“Asset Taxonomy as a Success Factor in Digital Transformation”

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2020 SMARCON
Maintenance and Reliability
المؤتمر السعودي للصيانة والاعتمادية
1 -2 Sept. 2020

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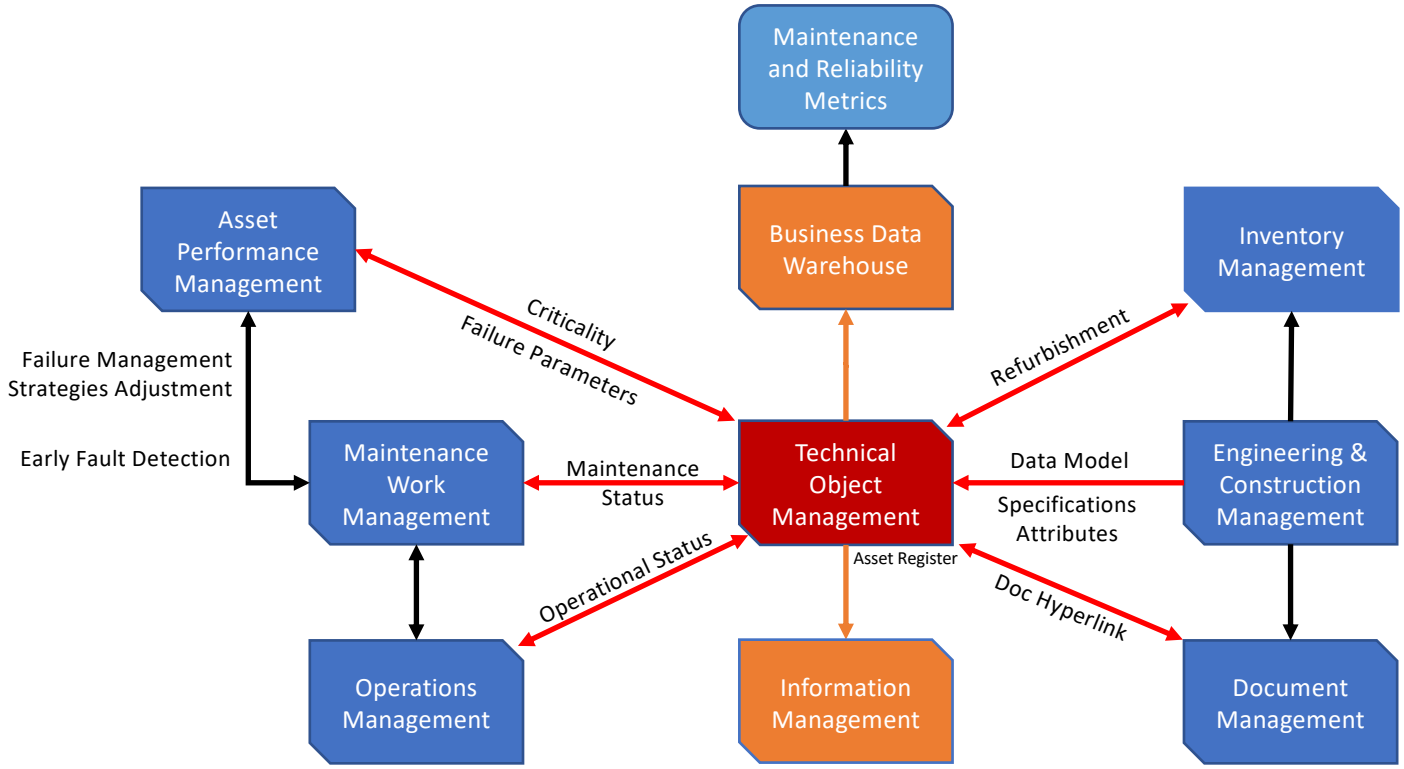


Asset Register

“The asset register is the backbone of an organization’s CMMS if structured correctly”

Business Value from a well-structured asset register,

- enables tracking and traceability of assets from installation to decommissioning
- enables data-driven decision-making and prioritization
- eases exchange of reliability and maintenance data
- provides a standard data structure for digital transformation

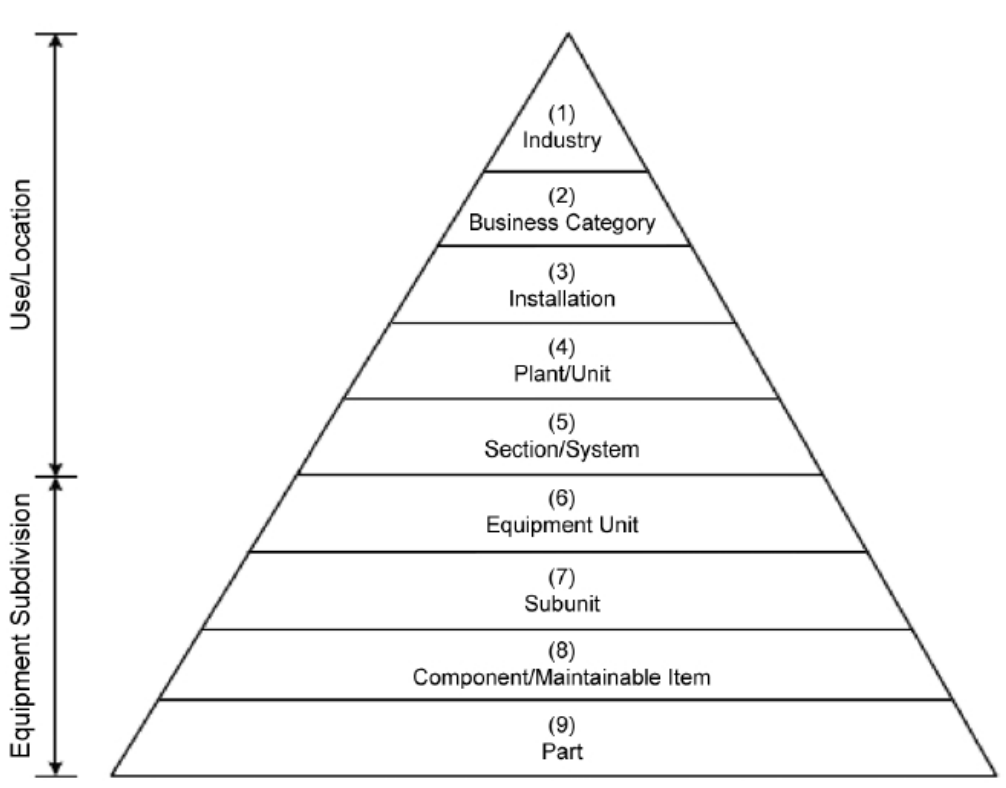
International Standards

- ISO 14224:2016 Petroleum, petrochemical and natural gas industries — collection and exchange of reliability and maintenance data for equipment.
- API STD 689 Collection and exchange of reliability and maintenance data for equipment.
- ASTM F2446-04 (2018) Standard classification for hierarchy of equipment identifiers and boundaries for reliability, availability, and maintainability (RAM) performance data. exchange.
- ATA SPEC 2000, Chapter 11, Aircraft reliability data collection and exchange.

An Overview of ISO 14224
Asset Taxonomy Relevant Content

- Data Collection Process
- Requirements of Equipment Data
  - Equipment Common Attributes
  - Equipment Class Specific Attributes and Parameters
- Equipment Boundaries
- Taxonomy
- Interpretation and Notation of Failure and Maintenance Parameters

An Overview of ISO 14224
Taxonomy

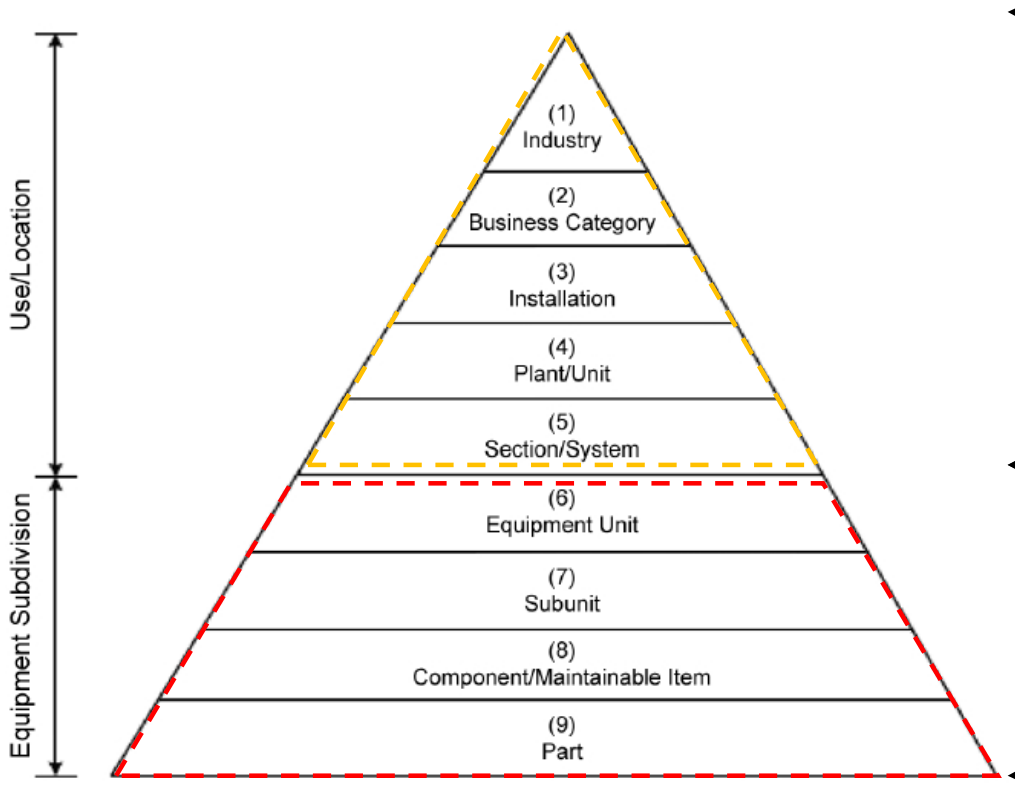


- Use/Location Attributes

- Common Attributes
- Class-specific Design Parameters
- Class-specific Operation Parameters
- Failure & Maintenance Parameters

ISO 14224:2016 Figure 3 – Taxonomy classification with taxonomic levels

Construction of an Asset Register
Step 1 - Documentation

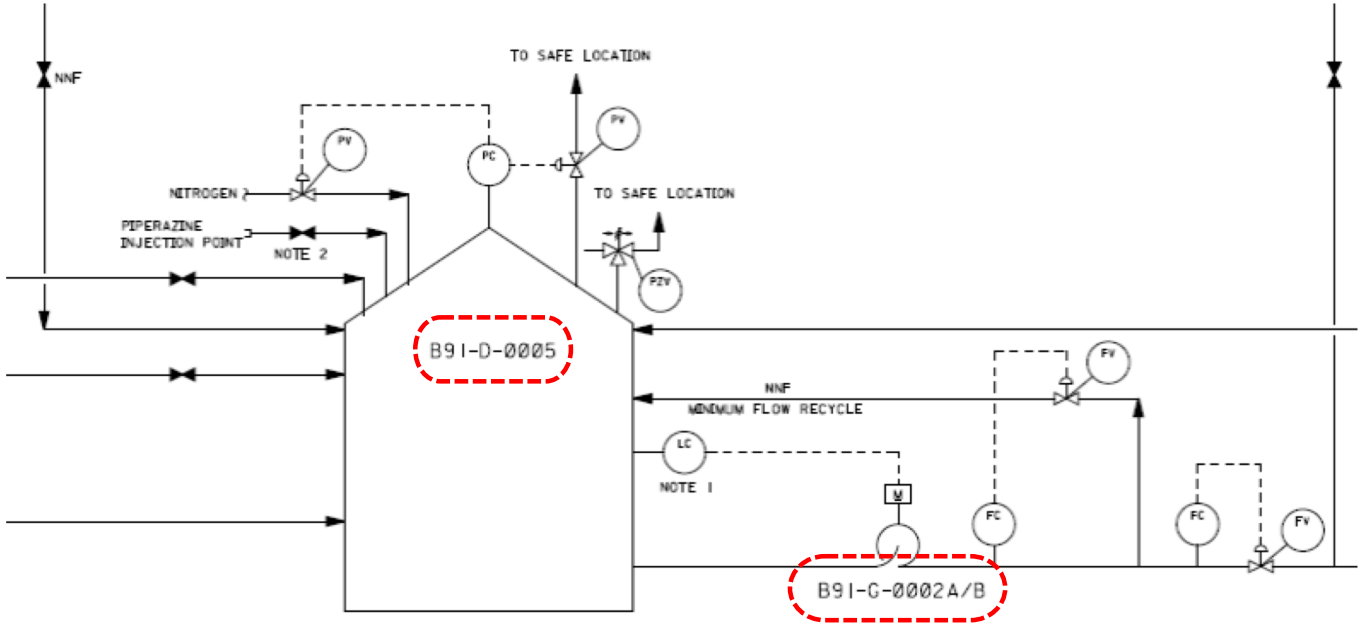


- Plot Plans
- Process Flow Diagrams (PFD)

- Piping & Instrumentation Diagrams (P&ID)
- Single-line Diagrams (SLD)
- Equipment Datasheets

ISO 14224:2016 Figure 3 – Taxonomy classification with taxonomic levels

Construction of an Asset Register
Step 2 - Equipment Unit Identification



Construction of an Asset Register
Step 3 - Equipment Unit Boundary

Table A.53 — - Type classification – Storage tanks

Equipment class - Level 6		Equipment type	
Description	**Code**	**Description**	**Code**
Storage tanks	TA	Fixed-Roof	FR
		Lifting Roof	LR
		Diaphragm	DP
		External Floating Roof	EF
		Roofless	RL
		Fixed Roof with Internal Floating Roof	IF

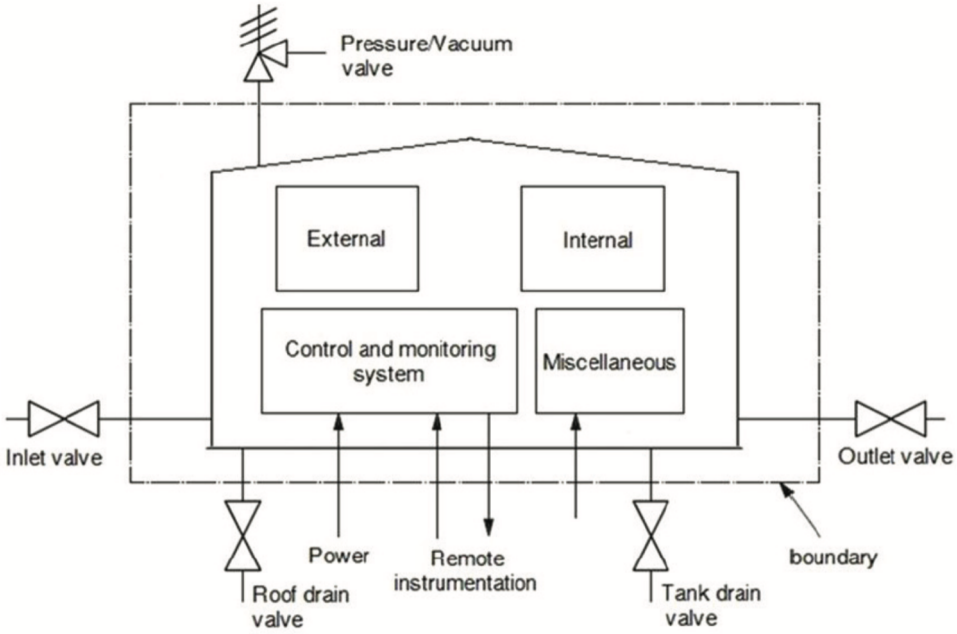
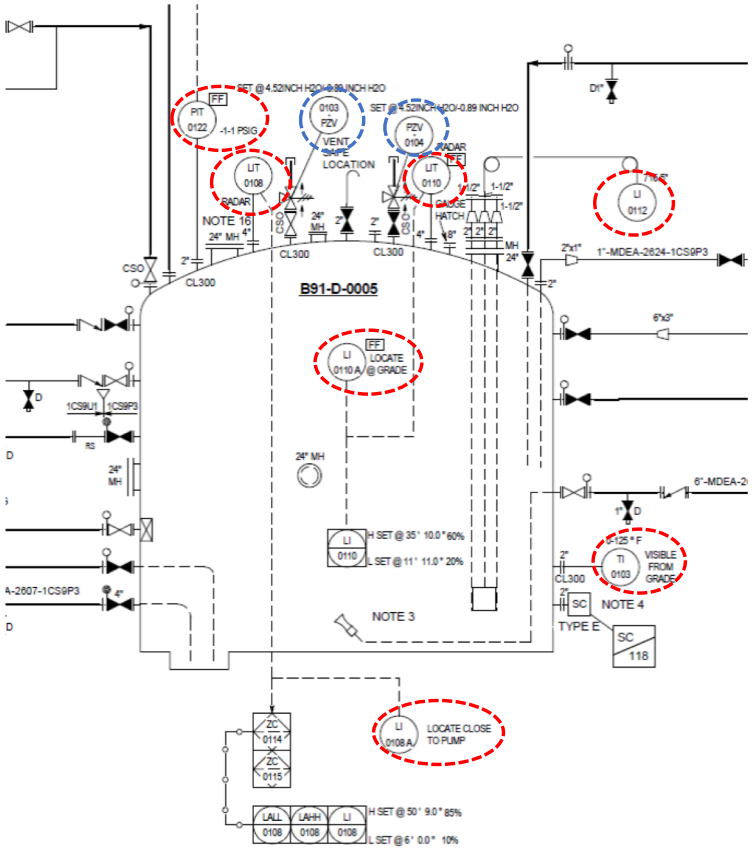


Figure A.18 — Boundary definition — Storage tanks

Construction of an Asset Register

Step 4 - Equipment Subunit Identification



Construction of an Asset Register
Step 5 - Equipment Subunits and Parts

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Table A.54 — Equipment subdivision — Storage tanks

Equipment unit	Storage tanks				
Subunit	**Tank structure**	**External**	**Internal**	**Control and monitoring**	**Miscellaneous**
Maintainable items	Shell (or side-walls) Roof Bottom Nozzles Manholes Cleanout Foundation	Bottom drain Roof drain [c] Seal [c] Platform Walkway Stairway Ladder [c] Centring and anti-rotation device [c] Secondary containment [d]	Heaters [a] Cathodic protection Nozzles Piping Swing line [c]	Sensors [b] Piping Open vent Flame arrester	Mixers Fire-fighting system Lightning protection system Others

[a] Applicable for heated storage tanks only.
[b] Specify type of sensor, e.g. pressure, temperature, level, etc.
[c] Applicable for floating roof tanks only.
[d] Applicable for refrigerated liquefied gas storage only.

Table A.71 — Type classification — Input devices

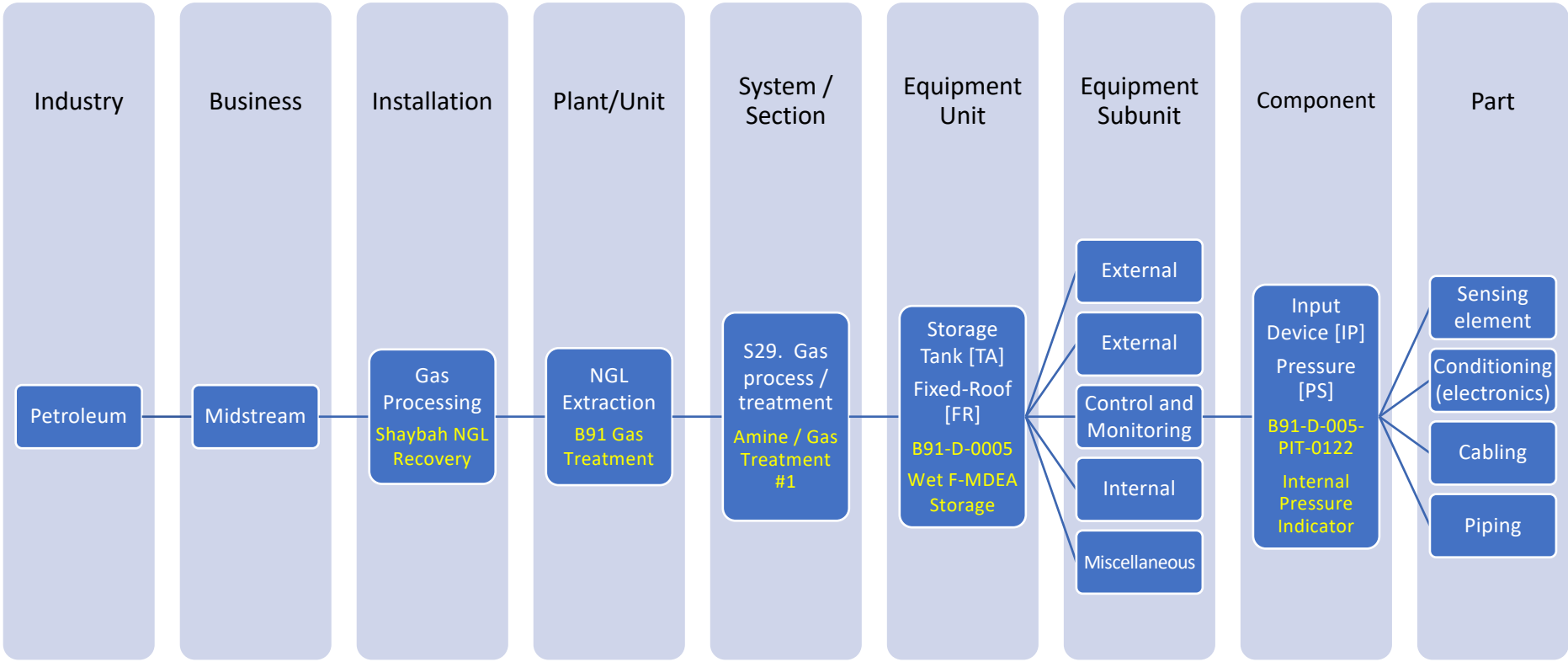
Equipment class — Level 6		Equipment type	
Description	**Code**	**Description**	**Code**
Input devices	IP	Pressure	PS
		Level	LS
		Temperature	TS
		Flow	FS

Table A.72 — Equipment subdivision — Input devices

Equipment unit	Input devices	
Subunit	**Sensor and electronics**	**Miscellaneous**
Maintainable items	Sensing element Conditioning (electronics)	Cabling Piping Others

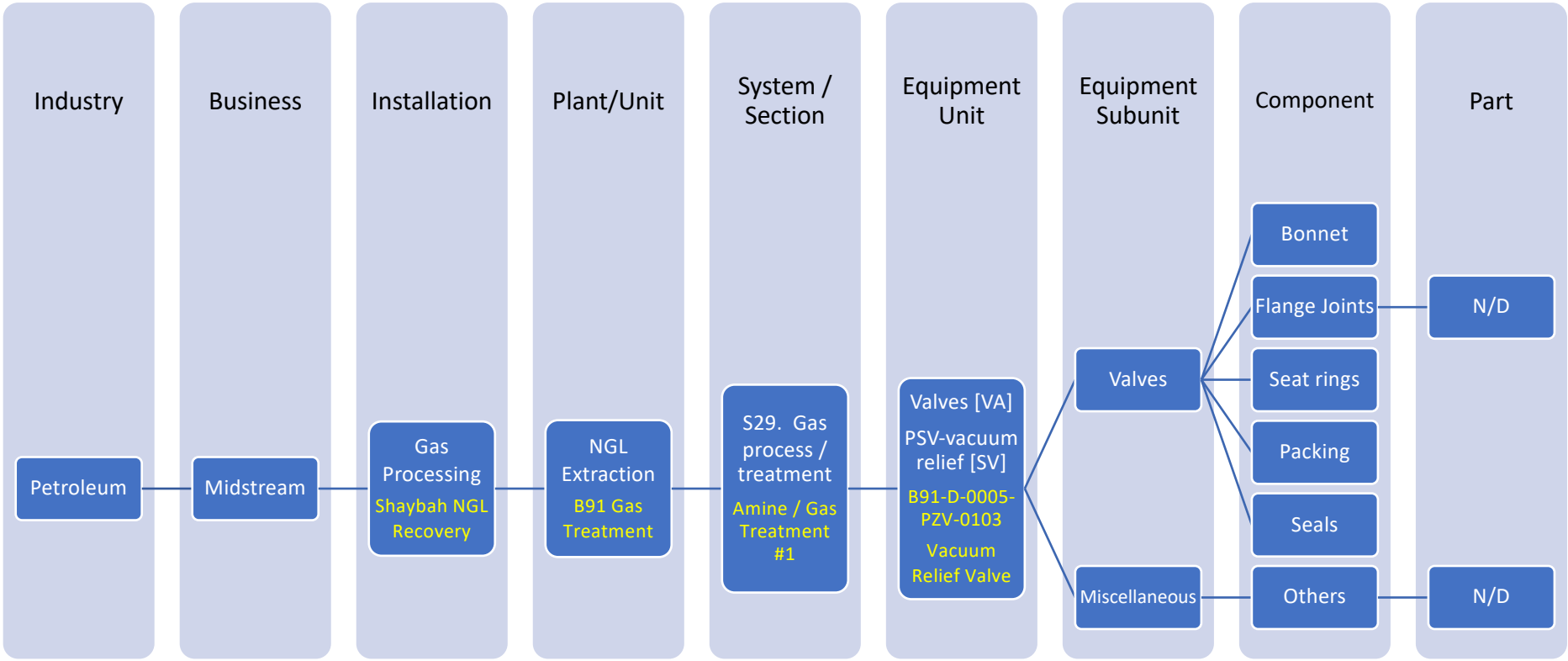
Construction of an Asset Register

Step 6 - Taxonomy [Storage Tank B91-D-005]



Construction of an Asset Register

Step 6 - Taxonomy [PSV-Vacuum Relief B91-D-005-PZV-0103]



Construction of an Asset Register
Step 7 - Equipment Attributes

Data category	Data
Use/ Location attributes	Industry
	Business category (*)
	Installation category
	Installation code or name (*)
	Owner code or name
	Geographic location
	Plant/Unit category (*)
	Plant/Unit code or name (*)
	Section/System (see Annex A) (*)
	Operation category

Data category	Data
Equipment attributes	Equipment class (see Annex A) (*)
	Equipment Type (see Annex A) (*)
	Equipment identification/ Location (e.g. tag number) (*) [b]
	Equipment description (nomenclature)
	Unique equipment identification number [b]
	Manufacturer's name (*) [c]
	Manufacturer's model designation [g]
	Design data relevant for each equipment class and subunit/component as applicable, e.g. capacity, power, speed, pressure, redundancy, relevant standard(s) (see also Annex A)

Operation (normal use)	Normal operating state/ Mode (*)
	Initial equipment commissioning date
	Start date of current service (*)
	Surveillance time, h (calculated) (*)
	Operational time, h [d] (measured/calculated)
	Number of periodic test demands during the surveillance period as applicable (*)[e]
	Number of operational demands during the surveillance period as applicable (*)[e]
	Total wells drilled during surveillance period (*)[f]
	Operating parameters as relevant for each equipment class; e.g. ambient conditions, operating power (see Annex A)

Construction of an Asset Register
Step 8 - Equipment-specific Parameters

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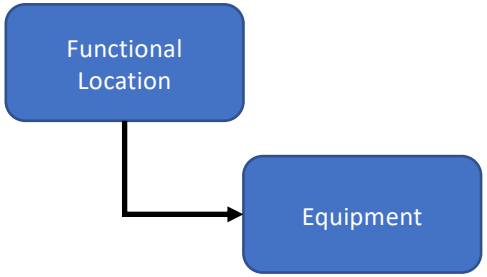
Table A.55 — Equipment-specific data — Storage tanks

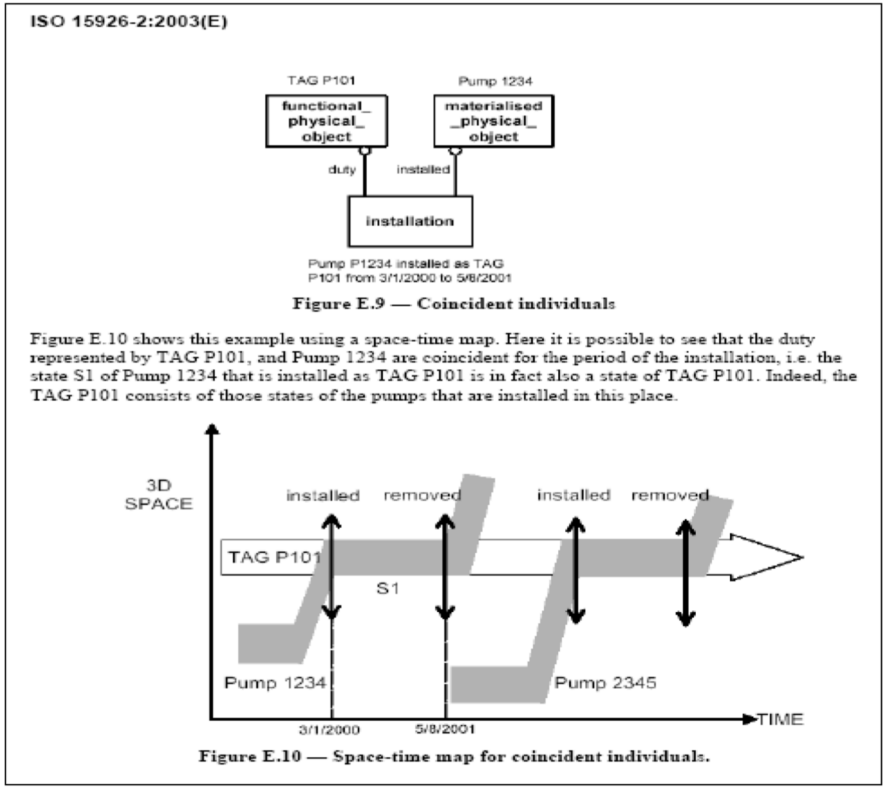
Name	Description	Unit or code list	Priority
Stored product(s)	Main product(s)	Crude oil, oily water, gasoline, diesel, methanol, water, refrigerated LPG, refrigerated LNG, chemicals	High
Product specific gravity	Relative density	Number	Medium
Design standard	Design standard	Standard / edition / addendum	Medium
Design pressure	Maximum positive gauge pressure	Pascal (bar)	High
Design vacuum	Maximum partial vacuum	Pascal (bar)	High
Volume	Nominal liquid capacity	Cubic metres	Medium
Size – diameter	Nominal diameter	Metres	Medium
Size – height	Nominal height	Metres	Medium
Temperature - design	Maximum design temperature	Degrees Celsius	High
	Minimum design temperature	Degrees Celsius	High
Temperature - operating	Operating temperature	Degrees Celsius	Medium
Shell material	Specify type or code	Specify	Medium
Roof material	Specify type or code	Specify	Medium
Coating	Specify	Yes/No	Medium
Heating system	Specify	Yes/No	Low
Refrigerated tank system	Specify	Yes/No	Medium
Roof type	Fixed or floating	Fixed or floating	Medium
Floating roof type	Specify	Specify	Medium
Wall thickness	Nominal thickness (1st course)	Millimetres	Medium
Mixer/agitator	Specify	Yes/No	Low
Secondary containment	Specify	Yes/No	Medium

Implementation of the Asset Register in the CMMS

Mapping and Structuring of Technical Systems



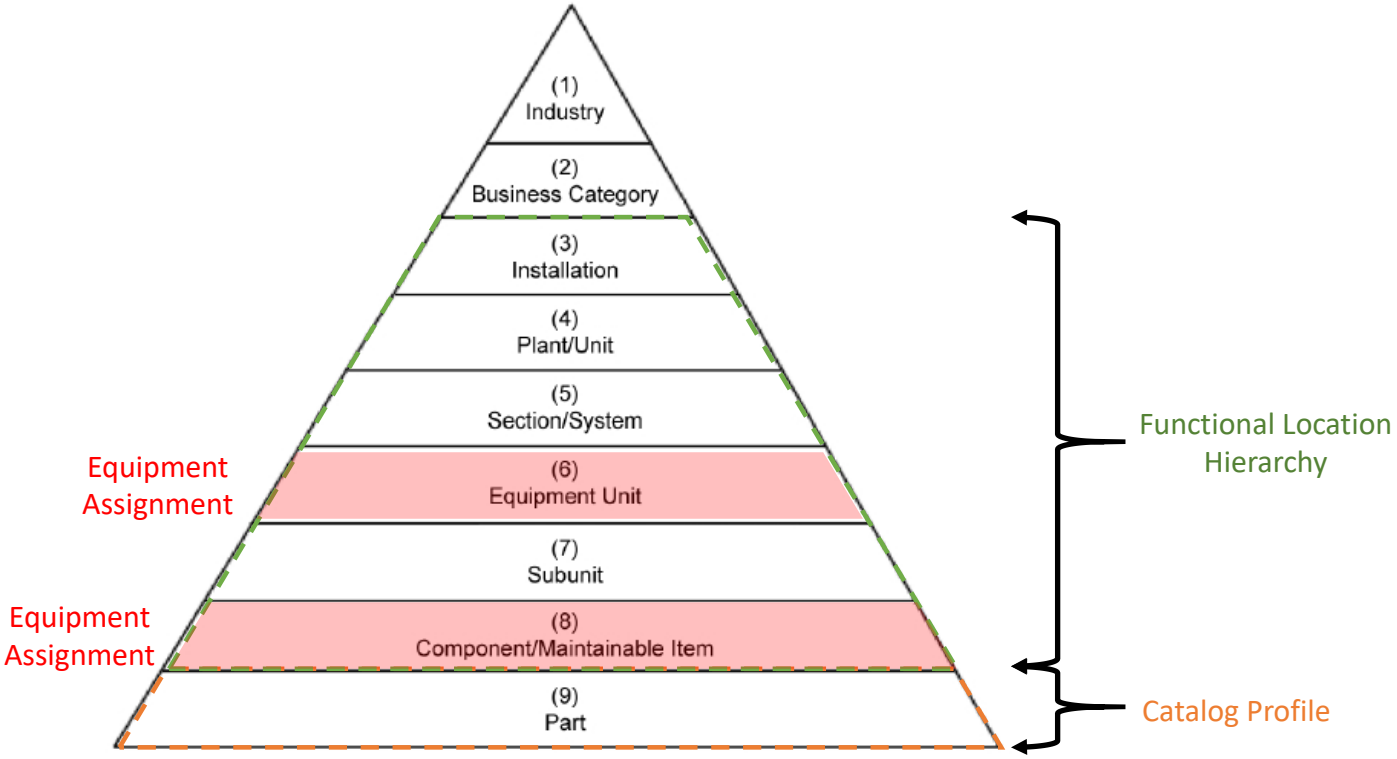
Structuring Sequence



ISO-15926-02: Integration of lifecycle data for process plants including oil and gas production facilities

Implementation of the Asset Register in the CMMS

Mapping and Structuring of Technical Systems



Technical Object Master Record

- Equipment Common Attributes
- Subset of Use/Location Attributes
- Subset of Operation Attributes

Technical Object Classification

- Subset of Use/Location Attributes
- Class Specific Design Attributes
- Class Specific Operation Attributes

Technical Object Structure

- Taxonomic Levels

Catalogs and Catalog Profiles

- Failure & Maintenance Parameters

Implementation of the Asset Register
Technical System Hierarchy

Installation
SHNGL – [Shaybah NGL Recovery]
- Plant/Unit
- SHNGL-B91 – [Gas Treatment]
  - System/Section
    - SHNGL-B91-AGT1 – [Amine/Gas Treatment #1]
      - Equipment Class
      - SHNGL-B91-AGT1-TA – [Storage Tanks]
        - Equipment Unit
        - SHNGL-B91-D-0005 – [Wet F-MDEA Storage D-0005]
          - 20000125 – [Fixed Roof Storage Tank]
          - Subunit
          - SHNGL-B91-D-0005-05 – [Control and Monitoring]
            - Component
            - SHNGL-B91-D-005-PIT-0122 – [Pressure Indicator PIT-0122]
              - 20000158 – Pressure Indicator/Transmitter
            - SHNGL-B91-D-005-TI-0122 – [Temperature Indicator TI-0122]
              - 20000163 – Temperature Indicator
      - SHNGL-91-AGT1-VA – [Valves]
        - SHNGL-B91-D-0005-PZV-0103 – [Vacuum Relief Valve PZV-0103]
          - 20000131 – [Vacuum Relief Valve]
        - SHNGL-B91-D-0005-PZV-0104 – [Vacuum Relief Valve PZV-0104]
          - 20000132 – [Vacuum Relief Valve]

Data shown is only representative not actual

Implementation of the Asset Register

Technical System Hierarchy – Non-Standard Hierarchy – Example #1

Level Nr.	Hierarchy Type	Example
1	Site	0424
2	Unit	0424-RHU – Residual Hydrocracking Units
3	System	0424-RHU-RHU3 - Residual Hydrocracking Unit 3
4	Subsystem	0424-RHU-RHU3-03CL – Reaction System
5	Functional location	0424-RHU-RHU3-03CL-301D – Reactor 301D, 1ST Unit
	Equipment	230011 - Pump, centrifugal, 100GPM
		230234 – Motor, AC, 30 HP, 286T, 1750 RPM
6	Control	0424-RHU-RHU3-03CL-301D-CM – Reactor 301D, Controls & Monitoring
7	Loop	0424-RHU-RHU3-03CL-301D-D301 - Loop, D3012, 301D Density
	Equipment	159871 – Transmitter, Density

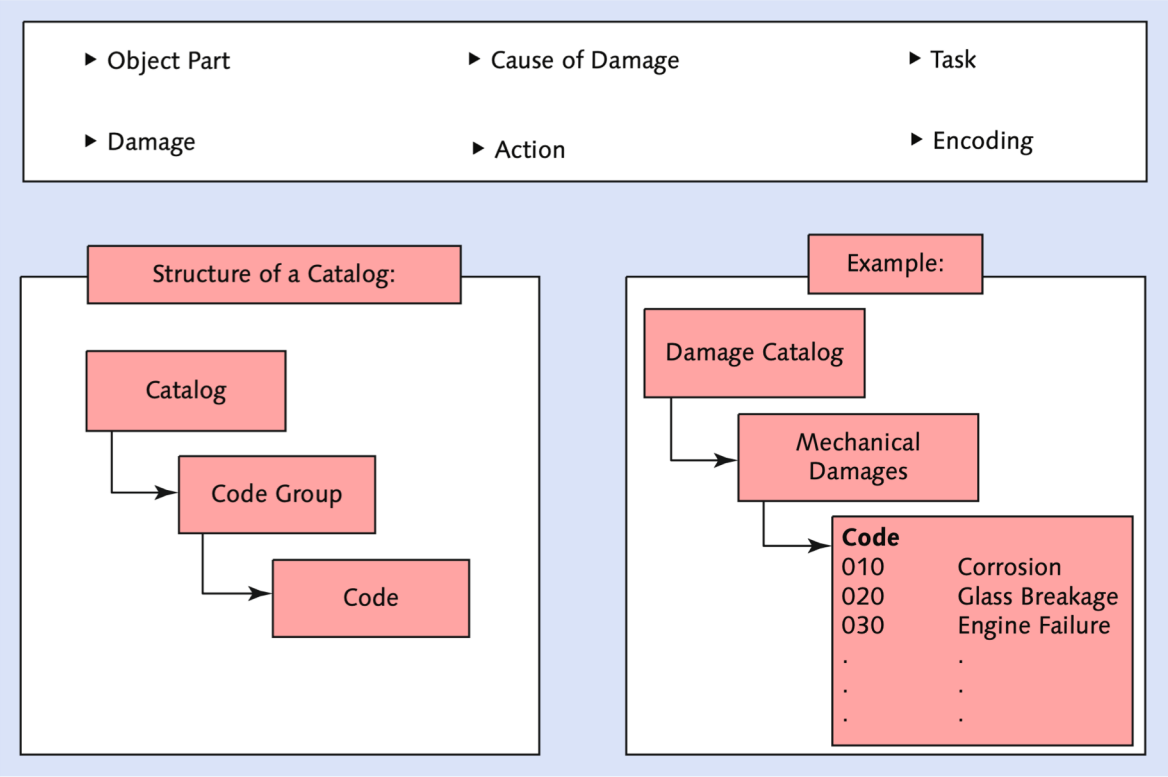
Implementation of the Asset Register

Technical System Hierarchy – Non-Standard Hierarchy – Example #2

Level Nr.	Hierarchy Type	Example
1	Site Type	GG – Gas Generation
2	Site	AB - Albuquerque
3	Unit	0 – Balance of Plant
4	System	AIR – Plant Air Systems
5	Subsystem	SAS – Service Air System
6	Equipment Type	CR – Service Air System Compressors
7	Functional Location or Loop	COMPR1 –Plant Air Compressor 01
8	Maintainable Item	Compressor, Reciprocating, 125PSIG

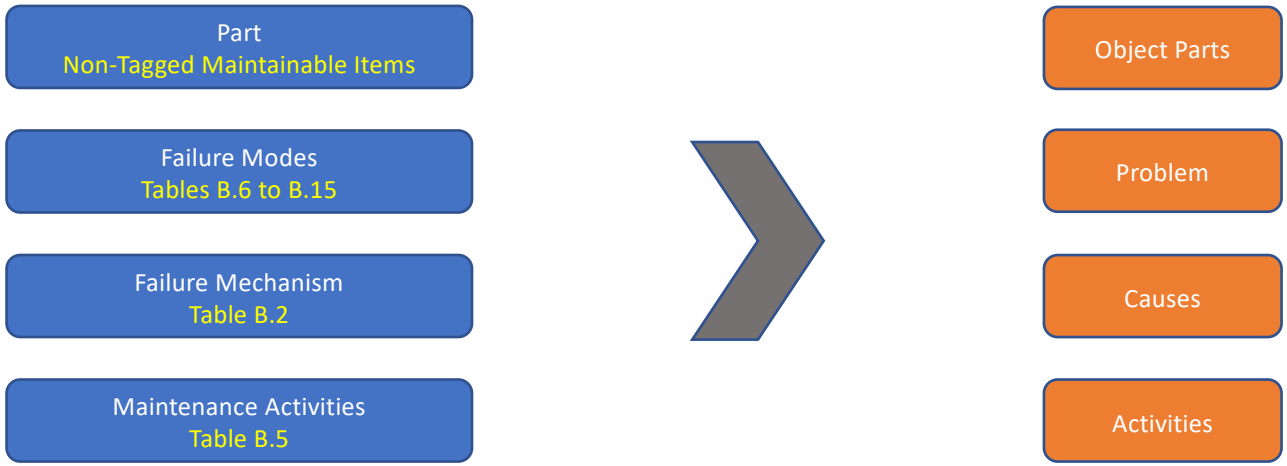
GG-AB-0-AIR-ASC-PP-P0001
Site Type
GG – Gas Generation
Site
AB - Albuquerque
Unit
0 – Balance of Plant
System
AIR – Plant Air Services
Subsystem
ASC – Air Service Compressors
Functional Location
CMPR01 - Compressor, P001, Oil/Water Sump Pump
Equipment
007654 - Compressor, Centrifugal, 150PSI, 1700CFM
007655 - Motor, AC, 125HP, 1780RPM, 445T

Implementation of the Asset Register in the CMMS
Mapping of Catalog Profiles



Default Structuring Sequence in SAP Plant Maintenance

Implementation of the Asset Register in the CMMS
Mapping of Catalog Profiles



ISO 14224-2016
Parts and Failure Parameters

Catalogs

Implementation of the Asset Register in the CMMS
Mapping of Catalog Profiles – Object Parts

Catalog Profile: TA/FR – Storage Tank - Fixed-Roof
Catalog: Object Part

Code Group: TA/FR/01 Tank Structure **Codes:** 1000 Shell 1100 Roof 1200 Bottom 1300 Nozzles 1400 Manholes 1500 Cleanout 1600 Foundation	**Code Group:** TA/FR/02 External **Codes:** 1000 Bottom drain 1100 Platform 1200 Walkway 1300 Stairway	**Code Group:** TA/FR/03 Internal **Codes:** 1000 Cathodic protection 1100 Nozzles 1200 Piping	**Code Group:** TA/FR/04 Control and Monitoring **Codes:** 1000 Sensors 1100 Piping 1200 Open vent 1300 Flame arrester	**Code Group:** TA/FR/05 Miscellaneous **Codes:** 1000 Fire-fighting system 1100 Lightning protection system

Implementation of the Asset Register in the CMMS
Mapping of Catalog Profiles – Problems

Catalog Profile: TA/FR – Storage Tank - Fixed-Roof
Catalog: Problem

Code Group:
TA/FR Storage Tank - Fixed-Roof

Codes:

ELP	External leakage – process medium
ELU	External leakage - utility medium
INL	Internal leakage
FLP	Failure in lightning protection system
LOB	Loss of buoyancy
OTH	Other
PLU	Plugged/Choked
SBU	Sludge build-up
SER	Minor in-service problems
STD	Structural deficiency
UNK	Unknown

Implementation of the Asset Register in the CMMS
Mapping of Catalog Profiles – Causes

Catalog Profile: TA-FR – Storage Tank - Fixed-Roof
Catalog: Causes

Code Group:
ISO/FM/10
Mechanical failure

Codes:
0010 General
0011 Leakage
0012 Vibration
0013 Clearance
0014 Deformation
0015 Looseness
0016 Sticking

Code Group:
ISO/FM/20
Material failure

Codes:
0020 General
0021 Cavitation
0022 Corrosion
0023 Erosion
0024 Wear
0025 Breakage
0026 Fatigue
0027 Overheating
0028 Burst

Code Group:
ISO/FM/30
Instrument failure

Codes:
0030 General
0031 Control failure
0032 No signal/alarm
0033 Faulty signal/alarm
0034 Out of adjustment
0035 Software error
0036 Common cause

Code Group:
ISO/FM/40
Electrical failure

Codes:
0040 General
0041 Short circuiting
0042 Open circuit
0043 No power/voltage
0044 Faulty power/voltage
0045 Earth/isolation fault

Code Group:
ISO/FM/50
External Influence

Codes:
0050 General
0051 Blockage/plugged
0052 Contamination
0053 Miscellaneous

Implementation of the Asset Register in the CMMS
Mapping of Catalog Profiles – Activities

Catalog Profile: TA-FR – Storage Tank - Fixed-Roof
Catalog: Activities

Code Group:
ISO/MA Maintenance Activities

Codes:
0001 Replace
0002 Repair
0003 Modify
0004 Adjust
0005 Refit
0006 Check
0007 Service
0008 Test
0009 Inspection
0010 Overhaul
0011 Combination
0012 Other

Frequently asked Questions