

C Code : 29134002  
 U Name : Thai Aviation Services Limited  
 T Address : Nakhon Si Thammarat Base, Thailand  
 O Site :  
 M Location :  
 E Test code : 874

E Unit ID : **HS HVF A231 00624 Main Gearbox**  
 Q Unit Type : Gearbox Reduction  
 I Unit Make : SIKORSKY  
 P Unit Model : S76D  
 M Oil type / Viscosity : MOBIL 1 ATF  
 L Oil System Capacity : 11.51 Liters



### Notes (Finding, Evaluation, Interpretation, Suggestion and Recommendation)

Note elemental analysis is showing diirt and abrasive wear.

Note large fatigue particles starting to appear.

Recommend check for other abnormal operating parameters, i.e., vibration, noise, heat etc. If abnormal condition exists, please inform laboratory with next sample.

Recommend RESAMPLE this component again, immediately upon receipt of this report, to monitor the abnormalities closely.

Andy Sitton

			Current Sample			Previous Sample						Baseline and Alarm Limit					
Condition History			Wear	Oil	Cont.	Wear	Oil	Cont.	Wear	Oil	Cont.	B A S E L I N E	Alarm Limit				
			W	W	C	W	C	C	N	C	C		Alarm Limit Matrix -Set Name (Equipment type / oil type)				
Lab ID			406529			395822			392637				Gearbox Main Sikorsky ASB766649 Mobil 1 ATF				
Bottle ID			1185644			1085619			1085602								
Date Sampled			16-Feb-18			11-Nov-17			17-Oct-17								
Oil Hours (Kms)			582.5			215.28			117.31								
Unit Hours (Kms)			1739.63			1372.38			1274.41								
Oil Change																	
Oil Added (Liters)																	
Filters Hours (Kms)						215.28			117.31								
Wear Condition												The New Oil (TNO)	Fine Wear (RDE)		Coarse Wear (RFS)		
Wear Element	Method	Unit	Fine Wear (RDE)	Coarse Wear (RFS)	Fine Wear (RDE)	Coarse Wear (RFS)	Fine Wear (RDE)	Coarse Wear (RFS)	The New Oil (TNO)	U-Caution	U-Warning		U-Caution	U-Warning			
Iron	D-6595	PPM	25.9 C	0.0	14.2	0.1	10.7	0.1	0	>25	>35	>13	>20				
Chromium	D-6595	PPM	2.1	0.0	1.3	0.1	0.9	0.3	0	>4	>7	>2	>4				
Lead	D-6595	PPM	0.7	0.0	0.5	0.1	0.9	0.1	0	>1	>2	>1	>2				
Copper	D-6595	PPM	6.2	0.1	2.2	0.4	1.7	0.3	0	>11	>15	>4	>7				
Tin	D-6595	PPM	0.7	0.0	2.3	0.1	2.5	0.1	0	>3	>4	>1	>2				
Aluminum	D-6595	PPM	1.1	0.0	1.2	0.1	0.3	0.1	0	>2	>3	>2	>3				
Nickel	D-6595	PPM	1.2 C	0.0	2.1 W	0.1	0.3	0.1	0	>1	>2	>1	>2				
Silver	D-6595	PPM	6.3 W	0.1	3.3	0.7	3.4	0.4	0	>4	>6	>1	>2				
Molybdenum	D-6595	PPM	0.0	0.0	26.4 W	0.1	1.5	0.1	0	>2	>3	>1	>2				
Titanium	D-6595	PPM	0.1	0.0	0.6	0.1	0.0	0.1	0	>1	>15	>1	>2				
Oil Condition												TNO	L-Warning	L-Caution	U-Caution	U-Warning	
Viscosity @ 40°C	D-445	cSt							6.3 C			7.5	<6.3	<6.7	>7.8	>8.3	
Viscosity @ 100°C	D-445	cSt	6.0 W			6.2 W											
Oxidation	E-2412M	Abs															
Nitration	E-2412M	Abs															
TAN	D-974	mg KOH/g	2.17			1.78			1.98			2.10		>2.5	>3		
TBN	D-4739	mg KOH/g															
Contamination												TNO			U-Caution	U-Warning	
Water	T-H2O	% (Wt.)	0.033			0.038			0.083			0.050			>0.1	>0.15	
Sodium	D-6595	PPM	6			4			6			0					
Silicon	D-6595	PPM	16.4 *			26.1 C			5.2			9.0	2.6	>22	>31	>24	>40
Additive Element												TNO					
Boron	D-6595	PPM	260			282			271			308					
Magnesium	D-6595	PPM	13			6			4			0					
Calcium	D-6595	PPM	161			94			117			132					
Barium	D-6595	PPM	0			0			0			0					
Phosphorus	D-6595	PPM	497			655			557			574					
Zinc	D-6595	PPM	3			0			2			0	0				
Additional Test												TNO	L-Caution	L-Warning	U-Caution	U-Warning	
Flash Point	D-3828	°C															
Viscosity Index	D-2270																

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline.

No Sign or : NORMAL , C or : CAUTION (first level warning limit) , W or : Warning (second level warning limit)

Accuracy of interpretation and recommendation are based on representatives sample and information supplied.

No warranty is expressed or implied for this report.

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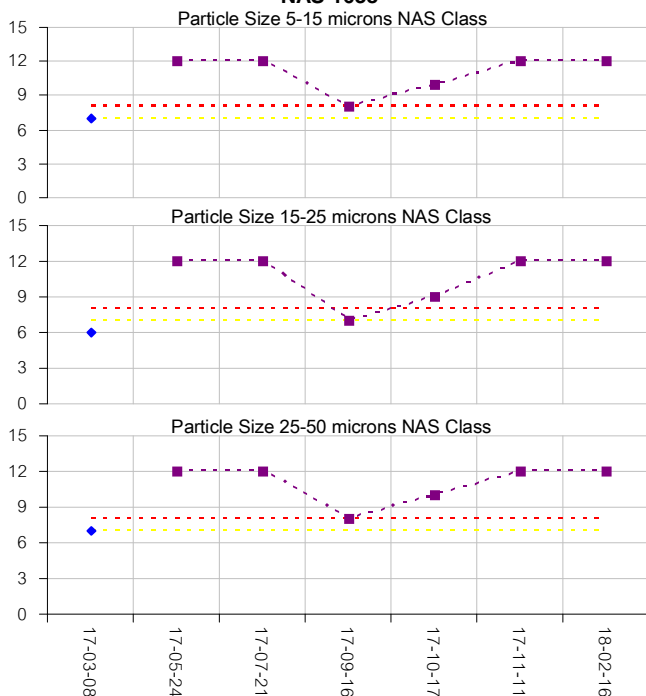
E  
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Unit ID : **HS HVF A231 00624 Main Gearbox**  
Unit Type : Gearbox Reduction  
Unit Make : SIKORSKY  
Unit Model : S76D  
  
Oil type / Viscosity : MOBIL 1 ATF  
Oil System Capacity : 11.51 Liters

**Notes (Finding, Evaluation, Interpretation, Suggestion and Recommendation)**

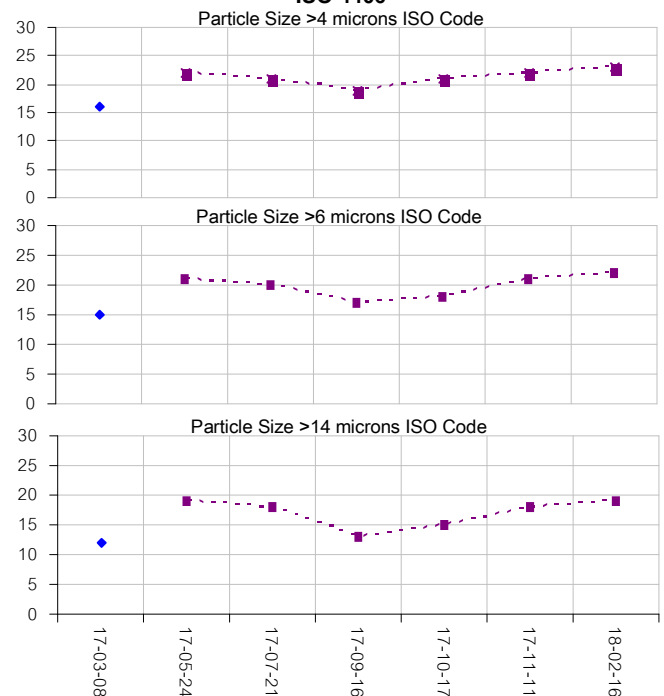
Particle count indicates that oil cleanliness level is above Alarm Limits range. ( Cleanliness Target )  
Contamination levels need to be improved to meet reliability objectives, targets and goals.

Lab ID Bottle ID Date Sampled Oil Hours (Kms) Unit Hours (Kms) Oil Change Oil Added (Liters) Filters Hours (Kms) PC Method	Current Sample		Previous Sample				Particle Count		NAS 1638 ISO 4406		
	406529		395822		392637		BASELINE	Alarm Limit          Gearbox Main Sikorsky ASB766649 Mobil 1 ATF			
	1185644		1085619		1085602						
	16-Feb-18		11-Nov-17		17-Oct-17						
	582.5		215.28		117.31						
	1739.63		1372.38		1274.41						
Contamination											
Particle Count NAS 1638 System Standard											
							U-Caution		U-Warning		
Particle Size Range	No. of Particles / 100ml.	Class	No. of Particles / 100ml.	Class	No. of Particles / 100ml.	Class	Class	No. of Particles / 100ml.	Class	No. of Particles / 100ml.	Class
Particle Size 5-15 microns	1,711,700	12 W	1,220,700	12 W	161,300	10 W		>16000	7	>32000	8
Particle Size 15-25 microns	269,680	12 W	135,400	12 W	18,300	9 W		>2850	7	>5700	8
Particle Size 25-50 microns	41,090	12 W	33,600	12 W	6,200	10 W		>506	7	>1012	8
Particle Size 50-100 microns	1,390	10	2,300	11	800	10					
Particle Size >100 microns	40	8	200	10	100	9					
Particle Count ISO 4406:1999 System Standard											
Particle Size Range	No. of Particles / ml.	Class	No. of Particles / ml.	Class	No. of Particles / ml.	Class	Class	No. of Particles / ml.	Class	No. of Particles / ml.	Class
Particle Size > 4 microns	42,478	23	25,840	22	11,711	21					
Particle Size > 6 microns	20,239	22	13,922	21	1,867	18					
Particle Size > 14 microns	3,122	19	1,715	18	254	15					
ISO 4406 Class Rating	23/22/19		22/21/18		21/18/15						

**NAS 1638**



**ISO 4406**


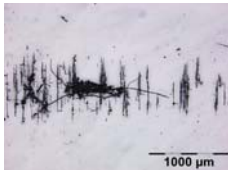
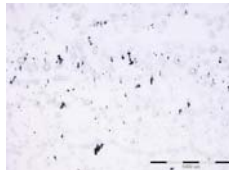
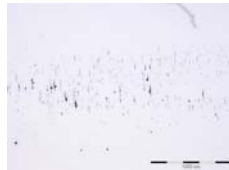
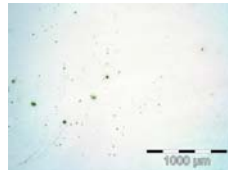
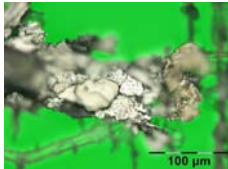
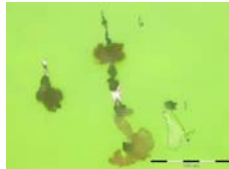
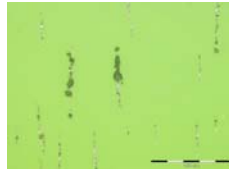
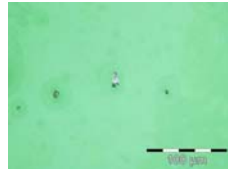
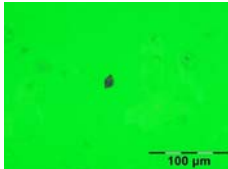
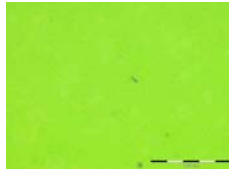
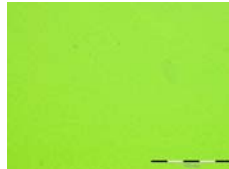
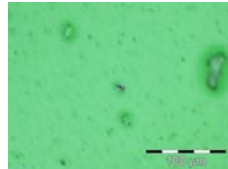


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E Q U I P M E N T  
 Unit ID : **HS HVF A231 00624 Main Gearbox**  
 Unit Type : Gearbox Reduction  
 Unit Make : SIKORSKY  
 Unit Model : S76D  
 Oil type / Viscosity : MOBIL 1 ATF  
 Oil System Capacity : 11.51 Liters

**Notes (Finding, Evaluation, Interpretation, Suggestion and Recommendation)**

Amount of visible ferrous particles, is cautionary, compared to the other similar samples.  
 Fatigue particles found in the ferrogram may be an indication of the dirt related fatigue wear.  
 Recommend check for other abnormal operating parameters to monitor and confirm the abnormalities closely.

	Current Sample			Previous Sample					
Lab ID	406529			395822			<div></div> <div>ASTM D 7690 M</div>		
Bottle ID	1185644			1085619					
Date Sampled	16-Feb-18			11-Nov-17					
Oil Hours (Kms)	582.5			215.28					
Unit Hours (Kms)	1739.63			1372.38					
Oil Change									
Oil Added (Liters)									
Filters Hours (Kms)				215.28		117.31			
Wear Condition									
Ferrographic Analysis							Typical Normal Condition		
Volume of Sample Used	3.00	ml		3.00	ml	3.00	3	ml	
Image of Wear & Contaminant (Ferrogram) Magnification 50X									
Image of Wear & Contaminant (Ferrogram) Magnification 500X									
Image of Wear & Contaminant (Filtergram) Magnification 500X									
Wear & Contaminants Particles	%Rating	Size (Micron)	Particle Type	%Rating	Size (Micron)	Particle Type	%Rating	Size (Micron)	Particle Type
Normal Rubbing Wear	60	2-3	1	70	2-3	1	80	2-3	1
Fatigue Gear Wear	25	5-40	1	10	5-15	1	10	5-10	1
Fatigue Bearing Wear									
Fatigue Sphere									
Severe Sliding Wear									
Cutting Wear									
Black Oxides	5	5-20	1	5	5-15	1	5	5-10	1
Red Oxides									
Corrosive Wear									
Dirt and Dust	10	10-60	3	15	10-60	3	5	10-40	3
Copper									
White Metal									
Ferrographic Analysis Rating (FAR) rating in grade	A B C D F			A B C D F			A B C D F		

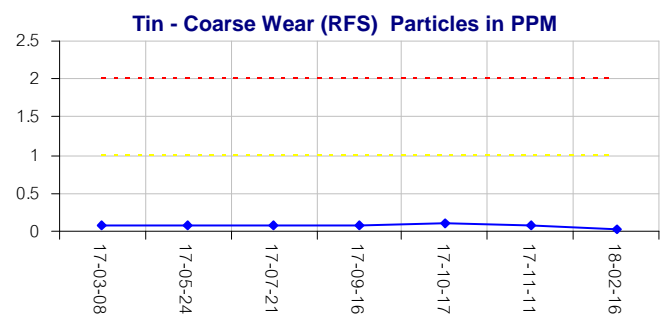
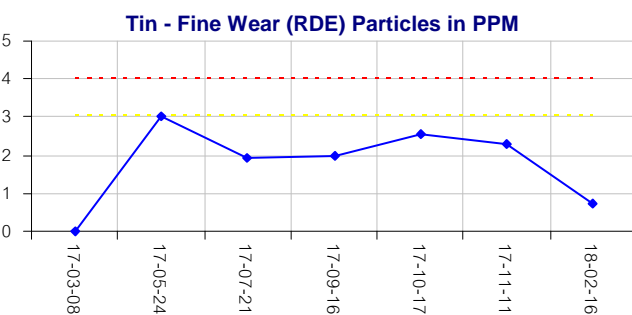
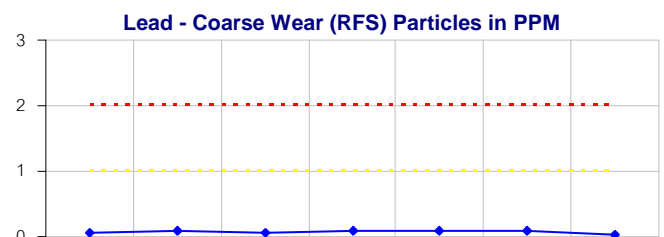
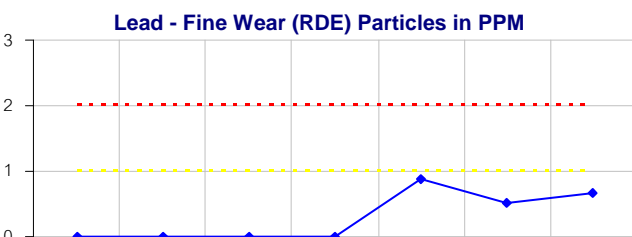
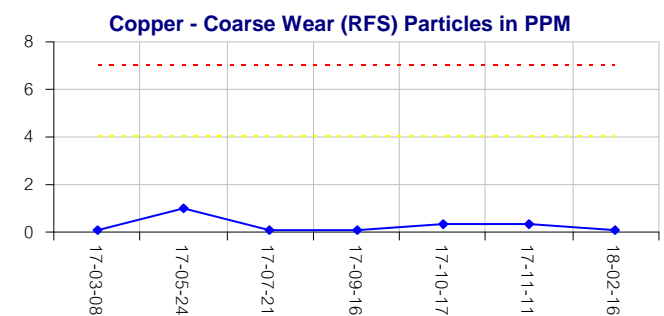
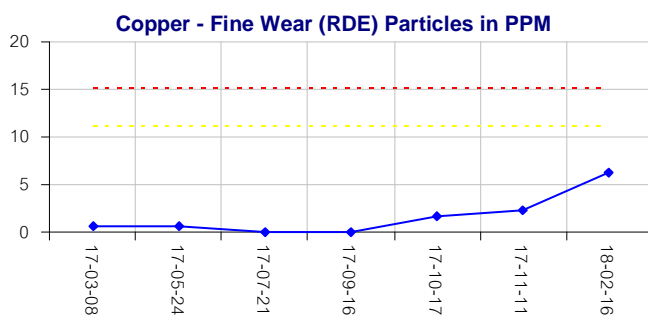
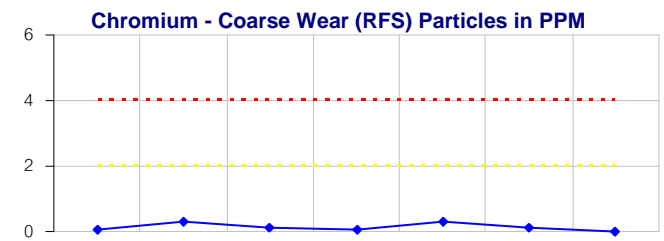
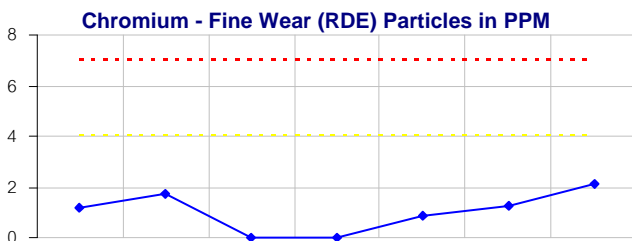
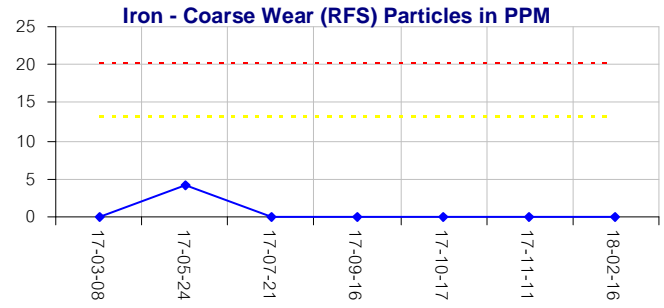
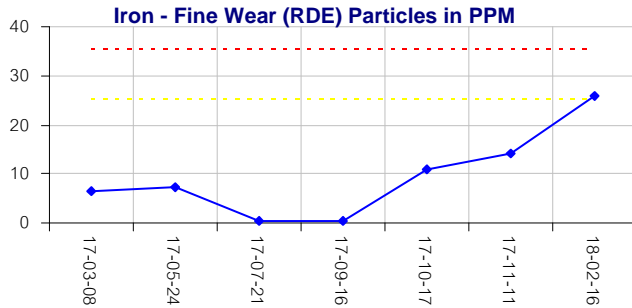
%Rating : Percent area covered by wear debris particles or contaminant particles.  
 Size : Size in micron unit (0.001 mm)  
 Particle Type :  
 1: Ferrous Wear Particles  
 2: Non-ferrous Wear Particles  
 3: Contamination Particles  
 3.1: Fibers  
 1.1: Low Alloy 1.2: Medium Alloy 1.3: High Alloy 1.4: Case Hardened  
 2.1: Copper 2.2: White Metal 2.3: Babbiting

**Ferrographic Analysis Rating (FAR) , rating in grade**  
 A : Excellent - normal rubbing wear condition  
 B : Good - normal rubbing wear condition  
 C : Fair or moderate - normal rubbing wear condition  
 D : Severe and/or critical - wear condition  
 F : Extreme severe and/or extreme critical - wear condition

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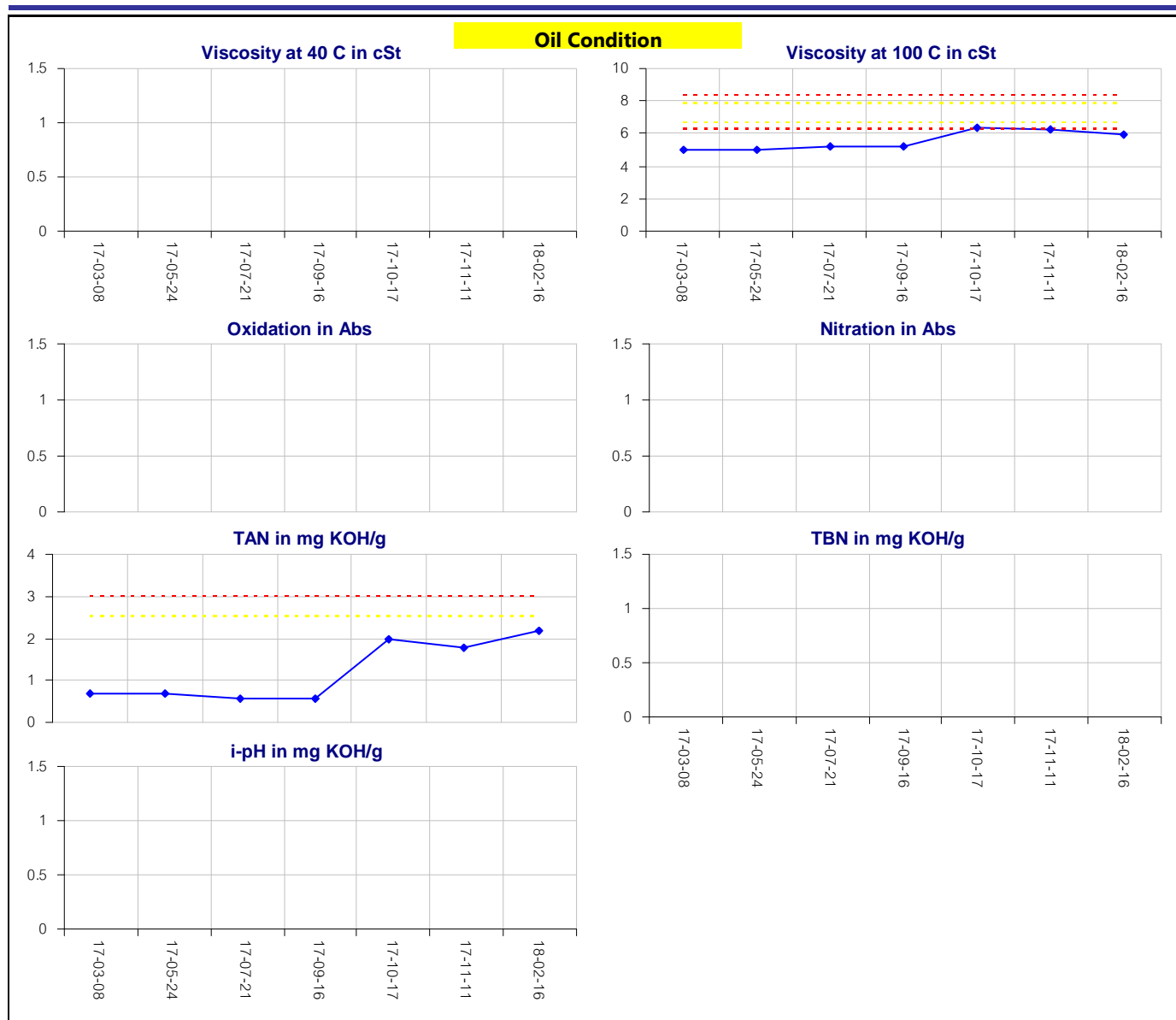
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### Wear Condition



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