A ontologia denominada “Informações para o Prognóstico e Gestão da Saúde (PHM) ” precisa de dados oriundos das técnicas de Diagnóstico de falhas e da elaboração de coleta de dados, que interagem em conjunto com itens da manufatura, especificamente com componentes mecânicos rotativos (segundo estudos são os mais propensos a apresentar falhas). Neste estudo, considerasse a hierarquia dos itens de manufatura usando uma abordagem *bottom up*: Componente, Máquina e Equipamento.

# Para dar início a este estudo, são realizadas consultas relacionadas a dados e informações para identificar: a hierarquia do componente, funções requeridas, nomenclatura de identificação, especificações dos itens, entre outras informações para assegurar a identificação correta do componente que está sendo analisando.

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

PREFIX owl: <http://www.w3.org/2002/07/owl#>

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>

PREFIX utfpr: <http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286#>

## Quais são os principais componentes mecânicos rotativos (Component), de uma máquina mecânica? (Em ordem alfabética)

SELECT ?Component

WHERE {?Component rdfs:subClassOf utfpr:Component }

ORDER BY ?Component

|  |
| --- |
| **Component** |
| utfpr:Bearing |
| utfpr:Component |
| utfpr:Coupling |
| utfpr:GlandPacking |
| utfpr:Impeller |
| utfpr:JournalBearing |
| utfpr:Lubricant |
| utfpr:MechanicalSeal |
| utfpr:RollingBearing |
| utfpr:Seals |
| utfpr:Shaft |

## Considerando que é analisado uma instância Component\_1, que possua uma determinada identificação (ID), e.g., “6306\_C3”. Qual é o Component\_1 que está sendo analisado?

SELECT ?Component

WHERE {?Component utfpr:hasID "6306\_C3"^^xsd:string }

**Outra forma:**

SELECT ?Component

WHERE {?Component utfpr:hasID "6306\_C3" }

**Outra forma:**

SELECT ?Component

WHERE {?Component utfpr:hasID ?valor

FILTER (?valor="6306\_C3") }

|  |
| --- |
| **Component** |
| RollingBearing\_1 |

## A qual Machine\_1 pertence o Component\_1?

SELECT ?Component ?OfMachine

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:isPartOf ?OfMachine }

|  |  |
| --- | --- |
| **Component** | **OfMachine** |
| utfpr:RollingBearing\_1 | utfpr:Pump\_1 |

## Qual é a especificação da Machine\_1?

SELECT ?Component ?OfMachine ?TypeOfPump

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:isPartOf ?OfMachine.

?OfMachine utfpr:hasSpecification ?TypeOfPump }

|  |  |  |
| --- | --- | --- |
| **Component** | **OfMachine** | **TypeOfPump** |
| utfpr:RollingBearing\_1 | utfpr:Pump\_1 | Is a Centrifugal Pump ^^xsd:string |

## A qual Equipment\_1 pertence a Machine\_1 do Component\_1?

SELECT ?Component ?OfMachine ?TypeOfPump ?OfEquipment

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:isPartOf ?OfMachine.

?OfMachine utfpr:hasSpecification ?TypeOfPump;

utfpr:isPartOf ?OfEquipment}

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **OfMachine** | **TypeOfPump** | **OfEquipment** |
| utfpr:RollingBearing\_1 | utfpr:CentrifugalPump\_1 | Is a Centrifugal Pump ^^xsd:string | utfpr:MachineWithSeparateDriver\_1 |

## Qual é a especificação do Equipment\_1?

SELECT ?Component ?OfMachine ?TypeOfPump ?OfEquipment ?TypeOfEquipment

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:isPartOf ?OfMachine.

?OfMachine utfpr:hasSpecification ?TypeOfPump;

utfpr:isPartOf ?OfEquipment.

?OfEquipment utfpr:hasSpecificatio ?TypeOfEquipment }

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **OfMachine** | **TypeOfPump** | **OfEquipment** | **TypeOfEquipment** |
| utfpr:RollingBearing\_1 | utfpr:Pump\_1 | Is a Centrifufal Pump^^xsd:string | utfpr:MachineWithSeparateDriver\_1 | Is a centrifugal pump for water supplies, with separate driver^^xsd:string |

## Qual é o ID da Machine\_1?

SELECT ?Component ?OfMachine ?MachineID

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:isPartOf ?OfMachine.

?OfMachine utfpr:hasID ?MachineID}

|  |  |  |
| --- | --- | --- |
| **Component** | **OfMachine** | **MachineID** |
| utfpr:RollingBearing\_1 | utfpr:Pump\_1 | BOM0225^^xsd:string |

## Qual é o ID do Equipment\_1?

SELECT ?Component ?OfMachine ?MachineID ?OfEquipment ?EquipmentID

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:isPartOf ?OfMachine.

?OfMachine utfpr:hasID ?MachineID;

utfpr:isPartOf ?OfEquipment.

?OfEquipment utfpr:hasID ?EquipmentID }

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **OfMachine** | **MachineID** | **OfEquipment** | **EquipmentID** |
| utfpr:RollingBearing\_1 | utfpr:Pump\_1 | BOM0225^^xsd:string | utfpr:MachineWithSeparateDriver\_1 | ES240BOM0225^^xsd:string |

## Qual é a função requerida do Equipment\_1?

SELECT ?Equipment ?EquipmentFunction

WHERE { ?Equipment utfpr:hasID "ES240BOM0225";

utfpr:hasFunction ?EquipmentFunction }

|  |  |
| --- | --- |
| **Equipment** | **EquipmentFunction** |
| utfpr:MachineWithSeparateDriver\_1 | Water treatment in a given sector of a particular company^^xsd:string |

## Qual é a função requerida da Machine\_1?

SELECT ?Machine ?MachineFunction

WHERE { ?Machine utfpr:hasID "BOM0225";

utfpr:hasFunction ?MachineFunction }

|  |  |
| --- | --- |
| **Machine** | **MachineFunction** |
| utfpr:Pump\_1 | Water transport from A to B, at a given flow rate, in m^3/h^^xsd:string |

E finalmente, para identificar o item mecânico a ser analisado e começas com a FMSA, precisamos saber.

## Qual é a função requerida do Component\_1?

SELECT ?Component ?ComponentFunction

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:hasFunction ?ComponentFunction }

|  |  |
| --- | --- |
| **Component** | **ComponentFunction** |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string |

## Quais são as funções de: Componente\_1, Machine\_1 and Equipment\_1?

SELECT ?Component ?ComponentFunction ?Machine ?MachineFunction ?Equipment ?EquipmentFunction

WHERE {?Component utfpr:hasID "6306\_C3"^^xsd:string;

utfpr:hasFunction ?ComponentFunction;

utfpr:isPartOf ?Machine.

?Machine utfpr:hasFunction ?MachineFunction;

utfpr:isPartOf ?Equipment.

?Equipment utfpr:hasFunction ?EquipmentFunction }

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **ComponentFunction** | **Machine** | **MachineFunction** | **Equipment** | **EquipmentFunction** |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Pump\_1 | Water transport from A to B, at a given flow rate, in m^3/h^^xsd:string | utfpr:MachineWithSeparateDriver\_1 | Water treatment in a given sector of a particular company^^xsd:string |

## Quais são as Machines que compõem o Equipment\_1?

SELECT ?EquipmentMachine

WHERE { ?EquipmentMachine utfpr:isPartOf utfpr:MachineWithSeparateDriver\_1 }

|  |
| --- |
| **EquipmentMachine** |
| CentrifugalPump\_1 |
| ElectricMotor\_1 |

## Qual é a função requerida da Machine\_1, seu ID e a qual Equipment pertence?

SELECT ?Required\_Function ?ID ?Belonging\_to

WHERE { utfpr:Pump\_1 utfpr:hasFunction ?Required\_Function;

utfpr:hasID ?ID;

utfpr:isPartOf ?Belonging\_to}

|  |  |  |
| --- | --- | --- |
| **Required\_Function** | **ID** | **Belonging\_to** |
| Water transport from A to B, at a given flow rate, in m^3/h^^xsd:string | BOM0225^^xsd:string | utfpr:MachineWithSeparateDriver\_1 |

## Quais são os principais Rotating Components of Macnhine\_1, passiveis de monitoramento?

SELECT ?Components

WHERE {?Components utfpr:isPartOf utfpr:Pump\_1}

ORDER BY ?Components

|  |
| --- |
| **Components** |
| RollingBearing\_1 |
| Coupling\_1 |
| Impeller\_1 |
| Lubricant\_1 |
| MechanicalSeal\_1 |
| Shaft\_1 |

## Qual é a função requerida, ID e a qual Machie pertence o Component\_1?

SELECT ?Required\_Function ?ID ?Belonging\_to

WHERE { utfpr:RollingBearing\_1 utfpr:hasFunction ?Required\_Function;

utfpr:hasID ?ID;

utfpr:isPartOf ?Belonging\_to}

|  |  |  |
| --- | --- | --- |
| **Required\_Function** | **ID** | **Belonging\_to** |
| Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | 6306\_C3^^xsd:string | utfpr:Pump\_1 |

## Qual são as principais características do Component\_1?

SELECT ?Component ?ComponentID ?TypeOfComponent ?OfMachine ?ComponentFunction

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:hasID ?ComponentID;

utfpr:hasSpecification ?TypeOfComponent;

utfpr:isPartOf ?OfMachine;

utfpr:hasFunction ?ComponentFunction }

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **ComponentID** | **TypeOfComponent** | **Ofmachine** | **ComponentFunction** |
| utfpr:RollingBearing\_1 | 6306\_C3^^xsd:string | Single row deep groove ball bearings^^xsd:string | utfpr:Pump\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string |

# Realizada a identificação do Component\_1 e principalmente a sua função requerida para com a Máquina/equipamento, agora é feito o levantamento do diagnóstico de falhas de dito Component\_1 (RollingBearing\_1) usando a técnica *Failure Mode Symptoms Analysis* (FMSA). Assim, são realizadas as seguintes consultas do Diagnóstico de falas, que é uma espécie de banco de dado, coletado de entrevistas, referencial bibliográfico e históricos de sistemas reias.

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

PREFIX owl: <http://www.w3.org/2002/07/owl#>

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>

PREFIX utfpr: <http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286#>

## Quais são os *Failure Modes* do Component\_1 (**RollingBearing\_1)**?

SELECT ?Component ?RequiredFunction ?FailureMode

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:hasFunction ?RequiredFunction

utfpr:hasMode ?FailureMode}

|  |  |  |
| --- | --- | --- |
| **Component** | **RequiredFunction** | **FailureMode** |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Deformation\_1 |

## Quais são as *Potencial Cause* de cada *Failure Mode* identificadas no Component\_1?

SELECT ?Component ?RequiredFunction ?FailureMode ?PotencialCause ?IsCausedBy

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:hasFunction ?RequiredFunction;

utfpr:hasMode ?FailureMode.

?FailureMode utfpr:hasCause ?PotencialCause.

?PotencialCause utfpr:isCausedBy ?IsCausedBy }

ORDER BY ?FailureMode

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **RequiredFunction** | **FailureMode** | **PotencialCause** | **IsCausedBy** |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Deformation\_1 | utfpr:PotencialCause\_14 | Angular misalignment of shaft due to mounting incorrect^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Deformation\_1 | utfpr:PotencialCause\_15 | Parallel misalignment of shaft due to mounting incorrect^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | utfpr:PotencialCause\_19 | Ductile crack due to interference fit above of specified^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | utfpr:PotencialCause\_20 | Ductile crack due to lack of free side for dilation^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | utfpr:PotencialCause\_21 | Fatigue due to fastening bolt loose^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | utfpr:PotencialCause\_17 | Fatigue in bearing parts by mounting with high pressure between housing and bearing/shaft^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | utfpr:PotencialCause\_18 | Ductile crack due to excessive tightening on the sides of the bearing^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | utfpr:PotencialCause\_16 | Fatigue in rolling bearing parts by housing misalignment^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_13 | Bolt specification with lower yield strength than required^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_11 | Loose bearing due to fracture in thread of bolt^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_12 | Incorrect tightening due to lack of tools^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_7 | Fretting wear due to excessive amount of lubricant (swirling)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_6 | Fretting wear due to poor sealing that contaminates the lubricant (forming blistering)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_9 | Wear of parts due to poor sealing that contaminates the lubricant with abrasive particles^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_8 | Wear due to lack of tightening of parts (looseness)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_3 | Adhesive wear due to low lubricant level^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_2 | Adhesive wear due to incorrect lubricant specification^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_10 | Pitting corrosion due to contamination of the lubricant^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_5 | Fretting wear due to vibration of bearing housing^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_4 | Fretting wear due to lack tightening on the bearing sides (looseness)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | utfpr:PotencialCause\_1 | Adhesive wear due to load above projected capacity^^xsd:string |

**OUTRA FORMA:**

SELECT ?Component ?RequiredFunction ?FailureMode ?IsCausedBy

WHERE {?Component utfpr:hasID "6306\_C3";

utfpr:hasFunction ?RequiredFunction;

utfpr:hasMode ?FailureMode.

?FailureMode utfpr:hasCause ?PotencialCause.

?PotencialCause utfpr:isCausedBy ?IsCausedBy }

ORDER BY ?FailureMode

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **RequiredFunction** | **FailureMode** | **IsCausedBy** |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Deformation\_1 | Angular misalignment of shaft due to mounting incorrect^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Deformation\_1 | Parallel misalignment of shaft due to mounting incorrect^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | Ductile crack due to interference fit above of specified^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | Ductile crack due to lack of free side for dilation^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | Fatigue due to fastening bolt loose^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | Fatigue in bearing parts by mounting with high pressure between housing and bearing/shaft^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | Ductile crack due to excessive tightening on the sides of the bearing^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Fracture\_1 | Fatigue in rolling bearing parts by housing misalignment^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Bolt specification with lower yield strength than required^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Loose bearing due to fracture in thread of bolt^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Incorrect tightening due to lack of tools^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Fretting wear due to excessive amount of lubricant (swirling)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Fretting wear due to poor sealing that contaminates the lubricant (forming blistering)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Wear of parts due to poor sealing that contaminates the lubricant with abrasive particles^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Wear due to lack of tightening of parts (looseness)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Adhesive wear due to low lubricant level^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Adhesive wear due to incorrect lubricant specification^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Pitting corrosion due to contamination of the lubricant^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Fretting wear due to vibration of bearing housing^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Fretting wear due to lack tightening on the bearing sides (looseness)^^xsd:string |
| utfpr:RollingBearing\_1 | Support and allows the shaft rotates without friction, at a given rpm^^xsd:string | utfpr:Wear\_1 | Adhesive wear due to load above projected capacity^^xsd:string |

**Consulta 8:** Quais são as causas potenciais e efeitos de cada modo de falha do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect}

**Resultado:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 17- Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 |

**Consulta 9:** Quais são os modos de falha, causas potenciais, efeitos e sua severidade (SEV) do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV }

**Resultado:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **SEV** |
| RollingBearing\_1 | Fracture\_1 | Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft/housing | OperationImpaired\_1 | "**4**" |
| RollingBearing\_1 | Fracture\_1 | Fatigue\_due\_to\_loose\_fastening\_screws | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Deformation\_1 | Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" |
| RollingBearing\_1 | Deformation\_1 | Incorrect\_bolt\_specification-lower\_yield\_strength\_than\_required | Overheat\_1 | "3" |
| RollingBearing\_1 | Deformation\_1 | Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" |
| RollingBearing\_1 | Wear\_1 | Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_lack\_tightening-looseness-on\_the\_bearing\_sides | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_adjustment\_out\_of\_specification-looseness\_between\_parts | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_lubricant\_contamination\_forming\_blistering-poor\_sealing | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear-due-to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" |

**Consulta 10:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV) e sintomas do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom}

**Resultado:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_10 |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_11 |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 |

**Consulta11:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV), sintomas e DGN do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN}

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** | **DGN** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 | "3" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 | "3" |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 | "3" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 | "3" |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 | "3" |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_10 | "3" |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_11 | "3" |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 | "4" |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 | "5" |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 | "5" |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 | "3" |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" | LubricantProperty\_1 | "5" |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 | "2" | LubricantProperty\_2 | "5" |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 | "2" | Vibration\_9 | "3" |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" | Vibration\_3 | "4" |
| RollingBearing\_1 | Wear\_1 | 12-Incorrect\_tightening\_due\_to\_lack\_of\_tools | Sound\_1 | "2" | Vibration\_8 | "4" |
| RollingBearing\_1 | Wear\_1 | 8-Wear\_due\_to\_lack\_of\_tightening\_of\_parts-looseness | Sound\_1 | "2" | Vibration\_5 | "5" |
| RollingBearing\_1 | Wear\_1 | 10-Pitting\_corrosion\_due\_to\_contamination\_of\_the\_lubricant | Sound\_1 | "2" | Vibration\_6 | "4" |
| RollingBearing\_1 | Wear\_1 | 1-Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" | Vibration\_1 | "5" |

**Consulta12:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV), sintomas, DGN e técnica de medição recomendada para o componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique}

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** | **DGN** | **Technique** |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 | "5" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 | "5" | OilAnalysis |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 | "3" | InfraredThermography |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VisulInspection |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" | LubricantProperty\_1 | "5" | OilAnalysis |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 | "2" | LubricantProperty\_2 | "5" | OilAnalysis |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 | "2" | Vibration\_9 | "3" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" | Vibration\_3 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 12-Incorrect\_tightening\_due\_to\_lack\_of\_tools | Sound\_1 | "2" | Vibration\_8 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 8-Wear\_due\_to\_lack\_of\_tightening\_of\_parts-looseness | Sound\_1 | "2" | Vibration\_5 | "5" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 10-Pitting\_corrosion\_due\_to\_contamination\_of\_the\_lubricant | Sound\_1 | "2" | Vibration\_6 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 1-Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" | Vibration\_1 | "5" | VibrationAnalysis |

**Consulta13:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV), sintomas, DGN, técnica de medição recomendada e DET para o componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique ?DET

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique;

utfpr:hasDET ?DET}

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** | **DGN** | **Technique** | **DET** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_10 | "3" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_11 | "3" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 | "4" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 | "5" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 | "5" | OilAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 | "3" | InfraredThermography | "5" |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VisulInspection | "5" |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" | LubricantProperty\_1 | "5" | OilAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 | "2" | LubricantProperty\_2 | "5" | OilAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 | "2" | Vibration\_9 | "3" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" | Vibration\_3 | "4" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 12-Incorrect\_tightening\_due\_to\_lack\_of\_tools | Sound\_1 | "2" | Vibration\_8 | "4" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 8-Wear\_due\_to\_lack\_of\_tightening\_of\_parts-looseness | Sound\_1 | "2" | Vibration\_5 | "5" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 10-Pitting\_corrosion\_due\_to\_contamination\_of\_the\_lubricant | Sound\_1 | "2" | Vibration\_6 | "4" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 1-Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" | Vibration\_1 | "5" | VibrationAnalysis | "5" |

**Consulta 14:** Quais são os modos de falha, com SEV = 4, do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV;

utfpr:hasSEV "4"xsd:integer }

SELECT

?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique ?DET

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique;

utfpr:hasDET ?DET.

FILTER (?SEV = 4 )}

**Resultado:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **SEV** | **Symptom** | **DGN** | **Techniqye** | **DET** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 | "3" | InfraredThermography | "4" |

**Consulta 15:** Os modos de falha com SEV 4 e DGN 5

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique ?DET

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique;

utfpr:hasDET ?DET.

FILTER (?SEV = 4 )

FILTER (?DGN = 5 )}

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Componente** | **Failure** | **Cause** | **Effect** | **SEV** | **Symptom** | **DGN** | **Technique** | **DET** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" | VibrationAnalysis | "5" |

SELECT DISTINCT ?tipo ?Component

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string .

?Component rdf:type ?tipo}

Ordenar de forma alfabética

SELECT DISTINCT ?Component ?modo WHERE {

?Component rdf:type utfpr:RollingBearing .

?Component utfpr:hasMode ?modo

} ORDER BY ?modo

Ordenar por SEV

SELECT DISTINCT ?Component ?Failure ?Cause ?Effect ?SEV

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV } ORDER BY ?SEV

Mostrar os comentários em inglês

SELECT DISTINCT ?tipo ?Component ?comentario

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string .

?Component rdf:type ?tipo .

?tipo rdfs:comment ?comentario

FILTER (langMatches(lang(?comentario), "en"))}

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

PREFIX owl: <http://www.w3.org/2002/07/owl#>

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>

PREFIX utfpr: < http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286#>

**Consulta 16**: Qual é o componente que tem o código **6306\_C3**?

SELECT ?Component

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string }

|  |
| --- |
| **Component** |
| RollingBearing\_1 |

**Consulta 17:** Com qual técnica de medição é monitorado o **componente\_1**?

SELECT ?Component ?Technique

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique }

|  |  |
| --- | --- |
| **Component** | **Technique** |
| RollingBearing\_1 | VibrationAnalysis\_1 |

**Consulta 18:** Que grandeza usa a técnica\_1?

SELECT ?Component ?Technique ?Magnitude

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude }

|  |  |  |
| --- | --- | --- |
| **Component** | **Technique** | **Magnitude** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 |

**Consulta 19:** Qual é a unidade da Magnitude\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude.

?Magnitude utfpr:hasUnit ?Unit}

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" |

**Consulta 20:** Qual tipo de coletor (transdutor) usa a técnica\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit ?Transducer

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude;

utfpr:useCollector ?Transducer.

?Magnitude utfpr:hasUnit ?Unit}

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** | **Transducer** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 |

**Consulta 21:** Quantas medições são feitas no componente\_1, usando a técnica\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit ?Transducer ?Measurement

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude;

utfpr:useCollector ?Transducer;

utfpr:hasMeasurementPoint ?Measurement.

?Magnitude utfpr:hasUnit ?Unit}

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** | **Transducer** | **Measurement** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_1 |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_2 |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_3 |

**Consulta 22:** Qual é a localização dessas medições no componente\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit ?Transducer ?Measurement ?Location

WHERE {?Component utfpr:hasCode "6306\_C3"^^xsd:string;

utfpr:isMonitoringWith ?Technique;

utfpr:hasMeasurementPoint ?Measurement.

?Measurement utfpr:hasLocation ?Location.

?Technique utfpr:useMagnitude ?Magnitude;

utfpr:useCollector ?Transducer.

?Magnitude utfpr:hasUnit ?Unit }

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** | **Transducer** | **Measurement** | **Location** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_1 | "BOM0225\_003\_AC\_180\_R\_N" |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_2 | "BOM0225\_003\_AC\_090\_R\_N" |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_3 | "BOM0225\_003\_AC\_315\_A\_N" |

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

PREFIX owl: <http://www.w3.org/2002/07/owl#>

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>

PREFIX utfpr: < [http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286#](http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286)>

**Consulta 23:** Quais são os grupos para avaliar zonas de limites?

SELECT ?Groups

WHERE {

?Groups rdf:type utfpr:GroupOfMachine }

|  |
| --- |
| **Groups** |
| Group\_1 |
| Group\_2 |
| Group\_3 |
| Group\_4 |

**Consulta 24:** Quase são as características de cada grupo?

SELECT ?Groups ?Features

WHERE {

?Groups utfpr:hasFeatures ?Features }

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_2 | "Machines with shaft heigh 160 mm <= H < 315 mm" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_1 | "Macines with shaft heigt H >= 315 mm" |
| Group\_4 | "Used in pump machine with integrated driver" |
| Group\_3 | "Is a pump" |
| Group\_1 | "Machines with rated power: 300 kW < P < 50 MW" |
| Group\_4 | "Is a pump" |
| Group\_3 | "Machines with rated power: P > 15kW" |
| Group\_1 | "Is an electrical machine" |
| Group\_4 | "Machines with rated power: P > 15kW" |
| Group\_2 | "Is an electrical machine" |
| Group\_2 | "Machines with rated power: 15 kw < P <= 300 kW" |

Ordenar por ordem alfabético, segundo grupo

SELECT ?Groups ?Features

WHERE {

?Groups utfpr:hasFeatures ?Features }

ORDER BY ?Groups

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_1 | "Macines with shaft heigt H >= 315 mm" |
| Group\_1 | "Machines with rated power: 300 kW < P < 50 MW" |
| Group\_1 | "Is an electrical machine" |
| Group\_2 | "Machines with shaft heigh 160 mm <= H < 315 mm" |
| Group\_2 | "Is an electrical machine" |
| Group\_2 | "Machines with rated power: 15 kw < P <= 300 kW" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |
| Group\_4 | "Used in pump machine with integrated driver" |
| Group\_4 | "Used in pump machine" |
| Group\_4 | "Machines with rated power: P > 15kW" |

**Consulta 25:** Qual grupo avalia zonas de limites para máquinas “bomba”?

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features

FILTER (?Features="Used in pump machine") }

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_3 | "Used in pump machine" |
| Group\_4 | "Used in pump machine" |

Outra forma

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features;

utfpr:hasFeatures "Used in pump machine"^^xsd:string }

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_4 | "Used in pump machine with integrated driver" |
| Group\_4 | "Machines with rated power: P > 15kW" |
| Group\_4 | "Used in pump machine" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |

Filtrando a consulta até chegar ao grupo desejado

**Consulta 25:** Grupo que atenda a máquinas “bomba” com potência > 15kW

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features;

utfpr:hasFeatures "Used in pump machine"^^xsd:string;

utfpr:hasFeatures "Machines with rated power: P > 15kW"^^xsd:string}

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_4 | ""Used in pump machine with integrated driver" |
| Group\_4 | "Machines with rated power: P > 15kW" |
| Group\_4 | "Used in pump machine" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |

**Consulta 25:** Grupo que atenda a máquinas “bomba” com potência > 15kW e que o sistema de acionamento (motor) seja separado

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features;

utfpr:hasFeatures "Used in pump machine"^^xsd:string;

utfpr:hasFeatures "Machines with rated power: P > 15kW"^^xsd:string;

utfpr:hasFeatures "Used in pump machine with separate driver"^^xsd:string}

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |
| Group\_3 | "Used in pump machine with separate driver" |