority
└── North District
    └── North WTP
        └── Filtration
            └── Filter 1
                └── Backwash Valve FV-101
```

Facilities Adaptation (5-6 Levels)

```
1. Portfolio / Company

2. Property / Campus

3. Building

4. Floor / Zone / System

5. Equipment

6. Component (optional)

Example:
ACME Properties
└── Downtown Campus
    └── Tower 1
        └── HVAC System
            └── AHU-3-01
                └── Supply Fan
```

Part 4: Data Collection Requirements

Minimum Data Set (Any Industry)

Equipment Data (collect once):

Field	Required	Example
Equipment ID	Yes	PP-001
Description	Yes	Cooling Water Pump 1
Equipment Class	Yes	1.1 - Centrifugal Pump
Location	Yes	Building A / Utility Room
Manufacturer	Yes	Grundfos
Model	Yes	CR 32-2-2
Serial Number	Yes	2024-12345
Install Date	Yes	2020-03-15
Criticality	Yes	B

Failure Data (collect every failure):

Field	Required	Example
Equipment ID	Yes	PP-001
Failure Date	Yes	2024-11-15
Operating Hours	If tracked	32,456
Failure Mode	Yes	ELP
Subunit Failed	Recommended	Mechanical Seal
Failure Mechanism	Recommended	1.1 - Wear

Failure Cause	Recommended	4 - Maintenance
Detection Method	Recommended	OBS - Observation

Maintenance Data (collect every repair):

Field	Required	Example
Equipment ID	Yes	PP-001
Activity Date	Yes	2024-11-15
Activity Type	Yes	RPL - Replace
Description	Yes	Replace mechanical seal
Downtime Hours	Recommended	4
Labor Hours	Recommended	6
Parts Cost	Recommended	£850

Enhanced Data Set (For Reliability Analysis)

Add these for serious reliability programs:

Field	Purpose
Time to failure	MTBF calculation
Time to repair	MTTR calculation
Operating context at failure	Understand failure conditions
Root cause analysis	Prevent recurrence
Corrective action	Track effectiveness

Part 5: Implementation Guide

Phase 1: Planning (Weeks 1-2)

1.1 Scope Definition

- [ ] Which sites/facilities?
- [ ] Which equipment types?
- [ ] What level of detail?
- [ ] Who are the stakeholders?

1.2 Gap Analysis

- [ ] Current data structure
- [ ] Current failure coding (if any)
- [ ] Data quality assessment
- [ ] System capabilities

1.3 Customization Decisions

- [ ] Hierarchy levels needed
- [ ] Custom equipment classes needed
- [ ] Failure code modifications
- [ ] Data fields to include

Phase 2: Design (Weeks 3-4)

2.1 Hierarchy Design

- [ ] Document hierarchy structure
- [ ] Create examples for each level
- [ ] Define naming conventions

2.2 Classification Design

- [ ] Map equipment to ISO 14224 classes
- [ ] Define custom classes
- [ ] Document boundary definitions

2.3 Failure Code Setup

- [ ] Select applicable failure modes
- [ ] Select applicable mechanisms
- [ ] Document code definitions
- [ ] Create selection guides

Phase 3: Configuration (Weeks 5-6)

3.1 CMMS Configuration

- [ ] Add classification fields
- [ ] Load failure code tables
- [ ] Configure dropdowns/lookups
- [ ] Set mandatory fields
- [ ] Build hierarchy structure

3.2 Documentation

- [ ] User guides
- [ ] Code selection aids
- [ ] Examples

Phase 4: Data Population (Weeks 7-10)

4.1 Equipment Classification

- [ ] Export equipment list
- [ ] Assign ISO 14224 classes
- [ ] Fill missing attributes
- [ ] Validate and load

4.2 Historical Data (Optional)

- [ ] Identify key equipment
- [ ] Review past failures
- [ ] Code historical failures
- [ ] Load to CMMS

Phase 5: Rollout (Weeks 11-12)

5.1 Training

- [ ] Train reliability engineers
- [ ] Train maintenance supervisors
- [ ] Train technicians

5.2 Go-Live

- [ ] Start collecting coded data
- [ ] Monitor compliance
- [ ] Support users

5.3 Continuous Improvement

- [ ] Review data quality monthly
- [ ] Refine codes based on usage
- [ ] Analyze failure patterns
- [ ] Take action on insights

Part 6: Industry-Specific Examples

Manufacturing Example: CNC Machine

Equipment Data:

Field	Value
Equipment ID	CNC-L1-001
Description	CNC Milling Machine
Class	MFG-3 (Custom)
Location	Line 1 / Machining Cell
Manufacturer	Mazak
Model	VCN-530C
Criticality	A

Component Structure:

```
CNC-L1-001 CNC Milling Machine
├── Spindle Assembly
│   ├── Spindle Motor
│   ├── Spindle Bearing
│   └── Tool Holder Interface
├── Axis Drives
│   ├── X-Axis Servo
│   ├── Y-Axis Servo
│   └── Z-Axis Servo
├── Coolant System
│   ├── Coolant Pump
│   └── Coolant Filter
├── Hydraulic Unit
│   ├── Hydraulic Pump
│   └── Hydraulic Valves
└── Control System
    ├── CNC Controller
    └── HMI Panel
```

Failure Record Example:

Field	Value
Date	2024-11-15
Equipment	CNC-L1-001
Subunit	Spindle Bearing
Failure Mode	VIB - Vibration
Mechanism	1.1 - Wear
Cause	4 - Maintenance (lubrication missed)
Effect	Surface finish out of spec
Action	Replace bearing
Downtime	8 hours

Water Utility Example: Lift Station Pump

Equipment Data:

Field	Value
Equipment ID	LS05-PP-001
Description	Lift Station 5 Pump 1
Class	1.1 - Centrifugal Pump
Location	Lift Station 5
Manufacturer	Flygt
Model	NP 3153
Criticality	A (no redundancy)

Failure Record Example:

Field	Value
Date	2024-10-20
Equipment	LS05-PP-001
Subunit	Impeller
Failure Mode	LOO - Low output
Mechanism	1.2 - Erosion
Cause	1 - Design (inadequate for debris load)
Effect	Lift station overflow
Action	Replace with hardened impeller
Downtime	6 hours

Quick Reference: ISO 14224 Universal Failure Modes

Code	Mode	Universal?
ELP	External leak	Yes - any sealed equipment
LOO	Low output	Yes - any equipment with output
VIB	Vibration	Yes - any rotating equipment
FTS	Fail to start	Yes - any driven equipment
OHE	Overheating	Yes - any powered equipment
NOI	Noise	Yes - any mechanical equipment
FTO/FTC	Fail to open/close	Yes - any valve/damper
PLU	Plugged	Yes - any flow path
AIR	Abnormal reading	Yes - any instrumented equipment
PDE	Parameter deviation	Yes - any controlled equipment

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