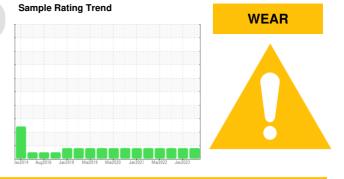


# **PROBLEM SUMMARY**

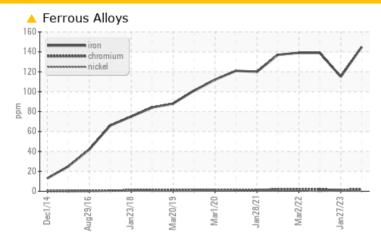
# SkyWay8/311325 Grey Road 8 202630 SkyWay8 T3

Component Wind Turbine Gearbox

**CASTROL OPTIGEAR SYNTHETIC CT 320 (395 LTR)** 



### **COMPONENT CONDITION SUMMARY**



#### RECOMMENDATION

We recommend an early resample to monitor this condition.

PROBLEMATIC TEST RESULTS								
Sample Status				<b>ABNORMAL</b>	ABNORMAL	ABNORMAL		
Iron	ppm	ASTM D5185(m)	>75	<u> </u>	<u>115</u>	<b>△</b> 139		

**Customer Id: VESTAS Sample No.:** WC0783140 Lab Number: 02576951 Test Package: IND 2

To manage this report scan the QR code

To discuss the diagnosis or test data: Kevin Marson +1 (289)291-4644 x4644 Kevin.Marson@wearcheck.com

To change component or sample information: Gloria Gonzalez +1 (289)291-4643 x4643 gloria.gonzalez@wearcheck.com

#### **RECOMMENDED ACTIONS**

Action	Status	Date	Done By	Description
Resample			?	We recommend an early resample to monitor this condition.

#### HISTORICAL DIAGNOSIS

#### 27 Jan 2023 Diag: Bill Quesnel

#### WEAR



We recommend an early resample to monitor this condition. Iron ppm levels are abnormal. The low ferrous density (PQ) index indicates the wear metal levels are due to corrosion. The system cleanliness is acceptable for your target ISO 4406 cleanliness code. The water content is negligible. The system and fluid cleanliness is acceptable. The AN level is acceptable for this fluid. The condition of the oil is suitable for further service.



### 15 Aug 2022 Diag: Kevin Marson

#### WEAR



We recommend an early resample to monitor this condition. Iron ppm levels are abnormal. The low ferrous density (PQ) index indicates the wear metal levels are due to corrosion. The system cleanliness is acceptable for your target ISO 4406 cleanliness code. The water content is negligible. The system and fluid cleanliness is acceptable. The AN level is acceptable for this fluid. The condition of the oil is suitable for further service.



#### 02 Mar 2022 Diag: Kevin Marson

#### WEAR



We recommend an early resample to monitor this condition. Iron ppm levels are abnormal. The low ferrous density (PQ) index indicates the wear metal levels are due to corrosion. The system cleanliness is acceptable for your target ISO 4406 cleanliness code. The water content is negligible. The system and fluid cleanliness is acceptable. The AN level is acceptable for this fluid. The condition of the oil is suitable for further service.



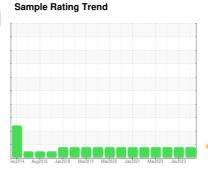


# **OIL ANALYSIS REPORT**

# SkyWay8/311325 Grey Road 8 202630 SkyWay8 T3

**Wind Turbine Gearbox** 

**CASTROL OPTIGEAR SYNTHETIC CT 320 (395 LTR)** 





### **DIAGNOSIS**

#### Recommendation

We recommend an early resample to monitor this condition.

#### Wear

Iron ppm levels are abnormal. The low ferrous density (PQ) index indicates the wear metal levels are due to corrosion.

#### Contamination

The system cleanliness is acceptable for your target ISO 4406 cleanliness code. The water content is negligible. The system and fluid cleanliness is acceptable.

#### **Fluid Condition**

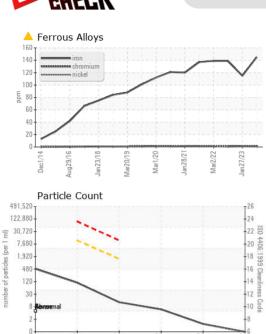
The AN level is acceptable for this fluid. The condition of the oil is suitable for further service.

Sample Number   Client Info   WC0783140   WC0305897   WC0305897   Sample Date   Client Info   14 Aug 2023   27 Jan 2023   15 Aug 2022   20 Jan 2023   15 Aug 2022   37 Jan 2023   15 Aug 2022   37 Jan 2023   37 Jan 2023   38 Jan 2022   38 Jan 2023   38 Jan 2033   38 J	0.11151.5		Aug. Aug				
Sample Date	SAMPLE INFORM	IATION	method	limit/base	current	history1	history2
Machine Age         mths         Client Info         0         0         0         0           Oil Age         mths         Client Info         0         0         0         0           Oil Changed         Client Info         N/A         N/A         N/A         N/A           Asample Status         Method         Imitity         Method         Imitity         N/A         N/A           WEAR METALS         method         limit/base         current         history1         history2           PQ         ASTM D518(m)         250         0         0         0         0           Iron         ppm         ASTM D518(m)         >50         2         1         2           Chromium         ppm         ASTM D518(m)         >10         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1	Sample Number		Client Info		WC0783140	WC0305897	WC0305839
Dil Age	Sample Date		Client Info		14 Aug 2023	27 Jan 2023	15 Aug 2022
Oil Changed   Client Info	Machine Age	mths	Client Info		0	0	0
Sample Status         ABNORMAL         ABSTORY         ASTORY         ABNORMAL         ABNORMAL         ABSTORY         ABSTORY <td>Oil Age</td> <td>mths</td> <td>Client Info</td> <td></td> <th>0</th> <td>0</td> <td>0</td>	Oil Age	mths	Client Info		0	0	0
WEAR METALS         method         limit/base         current         history1         history2           PQ         ASTM D8184¹         >50         0         0         0           Iron         ppm         ASTM D8185(m)         >75         145         ▲ 115         ▲ 139           Chromium         ppm         ASTM D8185(m)         >10         <1	Oil Changed		Client Info		N/A	N/A	N/A
PQ         ASTM D8184*         >50         0         0         0           Iron         ppm         ASTM D6185(m)         >75         ▲ 145         ▲ 115         ▲ 139           Chromium         ppm         ASTM D6185(m)         >5         2         1         2           Nickel         ppm         ASTM D5185(m)         >10         <1         <1         <1           Titanium         ppm         ASTM D5185(m)         >10         <1         <1         <1         <1           Aluminum         ppm         ASTM D5185(m)         >10         <1         <1         0         0           Aluminum         ppm         ASTM D5185(m)         >30         2         2         2         2           Copper         ppm         ASTM D5185(m)         >30         2         2         2         2           Copper         ppm         ASTM D5185(m)         >30         0         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1	Sample Status				ABNORMAL	ABNORMAL	ABNORMAL
Description	WEAR METALS		method	limit/base	current	history1	history2
Chromium	PQ		ASTM D8184*	>50	0	0	0
Nickel	Iron	ppm	ASTM D5185(m)	>75	<u> </u>	<u></u> 115	<u></u> 139
Titanium	Chromium	ppm	ASTM D5185(m)	>5	2	1	2
Silver	Nickel	ppm	ASTM D5185(m)	>10	<1	<1	<1
Aluminum	Titanium	ppm	ASTM D5185(m)	>10	0	0	0
Lead	Silver	ppm	ASTM D5185(m)		0	0	0
Copper         ppm         ASTM D5185(m)         >10         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0         <0 <td>Aluminum</td> <td>ppm</td> <td>ASTM D5185(m)</td> <td>&gt;10</td> <th>&lt;1</th> <td>&lt;1</td> <td>0</td>	Aluminum	ppm	ASTM D5185(m)	>10	<1	<1	0
Tin	Lead	ppm	ASTM D5185(m)	>3	2	2	2
Antimony	Copper	ppm	ASTM D5185(m)	>10	<1	<1	<1
Vanadium         ppm         ASTM D5185(m)         0         0         0           Beryllium         ppm         ASTM D5185(m)         0         0         0           Cadmium         ppm         ASTM D5185(m)         0         0         0           ADDITIVES         method         limit/base         current         history1         history2           Boron         ppm         ASTM D5185(m)         <1         <1         0           Barium         ppm         ASTM D5185(m)         0         0         0           Molybdenum         ppm         ASTM D5185(m)         2         2         2         2           Manganese         ppm         ASTM D5185(m)         2         2         2         2           Manganesium         ppm         ASTM D5185(m)         0         <1         <1         <1           Calcium         ppm         ASTM D5185(m)         6         5         7            Phosphorus         ppm         ASTM D5185(m)         264         278         281           Zinc         ppm         ASTM D5185(m)         4788         5039         4883           Lithium         ppm         ASTM D5185(m) </td <td>Tin</td> <td>ppm</td> <td>ASTM D5185(m)</td> <td>&gt;3</td> <th>0</th> <td>0</td> <td>0</td>	Tin	ppm	ASTM D5185(m)	>3	0	0	0
Beryllium	Antimony	ppm	ASTM D5185(m)	>3	0	<1	<1
Cadmium         ppm         ASTM D5185(m)         0         0         0           ADDITIVES         method         limit/base         current         history1         history2           Boron         ppm         ASTM D5185(m)         <1	Vanadium	ppm	ASTM D5185(m)		0	0	0
ADDITIVES	Beryllium	ppm	ASTM D5185(m)		0	0	0
Boron	Cadmium	ppm	ASTM D5185(m)		0	0	0
Barium         ppm         ASTM D5185(m)         0         0         0           Molybdenum         ppm         ASTM D5185(m)         <1         <1         <1           Manganese         ppm         ASTM D5185(m)         2         2         2           Magnesium         ppm         ASTM D5185(m)         0         <1         <1           Calcium         ppm         ASTM D5185(m)         6         5         7           Phosphorus         ppm         ASTM D5185(m)         264         278         281           Zinc         ppm         ASTM D5185(m)         31         40         27           Sulfur         ppm         ASTM D5185(m)         4788         50.39         4883           Lithium         ppm         ASTM D5185(m)         <1         <1         <1           CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6185(m)         >0.	ADDITIVES		method	limit/base	current	history1	history2
Molybdenum         ppm         ASTM D5185(m)         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1         <1<	Boron	ppm	ASTM D5185(m)		<1	<1	0
Manganese         ppm         ASTM D5185(m)         2         2         2           Magnesium         ppm         ASTM D5185(m)         0         <1         <1           Calcium         ppm         ASTM D5185(m)         6         5         7           Phosphorus         ppm         ASTM D5185(m)         264         278         281           Zinc         ppm         ASTM D5185(m)         31         40         27           Sulfur         ppm         ASTM D5185(m)         4788         5039         4883           Lithium         ppm         ASTM D5185(m)         <1         <1         <1         <1           CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           INFRA-RED	Barium	ppm	ASTM D5185(m)		0	0	0
Magnesium         ppm         ASTM D5185(m)         0         <1         <1           Calcium         ppm         ASTM D5185(m)         6         5         7           Phosphorus         ppm         ASTM D5185(m)         264         278         281           Zinc         ppm         ASTM D5185(m)         31         40         27           Sulfur         ppm         ASTM D5185(m)         4788         5039         4883           Lithium         ppm         ASTM D5185(m)         <1         <1         <1           CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED<	Molybdenum	ppm	ASTM D5185(m)		<1	<1	<1
Calcium         ppm         ASTM D5185(m)         6         5         7           Phosphorus         ppm         ASTM D5185(m)         264         278         281           Zinc         ppm         ASTM D5185(m)         31         40         27           Sulfur         ppm         ASTM D5185(m)         4788         5039         4883           Lithium         ppm         ASTM D5185(m)         <1	Manganese	ppm	ASTM D5185(m)		2	2	2
Phosphorus         ppm         ASTM D5185(m)         264         278         281           Zinc         ppm         ASTM D5185(m)         31         40         27           Sulfur         ppm         ASTM D5185(m)         4788         5039         4883           Lithium         ppm         ASTM D5185(m)         <1         <1         <1           CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0 <t< td=""><td>Magnesium</td><td>ppm</td><td>ASTM D5185(m)</td><td></td><th>0</th><td>&lt;1</td><td>&lt;1</td></t<>	Magnesium	ppm	ASTM D5185(m)		0	<1	<1
Zinc         ppm         ASTM D5185(m)         31         40         27           Sulfur         ppm         ASTM D5185(m)         4788         5039         4883           Lithium         ppm         ASTM D5185(m)         <1         <1         <1           CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Calcium	ppm	ASTM D5185(m)		6	5	7
Sulfur         ppm         ASTM D5185(m)         4788         5039         4883           Lithium         ppm         ASTM D5185(m)         <1         <1         <1           CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Phosphorus	ppm	ASTM D5185(m)		264	278	281
CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Zinc	ppm	ASTM D5185(m)		31	40	27
CONTAMINANTS         method         limit/base         current         history1         history2           Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Sulfur	ppm	ASTM D5185(m)		4788	5039	4883
Silicon         ppm         ASTM D5185(m)         >40         6         12         8           Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Lithium	ppm	ASTM D5185(m)		<1	<1	<1
Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	CONTAMINANTS		method	limit/base	current	history1	history2
Sodium         ppm         ASTM D5185(m)         >30         10         10         11           Potassium         ppm         ASTM D5185(m)         >20         2         2         2           Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Silicon	ppm	ASTM D5185(m)	>40	6	12	8
Water         %         ASTM D6304*         >0.02         0.005         0.002         0.004           ppm Water         ppm ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Sodium			>30	10	10	11
ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Potassium	ppm	ASTM D5185(m)	>20	2	2	2
ppm Water         ppm         ASTM D6304*         >200         54.7         21.2         42.8           INFRA-RED         method         limit/base         current         history1         history2           Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	Water	%	ASTM D6304*	>0.02	0.005	0.002	0.004
Soot %         %         ASTM D7844*         0         0         0           Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	ppm Water						
Nitration         Abs/cm         ASTM D7624*         3.1         2.7         2.9	INFRA-RED		method	limit/base	current	history1	history2
	Soot %	%	ASTM D7844*		0	0	0
<b>Sulfation</b> Abs/.1mm ASTM D7415* <b>12.5</b> 13.8 11.8							
	Nitration	Abs/cm	ASTM D7624*		3.1	2.7	2.9



number of particles (per 1

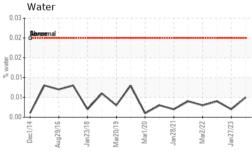
# **OIL ANALYSIS REPORT**



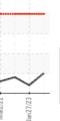
FLUID CLEANLINESS		method	limit/base	current	history1	history2
Particles >4µm		ASTM D7647		437	2268	140
Particles >6µm		ASTM D7647	>10000	94	684	21
Particles >14μm		ASTM D7647	>1300	11	50	3
Particles >21µm		ASTM D7647	>320	5	14	2
Particles >38μm		ASTM D7647	>80	1	1	1
Particles >71µm		ASTM D7647	>20	0	0	1
Oil Cleanliness		ISO 4406 (c)	>/20/17	16/14/11	18/17/13	14/12/9
FLUID DEGRADATION		method	limit/base	current	history1	history2
Oxidation	Abs/.1mm	ASTM D7414*		7.0	4.7	7.1
Acid Number (AN)	mg KOH/g	ASTM D974*		0.63	0.66	0.64

$4\mu$	6,4	$14\mu$	$21\mu$	$38\mu$	71μ
Acid	Number		,		
Severe					
2.00 Severe 2.00 Abnor 2.00 Abnor 2.00 Abnor	mal				
1.00					
0.50 - Abnor	mal				
0.00	9 8	6	00	21	23
Dec1/14	Aug29/16	Jan 23/10	Mar1/20	Jan 28/21	Jan27/23
	~	_			

VISUAL		method	limit/base	current	history1	history2
White Metal	scalar	Visual*	NONE	NONE	NONE	NONE
Yellow Metal	scalar	Visual*	NONE	NONE	NONE	NONE
Precipitate	scalar	Visual*	NONE	NONE	NONE	NONE
Silt	scalar	Visual*	NONE	NONE	NONE	NONE
Debris	scalar	Visual*	NONE	NONE	NONE	NONE
Sand/Dirt	scalar	Visual*	NONE	NONE	NONE	NONE
Appearance	scalar	Visual*	NORML	NORML	NORML	NORML
Odor	scalar	Visual*	NORML	NORML	NORML	NORML
<b>Emulsified Water</b>	scalar	Visual*	>0.02	NEG	NEG	NEG
Free Water	scalar	Visual*		NEG	NEG	NEG
FLUID PROPERT	TES	method	limit/base	current	history1	history2
Visc @ 40°C	cSt	ASTM D7279(m)	335	329	330	332

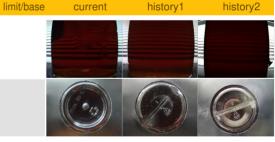


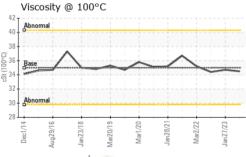




**Bottom** 

Color







Laboratory Sample No. Lab Number **Unique Number** 

: 5630011

: WearCheck - C8-1175 Appleby Line, Burlington, ON L7L 5H9 Vestas American Wind Technology Inc. : WC0783140 : 02576951

Received Diagnosed

: 18 Aug 2023 : 21 Aug 2023

Diagnostician : Kevin Marson Test Package : IND 2 ( Additional Tests: FT-IR, KF, KV100, PQ, TAN Man, VI ) 1417 NW Everett Street Portland, OR US 97209 Contact: Adam Glen adgen@vestas.com

To discuss this sample report, contact Customer Service at 1-800-268-2131. Test denoted (\*) outside scope of accreditation, (m) method modified, (e) tested at external lab. Validity of results and interpretation are based on the sample and information as supplied.

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