

WinDrive Cool Climate Test down to -40°C (-40°F)

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1. Research Objective

During the cool climate test, the performance of the WinDrive incl. the hydraulic system is tested at low temperatures with focus on tailspin and warm up operation starting from -40°C (-40°F).

2. Test Procedure

The WinDrive is cooled down to -40°C (-40°F) and tested in two separate runs. First the oil from the series machine is used. As this standard working oil (Total Azolla VTE 22) has a pour point above -40°C (-40°F) a second test run is performed using an alternative oil (Shell Tellus Arctic 32, pour point - 60°C (-76°F)).



Picture 1: Test field with isolated WinDrive and cooling unit

To perform the test the WinDrive with all it's related components (oil tank, coolers, pumps, etc.) is cooled down:



Picture 2: WinDrive and coolers at -35 °C (-31°F)

During the cooling down phase a start up cycle (tailspin operation plus run up) is performed at certain temperature levels e.g. to test the break away torque of the WinDrive and the oil flow capability. Tested temperature levels: 0; -10; -20; -30; -35°C (32; 14; -4; -22; -31°F) and respectively lower.



Picture 3: Gearbox oil at -30 °C (-22°F)

In both test runs, Mobilgear SHC XMP 320 with ISO VG 320 and a pour point of - 38°C (-36°F) was used as the gearbox oil.

The following working oils for the torque converter were selected for the two test runs:

	Test Run 1:	Test Run 2:
Working Oils:	Total Azolla VTE 22	Shell Tellus Arctic 32
Viscosity Class:	ISO VG 22	ISO VG 32
Pour Point:	-27°C (-17°F)	-60°C (-76°F)

3. Test Results

The following results were observed during the performed test runs:

- intake of the mechanical gear oil pump during tail spin operation sufficient
- discharge of gear oil with running gear oil pump sufficient
- oil lubrication (oil pressure, bearing temperatures) noncritical
- flow back speed of oil into the oil tank sufficient
- break away torque and torques during tail spin operation noncritical
- warm up phase: electrical heaters and heating capacity of torque converter sufficient
- oil supply unit: pumps can push low viscosity oil through pipes and coolers

The results for the different temperature levels are presented in the following table:

temperature level	intake gear oil pump	discharge gear oil	heating capacity torque converter
- 10°C (14°F)	✓	✓	✓ 20 kW (150rpm)
- 20°C (-4°F)	✓	✓	✓ 20 kW (150rpm)
- 30°C (-22°F)	✓	✓	✓ 20 kW (150rpm)
- 35/-40°C (-31/-40°F)**	✓	✓	✓ 12 kW (100rpm)

** Shell Tellus Arctic 32 (pour point - 60°C (-76°F))

Picture 4: Results

The tail spin operation and the warm up runs did not result in any increase of the vibration levels (acceleration/distance) and no damage was caused to the gears.

4. Summary:

In the cool climate test, the performance of the WinDrive incl. the hydraulic system was tested at low temperatures especially in tailspin operation and a warm up run from a temperature level of -40°C (-40°F). Using the standard working oil for the torque converter (Total Azolla VTE 22) the WinDrive can be operated at temperatures down to - 30°C (-22°F). Further operation down to - 40°C (-40°F) requires the use of Shell Tellus Arctic 32.