
ENLUSE
Bearing and Equipment Lubrication Strategies - Getting it Right.

What is it and Why Do It?

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Today we talk about

Lubrication Reliability

1. What is it & Why Do It?
2. Proactive Maintenance.
3. Assessments - Getting Started.
4. Management.
5. Implementation .
6. Lubrication Root Cause Failure Analysis

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What is it and Why Do It?

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The Impact.

- Direct effect on reliability!
- Reduces failures!
- Reduces wear!
- Uses less bearings!
- Reduces lube consumption!
- Increases business results!

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What is it and Why Do It?

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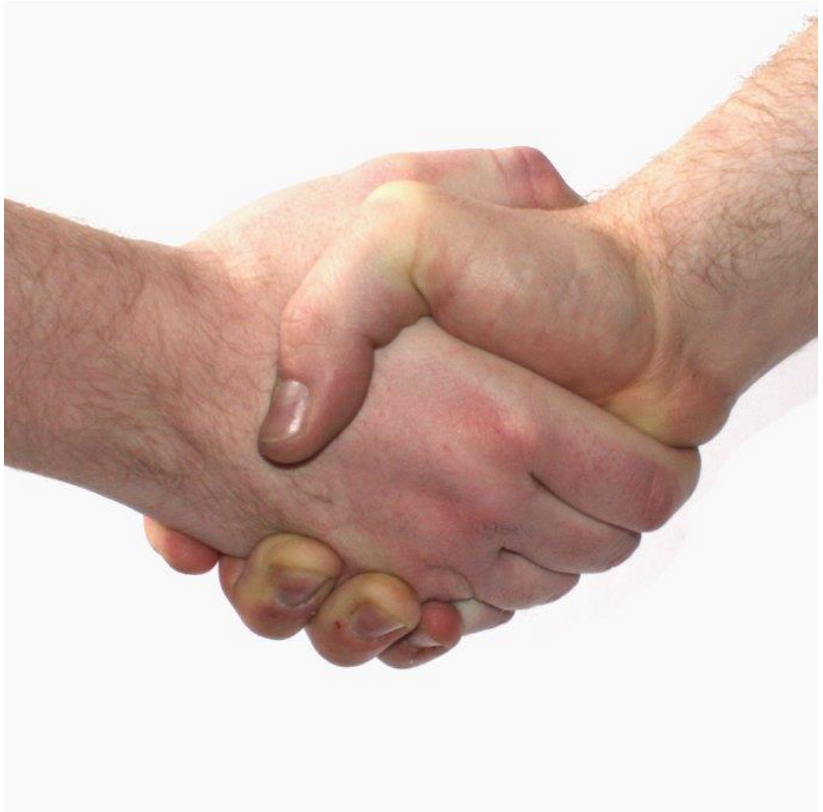
It's Not Easy!

The 6 Lubrication R's

- The *right* Lube.
- The *right* Time.
- The *right* Amount.
- The *right* Way.
- In the *right* Condition.
- Kept in the *right* Condition.



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What is it and Why Do It?

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The Evidence!

Over 60% of bearing failures are lubrication related.

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What is it and Why Do It?

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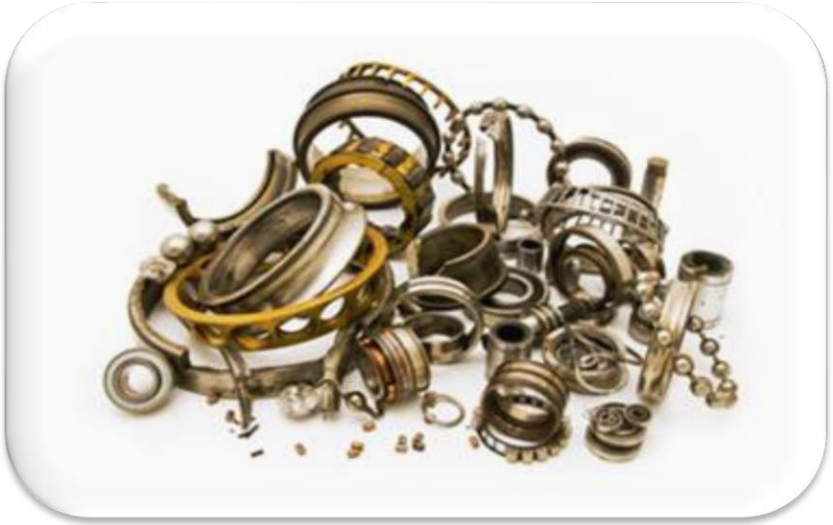
Our own Evidence!

- **Over 60% of bearing failures are lubrication related.**
- **15%** were due to poor **maintenance issues.**
- **5%** were due to **ignorance issues.**
- **15%** The balance (approx) **in good condition**



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What is it and Why Do It?

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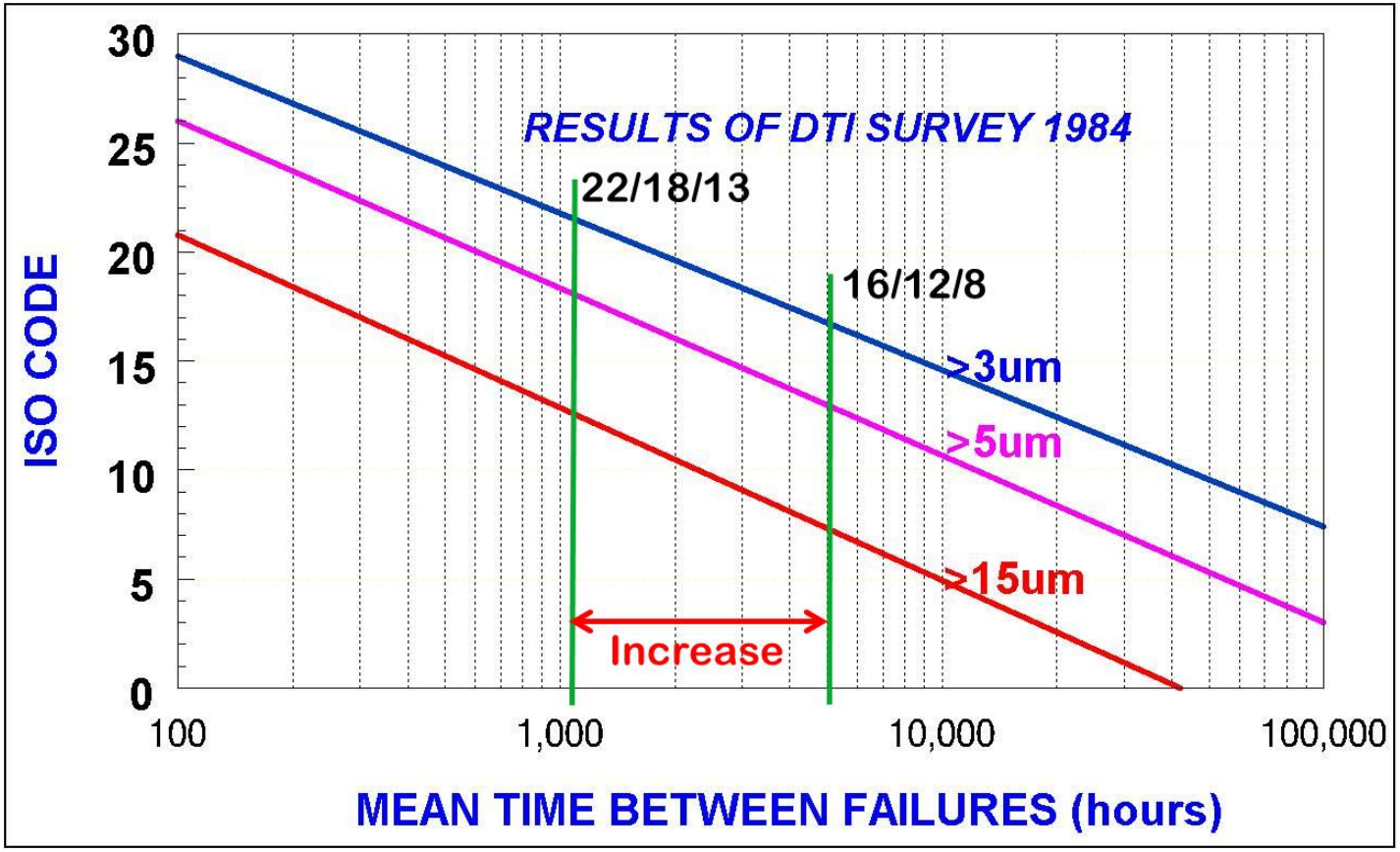
Important Consideration



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What is it and Why Do It?

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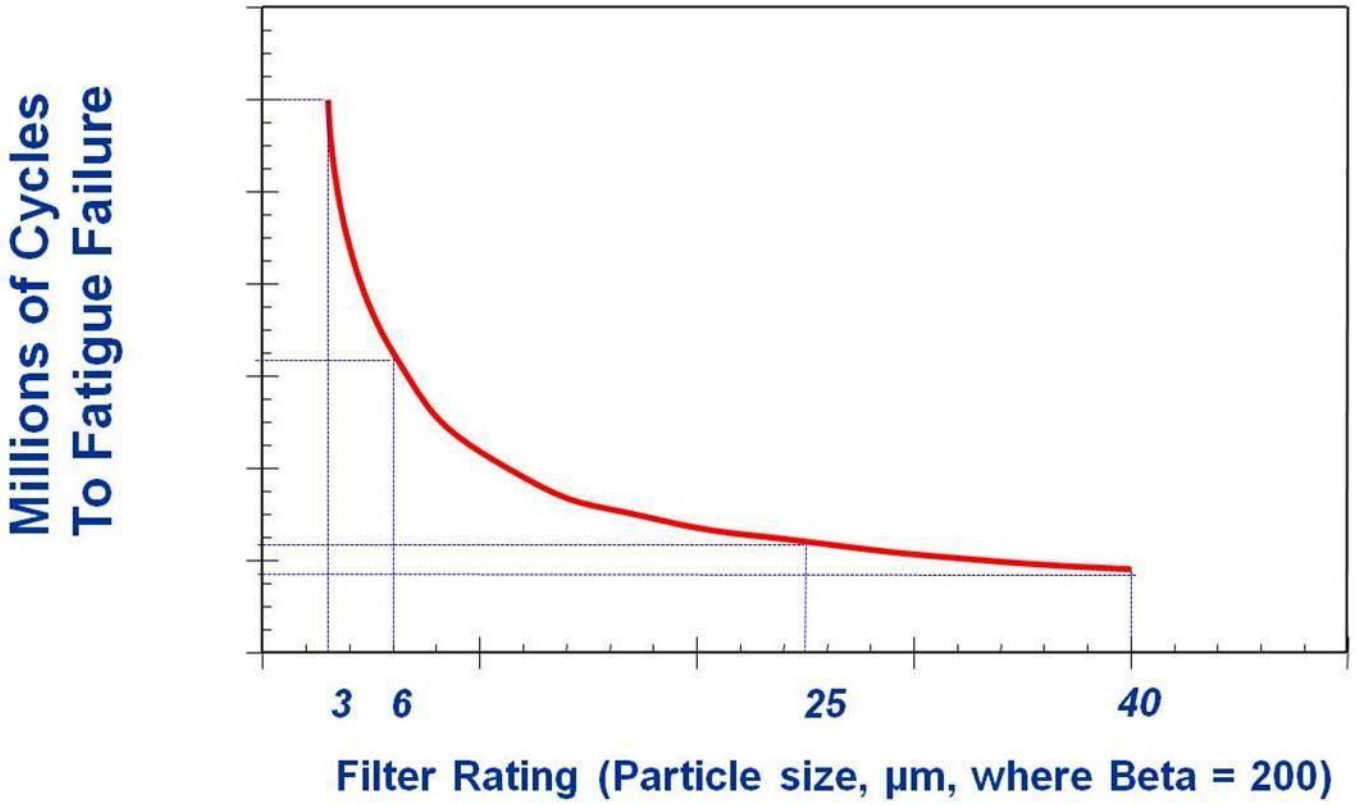
Important Considerations

Ref Dr. D.P. MacPhearson of Westland Helicopters Ltd.



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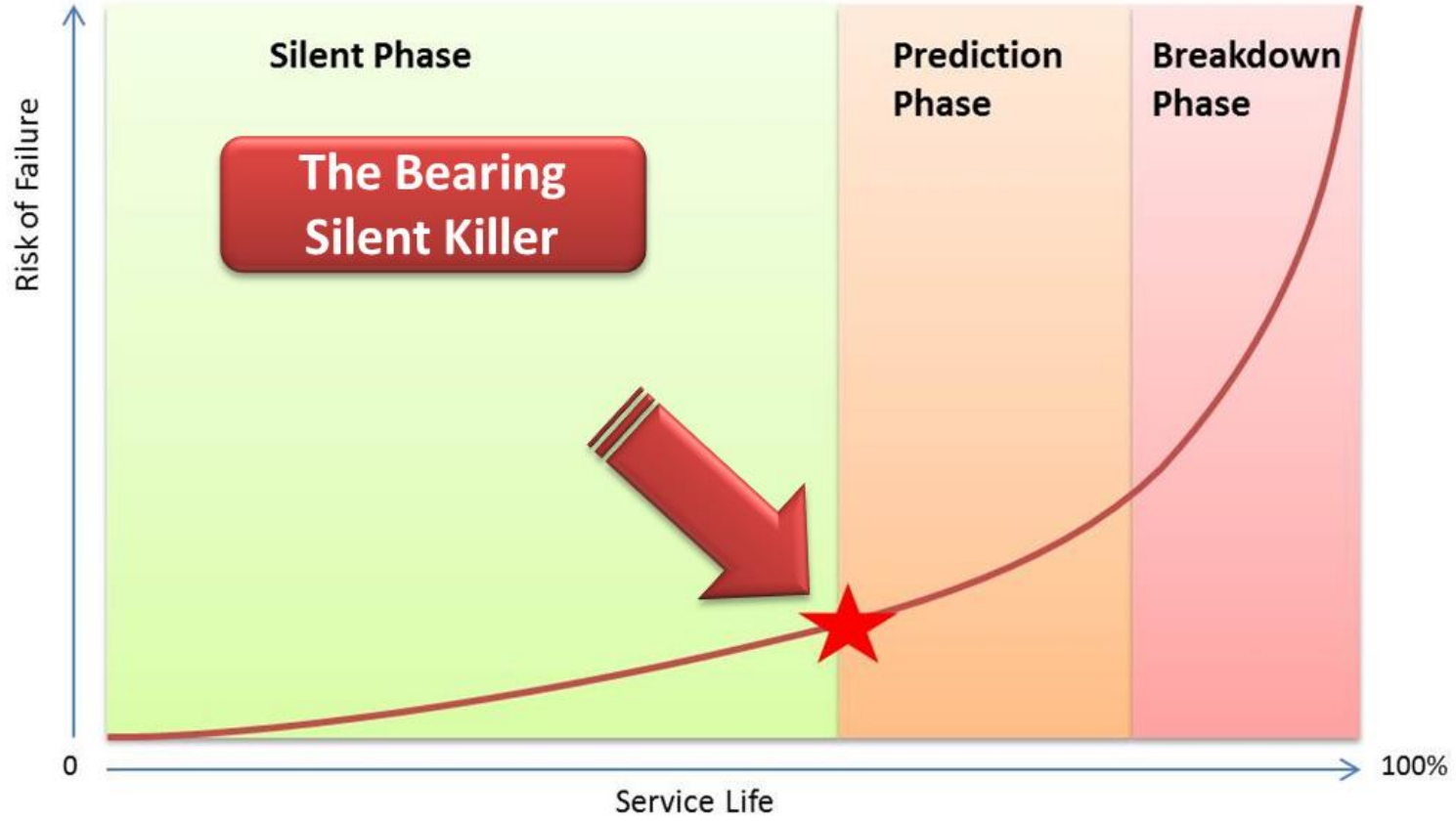
Important Considerations



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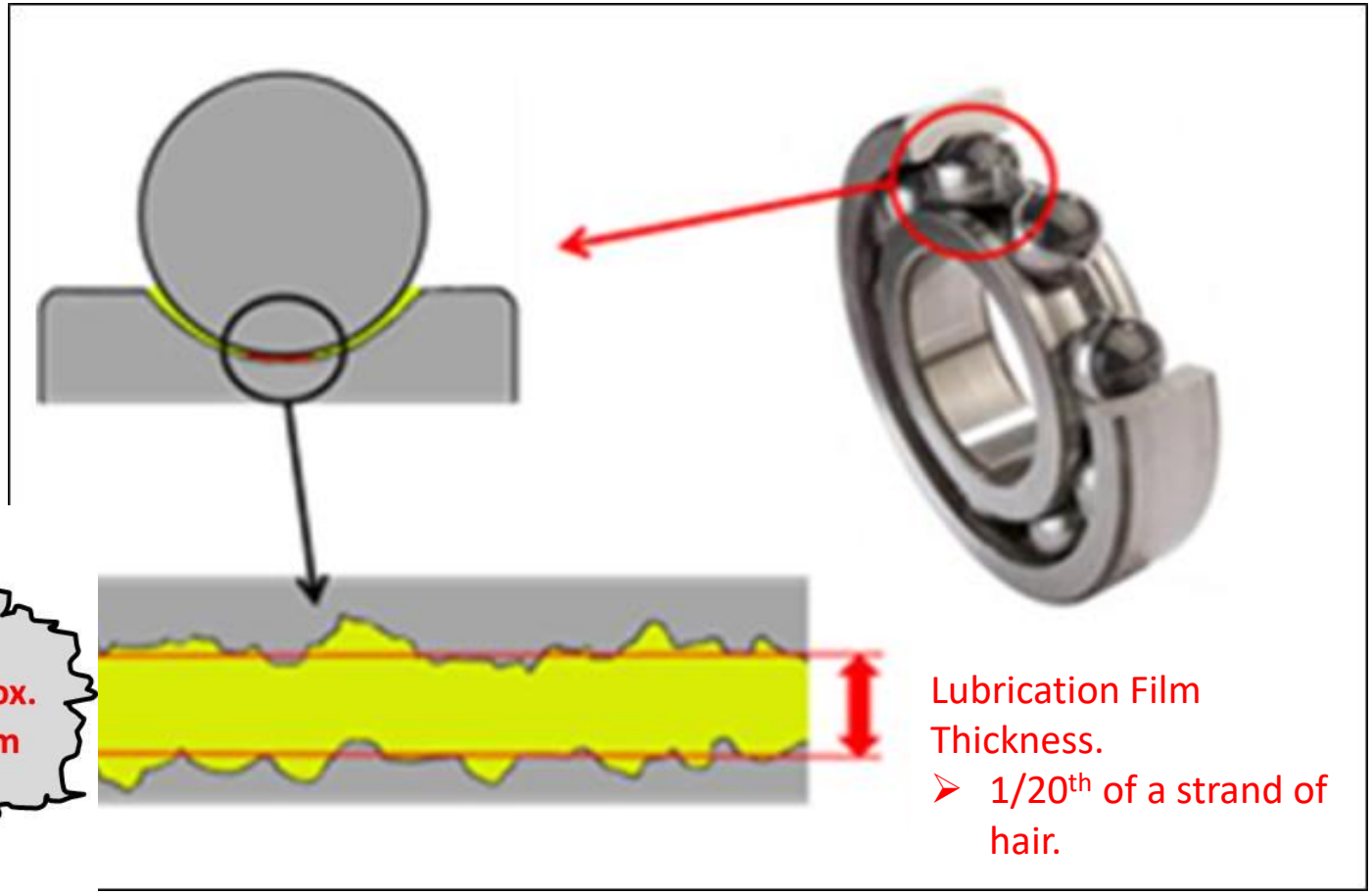
What is it and Why Do It?

Important Considerations



Lubrication Film Thickness.

- 1/20th of a strand of hair.

What is it and Why Do It?

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Lubrication Reliability Summary

1. Lubrication causes bearing damage

2. Bearings are the machine center

3. Lubrication must work reliably

4. Machine reliability will improve

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Lubrication Reliability
Part 2. ProActive Maintenance

ProActive Maintenance

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We Start with The 6 Lubrication Rights.

- Right Lube
- Right Time
- Right Qty
- Right Way
- Right Condition
- Maintained Right

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ProActive Maintenance

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The Right Lube

Many different lubes to select from.

- Different viscosities
- Different additives
- Different brands
- Not all are compatible

Don't allow mixing!

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ProActive Maintenance

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The Right Time

Oil and grease needs to be replenished.

- We might forget
- Outages can interfere
- We may over or under lube
- Frequency is application driven

Don't miss a schedule!

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ProActive Maintenance

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The Right Quantity

Speed, load & temperature defines the quantities needed.

- Don't over lube - heat!
- Don't under lube - starvation!
- Do we measure?
- Grease gun quantities!

Keep the machines fed!

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ProActive Maintenance

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The Right Way

Oil and grease needs to be dispensed correctly.

- No spillage!
- No contamination!
- Quantities measured
- Environmental protection

Satisfy the environment & the machines!

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ProActive Maintenance

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The Right Condition

Dirty or contaminated lube causes wear and damage.

- Use only clean oil
- Clean it in the storeroom
- Unclean containers pass on dirt
- It is a clinical process!

Use only clean lubricants!

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ProActive Maintenance

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Kept in the Right Condition

Oil in machines can become contaminated.

- Poor quality air breathers
- Operational contamination
- Oxidation can occur
- Are we filtering the dirty oil?

Keep operating lube clean!

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ProActive Maintenance

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Important Considerations!

Prediction?

Strategy?

Data Base?

6th R – Maintained in the Right Condition.

- Kept Clean
- Chemically Sound

…. Working Reliably!

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ProActive Maintenance

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Explaining ProActive Maintenance

A process of eliminating failures or problems that could be repetitive.

Based on the Deming Model of Plan, Do, Check and Act

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ProActive Maintenance

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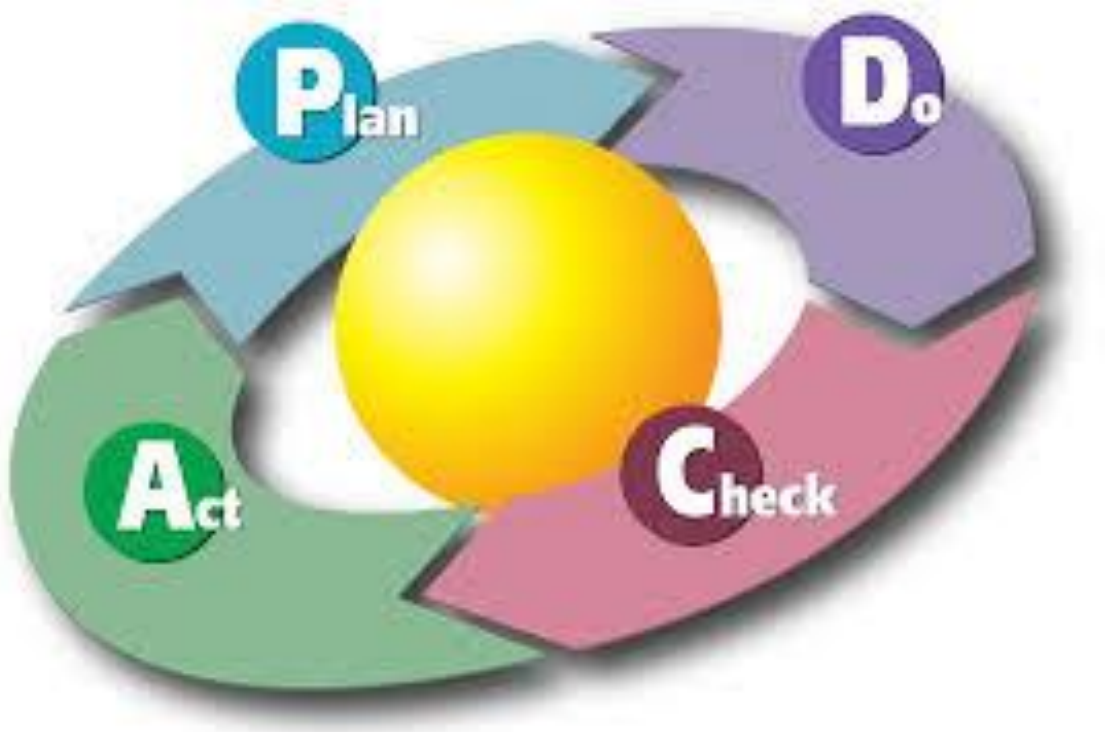
Plan, Do, Check and Act.



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ProActive Maintenance

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Must start with defined standards.

	Oil Analysis					
Line #1	Oilcirculation system	256348	28-feb-05	15/12		19/15
Line #2	Oilcirculation system	256349	14-feb-05	15/12		17/12
Line #3	Oilcirculation system	256350	14-feb-05	15/12		16/13
Line #4	Oilcirculation system	256351	23-feb-05	15/12		na
Line #5	Oilcirculation system	256352	14-feb-05	15/12		15/12
Line #6	Oilcirculation system	256353	14-feb-05	15/12		19/14
Line #7	Oilcirculation system	256354	17-mrt-05	15/12		16/12
Line #8	Oilcirculation system	256355	14-feb-05	15/12		15/11
Line #9	Oilcirculation system	256356	14-feb-05	15/12		17/13
Line #10	Oilcirculation system	256357	14-feb-05	15/12		19/16
Line #11	Oilcirculation system	256358	29-nov-04	11/9		16/12
Line #12	Oilcirculation system	256359	14-feb-05	15/12		14/10
Line #13	Oilcirculation system	256360	15-jul-04	11/9		16/13
Line #14	Oilcirculation system	256361	14-feb-05	15/12		16/12
Line #15	Oilcirculation system	256362	19-nov-04	11/9		17/13
Line #16	Oilcirculation system	256363	14-feb-05	15/12		16/13
Line #17	Oilcirculation system	256364	14-feb-05	15/12		na
Line #18	Oilcirculation system	256365	14-feb-05	15/12		16/12
Line #19	Oilcirculation system	256366	14-feb-05	15/12		15/12
Line #20	Oilcirculation system	256367	14-feb-05	15/12		15/12
Line #21	Oilcirculation system	256368	16-nov-04	11/9		16/13
Line #22	Oilcirculation system	256369	12-aug-04	11/9		16/13
Line #23	Oilcirculation system	256370		11/9		

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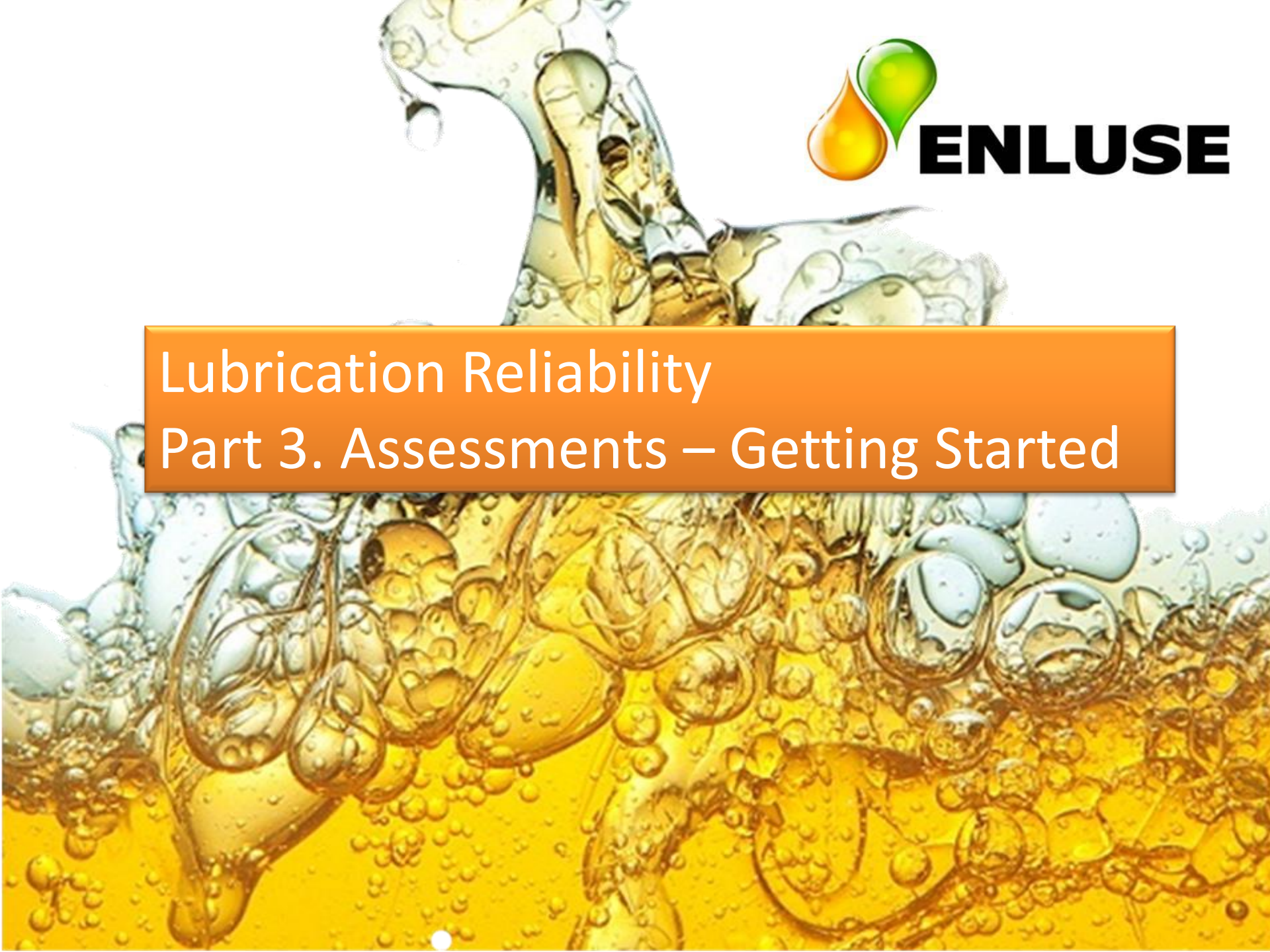

Lubrication Reliability
Part 3. Assessments – Getting Started

Assessments – Getting Started

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Fundementals!

Questions to answer

- Will a better strategy help us with our Reliability?
- Where are we compared to Best Practices?
- What are we doing Right?
- What are we doing Wrong?
- How much will it cost?
- Who will do it - Our self or via a Contractor.

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Assessments – Getting Started

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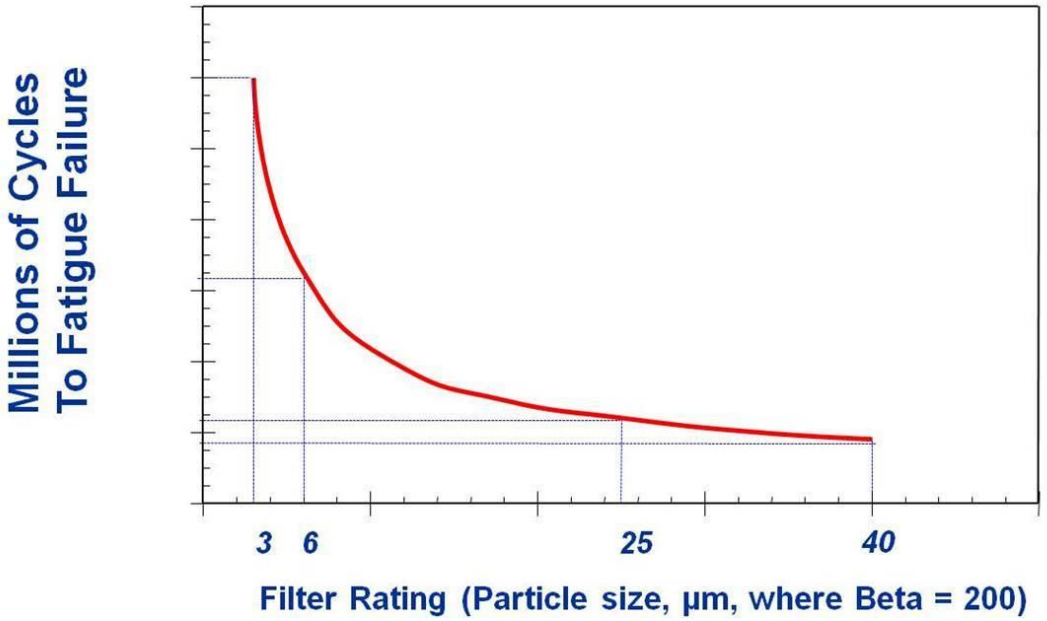
Will a better strategy help us with our Reliability?

Ref Dr. D.P. MacPhearson of Westland Helicopters Ltd.



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Assessments – Getting Started

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Where are we compared to Best Practices?

- Do you have an oil cleanliness standard?
- Do you have KPI's for bearing and Lube consumption?
- Do you apply the 6R's concept to each point?
- Are you doing RCFA on all damaged parts?

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Assessments – Getting Started

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What are we doing Right?

COLOUR	SHAPE	TYPE OF LUBRICANT	NAME OF PRODUCT	NLGI GRADE
RED	#1	Bearing Grease	(Company & product name)	?
BLUE	#2	Bearing Grease EP	(Company & product name)	?
MID GREEN	#3	Ball Mill Trunions	(Company & product name)	?
BLACK	#4	Spindle Grease	(Company & product name)	?
GREY	#5	Mobile Equipment	(Company & product name)	?
PURPLE	#6	Food Grade Grease	(Company & product name)	?
BEIGE	#7	Wire Ropes Grease	(Company & product name)	?
DARK GREEN	#8	Gearbox Grease	(Company & product name)	?
YELLOW	#9	Corrugator Rolls	(Company & product name)	?
ORANGE	#10	High Temperature	(Company & product name)	?

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Assessments – Getting Started

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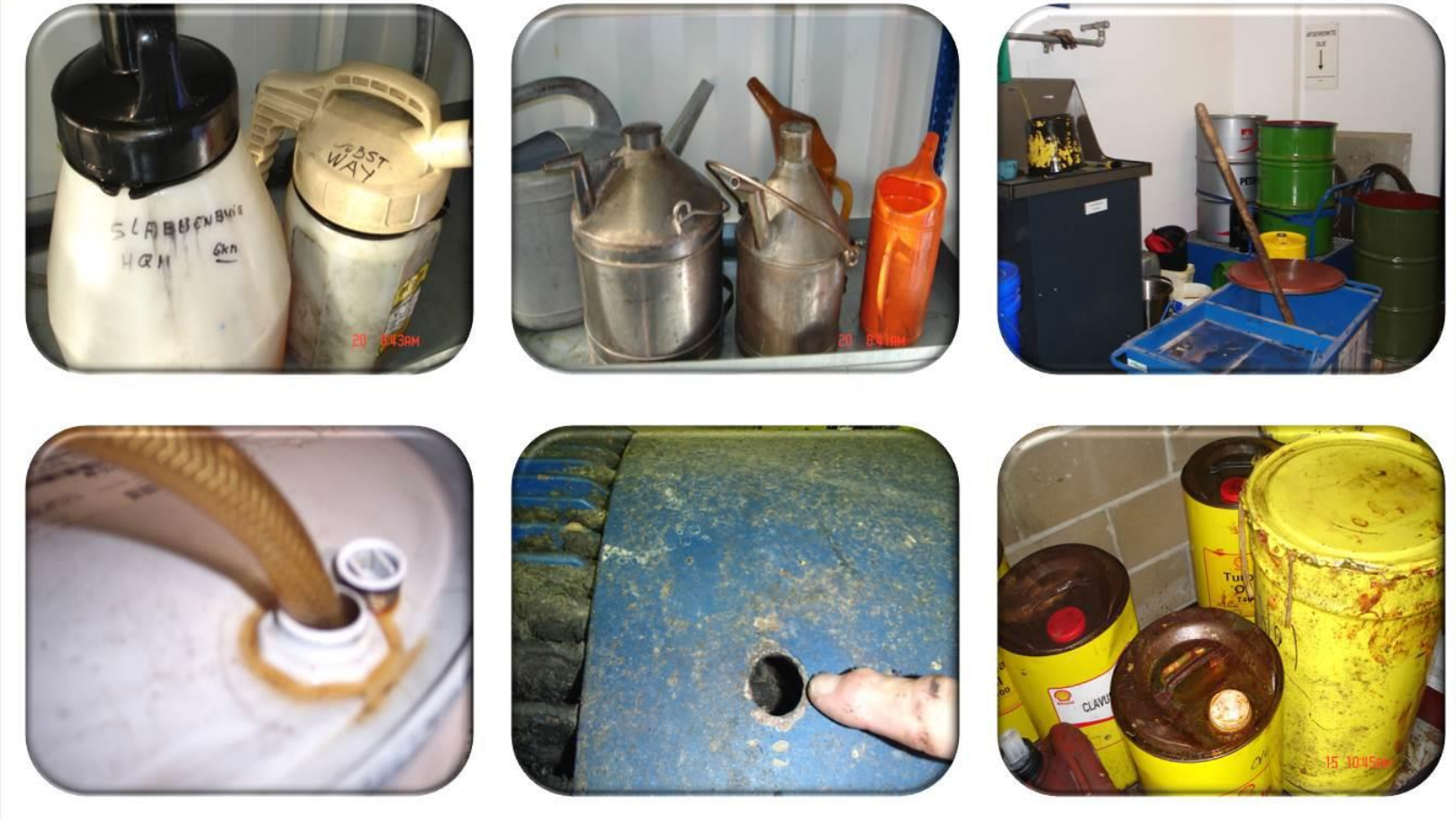
What are we doing Wrong?



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Assessments – Getting Started

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How much will it cost?

Consider it as an Investment.

And

Show the potential R.O.I.

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Assessments – Getting Started

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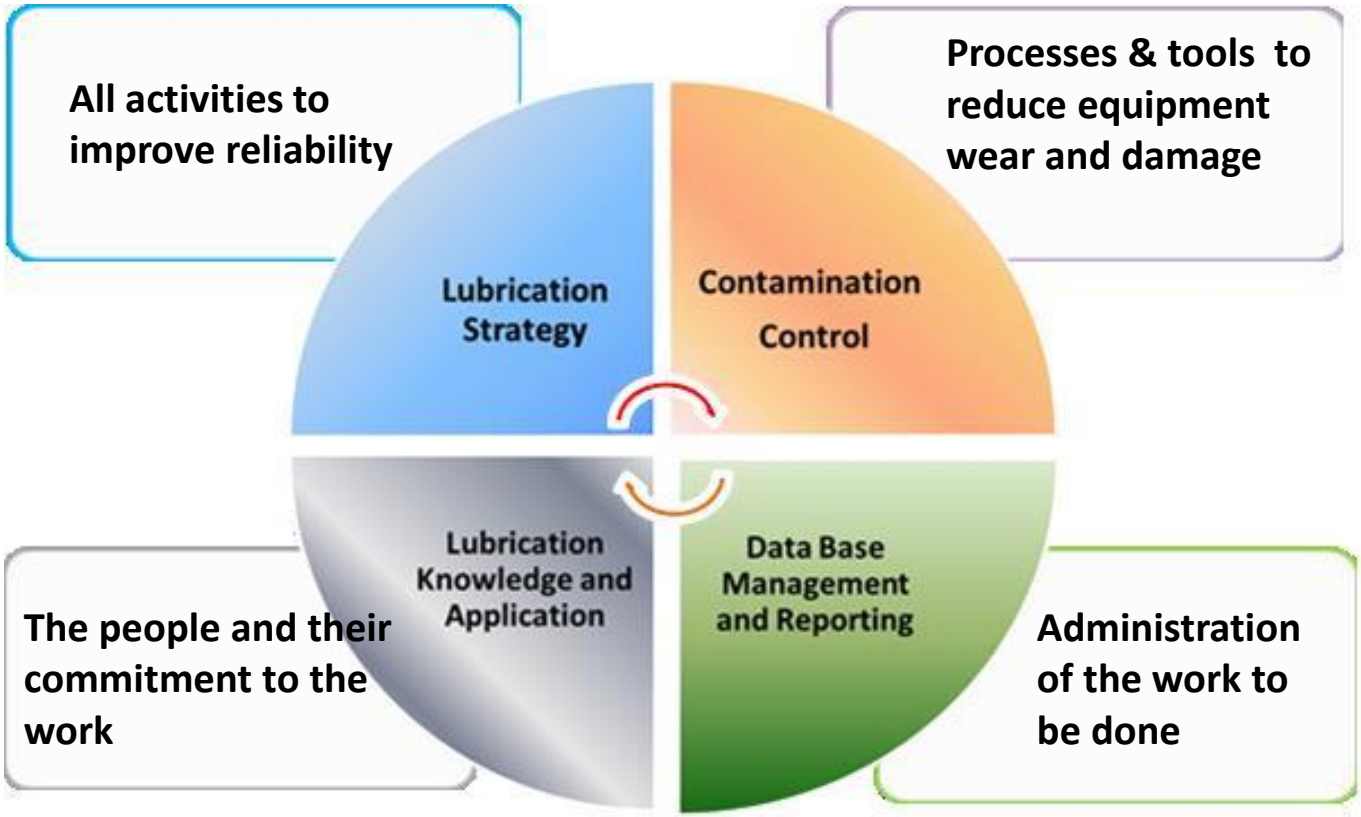
Strategic Parts!



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Assessments – Getting Started

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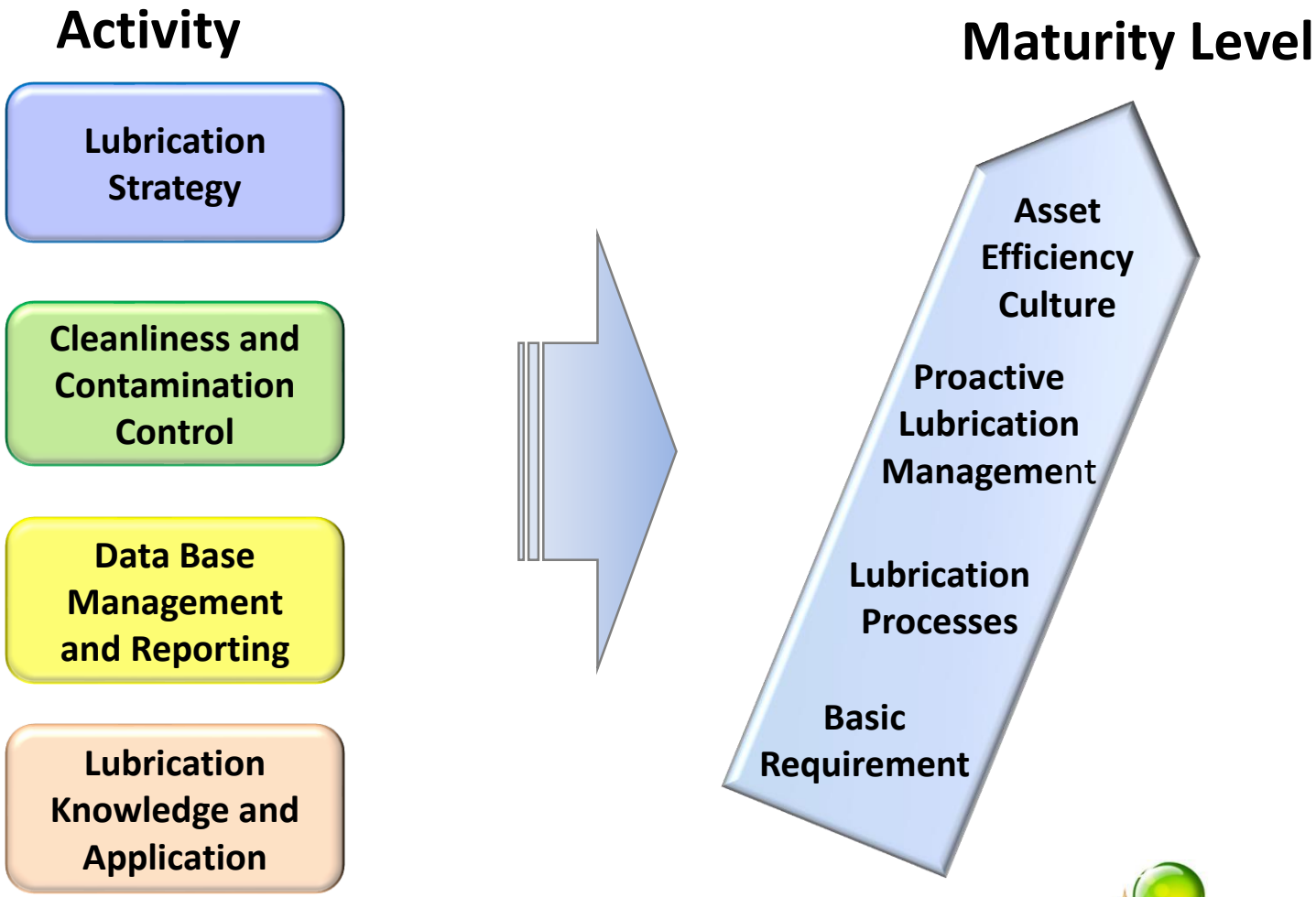
Maturity / Development Levels



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Assessments – Getting Started

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Targets	Lubrication Strategy	Cleanliness & Contamination Control	Data Base Management and Reporting	Lubrication Knowledge & Application
Asset Efficiency Culture	KPI's on Lube Effect to Reliability	Overall Plant Cleanliness Measurements	Integrated and Seamless to CMMS	Measurement of Activity Effectiveness
Proactive Lubrication Management	RCFA on all failed Parts	Oil Analysis and Evaluation	Dedicated Lube Software	Integrated in Reliability Program
Lubrication Processes	Instructions for the Work	Procedures for Reducing Contamination	Maintenance Planning Controls	Trained Staff on Lubrication
Basic Requirement	Dedicated Resources	Lube Room Standards in Place	Data Base Existence	Cost verses Investment in Uptime

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Assessments – Getting Started

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Targets	Lubrication Strategy	Cleanliness & Contamination Control	Data Base Management and Reporting	Lubrication Knowledge & Application
Asset Efficiency Culture	No KPI's on Lube Effect to Reliability	No Plant Cleanliness Measurements	Not Integrated and Seamless to CMMS	No Measurement
Proactive Lubrication Management	No RCFA on all failed Parts	Oil Analysis and Evaluation Started	No Lube Software	Limited Reliability Initiatives
Lubrication Processes	No Instructions for the Work	No procedures for Reducing Contamination	Lube Technician Controls	Staff untrained on Lubrication
Basic Requirement	1 dedicated Resources	No Lube Room Standards	No Data Base Exists	Activity perceived as a cost

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Assessments – Getting Started

Document your Plan


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Lubrication Reliability
Part 4. Management

Management

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Overview

Prediction.
Oil Analysis and
Contamination Control.

Data Base.
How we control the activity.

ROI.
Return on Investment

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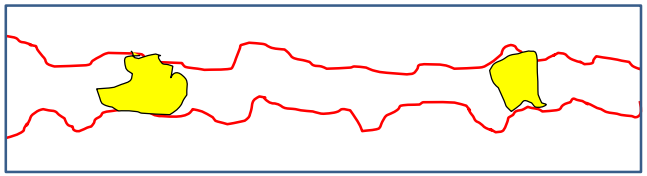
Management

Prediction.
Oil Analysis and Contamination Control.

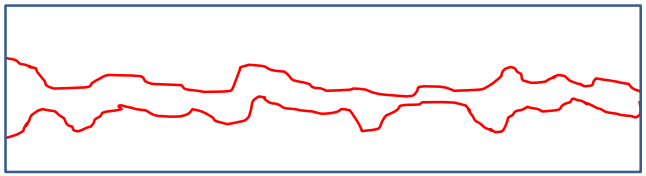
Determining when the lubrication is not working reliably.

Contamination



Oil Analysis

Loss of Lube Film Thickness



Oil Analysis
Vibration
Thermography
Ultra Sonics

Management

Prediction.
Oil Analysis and Contamination Control.

→

Determining when the lubrication is not working reliably.

Oil Analysis

Testing for:-

- Viscosity
- Oxidation
- Water
- Solid contaminants
- Loss of additives

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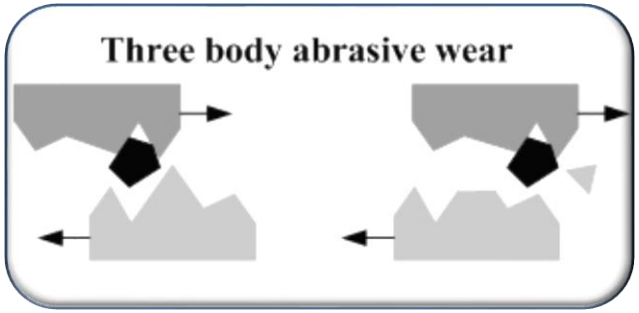
Number 1 cause of damage is 3 Body Abrasive Wear



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Management

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KPI for Oil Cleanliness = ISO 4406

- Shown by 3 numbers (22/18/13)
- Number of particles of 4, 6, and 14 *µm,* in 1 ml of oil.

Example = ISO Code 22/18/13

Larger than 4 *µm* = 22,340

Larger than 6 *µm* = 1,950

Larger than 14 *µm* = 43

Allocation of Particle Count Scale Numbers		
	Particles per milliliter	
ISO Scale Number	More than	Less than
22	20,000	40,000
21	10,000	20,000
20	5,000	10,000
19	2,500	5,000
18	1,300	2,500
17	640	1,300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.25	2.5

Table 2: ISO 4406 Allocation of particle count scale number

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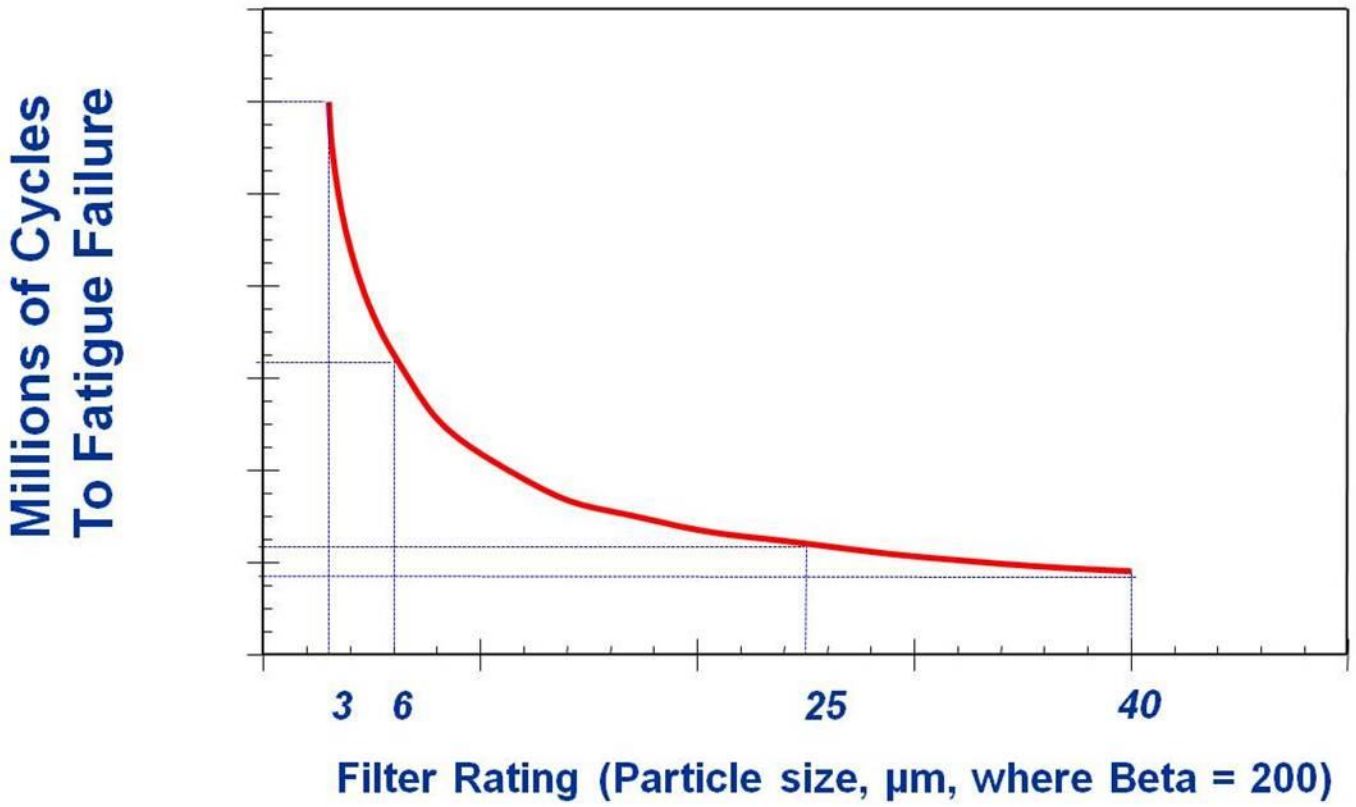
The Effects Of Filtration

Ref Dr. D.P. MacPhearson of Westland Helicopters Ltd.



Management

The Dirty Path of Contamination

Oil arrives on site
ISO 18/16/13

Oil barrel left open
ISO 20/18/15 (4x)

Dirty stick used to check level
21/19/16 (8x)

Oil dispensed in dirty container
ISO 22/20/17 (16x)

Dirty hoses and funnels used
ISO 23/21/18 (32x)

Machine run without protection
ISO 24/22/19 (64x)

WEAR AND FAILURE

How Do Contaminants Accumulate?

ISO Code	4 µm More than	Up to & incl.	6 µm More than	Up to & incl.	14 µm More than	up to & incl.
24/22/19	80,000	160,000	20,000	40,000	2,500	5,000
18/16/13	1,300	2,500	320	640	80	160
16/14/11	320	640	80	160	10	20

250 times less contaminants from 24/22/19 to 16/14/11

Management

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Prevention Mechanisms

Prediction.
Oil Analysis and Contamination Control.

Start with Clean Oil

Clean & Safe Dispensing

Ongoing Filtration

Data Base Management

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Management

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Data Base.
How we control the activity.

Fact!

Most CMMS do not go down into enough details to manage the lubrication activity effectively.

1. **Plant structure**
   - **Plant down to specific point.**
2. **Activity / point**
   - **Lube, Qty, Process, Freq.**
3. **Time based Schedules**
   - **Paper copies or Handheld PC's**
4. **Closing out completed schedules**
5. **Enabling / Disabling points**
6. **Catering for shut down activities**
7. **Managing Routes**
   - **Changing points / responsibilities**
8. **Reporting activities and consumption**

Ease of use

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Management

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Data Base.
How we control the activity.

- Stand Alone
  Vender Specific
- Stand Alone
  Vender Neutral
- Internet Based
  Vender Specific
- Internet Based
  Vender Neutral

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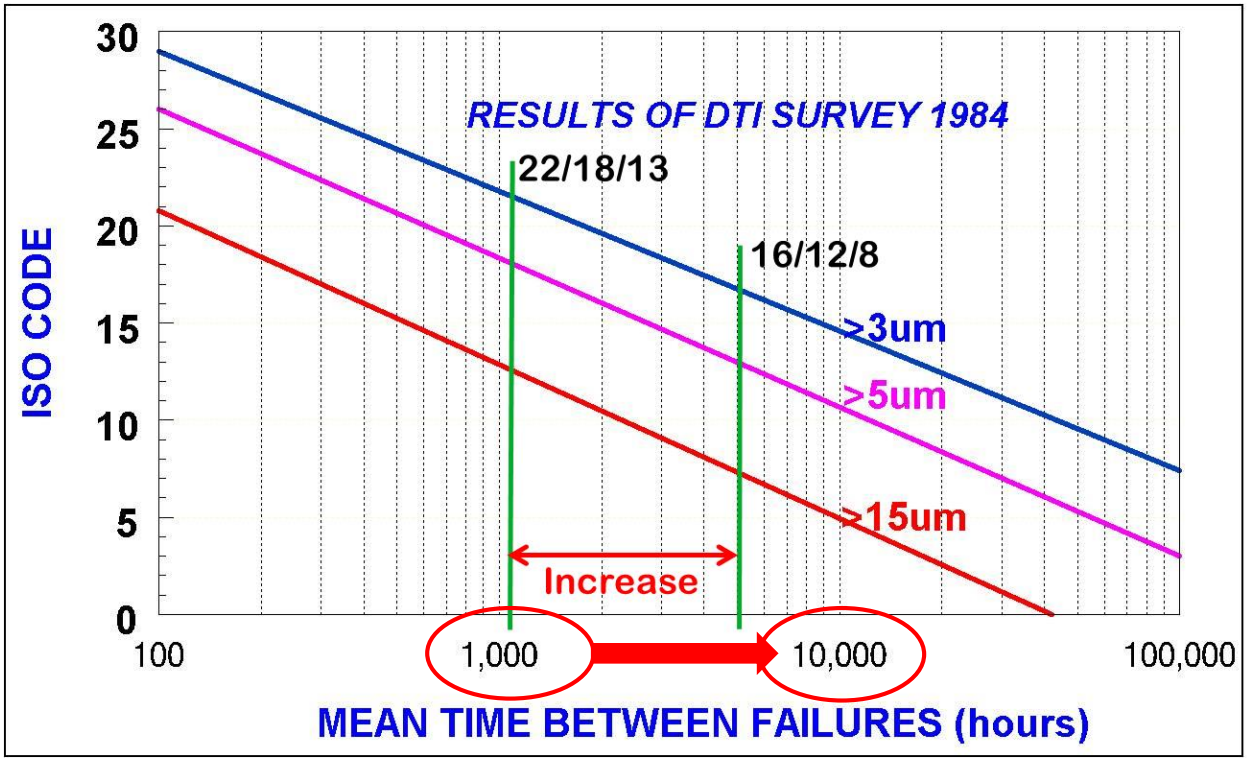
Management

ROI.
Return on Investment



Management

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ROI.
Return on Investment

Port of Tacoma Case Study
Improvements in Cleanliness of Diesel Engines

- From 19/16 ISO code to 15/12 gave a 3 X Life Extension.
- Mean Time Between Engine Rebuilds, from 7,200 hours to 21,000 Hours.

- **5 Year Net Gain = $ 702,391.00**
- **Rate of Return = 662%**
- **Payback Period = 2.04 m**

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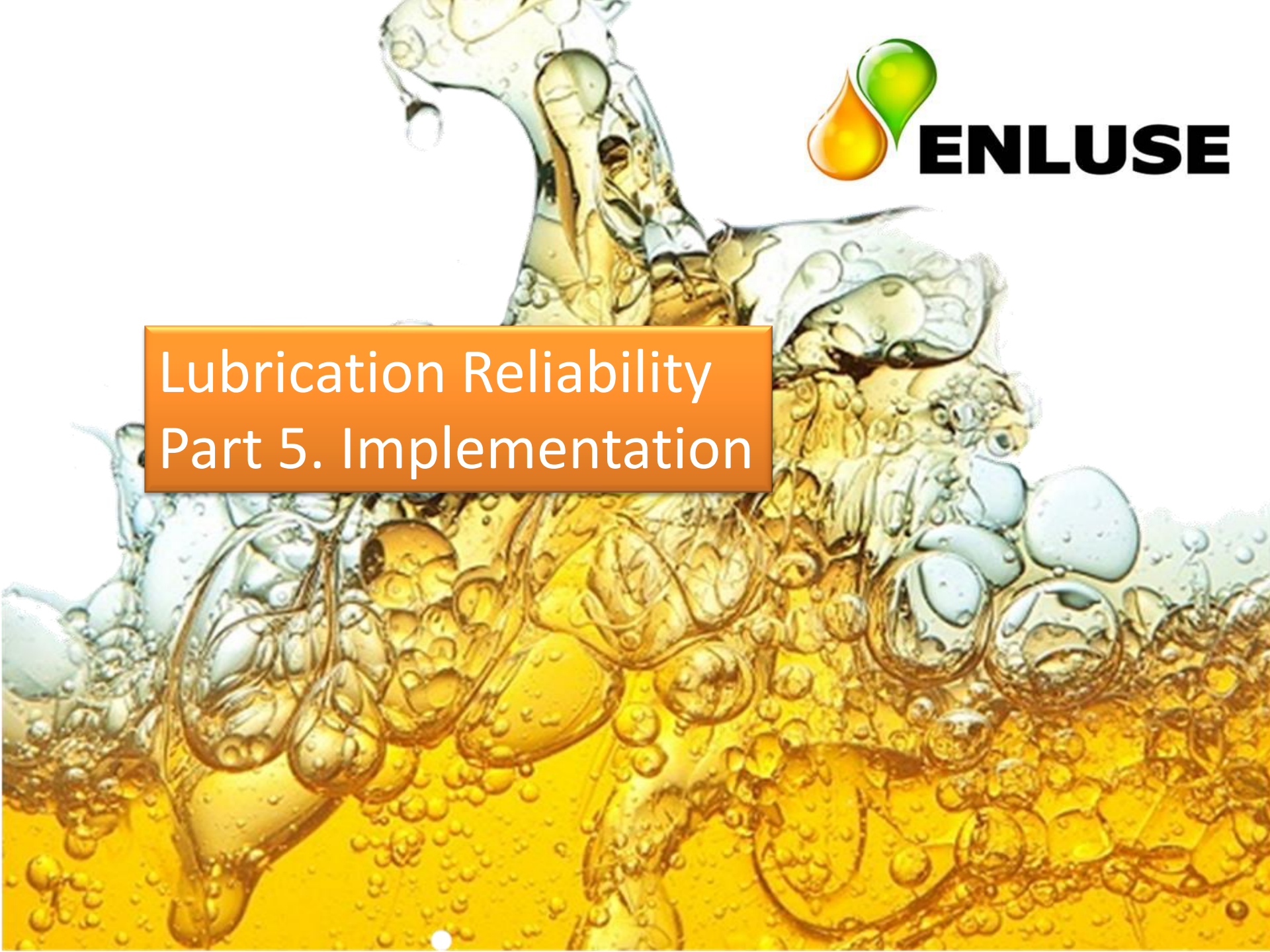
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Lubrication Reliability
Part 5. Implementation

Implementation Plan

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Key Activities

1. Define the lubes and create a colour coded system.
2. Establish and fill a Data Base.
3. Set KPI's for the lubrication activity.
4. Create a clean and dry Lube storage facility.
5. Create a labelling system for storage, dispensing and the machines.
6. Initiate an Oil Analysis program to control the KPI's.
7. Train the key lubrication staff on all facets of lubrication.
8. Fit desiccant breathers to all key oil systems.
9. Establish a filtering system to keep the oil clean.

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Implementation Plan

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The Continual Check List!

We ask ourselves In all planning activities. ***"Will this action ensure that we will always….."***

1. Add the *right* Lube in the right machine?
2. Add it at the *right* time.
3. Add the *right* amount of lube.
4. Done in the *right* way.
5. With it in the *right* condition.
6. And kept in the *right* condition.

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Implementation Plan

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Define the lubes and create a colour coded system.

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The Lubrication Reliability Specialists

Oil LUBRICANT LABELING CONVENTION

COLOUR	SHAPE	TYPE OF LUBRICANT	NAME OF PRODUCT	VISCOSITY
RED	#1 	Gear Box Oil	(Company & product name)	ISO ?
BLUE	#2 	Gear Box Oil	(Company & product name)	ISO ?
MID GREEN	#3 	Hydraulic Oil	(Company & product name)	ISO ?
BLACK	#4 	Hydraulic Oil	(Company & product name)	ISO ?
GREY	#5 	Transmission Oil	(Company & product name)	ISO ?
PURPLE	#6 	Transmission Oil	(Company & product name)	SAE ?
BEIGE	#7 	Compressor Oil	(Company & product name)	ISO ?
DARK GREEN	#8 	General Lube Oil	(Company & product name)	ISO ?
YELLOW	#9 	Turbine Oil	(Company & product name)	ISO ?
ORANGE	#10 	Motor Oil	(Company & product name)	SAE ?

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Implementation Plan

Establish and fill a Data Base.

Start with Key component standards

	Criticality bottum level proces:						
Bottum Level Proces: Line #1 press		Safety	Environment	Quality	Lost Production	M&R-loss	
	Risk	20	16	25	25	25	
Location : 256348	Line #1 press				Equipment nr. :	F 6749	
Maintainable unit :	Oil circulation system						
proces- & design information							
Medium :	Fuchs DS16 AYT				Cleanliness :	15//12	
Flow :	l/min				Water :	100 ppm	
Viscosity :	68cSt @ 40°C				System pressure :	60 bar	
Temperature :	50°C				Tank :	800 liter	
Failure modes:							Maintenance concepts
Cleanliness > 15/12	Risk	2	4	12	16	15	1 Monthly oilsampling
Oilpressure < 60 bar	Risk	10	8	16	16	15	2 Yearly calibration pr.switch
Oilpressure > 60 bar	Risk	10	12	16	16	15	3 Yearly calibration pr.switch
Water > 100 ppm	Risk	2	4	12	16	15	4 Monthly oilsampling
Analyse results	http://www.fuchs.isl/customer/256348						
Fuchs Analysis number : 256348	951085						
Analyse Freq :	1 mnd						
Filter sparepartnumber :	CMMS256348						

Implementation Plan

Establish and fill a Data Base.
Key Information.

Building ID
Route ID
Point ID
Lube ID and colour
Frequency Of lubrication
Quantity of lube to be added
Lubrication Schedule

Special Instruction
How to lube
Cleaning
Oil Analysis
Inspection
Filtering

Implementation Plan

Create a clean and dry Lube storage facility.

Implementation Plan

Set KPI's for the lubrication activity.

- Oil Cleanliness levels per application.
- Lubrication Consumption
- Bearing Consumption.
- 100% of achieved schedule.
- 100% of RCFA on damages.

Implementation Plan

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Create a labelling system for storage, dispensing and the machines.

ENLUSE
The Lubrication Reliability Specialists

Your company name and logo can go here

Your chart name can go here

Oil LUBRICANT LABELING CONVENTION

COLOUR	SHAPE	TYPE OF LUBRICANT	NAME OF PRODUCT	VISCOSITY
RED	#1	Gear Box Oil	(Company & product name)	ISO ?
BLUE	#2	Gear Box Oil	(Company & product name)	ISO ?
MID GREEN	#3	Hydraulic Oil	(Company & product name)	ISO ?
BLACK	#4	Hydraulic Oil	(Company & product name)	ISO ?
GREY	#5	Transmission Oil	(Company & product name)	ISO ?
PURPLE	#6	Transmission Oil	(Company & product name)	SAE ?
BEIGE	#7	Compressor Oil	(Company & product name)	ISO ?
DARK GREEN	#8	General Lube Oil	(Company & product name)	ISO ?
YELLOW	#9	Turbine Oil	(Company & product name)	ISO ?
ORANGE	#10	Motor Oil	(Company & product name)	SAE ?

Optional Info Box
I.e. MSDS are located in storage cabinet

Note any shape can be any colour

ENLUSE

Implementation Plan

Initiate an Oil Analysis program to control the KPI’s.

Implementation Plan

Train the key lubrication staff on all facets of lubrication.

Implementation Plan

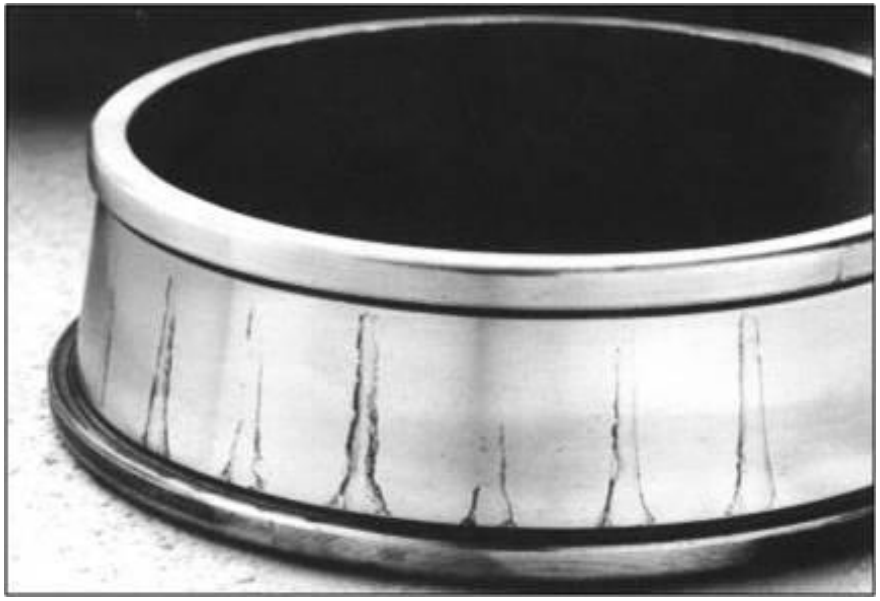
Fit desiccant breathers to all key oil systems. .

Implementation Plan

Establish a filtering system to keep the oil clean.

Implementation Plan

Train the staff on bearing Failure analysis.



Implementation Plan

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And finally to be innovative

LustorSystem

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