



# Indsamling af pålidelighedsdata

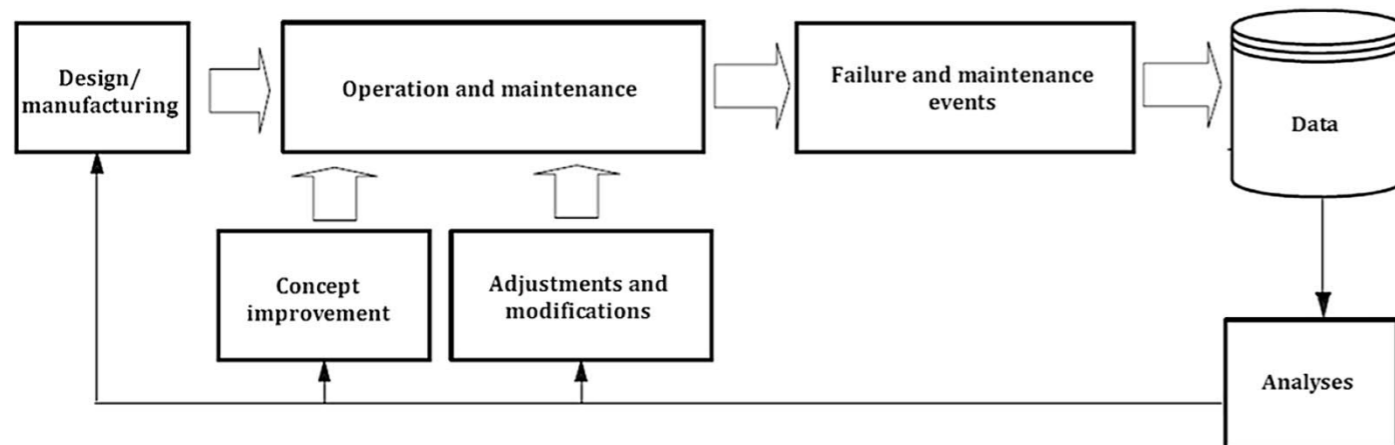
**DDV webinar 07-05-2020**

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- Næstformand i bestyrelsen for DDV.



## Hvorfor dette emne?



Data feedback loop fra ISO14224 – Petrokemisk industri og olie- og naturgasindustri - Indsamling og udveksling af data for driftssikkerhed og vedligeholdelse af udstyr.

### Formål med at indsamle pålidelighedsdata:

- Reduktion af OPEX/LCC
- 'License to operate'
- Levetidsforlængelse
- Sikkerhed/integritet
- Bedre grundlag for beslutninger
- Højere forudsigelighed

## Hvor trykker skoen?

'Fritekst i fejlrapporteringer umuliggør statistik

Sammenblanding af årsag og effekt samt fejlmekanisme.

Defekt, og nu ok' er måske den eneste fejlrapportering.

Forskellig tolkning af begreber og definitioner.



Mangel på struktur

Ikke standardiseret rapportering

Ingen klassifikation

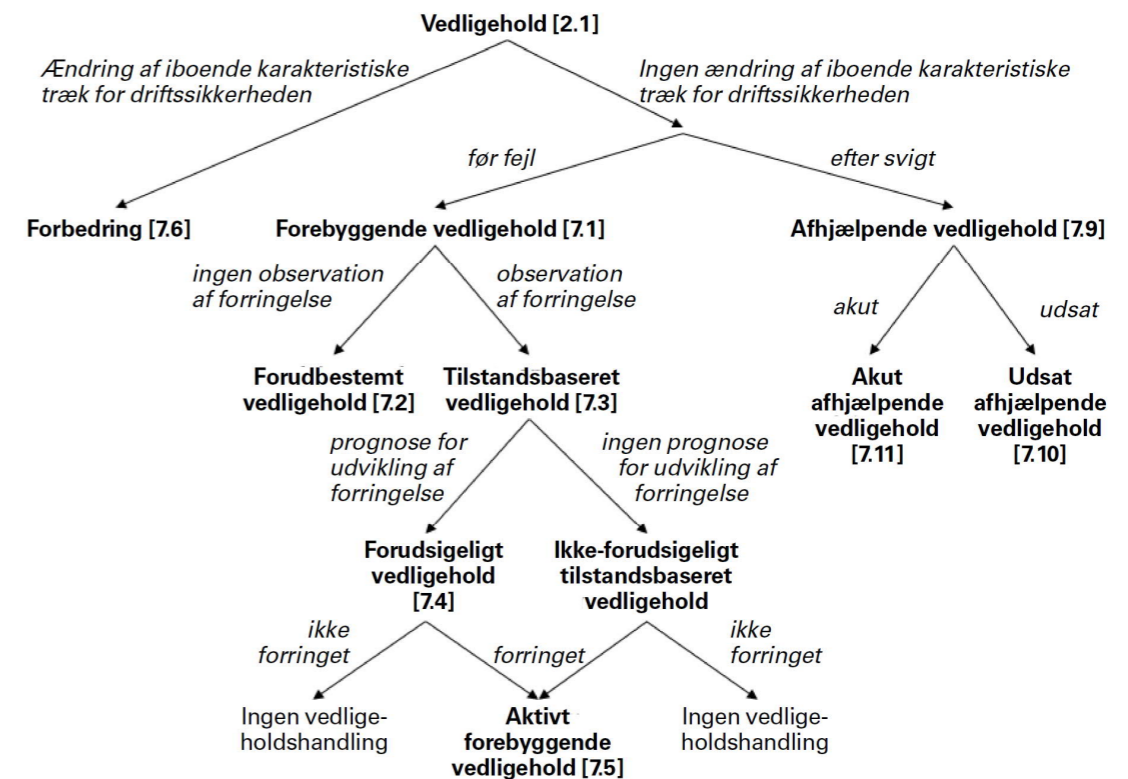
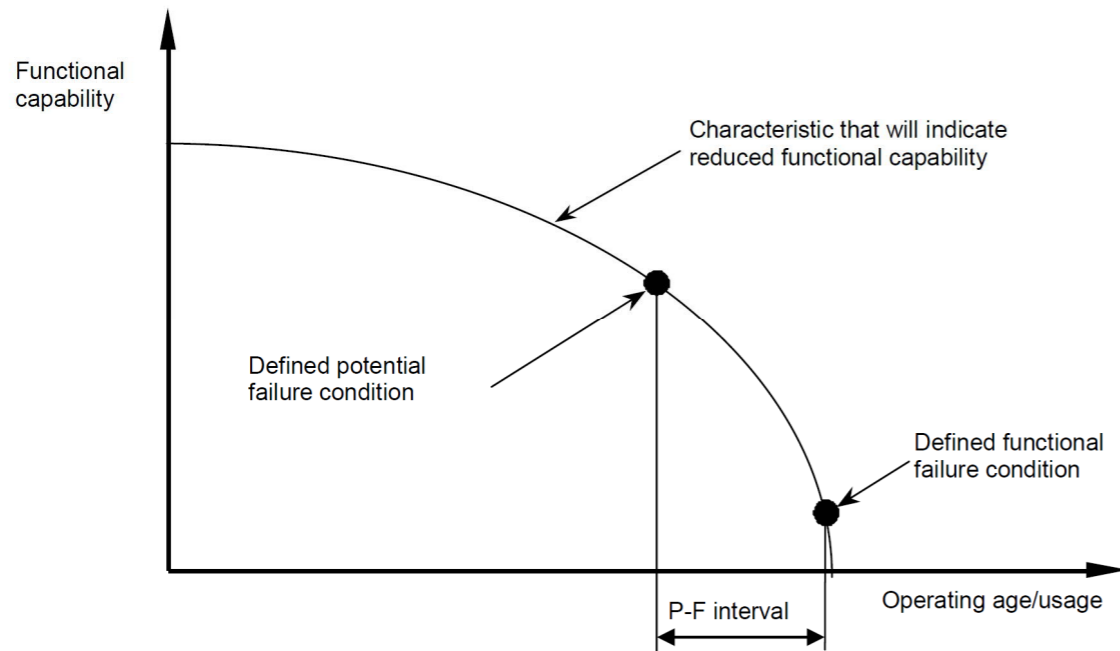
Ikke rapporteret mod den korrekte enhed/maskine.

Ufuldstændige arbejdsrapporter

**Pålidelighed:** ‘En enheds evne til at udføre en krævet funktion under givne forhold i løbet af et givet tidsinterval.’

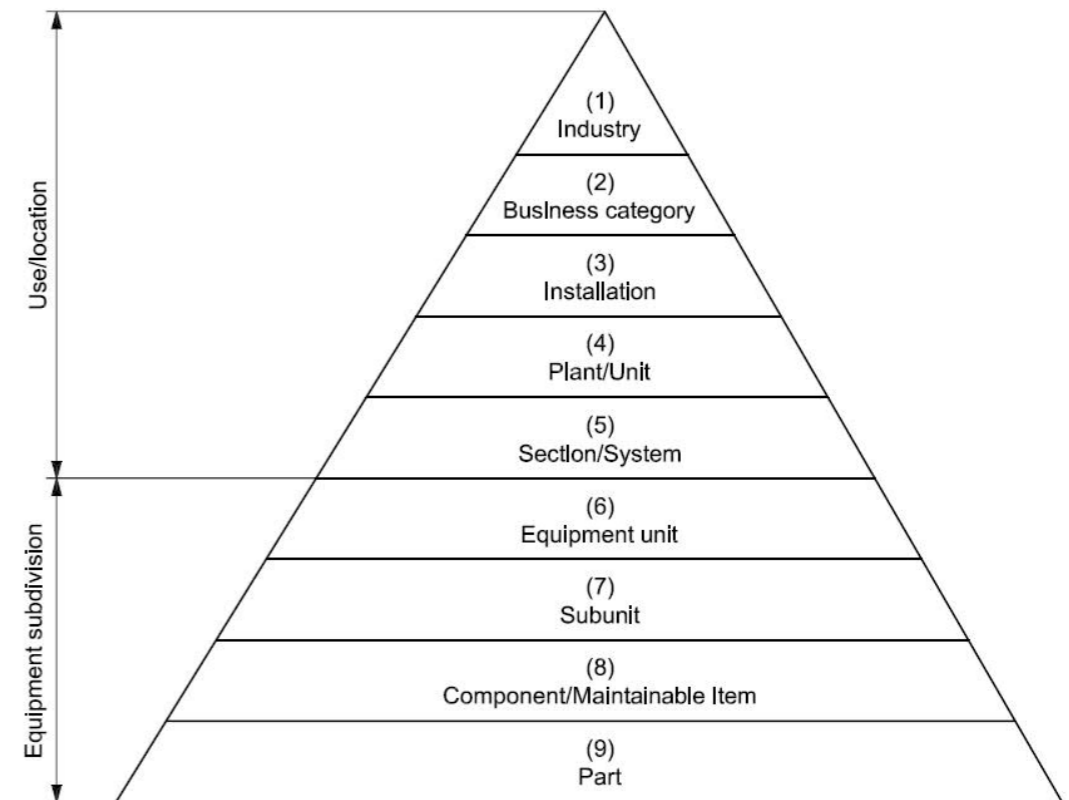
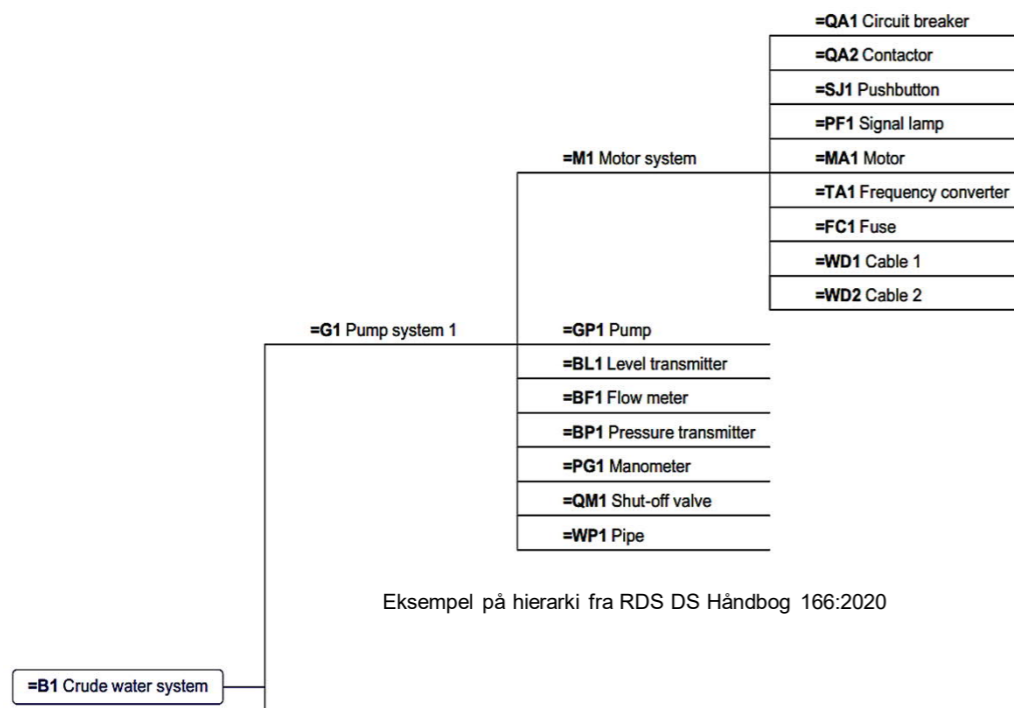
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“...Without a precise definition of what condition represents a failure, there is no way to assess its consequences or to define the physical evidence for which to inspect. The term failure must, in fact, be given a far more explicit definition than ‘an inability to function” (Nowlan & Heap, 1978)

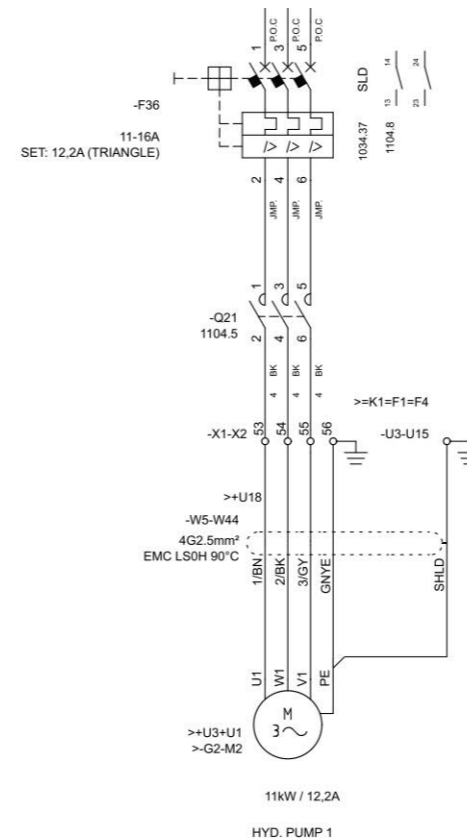
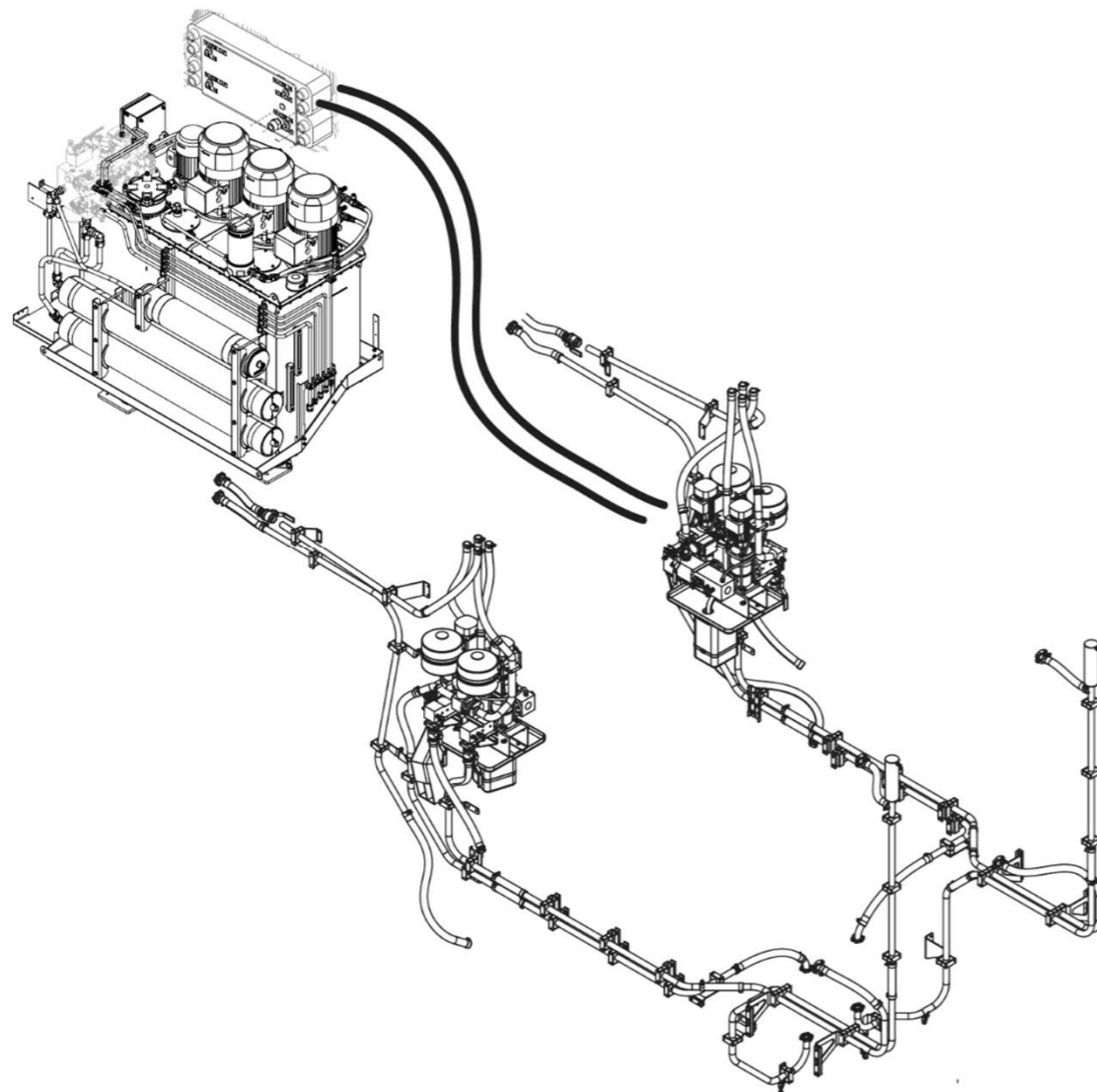


## Opbygning af anlægsregister 'biblioteket'

Funktionel nedbrydning vs andre former for nedbrydning



## Eksempel – Hydrauliksystem til vindmølle



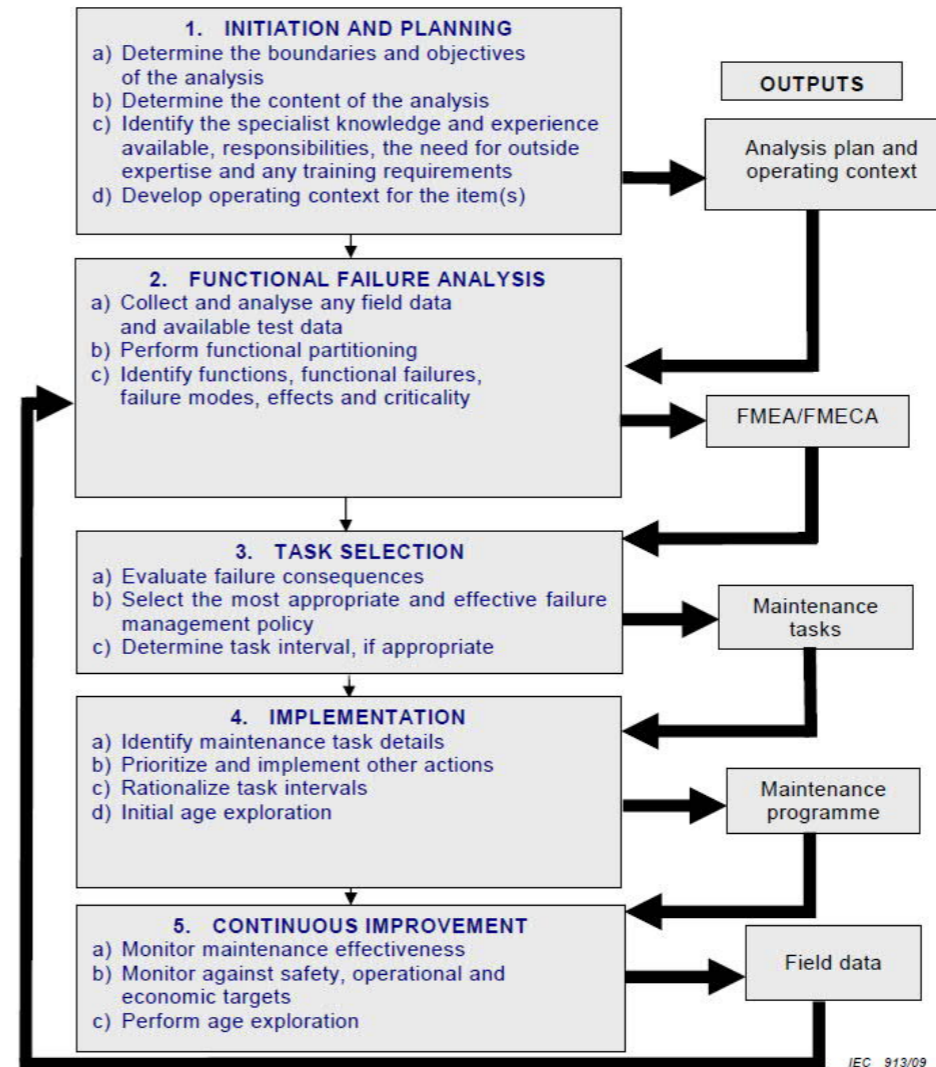
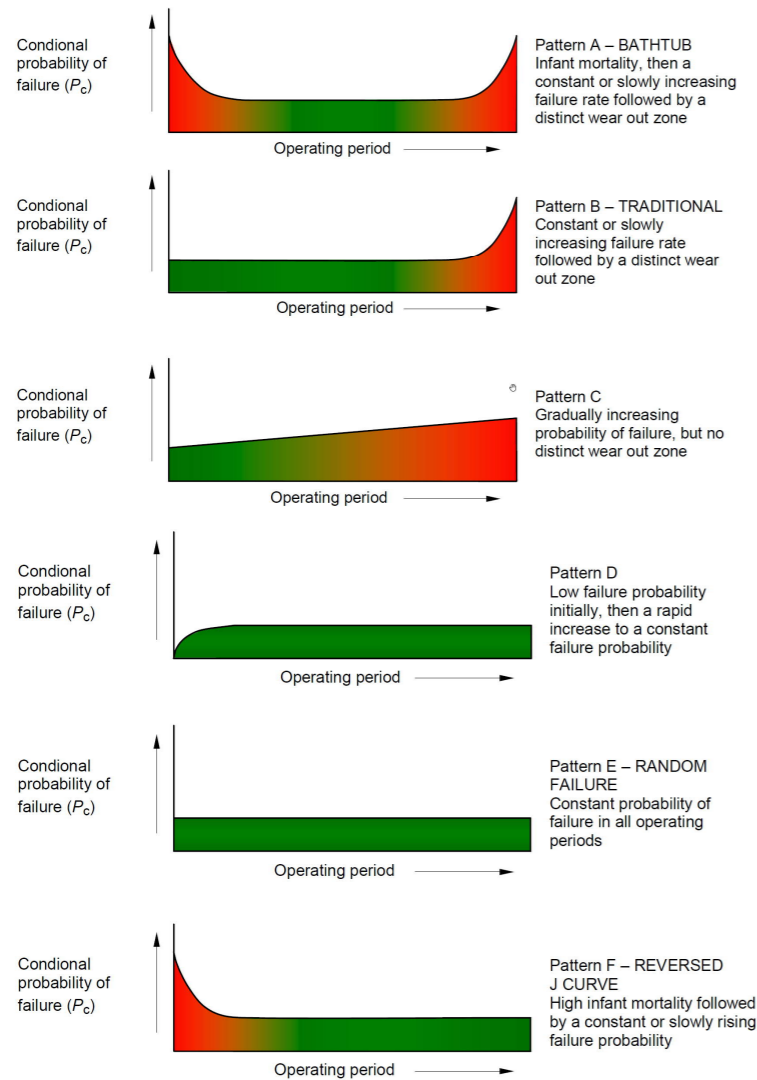
Krævet funktion:

Leverer hydraulikolie ved et vist tryk til en række undersystemer.

Primær funktion opnås ved 3 pumper, som er kaskadereguleret. I tilfælde af pumpeudfald, så leverer akkumulatore tryk til systemerne i en vis periode.



# Fejlmønstre og RCM



Fejlmønstre samt RCM proces fra EN60300-3-11:2009

## Kritikalitetsanalyse og vedligeholdsplan

| Function<br>(RDS-PP T32) |   | Component<br>(RDS-PP T32) |                                      | Criticality           |                   |                        |                 |            |             |
|--------------------------|---|---------------------------|--------------------------------------|-----------------------|-------------------|------------------------|-----------------|------------|-------------|
| RDS-PP                   | Basic Function Description              | Product code              | Product Function Description         | OC - Operations (1-3) | SC - Safety (1-3) | EC - Environment (1-3) | CC - Cost (1-3) | MTTF (1-4) | Criticality |
| BL001                    | Level Gauge, Hydraulic Oil Tank         |                           |                                      | 1                     | 1                 | 1                      | 1               | 1          | L           |
| BP001                    | Pressure, Hydraulic Oil                 |                           |                                      | 1                     | 1                 | 2                      | 1               | 1          | L           |
| BP005                    | Pressure, Hydraulic Oil Filter Return   |                           |                                      | 1                     | 1                 | 2                      | 1               | 1          | L           |
| BU001                    | Multi-variable Level/Temp, Hyd Oil Tank |                           |                                      | 1                     | 1                 | 2                      | 1               | 1          | L           |
| CM001                    | Hydraulic Oil Tank                      |                           |                                      | 1                     | 1                 | 2                      | 1               | 1          | L           |
| CM001                    | Hydraulic Oil Tank                      | -MM001                    | Hydraulic Oil, Central Hydraulic WTG | 1                     | 1                 | 1                      | 2               | 1          | L           |
| CM001                    | Hydraulic Oil Tank                      | -QM002                    | Oil Drain, Hydraulic Oil Tank        | 1                     | 1                 | 1                      | 1               | 1          | L           |
| CM001                    | Hydraulic Oil Tank                      | -WP001                    | Sump, Hydraulic Oil Tank             | 1                     | 1                 | 1                      | 1               | 1          | L           |
| CM002                    | Accumulator 1, 12l, Central Hyd System  |                           |                                      | 1                     | 1                 | 1                      | 1               | 1          | L           |
| EQ001                    | Hydraulic Oil Cooler, Air Cooled        |                           |                                      | 2                     | 1                 | 1                      | 2               | 2          | M           |
| FL001                    | Pressure Relief Valves, Central Hyd Sys |                           |                                      | 1                     | 3                 | 1                      | 1               | 1          | M           |
| FL001                    | Pressure Relief Valves, Central Hyd Sys | -FL010                    | Pressure Relief Valve, Hyd Oil Pump  | 1                     | 3                 | 1                      | 1               | 1          | M           |
| FL001                    | Pressure Relief Valves, Central Hyd Sys | -FL013                    | Pressure Relief Valve, Accumulator   | 1                     | 3                 | 1                      | 1               | 1          | M           |
| FL001                    | Pressure Relief Valves, Central Hyd Sys | -FL034                    | Pressure Relief Valve, Hatches       | 1                     | 3                 | 1                      | 1               | 1          | M           |
| GP001                    | Hydraulic Oil Pump 1, Central Hyd Sys   |                           |                                      | 1                     | 1                 | 1                      | 1               | 2          | L           |
| GP001                    | Hydraulic Oil Pump 1, Central Hyd Sys   | -FC001                    | Circuit Breaker, Hydraulic System    | 1                     | 1                 | 1                      | 1               | 2          | L           |
| GP001                    | Hydraulic Oil Pump 1, Central Hyd Sys   | -GP001                    | Pump, Hydraulic Oil Pump 1           | 1                     | 1                 | 1                      | 1               | 2          | L           |
| GP001                    | Hydraulic Oil Pump 1, Central Hyd Sys   | -MA001                    | Motor, Hydraulic Oil Pump 1          | 1                     | 1                 | 1                      | 1               | 2          | L           |
| GP001                    | Hydraulic Oil Pump 1, Central Hyd Sys   | -RM001                    | Check Valve, Hydraulic Oil Pump 1    | 1                     | 1                 | 1                      | 1               | 1          | L           |

Resultatet af dette resulterer i en RTF-strategi på pumpeenhederne, dvs. Afhjælpende vedligehold.

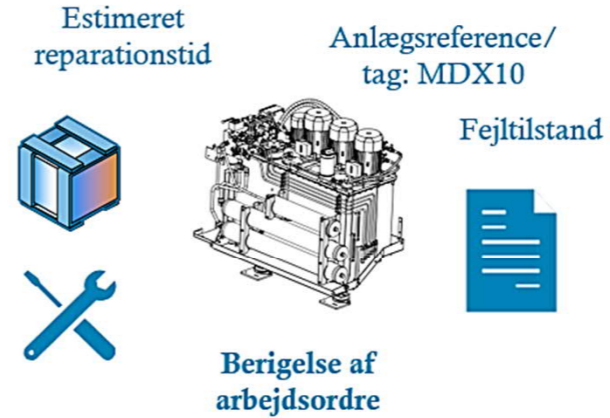
Er dette den mest optimale strategi ifht. OPEX/LCC?

Hvad får disse enheder til at fejle?

- Alder, driftstimer, driftsmønster, miljø, medie, materiale, design, produktion?



### Før afhjælpende vedligehold



### Under afhjælpende vedligehold



Fejltilstand vælges



Fejlmekanisme vælges



Fejlårsag vælges



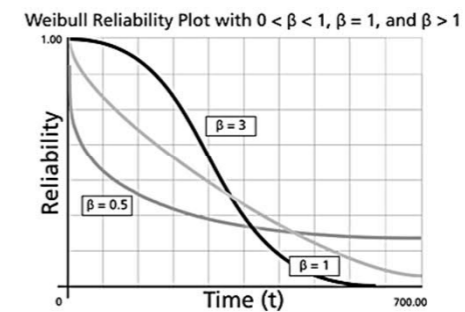
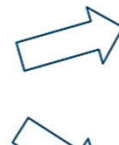
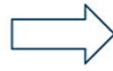
VH-aktivitet vælges



Anlægsreference opdateres

Materiale- og tidsforbrug registreres

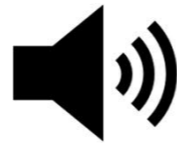
### Efter afhjælpende vedligehold



\* Detektionsmetode kan evt også registreres (Tabel B.4 ISO14224)

## Fejltilstand (Failure mode)

Eksempel på fejl:  
 Pumpeenhed støjer unormalt,  
 hvilket detekteres under arbejde i/på  
 maskinen.



### ISO14224 Failure modes, table B.2.6

| Pump                              |
|-----------------------------------|
| Failure to start on demand        |
| Spurious stop                     |
| Breakdown                         |
| High output                       |
| Low output                        |
| Erratic output                    |
| External leakage - process medium |
| External leakage - utility medium |
| Internal leakage                  |
| Vibration                         |
| Noise                             |
| Overheating                       |
| Plugged/choked                    |
| Parameter deviation               |
| Abnormal instrument reading       |
| Structural deficiency             |
| Minor in-service problems         |
| Other                             |
| Unknown                           |

## 5.2

### fejltilstand, fejlmåde

#### FRARÅDES: fejlrådt tilstand

måde, hvorpå en enhed mister evnen til at udføre en krævet funktion

Note 1 til term: En fejltilstand kan defineres ved den mistede funktion eller den overgang til en anden tilstand, der er indtrådt.

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## Fejlmekanisme (Failure mechanism)

### 5.13

#### fejlmekanisme

fysiske, kemiske eller andre processer, som kan føre til eller har ført til fejl DS/EN13306:2017

#### Eksempel:

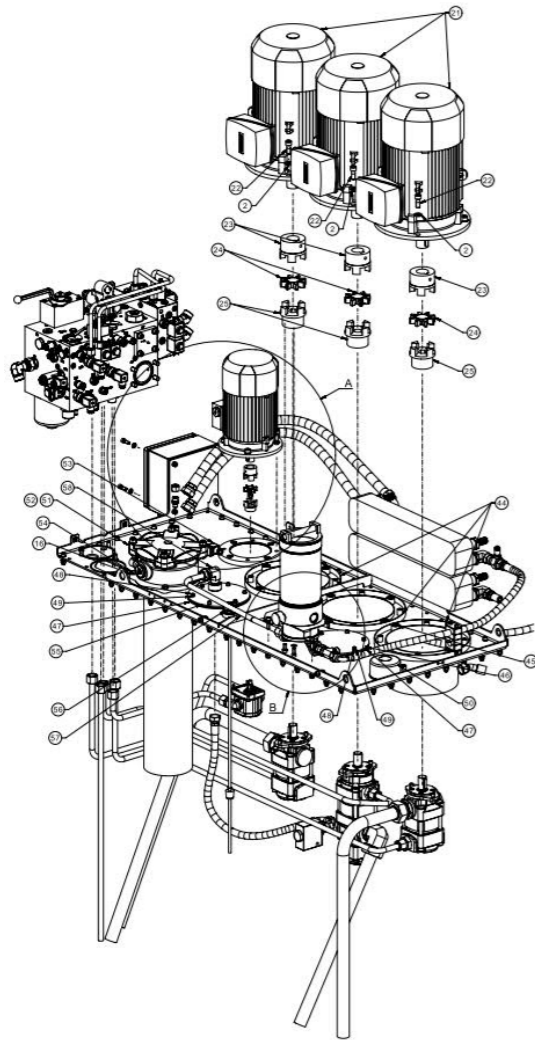
Fejllokalisering og fejlfinding udføres for at bestemme den berørte enhed i enhedsregister.

Herefter vælges fejlmekanisme  
1.2

| Failure mechanism  |      |
|--------------------|------|
| ISO 14224          |      |
| table B.2          |      |
|                    | Code |
| Mechanical_failure | 1    |
| Material_failure   | 2    |
| Instrument_failure | 3    |
| Electrical_failure | 4    |
| External_influence | 5    |
| Miscellaneous      | 6    |

| Subdivision of the failure mechanism |      |
|--------------------------------------|------|
| ISO 14224                            |      |
| table B.2                            |      |
|                                      | Code |
| General (Mechanical failure)         | 1.0  |
| Leakage                              | 1.1  |
| Vibration                            | 1.2  |
| Clearance/alignment                  | 1.3  |
| Deformation                          | 1.4  |
| Looseness                            | 1.5  |
| Sticking                             | 1.6  |

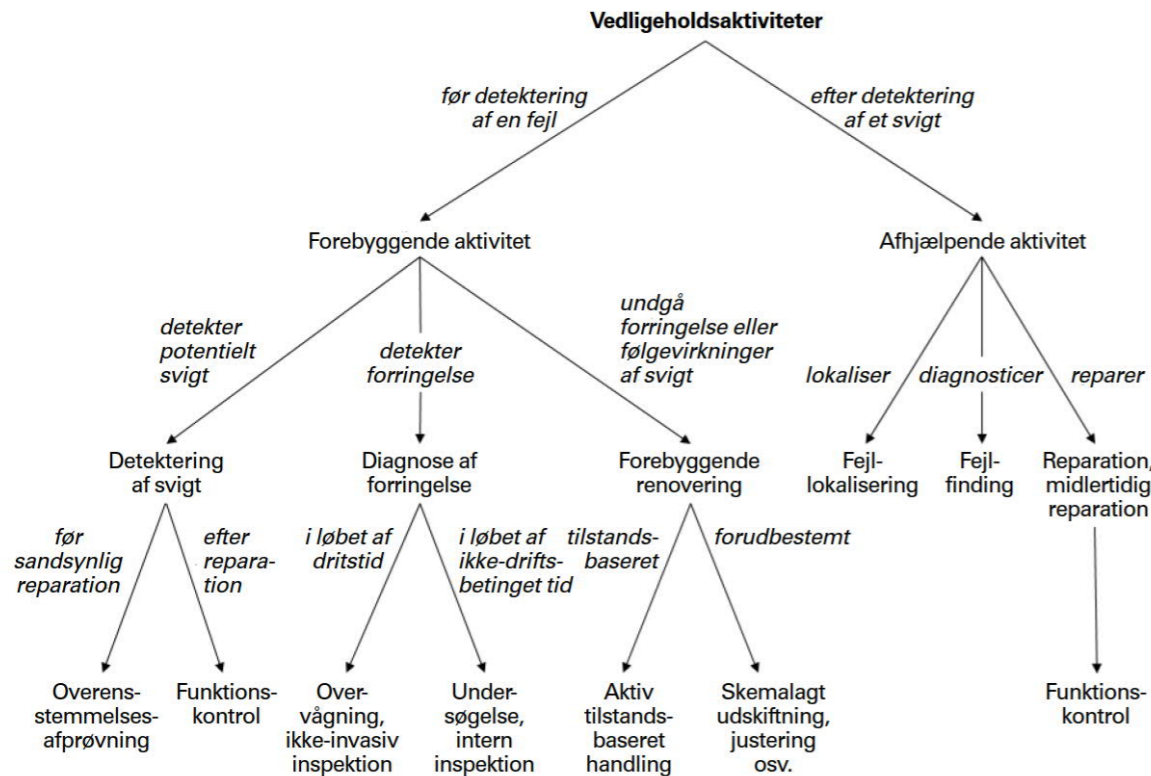
## Fejlårsag (failure cause)



| Failure Cause                               |      |
|---|------|
| ISO 14224                                   |      |
| Table B.3                                   |      |
|   | Code |
| Design_related_causes                       | 1    |
| Fabrication_or_installation_related_causes  | 2    |
| Failure_related_to_operation_or_maintenance | 3    |
| Failure_related_to_mangement                | 4    |
| Miscellaneous_                              | 5    |

| Subdivision of the failure Cause                      |      |
|---|------|
| ISO 14224   |      |
| Table B.3   |      |
|   | Code |
| General (Design_related_causes)                       | 1.0  |
| Improper capacity                                     | 1.1  |
| Improper material                                     | 1.2  |
| General (Fabrication_or_installation_related_causes)  | 2.0  |
| Fabrication error                                     | 2.1  |
| Installation error                                    | 2.2  |
| General (Failure related to operation or maintenance) | 3.0  |
| Off-design service                                    | 3.1  |
| Operation error                                       | 3.2  |
| Maintenance error                                     | 3.3  |
| Expected wear and tear                                | 3.4  |
| General (Failure_related_to_mangement)                | 4.0  |
| Documentation error                                   | 4.1  |
| Management error                                      | 4.2  |
| Miscellaneous - General                               | 5.0  |
| No cause found  | 5.1  |
| Common cause  | 5.2  |
| Combined cause  | 5.3  |
| Other   | 5.4  |
| Unknown   | 5.5  |

# Vedligeholdsaktivitet



EN13306:2017 Annex A

| Maint. Activity |      |
|-----------------|------|
| ISO 14224       |      |
| table B.5       |      |
| Description     | Code |
| Replace         | 1    |
| Repair          | 2    |
| Modify          | 3    |
| Adjust          | 4    |
| Refit           | 5    |
| Check           | 6    |
| Service         | 7    |
| Test            | 8    |
| Inspection      | 9    |
| Overhaul        | 10   |
| Combination     | 11   |
| Other           | 12   |

Måske har man udført flere handlinger, eks. Udskiftning (code 1) og Justering (code 4). Hvordan registreres det?

Bør anlægsregistret justeres?



## Sporbarhed i VH-systemet

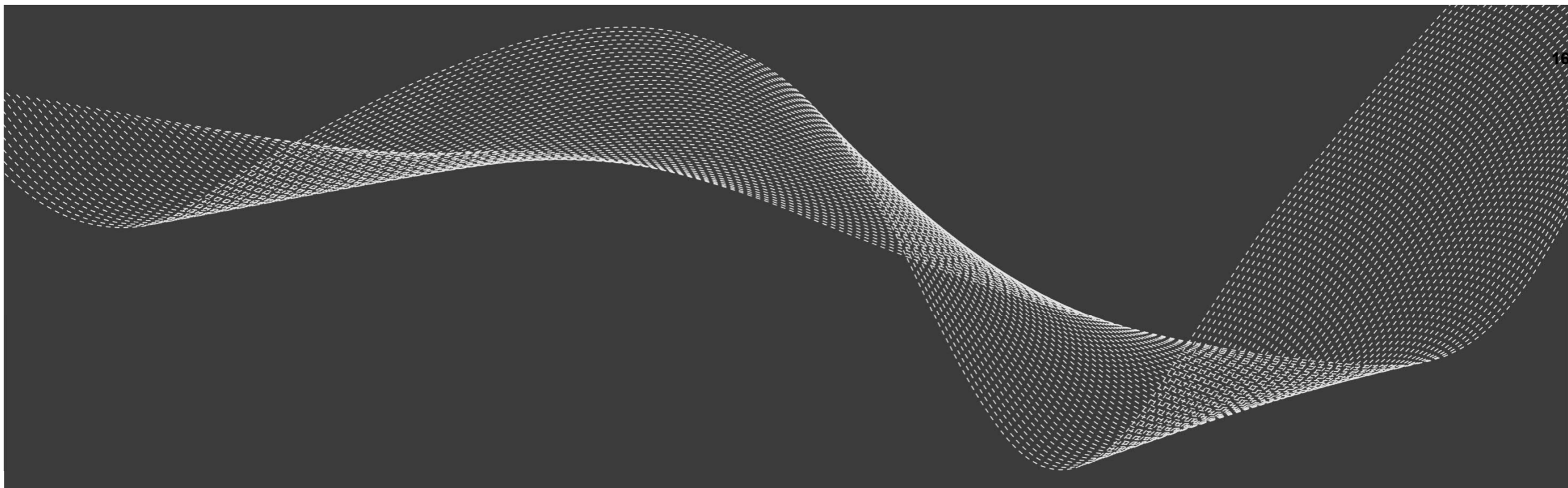
|   |                             |  |  |   |    |
|---|-----------------------------|--|--|---|----|
| ▶ | GB0087-001=MDX10BL001       | Level Gauge, Hydraulic Oil Tank            |  |   |    |
| ▶ | GB0087-001=MDX10BL002       | Level Sensor, Hydraulic Oil Tank           |  |   |    |
| ▶ | GB0087-001=MDX10BP001       | Pressure, Hydraulic Oil                    |  |   |    |
| ▶ | GB0087-001=MDX10BP005       | Pressure, Hydraulic Oil Filter Return      |  |   |    |
| ▶ | GB0087-001=MDX10BT001       | Temperature, Hydraulic Oil Tank            |  |   |    |
| ▶ | GB0087-001=MDX10CM001       | Hydraulic Oil Tank                         |  |   |    |
| ▶ | GB0087-001=MDX10CM002       | Accumulator 1, Central Hydraulic           |  |   |    |
| ▶ | GB0087-001=MDX10EQ001       | Oil Cooler, Cooling System Left            |  |   |    |
| ▶ | GB0087-001=MDX10EQ002       | Oil Cooler, Cooling System Right           |  |   |    |
| ▶ | GB0087-001=MDX10FC001       | Circuit Breaker, Control, Hydraulic SYST   |  |   |    |
| ▶ | GB0087-001=MDX10FL010       | Valve, Relief, Hydraulic Oil Pump          |  |   |    |
| ▶ | GB0087-001=MDX10FL013       | Valve, Relief, Accumulator                 |  |   |    |
| ▶ | GB0087-001=MDX10FL084       | Valve, Relief, Manual Pump                 |  |   |    |
| ▶ | GB0087-001=MDX10GP001       | Hydraulic Oil Pump 1                       |  |   |    |
| ▼ | GB0087-001=MDX10GP001-FC001 | Circuit Breaker, Hydraulic Oil Pump 1      |  |   |    |
| • | A9B10110558                 | Circuit Breaker 3P 10-16A S00 Screw L      |  | 1 | PC |
| • | A9B10076204                 | Switch Aux. 2PST-2NO S00/S0 for CB 3RV2 L  |  | 1 | PC |
| ▼ | GB0087-001=MDX10GP001-GP001 | Pump, Hydraulic Oil Pump 1                 |  |   |    |
| • | A9B00081364                 | Internal Gear Pump QX33-016 L              |  | 1 | PC |
| • | A9B10080020                 | BOLT M10x20 A4.80 ISO4762 L                |  | 2 | PC |
| • | A9B10249806                 | Washer M10 A4-200 ISO7089 L                |  | 2 | PC |
| ▼ | GB0087-001=MDX10GP001-MA001 | Motor, Hydraulic Oil Pump 1                |  |   |    |
| • | A9B10080143                 | El motor 11KW 3phase 400-690V 132 B5 LTB L |  | 1 | PC |
| • | A9B10052091                 | Bolt M12x30 A4.70 ISO4762 L                |  | 4 | PC |
| • | A9B10052101                 | Washer M12 200-A4 ISO7090 L                |  | 4 | PC |
| ▼ | GB0087-001=MDX10GP001-RM001 | Check Valve, Hydraulic Oil Pump 1          |  |   |    |
| • | A9B00089089                 | Check valve 17209-7/8 0.5bar 350bar 80L L  |  | 1 | PC |
| ▼ | GB0087-001=MDX10GP001-UA001 | Support, Hydraulic Oil Pump 1              |  |   |    |
| • | A9B10056367                 | Bellhouse gearpump, R 300-150-105 L        |  | 1 | PC |
| • | A9B10101925                 | Bolt M12x20 8.8 ISO4762 f1Znnc L           |  | 4 | PC |
| ▼ | GB0087-001=MDX10GP001-XN001 | Coupling, Hydraulic Oil Pump 1             |  |   |    |
| • | A9B10051480                 | Coupling pump A28.25GG L                   |  | 1 | PC |
| • | A9B10051493                 | Rubber spider ZK 28 HVID 92sh L            |  | 1 | PC |
| • | A9B10051494                 | Coupling for motor A28/38.38H7 GG L        |  | 1 | PC |
| ▶ | GB0087-001=MDX10GP002       | Hydraulic Oil Pump 2,Circulation/Cooling   |  |   |    |
| ▶ | GB0087-001=MDX10GP003       | Hydraulic Oil Pump 3                       |  |   |    |
| ▶ | GB0087-001=MDX10GP004       | Hydraulic Pump, Brakes&Rotor Lock          |  |   |    |
| ▶ | GB0087-001=MDX10GP011       | Manual Pump, Hydraulic                     |  |   |    |



## Hvordan får man teknikere til at bekymre sig om rapportering?

- Incitamenter, arbejdet er ikke færdigt før arbejdsordren er korrekt udfyldt.
- Gør det nemmest muligt, intuitivt at rapportere. Udnyt IT-muligheder.
- Udfyld notifikationer bedst muligt for at højne chancen for god data.
- Oversæt de tekniske begreber til 'hv- spørgsmål. Hvad er fejlet, hvordan og hvorfor?
- Datavalidering – gør hvad muligt for at få bedre data hjem. Gør nogle felter obligatoriske, andre kan der indbygges en automatisk validering. Eksempelvis at en tolerancemåling altid er med to decimaler.
- Standardiserede processer.





Spørgsmål ?