WHF017

Formula Classifications for Racing Hovercraft

WORLD HOVERCRAFT FEDERATION

PROPELLING GLOBAL HOVERSPORT

www.worldhovercraftfederation.org

World Hovercraft Federation

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Issue	**Date of Issue**	**Changes**
1	August 2023	Initial Issue
2025-1	February 2025	2.3 F3 4 stroke lift engne equivalency changed. 2.6 & 2.7 Reduction of Junior and colt thrust limits

For further information regarding this publication, please contact the Secretary:

Marie Trussler

World Hovercraft Federation

Email: secretary@whf.hovercraft.org.uk

CONTENTS

1. INTRODUCTION

1.1 General

A. These formulae definitions have been created by the Governing Board of the World Hovercraft Federation (WHF) to provide a harmonised set of formulae definitions to be used worldwide for racing hovercraft.

B. These rules are the copyright of the WHF but permission is given to National Governing Bodies to reproduce these rules in their own language. However English takes precedent in any dispute.

C. It is the responsibility of all National Governing Bodies to ensure that copies of these rules are available to all Competitors and Officials.

2. FORMULA SPECIFICATIONS

2.1 Formula 1

A. The following specifications apply:

Criteria	**Specification**		
Weight Limit	Not Controlled		
Thrust Limit	Not Controlled		
Engine	**2 Stroke**	**4 Stroke**	**Electric**
Total capacity of all engines	Over 600cc	Over 750cc	No limit on electrical power
Overbore Limits	Not Applicable		
Alternative Engine Types	Gas turbine engines		
	Wankel rotary engines - capacity rated at twice the swept volume per chamber, times the number of rotors		
	Rotary engines where all the induction air is passed through the rotor - capacity rated at swept volume per chamber times the number of rotors		
	Pressure charged engines (supercharged or turbo-charged) - capacity rated at twice their swept volume		

2.2 Formula 2

A. The following specifications apply:

<table>
<tr><th>Criteria</th><th colspan="4">Specification</th></tr>
<tr><td>Weight Limit</td><td colspan="4">Not Controlled</td></tr>
<tr><td>Thrust Limit</td><td colspan="4">Not Controlled</td></tr>
<tr><th>Engine</th><th>2 Stroke</th><th colspan="2">4 Stroke</th><th>Electric</th></tr>
<tr><td rowspan="2">Total capacity of all engines</td><td>Over 250cc
Under 600cc</td><td colspan="2">Over 500cc
Under 750cc</td><td rowspan="2">Full Electric: Full battery electric at this stage is not accommodated in F2 due to the difficulty of defining equivalency with an IC engine capacity limit.
Electric transmission: Electric transmission may be used with existing IC engine limits (e.g. IC engine used partly or fully to drive a generator that in turn runs an electric motor driving a fan). Batteries with maximum stored energy capacity of up to 1 KWh may freely be used to store prior energy / buffer the system.</td></tr>
<tr><td colspan="3">Where a combination of two-stroke and four-stroke engines is employed on a craft, the total engine capacity is defined as the sum of the two-stroke capacity and the equivalent two-stroke capacity of the four-stroke engine</td></tr>
<tr><td rowspan="2">Values for calculation of equivalent two-stroke capacity</td><td rowspan="2">Actual Capacity</td><td><600cc</td><td>4 stroke capacity / 1.5</td><td></td></tr>
<tr><td>>600cc</td><td>4 stroke capacity / 1.25</td><td></td></tr>
<tr><td rowspan="2">Lift Engine Notes</td><td colspan="3">Any engine used solely for lift that is direct drive (or driven at crank speed 1:1)</td><td rowspan="2">For the case of IC engine thrust and independent battery electric lift system, electric lift will count towards the IC engine capacity in the following way: For 2 stroke engine equivalency, peak electric power (KW), as measured by the product of current * voltage, will count to IC capacity limit at the rate of 6cc/KW.
For 4 stroke engine equivalency, peak electric power (KW), as measured by the product of current * voltage, will count to IC capacity limit at the rate of 7.5cc/KW. Example calculation: Electric lift system with peak power of 15KW (20.1 hp) For 2 stroke equivalency: 15KW * 6cc/KW = 90cc For 4 stroke equivalency: 15KW * 7.5cc/KW = 112.5cc</td></tr>
<tr><td>Actual capacity / 2</td><td colspan="2">Actual Capacity / 1.25</td></tr>
<tr><td>Overbore Limits</td><td>610cc</td><td colspan="2">768cc</td><td></td></tr>
<tr><td rowspan="4">Alternative Engines Types</td><td colspan="4">Wankel rotary engines - capacity rated at twice the swept volume per chamber, times the number of rotors</td></tr>
<tr><td colspan="4">Rotary engines where all the induction air is passed through the rotor - capacity rated at swept volume per chamber times the number of rotors</td></tr>
<tr><td colspan="4">Pressure charged engines (supercharged or turbo-charged) - capacity rated at twice their swept volume</td></tr>
<tr><td colspan="4">Non Original Equipment Manufacturer engines, or engines manufactured of components from more than one original manufacturer, must be demonstrated in their designated standard capacity, before they may exploit the engine overbore allowances</td></tr>
</table>

2.3 Formula 3

A. The following specifications apply:

<table>
<tr><th>Criteria</th><th colspan="4">Specification</th></tr>
<tr><td>Weight Limit</td><td colspan="4">Not Controlled</td></tr>
<tr><td>Thrust Limit</td><td colspan="4">Not Controlled</td></tr>
<tr><th>Engine</th><th colspan="2">2 Stroke</th><th>4 Stroke</th><th>Electric</th></tr>
<tr><td rowspan="2">Total capacity of all engines</td><td>Air Cooled</td><td>Under 450cc</td><td rowspan="2">Under 500cc</td><td rowspan="2">Full Electric: Full battery electric at this stage is not accommodated in F3 due to the difficulty of defining equivalency with an IC engine capacity limit.
Electric transmission: Electric transmission may be used with existing IC engine limits (e.g. IC engine used partly or fully to drive a generator that in turn runs an electric motor driving a fan). Batteries with maximum stored energy capacity of up to 1 KWh may freely be used to store prior energy / buffer the system.</td></tr>
<tr><td>Water Cooled</td><td>Under 250cc</td></tr>
<tr><td rowspan="2">Lift Engine Notes</td><td colspan="3">Any engine used solely for lift that is direct drive (or driven at crank speed 1:1)</td><td>For the case of IC engine thrust and independent battery electric lift system, electric lift will count towards the IC engine capacity in the following way:
For 2 stroke engine equivalency, peak electric power (KW), as measured by the product of current * voltage, will count to IC capacity limit at the rate of 6cc/KW.</td></tr>
<tr><td colspan="2">Actual capacity / 2</td><td>Actual Capacity / 2</td><td>For 4 stroke engine equivalency, peak electric power (KW), as measured by the product of current * voltage, will count to IC capacity limit at the rate of 7.5cc/KW. Example calculation: Electric lift system with peak power of 15KW (20.1 hp) For 2 stroke equivalency: 15KW * 6cc/KW = 90cc For 4 stroke equivalency: 15KW * 7.5cc/KW = 112.5cc</td></tr>
<tr><td rowspan="2">Overbore Limits</td><td>Air Cooled</td><td>450cc</td><td rowspan="2">512cc</td><td rowspan="2"></td></tr>
<tr><td>Water Cooled</td><td>256cc</td></tr>
<tr><td rowspan="4">Alternative Engines Types</td><td colspan="4">Wankel rotary engines - capacity rated at twice the swept volume per chamber, times the number of rotors</td></tr>
<tr><td colspan="4">Rotary engines where all the induction air is passed through the rotor - capacity rated at swept volume per chamber times the number of rotors</td></tr>
<tr><td colspan="4">Pressure charged engines (supercharged or turbo-charged) - capacity rated at twice their swept volume</td></tr>
<tr><td colspan="4">Non Original Equipment Manufacturer engines, or engines manufactured of components from more than one original manufacturer, must be demonstrated in their designated standard capacity, before they may exploit the engine overbore allowances</td></tr>
</table>

2.4 Formula 50

A. The following specifications apply:

Criteria	**Specification**					
Definition	Single Engine		Single Fan		Cooling fans <300mm solely for engine cooling are not included	
Weight Limit	Minimum 190kg for craft, driver and driver personal equipment at the end of race					
Thrust Limit	Not Controlled					
Engine	**2 Stroke**		**4 Stroke**		**Electric**	
Capacity	Specified Engines (see below)		Not permitted		Not Permitted	
Overbore Limits	512cc except for Hirth 2703 which is 521cc					
Specified Engines	**Engine Configurations Allowed**					
	Carburettor	Cylinders	Pistons and gaskets	Cylinder Head	Exhaust	Other
Standard Rotax 503	Single or twin, maximum diameter of 37mm (Bing 54) or 34mm (Mikuni VM34)	Engine cylinders to be standard cast liners and pistons to be twin ring type with both rings fitted	Pattern pistons up to 73mm maximum diameter and gaskets to standard Rotax specification are permitted	Must be standard Rotax cylinder head, additional cooling fins may be fitted	Any exhaust system may be used, but when tested with the craft static, the engine at full throttle must not exceed 200 RPM more than when compared to running the engine full throttle with standard Rotax 503 exhaust (Part number: 973275), Standard Rotax 503 exhaust manifold (Part number: 878937) and Standard Rotax connecting section (Part number: 973182). No adjustments may be made during this test	With or without cooling fan. Head rotation is permitted
Standard Rotax 503	Twin, maximum diameter of 34mm (Mikuni VM34)	Engine cylinders to be standard cast liners and pistons to be twin ring type with both rings fitted	Pattern pistons up to 73mm maximum diameter and gaskets to standard Rotax specification are permitted	Must be standard Rotax cylinder head, additional cooling fins may be fitted	Standard Bombardier Rotax Snowmobile two into one exhaust	With or without cooling fan. Head rotation is permitted
Standard Rotax 447	Single or twin, maximum diameter of 37mm (Bing 54) or 34mm (Mikuni VM34)	Engine cylinders to be standard cast liners and pistons to be twin ring type with both rings fitted	Pattern pistons up to Rotax maximum oversize and gaskets to standard Rotax specification are permitted	Must be standard Rotax cylinder head, additional cooling fins may be fitted	Any exhaust system may be used, but when tested with the craft static, the engine at full throttle must not exceed 200 RPM more than when compared to running the engine full throttle with standard Rotax 503 exhaust (Part number: 973275), Standard Rotax 503 exhaust manifold (Part number: 878937) and Standard Rotax connecting section (Part number: 973182). No adjustments may be made during this test.	With or without cooling fan.

F50 Specification Continued:

Specified Engines	**Engine Configurations Allowed**					
	Carburettor	Cylinders	Pistons and gaskets	Cylinder Head	Exhaust	Other
Standard Hirth 2703V	Single 38mm (TBC)	Engine cylinders to be standard Al-Nikasil and pistons to be twin ring type with both rings fitted	Pattern pistons and gaskets to standard Hirth specification are permitted	Must be standard Hirth cylinder head, additional cooling fins may be fitted	Hirth standard two into one exhaust. Any of the options in Appendix 1 are allowed	Max capacity 521cc (Al-Nikasil bore)
Standard Russian Mekanic RM-500 (also known as PM3-500, RMZ-500 or TAJGA-500)	Twin, maximum diameter of 34mm Mikuni VM34	Engine cylinders to be standard cast liners and pistons to be twin ring type with both rings fitted	Pattern pistons up to Tajga maximum oversize and gaskets to standard Tajga specification are permitted	Must be standard Tajga cylinder head, additional cooling fins may be fitted	Tajga Standard two into one exhaust	With or without cooling fan. Head rotation is permitted
Standard Russian Mekanic RM-500 (also known as PM3-500, RMZ-500 or TAJGA-500)	Single or twin, maximum diameter of 37mm Bing 54 or 34mm Mikuni VM34	Engine cylinders to be standard cast liners and pistons to be twin ring type with both rings fitted	Pattern pistons up to Tajga maximum oversize and gaskets to standard Tajga specification are permitted	Must be standard Tajga cylinder head, additional cooling fins may be fitted	Any exhaust system may be used, but when tested with the craft static, the engine at full throttle must not exceed 200 RPM more than when compared to running the engine full throttle with standard Rotax 503 exhaust (Part number: 973275), Standard Rotax 503 exhaust manifold (Part number: 878937) and Standard Rotax connecting section (Part number: 973182). No adjustments may be made during this test	With or without cooling fan. Head rotation is permitted
Standard Fuji Robin EC44	Single or twin, maximum diameter of 37mm	Engine cylinders to be standard cast liners and pistons to be twin ring type with both rings fitted	Pattern pistons up to Fuji maximum oversize and gaskets to standard Fuji specification are permitted	Must be standard Fuji cylinder head, additional cooling fins may be fitted	Standard Fuji two into one exhaust system	

2.5 **Formula S**

A. The following specifications apply:

Criteria	**Specification**		
Definition	Single Engine	Single Fan	Cooling fans <300mm solely for engine cooling are not included
Weight Limit	Not Controlled		
Thrust Limit	Not Controlled		
Engine	**2 Stroke**	**4 Stroke**	**Electric**
Capacity	No Limitation	No Limitation	No Limitation
Overbore Limits	Not Applicable		

2.6 Junior

A. The following specifications apply:

Criteria	Specification		
Definition	Single or twin engine, max 45HP recommended	Recommended Example Engines: Rotax 447, 503 single carburettor, F35, TZR 250	Thrust fan of minimum diameter 750mm All twin-engined craft must meet either the F3 or F35 specification
Weight Limit	Not Controlled		
Thrust Limit	**883N (90kg)**		
Thrust Test Procedure	A craft may be summoned for test at any time. The static thrust test should be carried out using either of the following test methods (refer to Competition Regulations): 1. A verified force gauge, on flat ground (maximum 2% incline in any direction) on a piece of tarpaulin or similar (e.g. breathable mat), with a minimum of 2 witnesses doing the test, with driver in the craft and parent looking over. 2 x 10 seconds at full throttle with level craft & straight rudders or 2. The calibrated HCGB test rig in accordance with its operating instructions and supervised by an approved official appointed by the Race Director, with a minimum of 2 witnesses doing the test, with driver in the craft and parent looking over. 2 x 10 seconds at full throttle with level craft & straight rudders For either test method, the average value of the 2 highest test readings must not exceed **the stated limit above**. The tester can require measurements to be taken with the splitter plate in any position (where variable). If a craft exceeds the limit a penalty may be applied (refer to applicable Competitions Regulations)		
Engine	**2 Stroke**	**4 Stroke**	**Electric**
Capacity	No Limitation	No Limitation	No Limitation
Overbore Limits	Not Applicable		

2.7 Colt

A. The following specifications apply:

Criteria	Specification		
Definition	Single engine, max 30HP recommended	Recommended Example Engines: Hirth F33, Rotax Max 125, Rotax 253, RMZ 250	Single fan of minimum diameter 750mm Fixed Splitter Plate (splitter plate may not be adjustable during a race)
Weight Limit	Not Controlled		
Thrust Limit	**540N (55kg)**		
Thrust Test Procedure	A craft may be summoned for test at any time. The static thrust test should be carried out using either of the following test methods (refer to Competition Regulations): 1. A verified force gauge, on flat ground (maximum 2% incline in any direction) on a piece of tarpaulin or similar (e.g. breathable mat), with a minimum of 2 witnesses doing the test, with driver in the craft and parent looking over. 2 x 10 seconds at full throttle with level craft & straight rudders or 2. The calibrated HCGB test rig in accordance with its operating instructions and supervised by an approved official appointed by the Race Director, with a minimum of 2 witnesses doing the test, with driver in the craft and parent looking over. 2 x 10 seconds at full throttle with level craft & straight rudders For either test method, the average value of the 2 highest test readings must not exceed **the stated limit above**. The tester can require measurements to be taken with the splitter plate in any position (where variable). If a craft exceeds the limit a penalty may be applied (refer to applicable Competitions Regulations)		
Engine	**2 Stroke**	**4 Stroke**	**Electric**
Capacity	No Limitation	No Limitation	No Limitation
Overbore Limits	Not Applicable		

2.8 Formula 35

A. The following specifications apply:

Criteria	Specification		
Definition	4 stroke industrial engine(s)	Recommended Engine Manufacturer: Briggs & Stratton, Honda, Kawasaki, Kohler, Tecumseh	
Weight Limit	Not Controlled		
Thrust Limit	Not Controlled		
Noise Limit	Low noise levels are a fundamental part of the Formula and will be strictly controlled. The Maximum noise limit is 82dBA static at full power. Static noise measurement will be taken at a distance of 25 metres from the craft with an instrument set at 1.2 metres from the ground. Measurements will be taken at various points around the craft. Fly by measurement to be 85dBA maximum at 25 metres.		
Engine	**2 Stroke**	**4 Stroke**	**Electric**
Capacity	Not permitted	F35 4 stroke engines of total horse power of not more than 35HP, or total engine capacity not exceeding 1000cc and engine revs not greater than 4500rpm. The use of the manufactures labelled four stroke / cycle, air cooled industrial engine(s) of a combined 35 HP and running at the manufactures engine speed will be permitted with the necessary supporting paperwork	**Full Electric:** Peak electrical power limited to 35 hp (=26.1 kW). Measured by taking product of current * voltage at all motors. **Hybrid IC/Electric:** The total of peak electric and IC engine power not more than 35hp (=26.1 kW). Electric power measured by taking product of current * voltage at all motors.
Other Craft Specifications	**Lift and Propulsion Systems:** Single or multi fan / propeller designs are acceptable. Craft with a separate lift fan shall have sea state performance. i.e. the lift fan blades shall be clear of the water level when floating with the engines stopped and carrying the normal crew. Designers are reminded that high fan rpm normally means high noise levels **Buoyancy: T**he craft shall have buoyancy providing a minimum of 100% of the maximum design weight and an additional 20kg of buoyancy per occupant when afloat on fresh water. The craft shall remain afloat when capsized or at an angle other than in the upright normal position. The definition of remaining afloat shall be that in the worst case of a craft capsizing or total flooding, the craft will not sink and will be capable of supporting crew in the water **Tow Points:** A front tow point shall be fitted, capable of withstanding the craft being dragged on land with engines off. This will be checked by the appropriate Scrutineers		

3. APPENDIX 1 HIRTH EXHAUST DRAWING

HIRTH

Hirth-Information

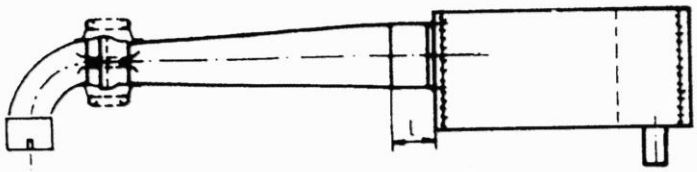
Mitteilung-Nummer: **0060**

Inhalt: **Exhaust System Assemblies**
(2-cylinder- and 4-cylinder engines)

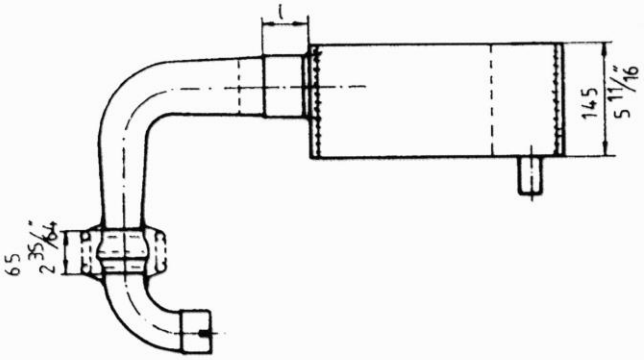
Datum: 12.06.2002

Basic System:

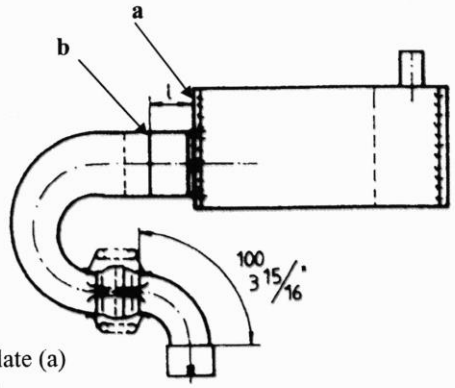
Version 1 (Straight Version):
278 T13U



Version 2 (90° Bow Version):
278 T14U



Version 3 (180° BowVersion):
278 T15U



Note:
The lenght „l" is from the top plate (a)
to the middle of the welding (b)

0060 engl. (Auspuffsystem Übersicht 2 + 4 Zylindermotoren).doc 7.11.2008 Page 1 of 5
Technical one subject to change

Component Part Numbers:
Manifold: 278A1U Silencer: 278E4U
Diffuser Cones: 278T19U (Straight), 278T20U (90deg), 278T21U (180deg)
Manifold to diffuser Connectors: 278E19U (90deg), F308A7U (Straight)
Distance (L) (See above) for all configurations = 30mm