UNIVERSITY OF TWENTE.

Faculty of Engineering Technology,
Mechanical Engineering

Updating rotating documentation in Grade 5 Nouryon Rotterdam Botlek

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M.Sc. internship essay
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Contents

Summary

At the Nouryon site in the Botlek the documentation program Grade 5 is currently used. This program is the controlled database for all the documentation. Because the documentation database is not complete and not up to date, it takes on average 60 minutes to find the technical documents. While this should be on average 6 minutes.

The goal of this internship is to find what kinds of documents are required by the employees for rotating equipment and make sure that these documents are transferred from several archives to Grade 5.

First, a voice of the customer was made with the different maintenance departments from Nouryon Botlek. From the voice of the customer, the five most important rotating documents that need to be stored in Grade 5 are derived. These documents are: The technical specification sheet, the pump curve, seal information, technical drawings and manuals.

Currently, the search for documents starts in Grade 5, when the documents are not found here the search continues to the paper archives. When the archives have been searched the next step is to go in the field and see what kind of pump is actually in operation in the factory. This is done because for some of the pumps there are documents from three different manufacturers. After this, all the documents are sorted, and the right ones are used for the project. This process takes on average an hour with a total lead time of multiple days. The ideal situation would be only to have to look into Grade 5.

The different archives, inspection archive, MEB archive, E&U archive and personal archives, have been looked into to find as many documents and to determine where the documents can be found. In total around 220 of the documents of the factory units, 3600 and 8100 have been found. This is around 50% of the required documents. The main reason that the yield of the documents is low is that all documents of a pump could be found or none of the documents of the pump could be found. The archives to look for further documents are the E&U and MEB paper archives. They have the most information stored.

It is recommended that for the pumps that have no documentation that this is requested at the project engineers in Arnhem.

The most important recommendation is that the archives need to be sorted to remove the duplicated documents. Also, if maintenance is performed, it is recommended to check if the rotating documentation is still up to date.

Acronyms

CTQ	Critical to Quality
DMAIC	Define, Measure, Analyze, Improve and Control
E&U	Energy and Utility's
GPM	Gallons per minute
KPIV	key process input variables
KPOV	key process output variables
MEB	Membraan Elektrolyse Bedrijf
MOC	Management of change
NVA	Non value adding
NPSHR	Net positive suction head required
PFA	Perfluoroalkoxy alkanes
SIPOC	Suppliers, Inputs, Process, Outputs and Customers
TSS	Technical specification sheet
VA	Value adding
VOC	Voice of the Customer
VSM	Value stream map

Table 1: Acronyms

1 Introduction

1.1 Background information

At the Nouryon (formerly AkzoNobel) site in the Rotterdam Botlek chlorine (CL_2), hydrogen (H_2), caustic soda (NaOH) and hydrochloric acid (HCL) are produced from salt using membrane electrolysis. This is done in the Membraan Elektrolyse Bedrijf (MEB), an overview of this process can be seen in figure 2. To produce these chemicals a lot of electrical energy and steam is required, part of the electrical energy and all the steam is produced in the Energy and Utility's (E&U). Both parts of the factory can be seen in figure 1. Chlorine, caustic and hydrochloric acid are highly corrosive and extremely dangerous, so high-quality maintenance is required to make sure that the factory keeps producing chlorine and caustic safely and reliably. A short and basic description of the process is as follows: The salt enters the plant as a solid, the salt is sodium chloride. Then the salt is dissolved in water. This solution is cleared of any impurities. The solution is sent to electrolysis machines. In this process, the chlorine is uncoupled from the sodium. Under the electric force the sodium is separate and is transported through the membrane, a by-product of this process is hydrogen gas. The chlorine gas is pressurised and subsequently condensed to liquid chloride. From this chlorine, many things can be made one of the examples is PVC. The caustic soda is a raw material for different industries. In different concentrations, it is transported to customers.
For most of the steps in the process, the products are in a liquid state. To transport these liquids pumps are used. As mentioned earlier these pumps require high-quality maintenance. For this maintenance documentation is needed that ensures the right maintenance is being performed on the right pump. This information includes what kind of liquid is transported, the material of the pump, technical drawings of the pump, and the manufacturer of the pump.

1.2 Problem description

At Nouryon in the Botlek, a technical documentation program is used. This program is called Grade 5. It will manage all the documents of the site. Currently, the rotating documentation is not up to date. Most of the rotating documents are stored in multiple archives and the desk's drawers of the employees. The archives are the inspection archive, the MEB archive and the E&U archive, the location of these archives can be seen in figure 1. Due to this, there is no central place with up to date (as built) controlled documents. While with Grade 5 the rotating documents are controlled and stored at a central location.
Because rotating documents are stored in multiple places, the rotating documents

are uncontrolled. For example, a pump that had sustained damage and needed repairs were looked up in Grade 5. From the Technical specification sheet (TSS) it became clear that the pump housing and the impeller both where made from cast iron. When the pump was inspected physically, it turned out the housing and impeller were made from stainless steel. From the inspection archive, it became clear that in 2002 the pump housing and impellers were changed to stainless steel due to similar failures. The revised TSS or a Management of change (MOC) was not documented and not in Grade 5.
It is essential that this kind of knowledge is readily available. Otherwise, assets with the incorrect specification are ordered, or the repairs are not adequate.

1.3 Objective

The goal of this internship is to find what kinds of documents are required by the employees and then make sure that the rotating documents are transferred from the archives and the personal archives to Grade 5. The focus of this internship is on the rotating assets. These are the pumps and the coupling of the pumps. The electric motor of the pumps, the static assets (pipelines) and instrumentation assets will not be taken into account. This assignment will be made according to the Define, Measure, Analyze, Improve and Control (DMAIC) structure of lean six sigma.

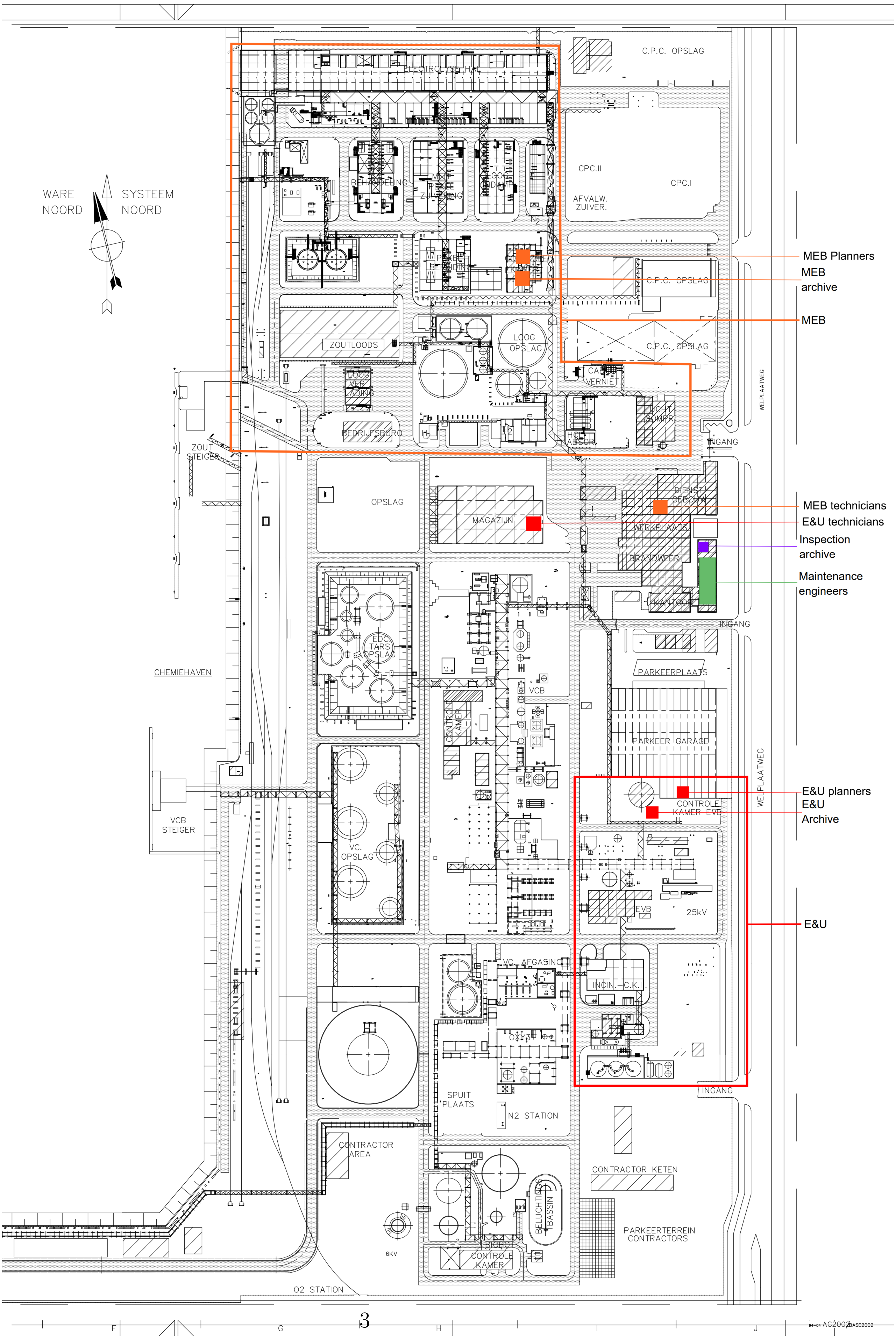

Figure 1: Factory layout

1.4 Structure description

The following structure is used for the report. In section 2 the scope of the project is determined. In this section, it is also mentioned how the assets are named and numbered. After this, the voice of the customer (VOC) is described with after that the critical to quality (CTQ) flowdown and the supplier, input, process, outputs, customers (SIPOC). The last part of this section is the value stream map (VSM). In section 3 the most important documents that have to be put in Grade 5 are explained. The next section, section 4 gives the Ishikawa diagram and the cause & effect matrix. In section 5 the method how to keep track of the documents is described. In section 6 the method that is used to find the documents is described. In section 7 the results from the visual inspection of the pumps is shown. Section 8 show the proposed procedure to find the documents. In section 9 the amount of found documents is shown. The next section, section 10 show to the documents are imported in Grade 5. Section 11 give the conclusions of the report. The last section 12 gives all the recommendation.

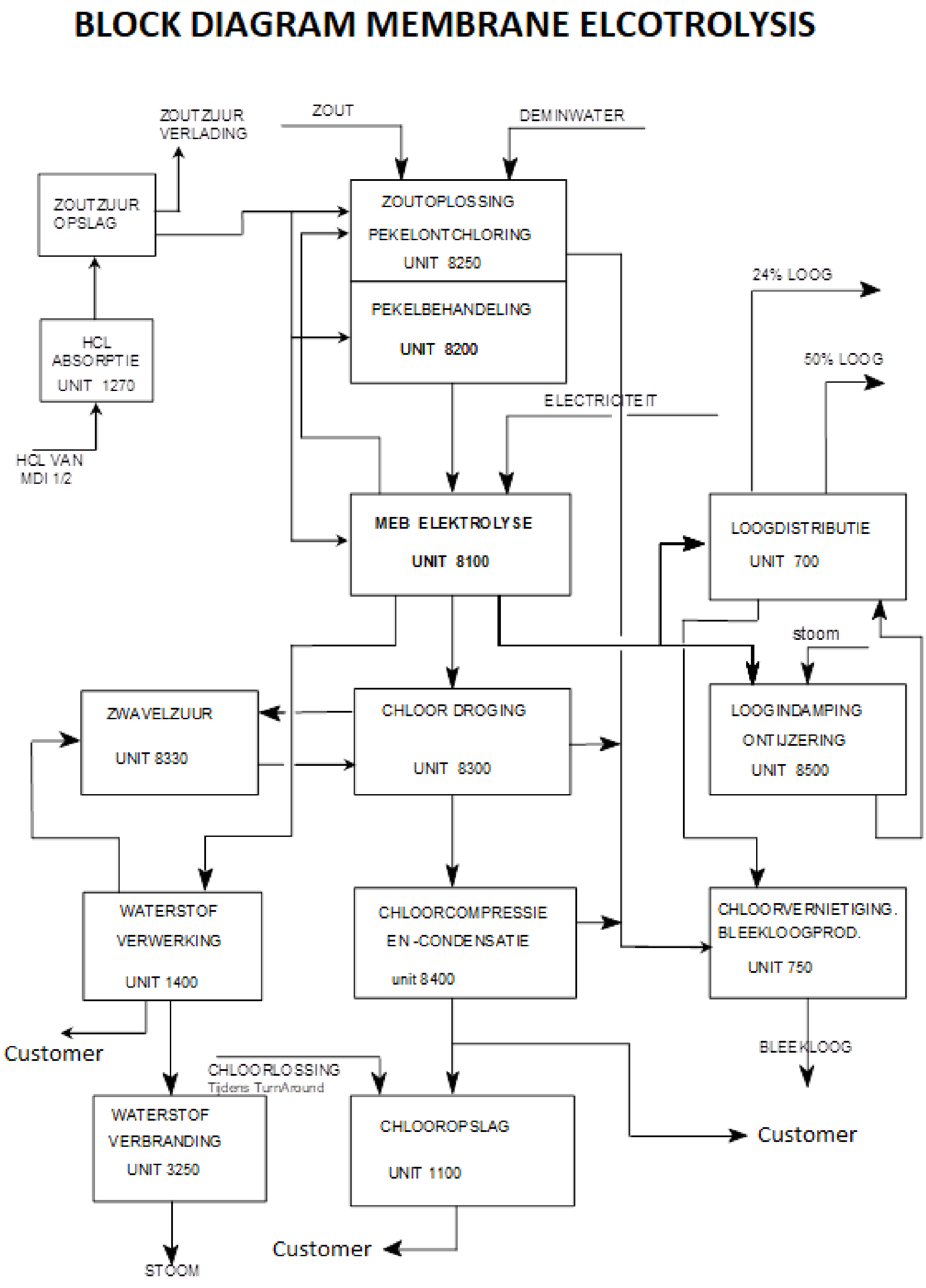

Figure 2: Block diagram MEB

2 Define

2.1 Scope of the project

The first step of the project is to define the scope. For this project, the scope is the technical documentation of the rotating assets of the Nouryon plant in the Botlek. The pumps of the unit 3600 and the unit 8100, these are the priority one assets for this project. These pumps need to have a high availability. If they are not available, then it has major financial consequences for Nouryon. The main focus is on the pumps, the electric motor that drives those pumps is not part of the project, as can be seen in figure 3. The two green parts, the pump and the coupling are in the scope of this project. The red part, the electric motor, is not in the scope of this project. Electronic and static maintenance documents not part of the scope.

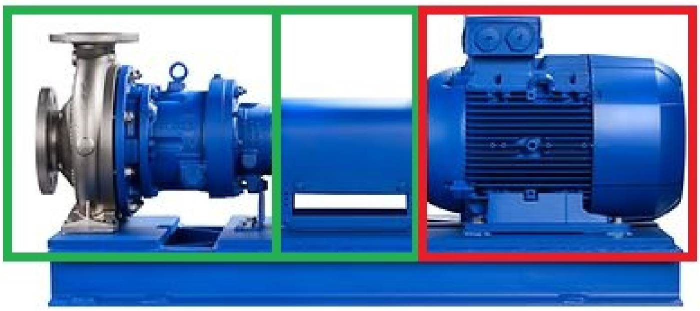

Figure 3: Scope of the project, the green parts are included the red parts are excluded. [4]

2.2 Product naming

The factory is divided into multiple different units. Each unit has its own purpose and its own numbering. In figure 2 the units of the MEB can be seen. In the factory, there are multiple different sections each with its own specific function like the E&U and the MEB. For this internship the unit 3600 and the unit 8100 will be analysed and improved, more on that in section 2.1. Each unit has its own specific function. The unit 8100 is part of the MEB this means this unit delivers all the necessities for the electrolysis.

Unit 3600, which can not be seen on figure 2, delivers the process water and the boiler feed water for the steam boiler. This water is used for the production of steam

that is used for the process in figure 2.
The number that an asset in the unit has consists of two letters and four numbers. A pump has the letters AP. So a pump in the unit 8100 has the code AP8100.
There are many different pumps in unit 8100, each pump has its own locations and needs to pump different fluids. The numbering is the last two digits. The first pump of unit 8100 is the AP8101. This numbering increases till 99.

2.3 Voice of the customer

To determine what needs to be improved to make the search for documents easier a voice of the customer is made.
For the voice of the customer [1], [2], [7], a set of questions was asked to seven different departments to find out what kind of documents are required for their work and where they want to find them.
The departments that were interviewed are Maintenance Engineers, MEB Technicians, MEB Technologists, MEB Planners, E&U Technicians, E&U Technologists and E&U Planners. The following questions were asked to the different departments:

- What documentation are you looking for?
- Where do you look?
- Where should you look?
- What is the ideal search tool, program and search characteristics?
- How much time do you on average spend on searching?

From these interviews the situation on what kind of documents are required, how the searching for documents is done and how the employees would like to have it became clear.

2.3.1 What documentation are you looking for?

From the VOC with the departments, the most important documents that are required to perform the proper maintenance actions could be determined. The most important documents that most departments need are:

- Technical specification sheet
- Pump curve
- Operating manual from the supplier

- Technical drawings
- Seal information

Besides these points, there are also some less essential documents that one or two departments want to have, but due to the short time of the internship, these documents will not be included in the scope of the internship. Some of these points are:

- Spare parts, bill of material
- Foundation drawings
- Standard work package
- Stress calculations
- Material choice
- Basis of design
- Maintenance history

2.3.2 Where do you look?

Grade 5 is the documentation system. This is the controlled environment for documents. This system is and should be the central point for the documentation. However, most of the times the employees have to search in different locations. Then the usual location to search are the archives. These archives can be digital or paper and are uncontrolled. The search in these archives takes a lot longer. Another problem with searching in these archives is that the same documents could be found multiple times.

2.3.3 What is the ideal search tool, program and search characteristics?

According to the VOC, Grade 5 should be the leading database for the documents.

2.3.4 How much time do you on average spend on searching?

If the documents can be found the Grade 5 the average search time is around 6 minutes. If the documents are not in Grade 5 the search time can vary from 60 minutes to multiple days.

2.4 CTQ flowdown

When the VOC is known the CTQ flowdown [1] can be made. The CTQ will result from the VOC and will make it into measurable specifications.

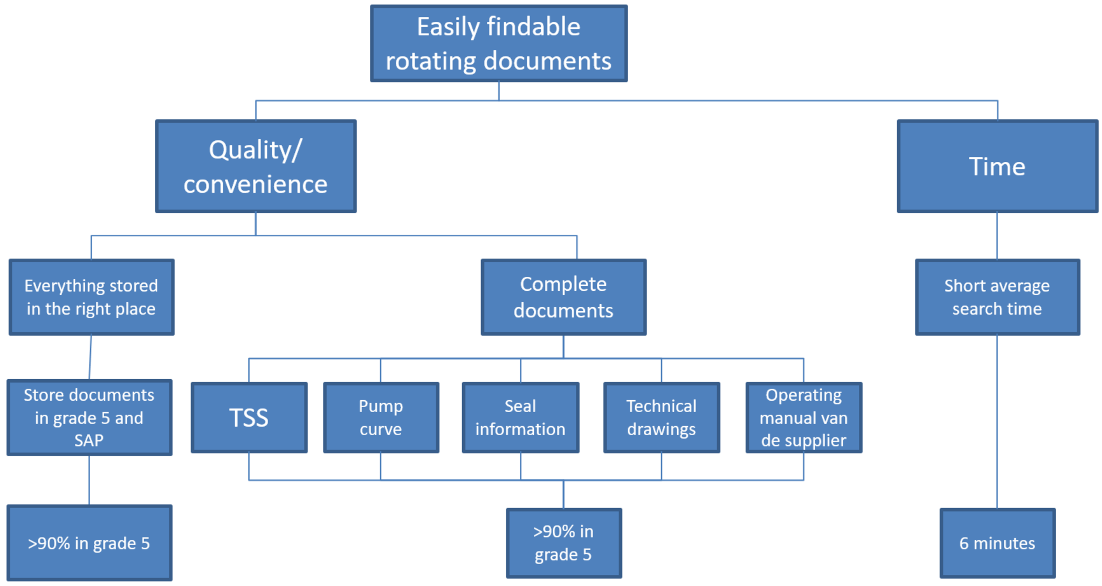

Figure 4: CTQ

The CTQ's gives the requirements that need to be met in order to satisfy the customer demands. The CTQ can be seen in figure 4. These requirements are the thread to follow for the entire project.
The VOC of the customer is to make sure that the rotating documentation can be found easily. The main CTQ's are quality, convenience and time. For the time specific CTQ the average search time needs to reduced. The hard and measurable specification for this is that the average search time needs to be 6 minutes.
For the quality and convenience CTQ, there are two parts, everything needs to be stored in the right place, and the documents need to be complete. The right place to store the documents is Grade 5. At least 90% of the documents need to be stored in grade. To complete the documentation, the five documents that mentioned above need to be stored in Grade 5.

2.5 SIPOC

The SIPOC is a high-level process description. The SIPOC can identify the following things: making a high-level process description, the Suppliers and Customers and

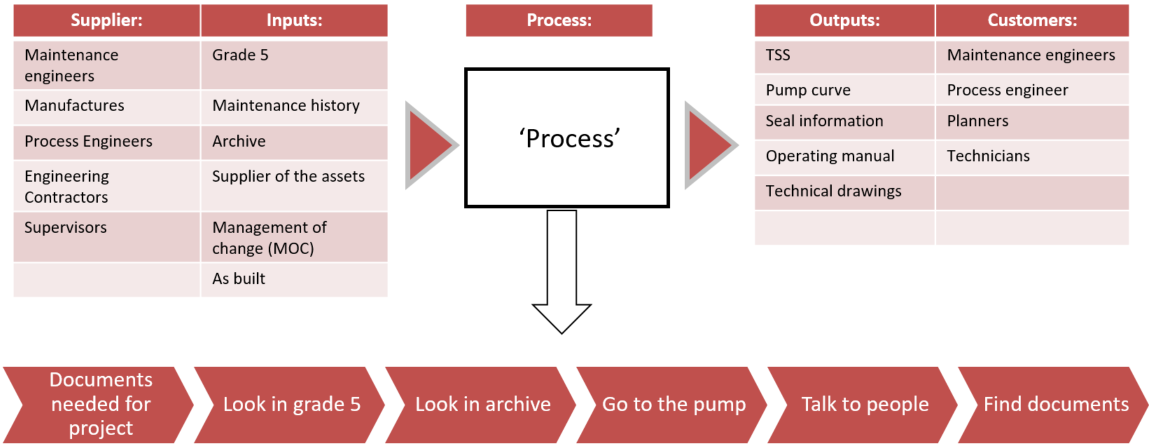

Figure 5: SIPOC

the Inputs and Outputs. It helps to find the most important phase of the process that needs improvement [7]. With the SIPOC a more detailed VSM can be generated, this can be seen in section 2.6. The SIPOC gives a visualisation of the entire process and the relations with the problem [1], [2]. An input for the SIPOC is the CTQ that can be seen in figure 4.
From figure 5 the entire process with the supplier, inputs, outputs and customers can be seen.

2.5.1 Process

The documentation collection process itself is described as follows: A new project is started, for example, this can be due to corrective or preventive maintenance. For this project, asset specification documents are needed. The first action that is taken is that the available information about the asset in SAP is looked up. This information is mostly about what kind of assets, what these assets include and the naming of the assets. The next step is to look at Grade 5 for the available documents. The ideal situation is that all documents are available in Grade 5, but currently, this is not certainly true. Because of this, it is necessary to look at different locations. The first location where is looked after Grade 5 has been used are the archives. There are different archives at Nouryon Rotterdam. The three most important ones are the inspection archive, here all the historical inspection information and also general information of the assets are located. The second location is the E&U archive, here information about all assets of the E&U are store specifically for the unit 3600. The last plant-specific historical maintenance archive is the MEB archive, here all the information from the MEB assets is stored, concerns assets specifically in the unit

8100.
Besides these three archives, there are also small uncontrolled archives that people made themselves. These can be paper or digital archives. These can contain much valuable information but are unstructured and not always easily accessible.
When the archives have been inspected, and some documents are found the employees will go to the pump itself to check what kind of pump is actually in operation. This is very important because there can be documents from three different manufacturers. The best way to check what is the current pump is to go and look. However, with this method, it is only possible to look at the exterior and tag plate, it is unknown what is inside the pump, for example, the impeller type and size.
After the pump is looked at, the employee will go with the selected documents to a maintenance engineer. These maintenance engineers will help to review and judge what documents are up to date and what historical changes occurred to the pump. With this information, it is possible to determine what the newest documentation of the pump is.
When this is done then the documents are found, and the project can continue.

The ideal process is that the basic information is found in SAP. After that Grade 5 is consulted, here all the documents, old and updated are stored. It is stated what is as built and what documents are not valid any more. Then the required documents can be taken form Grade 5, and the project can continue.

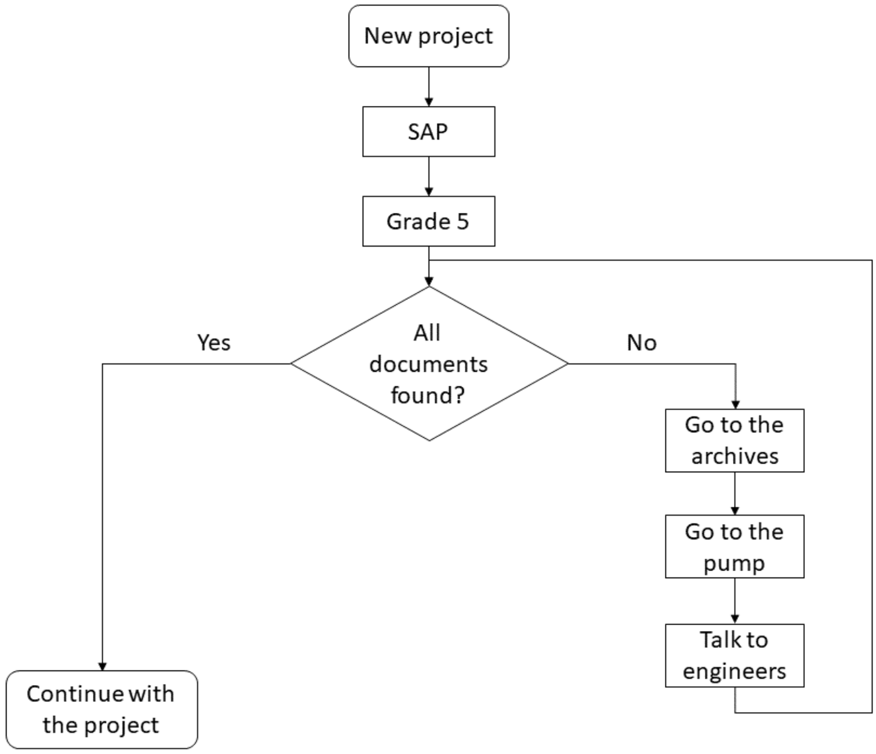

Figure 6: Flow diagram of the process

In figure 6 a flow diagram for the process can be seen. If the required information is found in Grade 5, it is more efficient and convenient. If not all documents are found it adds three steps that are all three necessary to determine and collect the correct and up to date documents.

2.5.2 Outputs

The definition of outputs in lean six sigma are the measurable results form the process that satisfies the requirements of the customers [1], [7]. The outputs from this process are the pump specific technical documents. These are the five essential documents that can be seen in the CTQ, more information about these documents can be seen in section 3.

2.5.3 Customers

The definition of customers in lean six sigma are the stakeholders that experience the problem and receive the outputs of the process [1], [7]. The customers of this process are the maintenance engineers, planners and technicians. They are also the suppliers because they require a lot of these documents for these project, so the maintenance engineers also make these documents that they need for future projects. Other customers are the process engineer, planners and technicians. All these departments use the specified documents for their work. Some departments use them more often than other departments.

2.5.4 Inputs

The inputs are the products or information that are needed for the process [1], [7]. The inputs that are needed for this process are: Grade 5, the maintenance history of the assets, the archives, suppliers of the assets, the management of change and the as build documents.

2.5.5 Supplier

The suppliers deliver the products or information for the input [1], [7]. The suppliers are the maintenance engineers, the manufactures, the process technologists and the supervisors. All parties supply documents that are needed for the process.

2.6 Current process

To give an overview of how the current process is done and where the points of improvement are located an value stream map has been made [1], [2], [6], [7]. The current process of how a project is currently done is described here. The times have been measured to give an accurate image of the current process.

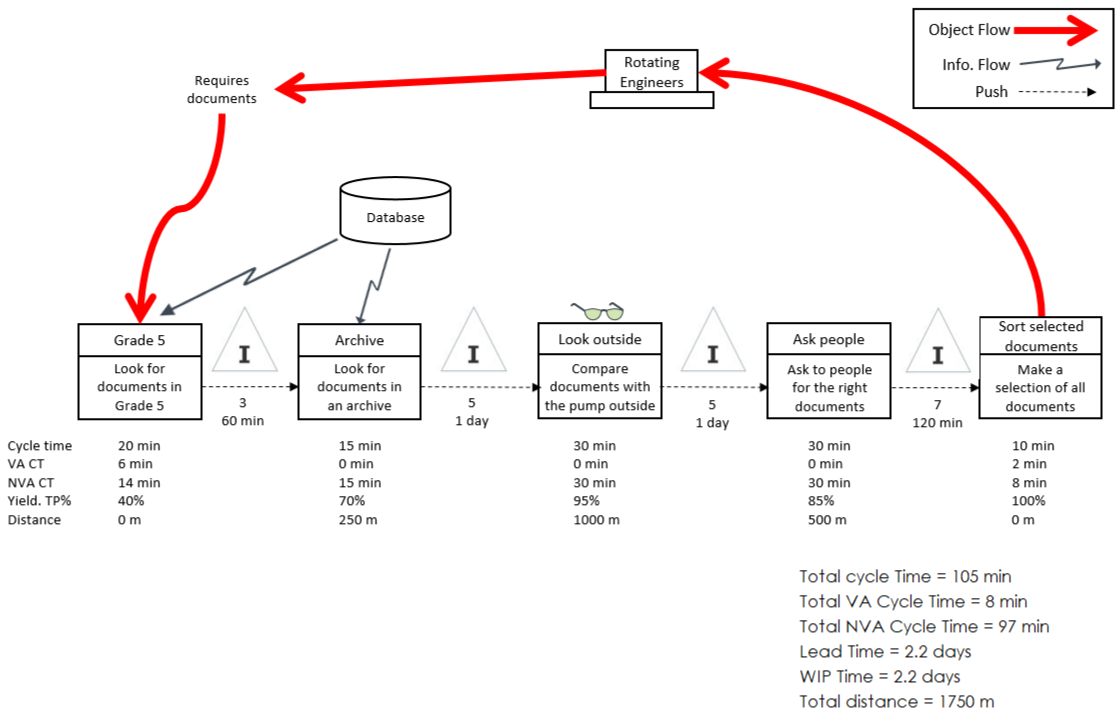

Figure 7: value stream map

In figure 7 the total process can be seen. It starts with a new project for the maintenance engineers. For this project documents of the assets are necessary. To find these documents first, Grade 5 is looked into. Currently, this takes around 20 minutes while it is only supposed to take 6 minutes. So most of the search time is non-value adding, and the yield of this processes is also low. After Grade 5 has been looked into and not all documents are found then the next step is to look into the different archives. This takes around 15 minutes and is non-value adding. The yield of this process is higher than the yield from Grade 5, but it is still not a 100%. The archives also require some travelling as can be seen in figure 1. After the documents have been found, they are compared with what kind of pump is standing in the factory. This takes quite a lot of time and is non-value adding. The yield of this process is high, but not everything can be seen from the exterior of the pump. When the pump has been looked at the acquired information of the asset is discussed with a maintenance engineer to see what documents are up to date and what documents are not valid any more. This also takes some time, around 30 minutes. None of this time is value adding. Because the maintenance engineers are stationed all over the plant, it requires some travelling to get to the engineer. The final step is to pick the required documents and use these for the project. This takes around ten minutes of which two minutes are value adding. From this selection the yield is 100%, there will always be some documents of information which can be used.

Between all the steps there is a small inventory of documents that have been acquired. The further in the process, the more documents and information is acquired. Between each step, there is also a lot of time. This time can vary from 60 minutes to days. This is because the engineers have multiple tasks and projects in the factory and it takes too much time to perform all steps at ones.
As can be seen, the total value added cycle time is 8 minutes while the total cycle time is 105 minutes. Currently, the looking outside and the discussing of the documents with other people takes much time and the total lead time is multiple days. This can be seen in figure 8 almost all of the search time is not wanted. Only a minimal amount adds to the project.

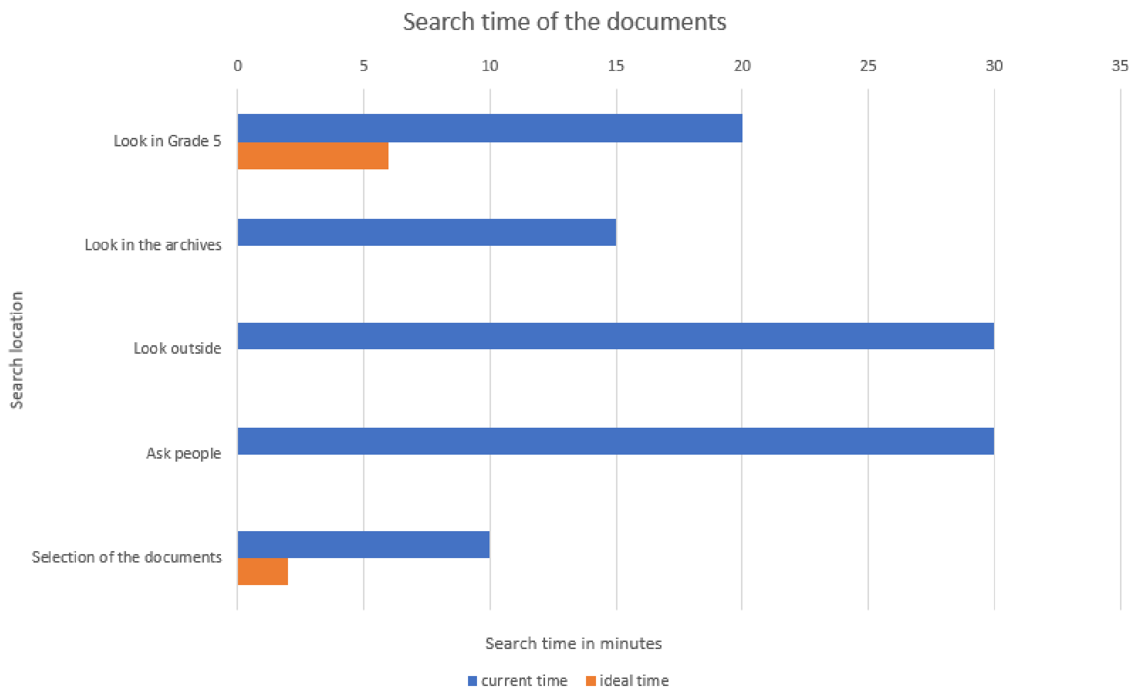

Figure 8: Current and ideal search times

3 The five documents

In this section, the different documents are explained on the individual and specific characteristics of the documents.

3.1 Technical specification sheet

As the name already suggests the technical specification sheet (TSS) is a document of all the technical specifications of an asset. Each individual asset in industry is specified in a TSS.
An example TSS can be seen in figures 9, 10, 11, 12, 13.

The TSS is divided into multiple sections:

- Process data
  In the process data part, the kind of fluid that is being pumped, what kind of pump it is and the location of the pump is specified. Furthermore, the capacity of the pump is specified. In figure 9 it can be seen that it is a centrifugal pump that is pumping Brine. That operates at 55 °C and has a capacity of 70 m^3/h.

- Performance data
  At the performance data, the speed and temperature of the pump are specified together with the capacity. The pump operates at 1500 rpm and has a design temperature of 100 °C.

- Mechanical data
  At the mechanical data the pump brand, classification, seal type and bearings are stated. This pump is a Richter MNK pump that has no seal and has ball bearings.

- Accessories
  The accessories mention possible extras for the pump like a base plate and a coupling. As can be seen in figure 10 this pump has a base plate and a coupling.

- Materials of construction
  The materials of construction state all the different materials used in the pump. The casing and the shaft are made from carbon steel while the impeller is made from Perfluoroalkoxy alkanes (PFA) lined steel.

- Fabrication, Testing, Inspection & safety
  Fabrication, testing, inspection & safety gives the information about the testing of the pump. For example, tested the pump and what was tested. This pump is tested by the pump supplier and the tests were witnessed by AkzoNobel.

- Motor data
  At the motor data what kind of motor is used is specified. For this pump, an electrical motor is used, and the drive is supplied and mounted by the pump manufacturer.

- Operating data
  The operating data gives information about where the pump is located, rotating direction and operating power. This specific pump is located outdoors in a non-hazardous area.

- Electrical data At the electrical data the voltage, speed and current are mentioned. The pump operates at 690V at 50Hz.

- Design and construction data
  The design and construction data gives the location for connections and the painting and lubrication information. The location of the connection box is on top of the pump.

- Accessories
  Accessories give the information of possible electric accessories like thermal elements and transducers. This pump does not have any transducers.

- Inspection and shipment data
  At inspection and shipment data the dimensions and mass are stated. The inspection for this pump is done by AkzoNobel.

- Nozzle data
  The nozzle data informs what kind of nozzle and how many are required. For this pump, there is one suction nozzle and one discharge nozzle.

- Allowable sound levels
  The allowable sound levels state how much sound each part is allowed to make.

At the bottom of each page document, specific information is stated. Here the following is stated: unit code, the tag number, revisions, document number and project number. This is pump AP-8171 A/B, with project number 452.380 and documents number 3.520.081. The project number indicates within which project this pump is located. This makes it easier to determine who made the project and the decisions. The document number is to make sure that this specific document can be found, each document has its own number.

1	PROCESS DATA						Rev.
2	Fluid Description	Brine		Solidification Temperature		°C	
3	Solids Content		w %	Pump Type	Centrifugal, horizontal		
4	Abrasive			Operation	Continuous		
5	Solids Particle Size D50		mm	Location	Outdoor		
6	**Case Definition**	**Minimum Capacity**	**Normal Capacity**	**Extra Case**	**Design Capacity**		
7	Operating Temperature	55	55	55	55	°C	
8	Density At O.T.	1128	1128	1128	1128	kg/m³	
9	Viscosity At O.T.	0.85	0.85	0.85	0.85	mPa.s	
10	Vapour Pressure At O.T.					bar(a)	
11	Heat Capacity At O.T.					kJ/(kg.K)	
12							
13	Capacity	35	70	70	155	m³/h	B
14	Suction Pressure	2.66	1.58	2.66	1.05	bar(a)	B
15	Discharge Pressure	3.6	3.6	3.6	3.6	bar(a)	B
16	Differential Pressure	1	2	1	2.6	bar	B
17	Differential Head	8.5	18	8.5	24	m (liq)	B
18	Available NPSH	7	7	7	7	m (liq)	B
19	PERFORMANCE DATA						
20	Operating Power Hydraulic	*	kW	Installed Motor Power *		kW	
21	Operating Power Expected Max.	*	kW	Design Temperature *	100	°C	
22	Preferred Speed	variable	rpm	Design Pressure *	11	bar(g)	
23	Installed Speed	1500 *	rpm				
24		**Minimum Capacity**	**Normal Capacity**	**Extra Case**	**Design Capacity**		
25	Capacity *					m³/h	
26	Head *					m (liq)	
27	Efficiency At Capacity *					%	
28	NPSH Required At Capacity *					m (liq)	
29	Power Absorbed *					kW	
30	Power Absorbed At End Of Curve *					kW	
31	Shut Off Pressure *					bar	
32	Absolute Stuffing Box Head At Capacity *					m (liq)	
33	Sound Pressure Level At 1m (LpA) *					dB(A)	
34	REMARKS						
35							
36							
37							
38							
39							
40							
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42							
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58							
59	* data to be determined, checked or completed by manufacturer						

452	81			8100	AP-8171 A/B	A401		81.101
fact. no.	fact. dpt.	build	ext.	processgr./-unit	item code / tag no.	requisition no.	classification	PID draw. no.

title: Spoel pekel pomp		B	17-12-2015	R. Landa	EQ	
Centrifugal Pump		-	16-10-2015	R. Landa	EQ	
factory descr. : MEB Rotterdam		rev	date	author/typist	team	ckd
dpt./build. descr. :		ext. doc. id.:				
project descr. : Spoelpekel		project no. 452.380	DDTA 20 TSS	eq. status New	page 1	of 5
spec. status : For inquiry						
Projects & Engineering © AkzoNobel Projects & Engineering Specialty Chemicals	size A4	P&E doc. no. 3.520.081	sh. 1	rev.	ver.	

57.42.21 Comos 2007

Figure 9: TSS page 1

					Rev.
1	**MECHANICAL DATA [3]**				
2	Pump Classification	Medium duty, Class II	Bearings Type/Manufacturer *	Ball bearings *	
3	Pump Classification Acc. To	ISO 5199	Lubrication *	Oil lubricated with constant level oiler	
4	Manufacturer/Pump Type *	Richter MNK	Insulation	Yes **[1]** thickness: mm	
5	Special Features	Lined pump, magnetic coupled	Insulation By	AkzoNobel	
6	Casing Split	Vertical			
7	Casing Mounted	Foot	Seal Type	Sealless	
8	Impeller Type	Closed	Mechanical Seal	see sheet: -	
9	Diameter Impeller Min. / Bid / Max. *	- - * mm	Cooling On	-	
10	Shaft Sleeve	Lined shaft, PFA	Heating On	-	
11	Wear Rings	No	Flushing	-	
12	Rotational Direction	* (Seen From Driver Side)	Quenching	-	
13	**ACCESSORIES**				
14	Base Plate	Yes acc. to: ISO 3661	Coupling	Yes	
15	Base Plate Size	*	Coupling Make & Type	Flender N-Eupex H	
16	Foundation Bolts	By AkzoNobel	Coupling Spacer Length	* mm	
17	Nameplate Required	Yes, SS316	Coupling Guard	Yes, SS316	
18	**MATERIALS OF CONSTRUCTION**				
19	Casing	CS	Gaskets	PTFE	
20	Casing Internal Lining	PFA	Gland	-	
21	Impeller	PFA	Packing (stuffing Box)	-	
22	Wear Rings Impeller	-	Lantern Ring	CS	
23	Wear Rings Casing	-	Coupling Guard	SS316 or equivalent	
24	Shaft	CS	Base Plate	Cast iron	
25	Shaft Sleeve	PFA liner	External Piping	CS (drain)	
26	Shroud (can)	Carbon fiber reinf. plastic / PTFE liner	Bolts/Nuts	CS CS	
27	Internal Bearings	SSiC	Insulation	Mineral wool (by AkzoNobel)	
28	**FABRICATION, TESTING, INSPECTION & SAFETY**				
29	Inspection Authority	AkzoNobel	Testing Hydrostatic	Yes	
30	Material Certificates	EN 10204 - 2.1	Testing Mechanical Running	Yes witnessed	
31	Surface Treatment	Yes acc. to: RAL 7037 **[2]**	Testing Performance	Yes witnessed	
32		**MASS***	Testing NPSH	No	
33	Total Mass Empty	* kg	Testing Noise Level	Yes witnessed (by hand device)	
34	Mass Pump + Driver + Base Plate	* kg	Testing According To ISO 9906	Yes (see above)	
35	**MOTOR DATA**				
36	Type of Drive	electrical motor	Drive Supplied By	pump manufacturer	
37	Refer To Technical Spec.	Sheet: 3	Drive Mounted By	pump manufacturer	
38	Frequency Converter	yes	Freq. Conv. Supplied by	AkzoNobel	
39	**REMARKS**				
40	Notes:				
41	[1] Pump will be electrical traced by AkzoNobel.				
42	[2] Class C5 coating system. E-motor has C3 coating acc. ABB std., color blue.				
43	[3] Sound level of the pump shall be max. 70 dB(A) at 1 meter. See sheet 5 for sound data to be provided by the vendor.				
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59	* data to be determined, checked or completed by manufacturer				

452	81			8100	AP-8171 A/B	A401		81.101
fact. no.	fact. dpt.	build	ext.	processgr./-unit	item code / tag no.	requisition no.	classification	PID draw. no.

title: Spoel pekel pomp		B	17-12-2015	R. Landa	EQ	
Centrifugal Pump		-	16-10-2015	R. Landa	EQ	
factory descr. : MEB Rotterdam		rev	date	author/typist	team	ckd
dpt./build. descr. :		ext. doc. id.:				
project descr. : Spoelpekel		project no. 452.380	DDTA 20 TSS	eq. status New	page 2 of 5	
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spec. status : For inquiry

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Figure 10: TSS page 2

1		**OPERATING DATA**							Rev.
2		Location	Outdoor			Altitude Above Sea Level	<= 1000	m	
3		Hazardous Area	No			Ambient Temperature	<= 40	°C	
4		ATEX Zone	-			Other Environmental Influences	Heavy industrial / marine environment		
5		ATEX Explosion Group	-			(IEC 60364-5-51)			
6		ATEX Temperature Class	-						
7	*	Rotational Direction							
8	*	Type of Coupling			*	Speed Equipment Min/Max	* / *	rpm	
9	*	Moment of Inertia (J) of Driven		kg/m²		Operating Power Expected Max.	*	kW	
10		Machine Reduced to Motor Shaft				Power Absorbed Max.	*	kW	
11		Type of Motor Starter	Frequency converter		*	Breakaway Torque of Driven	*	Nm	
12	*	Operation acc. to IEC 60034-1	Continuous			Machine Reduced to Motor Shaft			
13		**ELECTRICAL DATA**							
14	*	Installed Motor Power	*	kW					
15		Supply Voltage	690 V 3 Ph 50	Hz		Wiring Connection	*		
16	*	Synchronous Speed	*	rpm	*	Locked Rotor Current		% Of Rated Value	
17	*	Full Load Current		A	*	Locked Rotor Torque		% Of Rated Value	
18	*	Power Factor At Full Load			*	Pull-Up Torque		% Of Rated Value	
19	*	Efficiency At Full Load		%	*	Break Down Torque		% Of Rated Value	
20		Efficiency (IEC 60034-30)	IE2			Torque - speed (M-n Curve)	*		
21	*	Moment of Inertia (J) motor		kg/m²		Short Circuit Level of Power Supply	*	A*s	
22		**DESIGN AND CONSTRUCTION DATA**							
23		Design must Comply with	GSS 1.586.650		*	Bearings Driven End (D)			
24	*	Conn. Box Shortcircuit Proof	A	s	*	Bearings Non Driven End (N)			
25		Ignition Protection (ATEX 94/9/EC)			*	Lubrication	greased for life		
26		Enclosure Class (IEC 60034-5)	IP55			Painting	RAL 6001		
27		Material of Construction Housing	Cast iron			Painting Spec	Manufacturer's std, class C5		
28		Thermal Class (IEC 60034-18-1)	F / 155		*	Sound Pressure Level At 1m (LpA)		dB(A)	
29		Temperature Rise (IEC 60034-1)	B		*	Manufacturer	ABB		
30		Cooling (IEC 60034-1)	TEFC		*	Motor Type Number	M3BP		
31		Location of Connection Box	Top		*	IEC Frame No.			
32		(facing shaft end)			*	Critical Speed		rpm	
33		Location Of Aux. Connection Boxes	Top * [2]			(>120% of Rated Value)			
34		Cable Gland	Metal (SS316)			Vibration Grade (IEC 60034-14)			
35		Screw Thread	Metric			Vibration Mounting (IEC 60034-14)	Rigid Mounting		
36	*	Max. Size Supply Cable		mm	*	Outline Drawings (IEC 60072)			
37		**ACCESSORIES**							
38		Thermal Elements a)	PTC Total Number 6		*	Slide Rails	No Size	mm	
39		Function	Signal						
40		Transducers (number)	No						
41		Power Supply Transducers	A	V					
42		Stand Still Heating a)	No V	W					
43		a) Provided with separate connection box							
44		**INSPECTION AND SHIPMENT DATA**							
45		Inspection Authority	AkzoNobel			Overall Dimensions (H x L x W)	*	mm	
46		Total Mass Motor	*	kg		Required Reports	Type / Acceptance Test		
47		Shipment Mass	*	kg		Shipping Address			
48		**REMARKS**							
49		* Data to be determined, checked or completed by manufacturer							
50		Notes:							
51		[1] Vendor shall provide the moment of inertia of the pump.							
52		[2] Separate junction box for aux.							
53									
54									
55									
56									
57									
58									
59									

fact. no.	fact. dpt.	build	ext.	processgr./-unit	item code / tag no.	requisition no.	classification	PID draw. no.
452	81			8100	AP-8171 A/B	A401		81.101

title: Spoel pekel pomp	B	17-12-2015	R. Landa	EQ	
Tag No.: AP-0001	-	16-10-2015	R. Landa	EQ	
factory descr. : MEB Rotterdam	rev	date	author/typist	team	ckd
dpt./build. descr. :	ext. doc. id.:				
project descr. : Spoelpekel	project no. 452.380	DDTA 20 TSS	eq. status New	page 3 of 5	
spec. status : For inquiry					
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Figure 11: TSS page 3

	SKETCH	Rev.
1–31		

	NOZZLE DATA							
33	Mark	Service	NumberRequired	Nominal Size	Units	Flange		Remarks
34						Rating In	Standard / Type	
35	N1	Suction nozzle	1	*	DN	150#	ASME B16.5	
36	N2	Discharge nozzle	1	*	DN	150#	ASME B16.5	
37	N3	CANCELLED			DN			
38					DN			
39					DN			
40					DN			
41					DN			
42					DN			
43					DN			
44					DN			
45					DN			
46					DN			
47					DN			
48					DN			
49					DN			
50					DN			
51					DN			
52					DN			
53					DN			
54					DN			
55					DN			
56					DN			
57					DN			
58					DN			
59	* data to be determined, checked or completed by manufacturer							

fact. no.	fact. dpt.	build	ext.	processgr./-unit	item code / tag no.	requisition no.	classification	PID draw. no.
452	81			8100	AP-8171 A/B	A401		81.101

title: Spoel pekel pomp
Sketch

rev	date	author/typist	team	ckd
B	17-12-2015	R. Landa	EQ	
-	16-10-2015	R. Landa	EQ	

factory descr. : MEB Rotterdam
dpt./build. descr. :
project descr. : Spoelpekel
spec. status : For inquiry

ext. doc. id.:

project no.	DDTA	eq. status	page	of
452.380	20 TSS	New	4	5

size	P&E doc. no.	sh.	rev.	ver.
A4	3.520.081	4		

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Figure 12: TSS page 4

ALLOWABLE SOUND LEVELS*

The maximum allowable sound level of each piece of equipment or integrated unit is specified below as the maximum sound pressure level (Lp) around the equipment at 1 m distance from equipment surface and / or as the maximum sound power level (Lw).

max. allow. sound level in: (re: Lp 20μPa; Lw: 1 pW)	dB / dB (A)	31.5	63	125	250	500	1000	2000	4000	8000	16000	Overall dB	Remarks
		Octave Band Centre Frequency In Hz											
1 Lp													
2													
3 Lw													
4													

Testing Required On a Test Location For A Single Type / All Types Of Equipment

DATA OF VENDOR (see also page 2)

1 Fill in this part completely for each piece of equipment or integrated unit.

2 If the actual sound pressure level (Lp) or sound power level (Lw) of the normal design does not exceed the values of the maximum allowable sound level in any octave band, omit point 3.

3 If the actual Lp or Lw exceeds the maximum allowable sound level, complete "special design" or "acoustic treatment" andspecify performance and cost thereof.

4 If the sound generated by the equipment contains pure tones or can be considered as impulse, the actual sound level to be specified below has to be increased by 5dB for all octave bands.

5 The specified actual sound levels are obtained by:

Measurement	Acc. To ISO 3744		
	Average To	(qty) measuring positions	
	Maximum Of	(qty) measuring positions	
Measurement On	Quoted Equipment		Identical Equipment
Calculation	According To		
Measuring Equipment	Acc. To IEC 60651, type 1		
Operating Conditions Equipment	Full Load		

6 Nature of sound level specified:

Steady And Broad Band	Steady With Pure Tones Or Impulsive
Fluctuating And Broad Band	Fluctuating With Pure Tones or Impulsive

max. allow. sound level in: (re: Lp 20μPa; Lw: 1 pW)	dB / dB (A)	31.5	63	125	250	500	1000	2000	4000	8000	16000	Overall dB	Remarks
		Octave Band Centre Frequency In Hz											
1 Lp (Normal)													
2													
3 Lp (Special)													
4													
5 Lp (With Accoustic Treatment)													
6													
7 Lp Of Operators Position													
8													
9 Lp Of Background Noise													
10													
11 Lw (Normal)													
12													
13 Lw (Special)													
14													
15 Lw (With Accoustic Treatment)													
16													

REMARKS

* Data to be determined, checked or completed by manufacturer

* data to be determined, checked or completed by manufacturer

452	81			8100	AP-8171 A/B	A401		81.101
fact. no.	fact. dpt.	build	ext.	processgr./-unit	item code / tag no.	requisition no.	classification	PID draw. no.

title: Spoel pekel pomp	B	17-12-2015	R. Landa	EQ		
Sound Levels	-	16-10-2015	R. Landa	EQ		
factory descr. : MEB Rotterdam	rev	date	author/typist	team	ckd	
dpt./build. descr. :	ext. doc. id.:					
project descr. : Spoelpekel	project no. 452.380	DDTA 20 TSS	eq. status New	page 5	of 5	
spec. status : For inquiry						
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Figure 13: TSS page 5

3.2 Pump curve

The pump curve gives the information about the operating specifications of the pump. An example pump curve can be seen in figure 14.
The pump curve gives information about the impeller diameter, impeller configuration, efficiency, capacity and pump head. The impeller diameter indicates how big the impeller is and how much and how high the liquid can be pumped. The impeller configurations shows how the vanes of the impeller are situated. The efficiency is how efficient the pump operates. If a pump operates efficiently, it takes less energy and thus less money to operate. The capacity states how much liquid can be pumped. The pump head is how high the pump the liquid can move.
The X-axis is the capacity of the pump in gallons per minutes (GPM). The Y-axis gives the head of the pump the left side is in feet and the right side in meters.
The lines that start horizontal at the Y-axis are the impeller sizes. A pump can have different impeller sizes to have specific performances.
At the right side of the graph, there are dotted lines with horsepower. These lines give the required engine power for the pump.
The vertical dotted lines are the net positive suction head required (NPSHR). The NPSHR is the required hydrostatic pressure to operate without cavitation. Cavitation is the forming of a partial vacuum and vapour bubbles that can damage the pump and reduce the lifespan, so this has to be avoided.
The ovals in the graph are the operating efficiency. The more efficient the pump operates, the less energy is used for the operation purpose.
From figure 14 it can be seen that the pump has a capacity of 132 GPM and a head of 84 feet. The impeller diameter is 11 inch, the net positive suction head required is 2.5 feet. The required horsepower for the pump is 7.5 hp, and the efficiency is 52%, so 52% of the electrical engine power in converted to pump power. For this pump, the 53% efficiency is relatively high because the maximum efficiency is around 60%. Large centrifugal pumps can reach an efficiency of 90% [9].

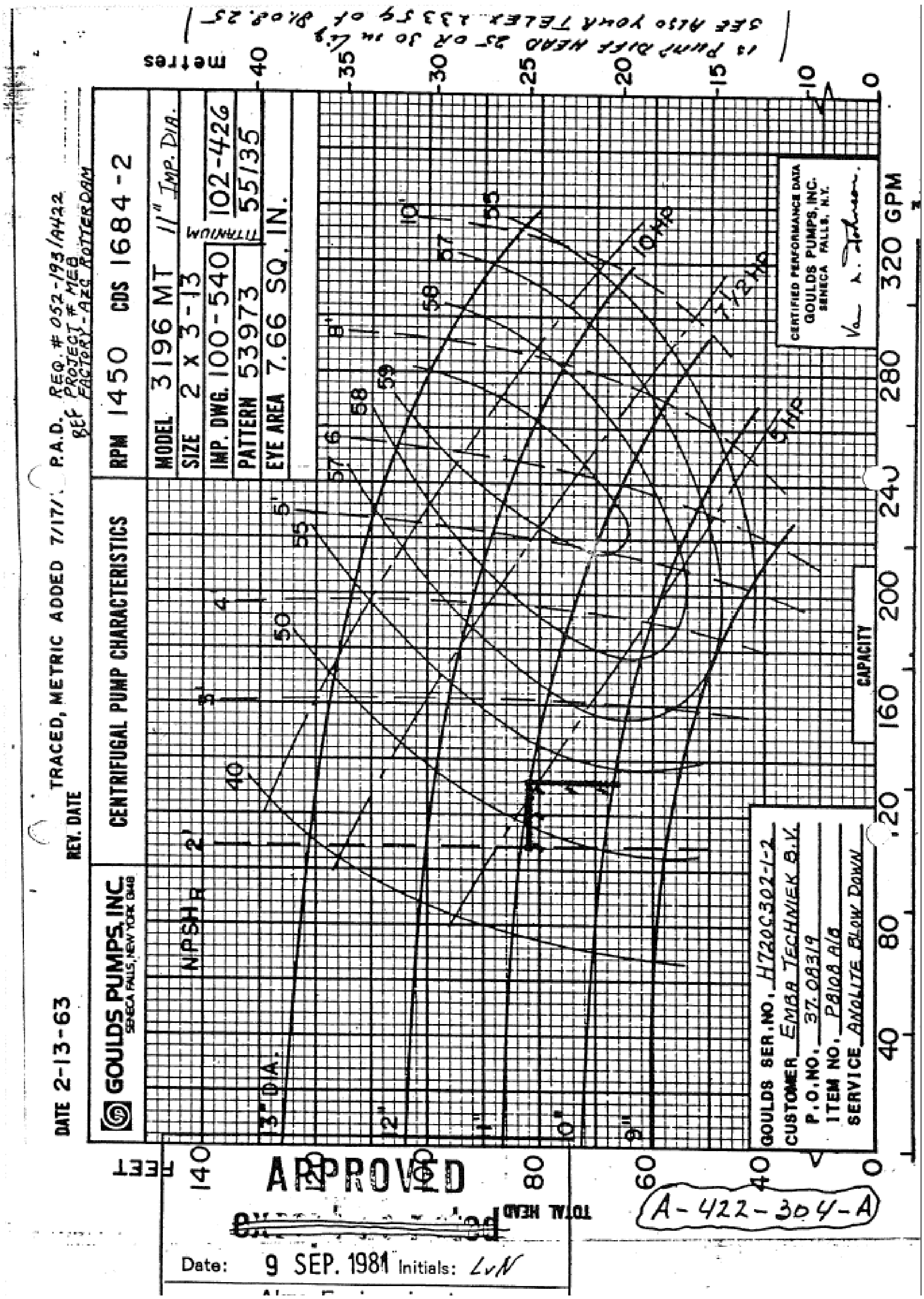

Figure 14: Pump curve R-AP8108 A/B

3.3 Technical drawing

There are multiple possible technical drawings like: the overview drawing, the sectional drawing and the seal drawing. Besides these drawings, there are also axle drawings and part lists. The overview drawing shows how to install the pump on the base plate. The sectional drawing shows a cross section of the pump with a number to each part to give an overview of all parts of the pump. The seal drawing gives the dimensions of the seal. The axle drawing gives all the dimensions of the axle on which the seal is located. The part list is usually in combination with the sectional drawing, all the numbers from the sectional drawing will get their name, quantity and material from the part list.
Because there are many different pumps form many different suppliers the technical drawings can vary. All suppliers have their own way of making the technical drawings. An example of these drawings can be seen in appendix D.

3.4 Seal information

The seal makes sure that the input shaft of the electric motor can enter the casing of the pump without loss of pressure and leaks from the internals of the pump. It seals the internal of the pump from the atmosphere and vice versa. Especially for a dangerous chemical like caustic soda or chlorine, it is critical that these chemicals stay inside the pump and do not leak to the outside. This seal needs to be able to handle the friction of the rotating shaft.
There are two commonly used seals for Nouryon Rotterdam, the gland gasket seal and the mechanical seal.
The gland gasket is made of braided cords like aramid or PTFE. This can be seen in figure 15.

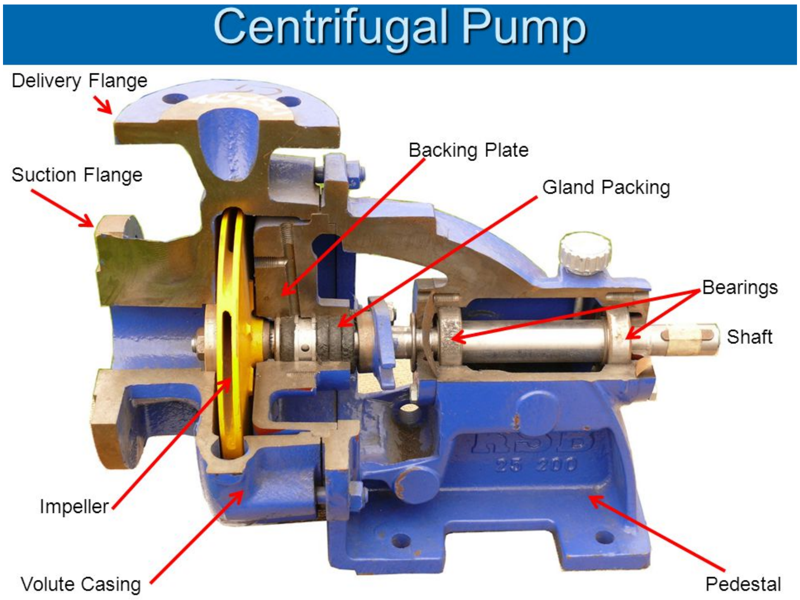

Figure 15: Gland packing. [8]

The mechanical seal consists of two machined surfaces that are pressed together with mechanical and hydraulic forces. Between these machined surfaces, there is a sealing gap. This gap is filled with a lubrication film. This lubrication film can be the processed fluid or a special lubrication and seal fluid. There is still a tiny amount of leakage between this gap. The most common seal installation that is used is so-called seal plan 11. There are many plans on how to install seals. In plan 11 a small amount of the process fluid is used to flush the seal, this cools and lubricates the seal this plan can be seen in figure 16. On the other side of the seal, demi water is used for the quench. The purified water is on an overpressure, this is to make sure that quench fluid enters the pump, and the process fluid does not leave the internal of the pump. The disadvantage of this system is that the quench fluid enters the process fluid, so the purity of the process fluid will be lower. The advantage of the mechanical seal is that requires less maintenance then the gland packing [5].
It is also possible that a pump does not have a seal. These pumps are magnetically coupled. This means that the power of the electric motor is transferred using magnets so the fluid is always contained and there is no change of a leaking seal. The most crucial seal information is the material, the manufacturer and the type. There is some seal information on the TSS. All the seal information should be on the TSS. Sometimes there are technical drawings of the seal. Seal specific information is in the manufacturing documents.

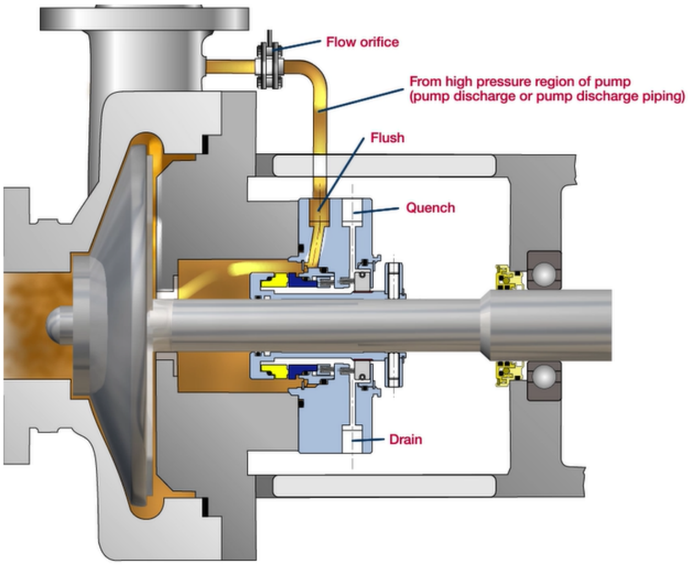

Figure 16: Seal installation plan 11. [3]

3.5 Operating manual

The operating manual gives information on how to install, use and maintain the pump. It usually starts with an extensive installation manual. This shows how to install all the pipes that connect the pump and how to align the coupling properly. It shows how to commission the pump and how to operate it, the manual shows how to operate in many different conditions like with a reduced head and under freezing conditions. There is also a lot of maintenance information in the manual. This includes how to lubricate the pump, how to adjust the impeller and how to overhaul the pump. The final section of the manual includes technical drawings. Each supplier has his own manual with its own content, but in general, they are very similar.

4 Analyse

To determine possible causes for this problem an Ishikawa diagram is made. This diagram shows six groups of possible causes for the problem. The groups are as follows:

- Machine
- Methods
- Materials
- Men
- Measurement
- Mother Nature (Environment)

These are called the 6 Ms. All the possible causes can be seen in figure 17 [1].

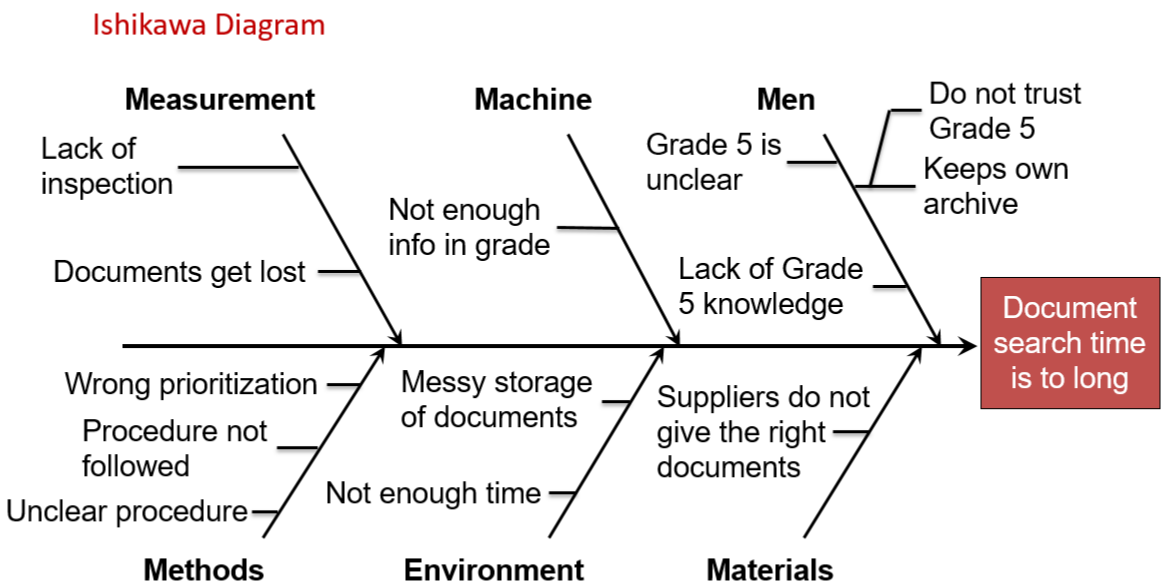

Figure 17: Ishikawa diagram

For the diagram, it can be seen that there are many possible causes for this failure. To determine what the main causes are a Cause & Effect matrix has been made [1], [2]. In this matrix, the key process input variables (KPIV) are plotted against the key process output variables (KPOV). A rating has been given to the KPOV to indicate customer importance. This has a value from 1 to 10. The relation between the KPIV and the KPOV has the value 0, 1, 3 or 9, where 0 is no effect, and 9 is a strong effect. A score is given to all the KPIV to determine the most important ones. The total Cause & Effect matrix can be seen in figure 18. The most important causes are unstructured and uncontrolled storage of documents, not following procedures and not getting the right documents from suppliers.

		Key Process Outputs						
	Customer importance	10	8	8	9	10		
		1	2	3	4	5		
	KPIV	TSS	Pump curve	Seal information	Technical drawings	Operating manual	Total	Rank
1	Lack of inspection	3	3	3	3	3	135	7
2	Documents getting lost	1	1	1	1	1	45	8
3	Lack of time	9	3	3	3	1	175	5
4	Unstructured and uncontrolled storage	9	3	3	9	9	309	1
5	Grade 5 is unclear	3	3	3	3	3	135	7
6	Not enough information in Grade 5	3	3	3	9	3	189	4
7	Wrong Prioritization	1	1	1	1	1	45	8
8	Procedure not followed	3	3	3	9	9	249	2
9	Unclear procedure	9	1	1	1	3	145	6
10	Suppliers do not give the right documents	1	1	3	9	9	213	3
11	Want own archive	1	1	1	1	1	45	8
12	Lack of Grade 5 knowledge	1	1	1	1	1	45	8
	Total	440	192	208	450	440		

Traget	More than 90% in Grade 5, findable within 6 minutes

Rating
0 no effect
1 weak effect
3 moderate effect
9 strong effect

Figure 18: Cause & Effect matrix

5 Keeping track of the documents

For this internship 87 assets are in scope, each asset needs five documents so in total 435 documents are in scope and should be reviewed and processed into Grade 5. It is essential to keep track of all locations that have been searched for each document and to keep track of all the found documents. Otherwise, the same locations will be looked at multiple times.

An excel document with all the functional locations, the description, priority and required documents has been made. This is to keep track of the project and the progress of the project. In this excel file, if a document is found the week number can be inserted, this will be shown in a graph to see the weekly progress and keep track on how well the search is going. In appendix C is an example of this document. The excel file has the five main documents of which the newest version needs to be put in Grade 5 and only if the as built document is found it will be inserted in the excel file.

The found documents will be put in a temporary file on a server. When all documents are collected, they are reviewed to determine which are as built. All the found documents will then be imported into Grade 5. The older documents that are not as built any more will be labelled as expired and stored in Grade 5.

To keep track of all the locations where the documents were found and where has been looked a word file will be added with all search information of that pump.

6 Finding the documents

6.1 Grade 5

The first step to look for the required documents is to see what is already stored in Grade 5.
The amount of documents in Grade 5 varies greatly for each pump. For some pumps, there is no information in the Grade 5 system, while for others there are four different manuals, two different TSS and a seal drawing available. The current amount of documents in Grade 5 is as follows:

- 45.5% of the pumps have documents in Grade 5
- 2% has all the five documents in Grade 5
- 31% has one or 2 documents in Grade 5
- 12.5% has half of the documents in Grade 5

The origin of the Nouryon factory is in the '60s. From that period on major changes are continuously executed. The MEB originates for a vast majority out of the '80s and the E&U from the '60s. This means some assets in the plant could be in operation over 35 years. Some documentation is original and as built from that period and with that adequate. However, that does not account for all assets and their documents.

6.2 Inspection archive

When the current situation of Grade 5 is reviewed, the next step is to look into the archives. The first archive that will be checked is the inspection archive located close by the maintenance engineers. In this archive, all the inspection reports of the pumps are located. These reports are out of scope for this internship.
For some pumps, entire manuals and complete technical drawings are stored in the inspection archive.
After reviewing all the pumps in the inspection, archive conclusions can be drawn between this archive and Grade 5. The content form the inspection archive is very similar to Grade 5. The documents form the inspection archive and Grade 5 are usually the same. They have the same date and the same document specifications and contain similar information. The inspection archive does have more documents and more complete packages then Grade 5. It also contains a manual where in Grade 5 this is missing.

The documents form the inspection archive are old. Most documents are from the 80' just as Grade 5.
Most documents in the inspection archive are stored two to three times in the same file. There are many copies form the same drawing and even copies from copies. This will give a bad quality and makes searching for documents a lot slower.

6.3 Review of the documents

When Grade 5 and the inspection archive have been compared, the found documents of two pump were shown to a maintenance engineer at Nouryon to see how to useful these documents are. The documents were specifically for the R-AP8102 and the R-AP8153. For these two assets, all the documents have been looked over with a maintenance engineer to see if they are up to date and if they are the required documents.
During this meeting, an explanation was given about the documents, and an indication was given which documents are necessary for the work of the maintenance engineer. A good TSS is essential while a manual is less important for the rotating maintenance engineer. This gives a better impression of how a maintenance engineer searches for rotating documents.

6.4 Personal archive

The next place to look is the personal archives of employees. These are folders on the Nouryon servers where employees store their documents or files that they store in a desk drawer. It can be difficult to locate these uncontrolled personal archives.
The first personal archive that was searched is that of one of the technicians from the MEB, so there is only information about MEB and not from the E&U. This means only the unit 8100 not about the unit 3600. In this archive, there are a lot of pump shaft and axle sleeve drawings. These drawings cannot be found in Grade 5 or the inspection archive. Besides these documents, there are also sectional drawings and one or two pages of a manual. It is important that these documents are also put into Grade 5 because these documents are frequently used by the technicians.
Overall this archive did not contain much information, the sectional drawings and manuals can be found in different places.

On the server, there is another personal archive. In this archive, there is information about all the pumps in the factory.
Surprisingly the information in this personal archive about the unit 8100 is the same as the information that is stored in the previously mentioned personal archive. That

despite that fact that two different persons from two different parts of the factory have these archives. This means that there is one uncontrolled archive that has been copied multiple times. Due to this, there are even more uncontrolled copies of these documents.
For the unit 3600 there where mostly sectional drawings, some cannot be found elsewhere other ones where already in Grade 5.
In this archive, there is also a bill of material for almost all pumps. In this bill of material, the seal information is mentioned, with the material number and seal number. Also, material information about the axles, impeller and o rings is mentioned.

6.5 MEB archive

The archive of the MEB is the next one to be looked into. Because this is the MEB archive there will only be information about the unit 8100, information about the unit 3600 can be found in the E&U archive.
In this archive, there is a lot of information. It has a part of the axle drawings, the same ones as from the personal archives. There are manuals, TSS, pump curves, drawings. So almost all the necessary information. The only problem is that it is unknown if this information is up to date because it is an uncontrolled environment. It is essential to also look at the rest of the documents in the MEB archive because there is much information.

6.6 Seal information

For most assets when there are technical drawing, there is also a drawing of the seal. Seal information can also be found on the TSS, but seals do not last as long as a pump. This is because the seal is continuously rotating against a stationary part and it is in constant contact with the chemical. From a conversation with an employee that orders the new seals, it became clear that most pumps of the unit 8100 have new seals while for only a few there are new drawings. This means that for nearly all pumps in the unit 8100 there is no up to date seal information. Some documents state what type of seal is in what pump, these documents cannot be found in Grade 5. The technical drawings form the seal can be acquired from the supplier.

6.7 Current state of the documents

After searching through Grade 5, inspection archive, the MEB archive and the personal archive some clear patterns emerge.
As mentioned in section 6.6 for most pumps the seal information is missing but this can be acquired fairly easily.
For the other documents a lot has been found but, for some pumps, there is much information and this information is usually stored in multiple places or even in the same place multiple times.
For some other pumps, there is no information available. In all the locations there is nothing to find on these pumps. So, or all the information for the pump can be found, and it is probably stored in one of the mentioned locations, or the information was never acquired, or there is another location with this information. The found documents are compared with the excel file ”Rotating equipment”, that is located on the Nouryon server (this file is not completely up to date), that has the manufacturer, type, material, impeller diameter and seal information. With all this combined a decent estimate can be made on what is up to date and what is not.

7 Visual inspection of the pumps

To determine which of the documents are old and which are new all the pumps tags are checked. On this, the pump manufacturer, pump type and serial number are mentioned. Some manufacturers have more elaborate pump tags. These tags include impeller diameter and date of placement. An example can be seen in figure 19. All these tags are compared with the TSS and the drawings to make sure that it is the same pump. Some do not have a tag, or that tag is unreadable due to age and the weather. In this case, the type cannot be compared. In most of these cases, the pump manufacturer is mentioned on the pump casing. This can be used to check if the manufactures are the same as the documents.

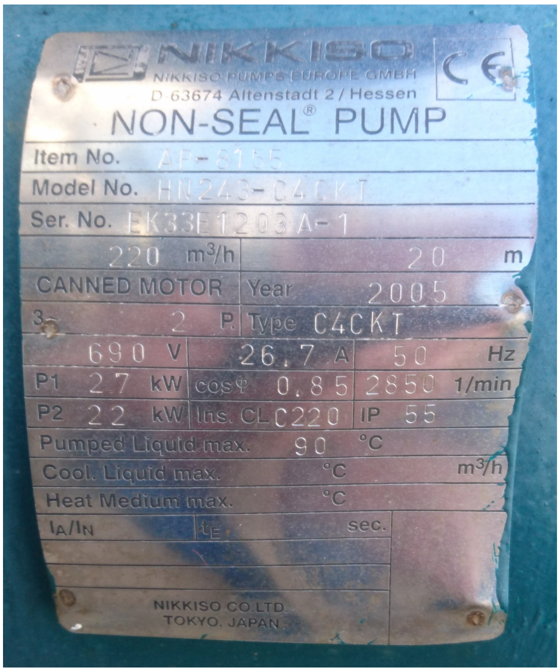

Figure 19: Tag of the pump 8155. Taken by: T.G. Mes on 18-09-2018

After the rotating documents have been checked with the pump tags the following can be concluded. From almost all the pumps the information was the same, only for one or two pumps, there was a difference. This means that most of the rotating documents regarding the pump type and manufacturer are up to date. The pumps with rotating documents from more than one manufacturer can be easily seen what the new documents are and what the old rotating documents are.

8 Procedure

To make sure that the problem that the rotating documentation is currently hard to find and that there are a lot of uncontrolled copies does not occur again a procedure will be made.

8.1 Problem location

The problem has multiple origin points. First of all, there is no uniform work process to asses the documents.
Grade 5 is implemented as replacement of the former documentation management program, Meridian. Due to the recent implementation of Grade 5 employees do not know how to use it properly.
The last problem are the archives. There are currently multiple uncontrolled archives. These archives have a lot of the same information, sometimes even in the same map. This makes the archives unnecessary full, and it takes much more time to compare all the documents.

8.2 Improvements

For Grade 5 itself, this needs to be expanded. Many options will make the search for documents much easier, but they are currently not used. For example, there is an option to search for an asset, when an asset is clicked on there is currently no information. However, if it is done correctly, all the documents from that asset will be available.
If a document is required and it is not available in Grade 5 then the best place to look is in the MEB or E&U archive. These archives have more information than any other archive. Another place that can be used for getting the documentation is the project engineers in Arnhem. Here all the projects are engineered, and all the documentation goes through here. A part of this documentation is sent to the site in Rotterdam but is not always correctly documented.
All the archives need to be sorted. All the double information needs to be discarded. This will make the archives smaller and makes it faster to find documents.
If the total number of archives is reduced, this will make it easier to have one controlled physical archive. So all the three archives will have to go, and Grade 5 will be the leading documentation storage.
If it is doubtfully what kind of pump and its material and impeller diameter then the excel file ”Rotating equipment” on the server will be consulted.

8.3 Risks

The risk of this procedure is that employees still make their own uncontrolled archives. It is tough to counter this, one of the best ways to do it is to have a good working system in Grade 5 and to have a uniform work process for employees.
Getting rid all the three archives will be an ongoing process. A good method to sort the documents is to check them, discard the double documents and import the documents in Grade 5. This way it is possible to increase the number of documents in Grade 5 and at the same time clean up the archives.
Another risk is that the documents will be labelled wrong in Grade 5, this can happen if old documents are labelled as built.

9 Found documents

In total 220 documents of the unit 3600 and unit 8100 have been found. This is 51% of the documents for these units. Most of the seal documents are still missing. For most pumps, it is known what kind of seal is in this pump, but the documents are not being requested from the supplier. If these documents are requested and put into Grade 5, then the total number of found documents will be around 64%. One of the pumps is a magnetically coupled pump, and six other pumps are canned pumps, so these pumps do not have a seal and do not require any seal information.
A pattern emerged from the search of the documents. Alternatively, all the documents could be found (except the seal information), or none of the documents could be found. This is the main reason the 90% has not been reached. For example, there are 21 pumps in the unit 8100 that have almost no documentation.

10 Importing the documents in Grade 5

Before the found documents can be imported in Grade 5 some more information about the documents is necessary.
First of all, all documents that will be imported in Grade 5 need to have a document number. The document number is a seven digit number that looks as follows: 1.111.111. So there is one digit then a point then follow three digits then another point and another three digits. These digits can vary between 0 and 9.
Before the documents number can be assigned to a document, some additional information is necessary. This information consists of a description of the asset, the revision of the drawing, the project number and the tag number. Because most of the documents are from the supplier, they lack all these numbers and information. These numbers are generated by Grade 5. So this information needs to be found and handed over to the document officer.

11 Conclusion

The rotating documentation at Nouryon in the Botlek is currently incomplete and partly uncontrolled, and it takes much time to find the documents. To solve this problem, the rotating documentation for the units 3600 and 8100 has been searched for. To find these rotating documents first, Grade 5 has been checked. After that, the paper archives have been searched for rotating documents. Then the personal archives of the employees have been checked. After all these documents have been collected, they are compared with the pump in the factory. These documents will be imported in Grade 5 to make sure that they are readily available and are in a controlled environment.
In total for the units 3600 and 8100 51% of the documents have been found. This is not the 90% that was needed to reach the CTQ. For most pumps, there are no new seal drawings. It is known what kind of seals is in these pumps. The seal drawings can be requested at the manufacturer. If this is done for all the pumps in the unit 3600 and unit 8100, then the total amount of found documents will go to 64%. For most pump the following is true, or all documents can be found, or no documents could be found, this can be seen in appendix C. This is the main reason that the 90% has not been reached.
During the search of the archives, the places where to search and where not to search became clear.
Grade 5 is always the starting point of the search for documents. If the documents cannot be found in Grade 5, then the best place to search is in the E&U or MEB archives. These archives have much information about the units that they consist of. If a specific change or an inspection is required, then the inspection archive will likely have the right documents. As the last reserve, the project engineers in Arnhem can be contacted about a specific project.

12 Recommendations

To decrease the time it takes to search for the right document and to make the searching for the documents easier the following actions are recommended.

1. In most of the archives, there are a lot of double documents. In some cases, there was an original, two copies and a copy of a copy. Due to this the total documentation in an archive from a pump is more than doubled than it should be. Searching and comparing all these documents takes much time.
   Therefore it is necessary that all the archives are sorted, and the uncontrolled documents are removed from the archives or labelled ”Uncontrolled copy”.

2. Currently there are three archives and Grade 5 with all overlapping information. Because Grade 5 will be the leading and controlled environment for the documents, there is no need for all three the archives.

3. If a new project is started or a current asset in revised then it is important that these are documented and updated in Grade 5.

4. Currently almost all documents in Grade 5 are ”as built” while this is not the case. It is recommended that the documents in Grade 5 are checked and are given their accurate status.

5. For the pumps that have almost no documentation, it is recommended that the documentation is requested from the project engineers in Arnhem. If it is available in Arnhem

6. For almost all the pumps there are part lists made in excel and put onto the server. All these part lists need to move to the controlled environment, Grade 5. The other copies need to be deleted.

7. For future maintenance processes, it is recommended that a task rule is added to the maintenance plans in SAP. This task will state that the rotating documents will be checked with the pump to make sure that the documents are up to date.

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A Employer description

AkzoNobel is a company that makes paint, coatings and speciality chemicals. It is a Dutch company that can be traced back to 1792. AkzoNobel is active in 80 countries with more than 45000 employees.
During the internship, the speciality chemicals part of the company was sold. Therefore the name was changed from AkzoNobel speciality chemicals to Nouryon.
AkzoNobel creates some well known paint brands like Flexa and Sikkens.
As a coating manufacturer, AkzoNobel is the leading global supplier of performance coatings. These coatings are used for a variety of things like: Ships, cars, aircraft, yachts, architectural components and consumer goods.
The speciality chemicals are used in all sorts of products like: paint, detergents, foods, plastics, construction, paper, pharmaceuticals and agriculture.
Nouryon Rotterdam Botlek is part of the speciality chemicals. In this plant, they make chlorine, caustic, hydrochloric acid and hydrogen out of salt.

B Reflection

Before the internship started, the supervisor had already planned many meetings with a lot of different departments. This was to make sure that the internship could start immediately. With these conversations, it was possible to learn the company in quite a fast rate, and they also give the start for the internship, so I could hear the problems the engineers experienced. At the beginning of the internship, it was quite hard to follow conversations because there are many abbreviations. It took some time to learn them all but eventually I could follow most of the conversations.
Because of the fact that at this plant there are a lot of dangerous chemicals like caustic, chlorine and hydrochloric acid, I was not allowed to walk on the factory floor unsupervised. This created some problems because all the pumps are outside and also a large part of the offices and archives are located in the factory. After one and a half months I got the opportunity to get a VOL-VCA certification. With this certification, you are allowed to go into the plant by yourself. So after I got this the internship when smoother because I was not dependent on other people to walk through the plant any more.
Almost every week I had contact with my supervisor to check the progress and discuss how to move forward.

C Planning

Functional Loc.	TSS	Pumpcurve	Technical drawing	seal information	Operating manual
EVB-AP3601A-01	Niet	Niet	Niet	Niet	Niet
EVB-AP3601B-01	Niet	Niet	Niet	Niet	Niet
EVB-AP3601C-01	Niet	Niet	Niet	Niet	Niet
EVB-AP3601D-01	41	41	41	Niet	41
EVB-AP3601E-01	41	41	41	Niet	41
EVB-AP3602A-01	41	41	41	Niet	Niet
EVB-AP3602B-01	41	41	41	Niet	Niet
EVB-AP3602C-01	41	41	41	Niet	Niet
EVB-AP3604-01	41	41	Niet	Niet	41
EVB-AP3604A-01	41	41	Niet	Niet	41
EVB-AP3606	Niet	Niet	Niet	Niet	Niet
EVB-AP3607A-01	Niet	Niet	Niet	Niet	Niet
EVB-AP3607B-01	Niet	Niet	Niet	Niet	Niet
EVB-AP3607C-01	41	41	41	Niet	Niet
EVB-AP3608	Niet	Niet	Niet	Niet	Niet
EVB-AP3610A-01	41	41	Niet	Niet	Niet
EVB-AP3610B-01	41	41	Niet	Niet	Niet
EVB-AP3612-01	41	Niet	Niet	Niet	41
EVB-AP3616-01	41	41	41	Niet	41
EVB-AP3620-01	41	41	41	Niet	38
R-AP3651A-01	39	Niet	38	Niet	40
R-AP3651B-01	39	Niet	38	Niet	40
R-AP3652A-01	40	40	39	Niet	40
R-AP3652B-01	40	40	39	Niet	40
R-AP3653A-01	39	40	39	Niet	40
R-AP3653B-01	39	40	39	Niet	40
R-AP8101A-01	40	40	40	Niet	40
R-AP8101B-01	40	40	40	Niet	40
R-AP8102A-01	40	40	40	Niet	40
R-AP8102B-01	40	40	40	Niet	40
R-AP8103A-01	40	40	40	40	40
R-AP8103B-01	40	40	40	40	40
R-AP8104A-01	40	40	40	40	38
R-AP8104B-01	40	40	40	40	38
R-AP8106A-01	41	41	41	41	38
R-AP8106B-01	41	41	41	41	38
R-AP8108A-01	38	39	38	39	41
R-AP8108B-01	38	39	38	39	41
R-AP8109A-01	Niet	Niet	Niet	Niet	Niet
R-AP8109B-01	Niet	Niet	Niet	Niet	Niet
R-AP8111	Niet	Niet	Niet	Niet	Niet
R-AP8120A-01	41	41	Niet	Niet	Niet
R-AP8120B-01	41	41	Niet	Niet	Niet
R-AP8122	44	44	44	44	44
R-AP8123	44	44	44	44	44
R-AP8124	44	44	44	44	44
R-AP8130A-01	Niet	Niet	Niet	Niet	41
R-AP8130B-01	Niet	Niet	Niet	Niet	41
R-AP8131A-01	Niet	Niet	Niet	Niet	Niet

Week number	Found documents
38	25
39	12
40	78
41	57
42	12
43	0
44	21
45	0
total	205

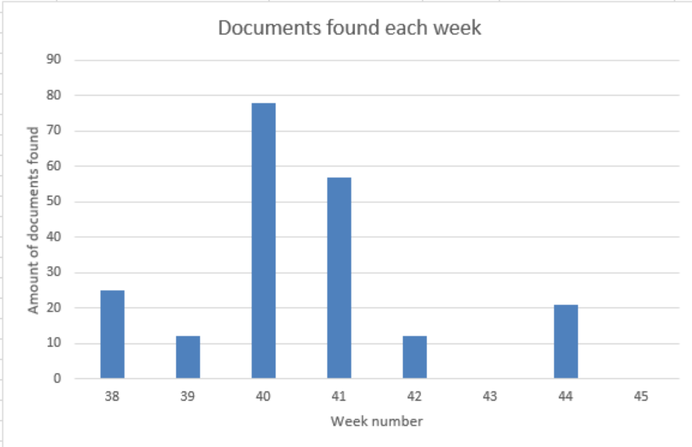

Figure 20: The progress excel file with how much documents found each week

D Technical drawings

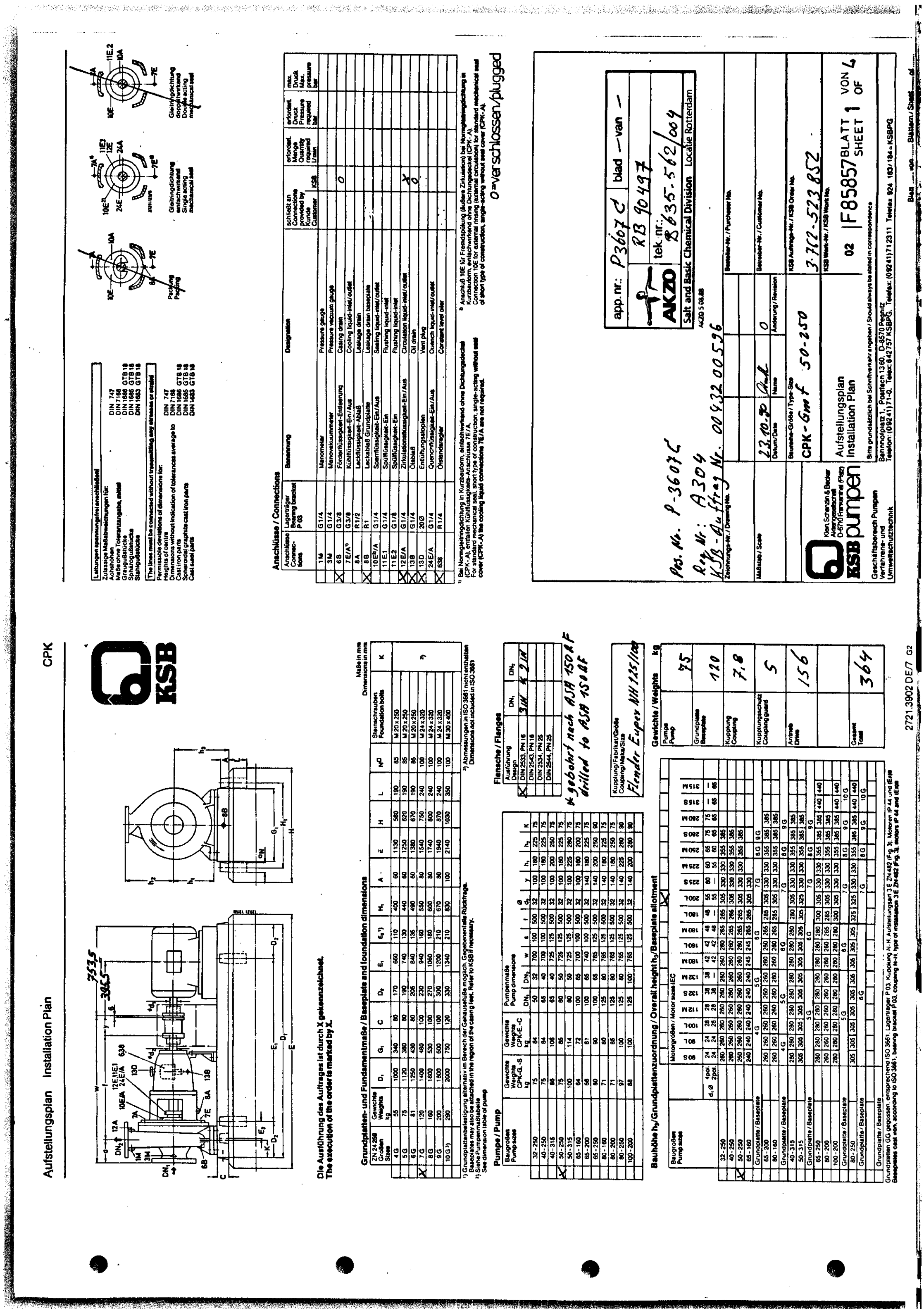

Figure 21: Drawing R-AP3607C 1 of 4

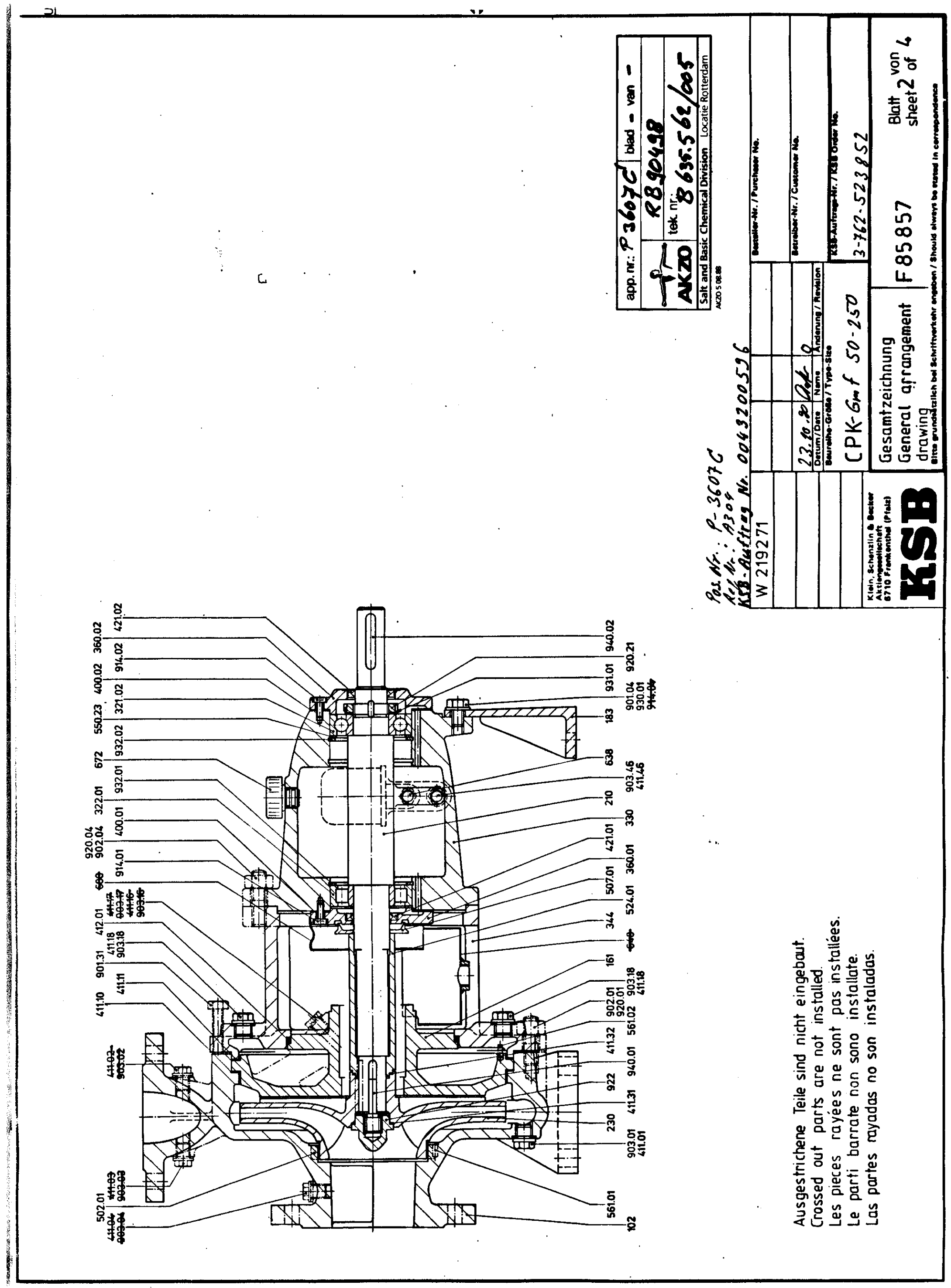

Figure 22: Drawing R-AP3607C 2 of 4

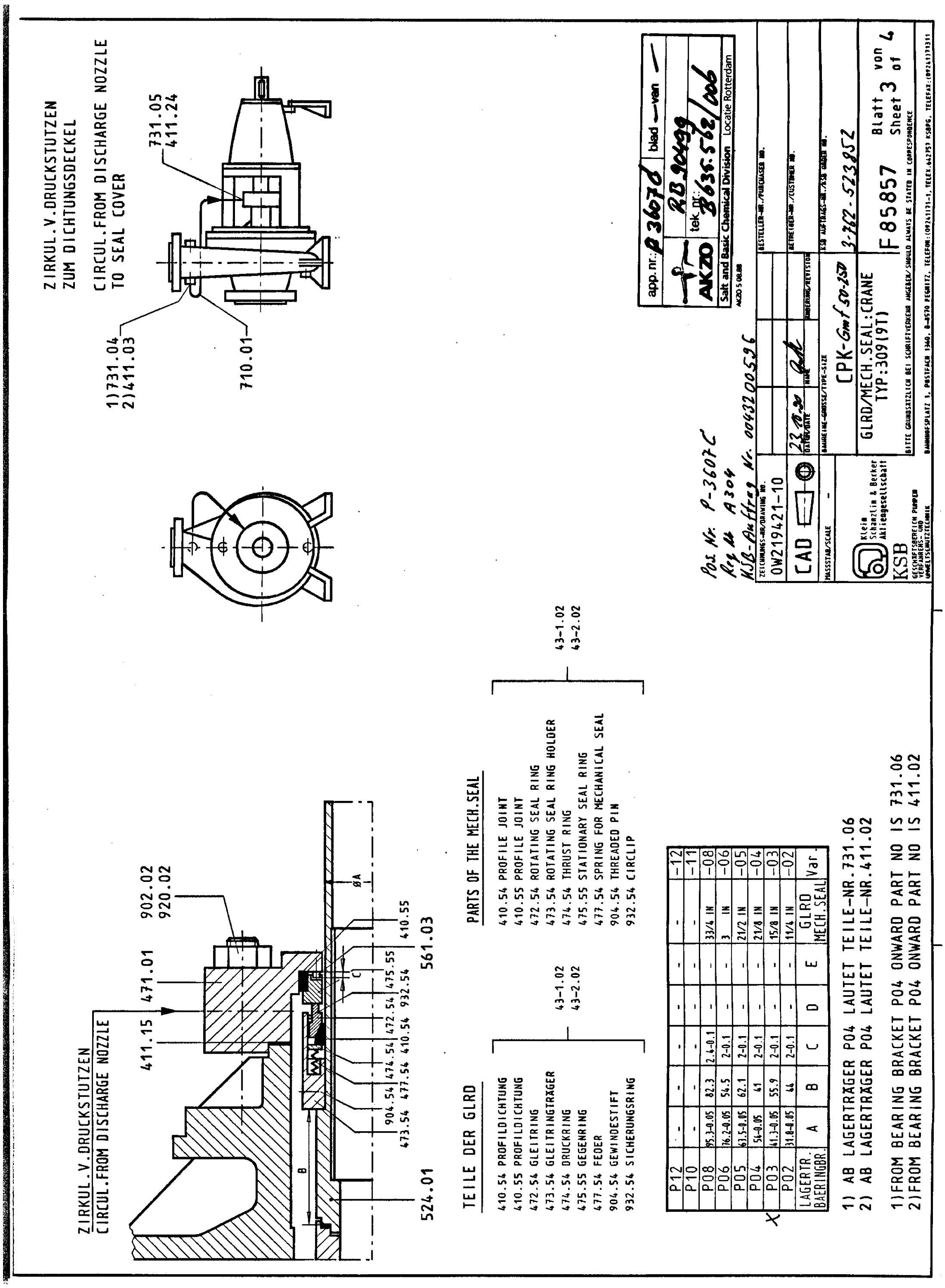

Figure 23: Drawing R-AP3607C 3 of 4

TEILE-NR. PART-NO. REPÈRE	STÜCK PIECE QTÉ.	BENENNUNG DENOMINATION DÉSIGNATION		WERKSTOFF MATERIAL MATÉRIAUX
102	1	SPIRALGEHAEUSE VOLUTE CASING	050-250	GG-25
161	1	GEHAEUSEDECKEL CASING COVER	P03-250	GG-25
183	1	STUETZFUSS SUPPORT FOOT	110X 94	GGG-40
210	1	WELLE SHAFT	45X516,5	C 45 N
230	1	LAUFRAD IMPELLER	260-050-250	GG-25
321.02	1	RILLENKUGELLAGER DEEP GROOVE BALL BEARING	6307- C3	ST
322.01	1	ZYL-ROLLENLAGER CYLINDRICAL ROLLER BEARING	NU 307	ST
330	1	LAGERTRAEGER BEARING BRACKET	0300	GG-25
344	1	LAGERTRAEGERLAT BEARING BRACKET LANTERN	P03/P04-250	GG-25
360.01	1	LAGERDECKEL BEARING COVER	A 35/ 80	GG-25
360.02	1	LAGERDECKEL BEARING COVER	E 35/ 80-2	GG-25
400.01	1	FLACHDICHTUNG FLAT GASKET	H 80/120X0,5-602	DPAF
400.02	1	FLACHDICHTUNG FLAT GASKET	H 80/120X0,5-602	DPAF
411.01	1	DICHTRING SEAL RING	A 17 X 21	PTFE-GF 25
411.03	1	DICHTRING SEAL RING	A 14 X 18	PTFE-GF 25
411.10	1	DICHTRING JOINT RING	262 /274 X0,5	PTFE-GF 25
411.11	1	DICHTRING JOINT RING	262 /274 X0,5	DPAF
411.15	1	DICHTRING JOINT RING	68 / 79 X0,5	PTFE-GF 25
411.18	2	DICHTRING SEAL RING	A 17 X 21	DPAF
411.24	1	DICHTRING SEAL RING	A 14 X 18	PTFE-GF 25
411.31	1	DICHTRING GASKET	34/ 41X 1	PTFE-GF 25
411.32	1	DICHTRING GASKET	34/ 41X 1	PTFE-GF 25
411.46	1	DICHTRING SEAL RING	A 14 X 18	DPAF
412.01	1	O-RING O-RING	158,12X 5,33	EPDM-E540-80

KSB-Auftrag Nr. 0043200536

Reg Nr. A304
Pos. Nr. P-3607 C

CPKGFM 50-250 — 3-762-523852

BENENNUNG/DENOMINATION/DÉSIGNATION: EINZELTEILVERZEICHNIS
LIST OF COMPONENT PARTS

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BEARB. PREPARED PRÉPARÉ
DATUM DATE DATE | NAME NAME NOM

Pumpen Armaturen KSB

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Figure 24: Drawing R-AP3607C 4.1 of 4

TEILE-NR. PART-NO. REPÈRE	STÜCK PIECE QTÉ.	BENENNUNG DENOMINATION DÉSIGNATION	WERKSTOFF MATERIAL MATÉRIAUX
421.01	1	WELLENDICHTRING AS 35X 52X 7 ROTARY SHAFT SEAL	72 NBR902
421.02	1	WELLENDICHTRING AS 32X 52X 7 ROTARY SHAFT SEAL	72 NBR902
43-1.01	1	UML-EINHEIT 0412- 9T ROTATING UNIT	QR1-1
43-2.02	1	FEST-EINHEIT A 0412-036-037 STATIONARY UNIT	Q--C-
471.01	1	DICHTUNGSDECKEL 42,5/120X42 SEAL COVER	1.4408
502.01	1	SPALTRING 105/120X15 CASING WEAR RING	GG
507.01	1	SPRITZRING B 35 SW THROWER	PPO-GF30
524.01	1	WELLENSCH-HUELSE27/45,3X140, SHAFT PROTECTING SLEEVE	1.4571
550.23	1	STUETZSCHEIBE A 70/ 80X 3 SUPPORT DISC	ST
561.02	1	KERBSTIFT 6 X 12 GROOVED PARALLEL PIN	1.4305
561.03	1	KERBSTIFT 2 X 12 GROOVED PARALLEL PIN	1.4305
638	1	OELSTANDREGLER AR 1/4 CONSTANT-LEVEL-OILER	ST-GLAS
672	1	ENTLUEFT-STOPFEN B 20 BALANCE PLUG	AL
710.01		ROHR 8 X 1 WELDED STEEL PRECISION TUBE	ST35GBK GAL ZN
731.04	1	VERSCHRAUBUNG DL 8 SOLDERLESS TUBE FITTING	ST-GT
731.05	1	VERSCHRAUBUNG DL 8 SOLDERLESS TUBE FITTING	ST-GT
901.04	1	6KT-SCHRAUBE M 12 X 20 HEXAGON HEAD SCREW	8.8
901.31	3	6KT-SCHRAUBE M 12 X 35 HEXAGON HEAD SCREW	8.8
902.01	12	STIFTSCHRAUBE M 16 X 35 STUD	CK 35 V
902.02	4	STIFTSCHRAUBE M 12 X 70 STUD	A 4-70
902.04	4	STIFTSCHRAUBE M16-M16X1,5X 35 STUD	CK 35 V
903.01	1	VERSCHLUSSCHRBE G 3/8 A HEXAGON HEAD SCREW PLUG	ST
903.18	2	VERSCHLUSSCHRBE G 3/8 A HEXAGON HEAD SCREW PLUG	ST
903.46	1	VERSCHLUSSCHRBE G 1/4 A HEXAGON HEAD SCREW PLUG	ST

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Figure 25: Drawing R-AP3607C 4.2 of 4

TEILE-NR. PART-NO. REPÈRE	STÜCK PIECE QTE	BENENNUNG DENOMINATION DÉSIGNATION	WERKSTOFF MATERIAL MATÉRIAUX
914.01	3	ZYLINDERSCHRAUBE M 8 X 16 HEXAGON SOCKET HEAD CAP SCREW	8.8
914.02	3	ZYLINDERSCHRAUBE M 8 X 16 HEXAGON SOCKET HEAD CAP SCREW	8.8
920.01	12	6KT-MUTTER M 16 HEXAGON NUT	C 35 N
920.02	4	6KT-MUTTER M 12 HEXAGON NUT	A 4-70
920.04	4	6KT-MUTTER M 16X1,5 HEXAGON NUT	C 35 N
920.21	1	NUTMUTTER KM 7 LOCKNUT	11 H
922	1	LAUFRADMUTTER M16X1,5 IMPELLER NUT	1.4571
930.01	1	FEDERSCHEIBE B 12 SPRING WASHER	FST
931.01	1	SICHERUNGSBLECH MB 7 LOCKWASHER	ST 1203
932.01	1	SICHERUNGSRING 80X2,5 RETAINING RING FOR BORES	FST PHR
932.02	1	SICHERUNGSRING 80X2,5 RETAINING RING FOR BORES	FST PHR
940.01	1	PASSFEDER 8X7X53,5 KEY	C 45 K
940.02	1	PASSFEDER A 10X 8X 56 PARALLEL KEY	C 45 K

CPKGFM 50-250 3-762-523852

INDEX 0 — ÄNDERUNG ALTERATION CORRECTION	DATUM DATE DATE 22.10.90	NAME NAME NOM
NORM STANDARD NORME		
GEPRÜFT APPROVED APPROUVÉ		
BEARB. PREPARED PRÉPARÉ	DATUM DATE DATE	NAME NAME NAME

KSB Pumpen Armaturen

P 3607 C
B 635.562/007
RB 90500.3

BENENNUNG · DENOMINATION · DÉSIGNATION
EINZELTEILVERZEICHNIS
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ERS. FÜR / REPL. FOR | ENTST. AUS/ORIGINAT. FROM

ANZ. D. BLÄTTER NO OF SHEETS FEUILLE NO 3

Figure 26: Drawing R-AP3607C 4.3 of 4