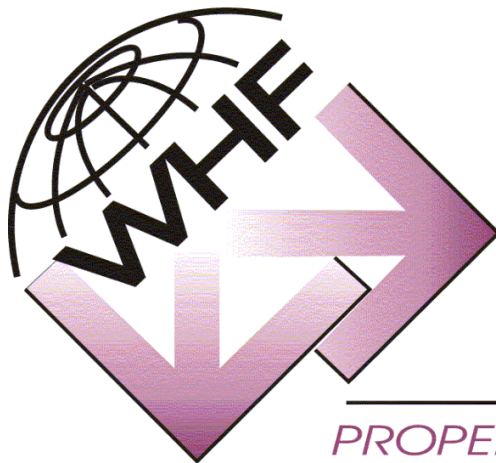


**WHF015**

# Homologated Fans



**WORLD  
HOVERCRAFT  
FEDERATION**

*PROPELLING GLOBAL HOVERSPORT*

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2012-1	April 2012	
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For further information regarding this publication, please contact the Secretary:

Sacha Rouchier  
World Hovercraft Federation

Email: [Sacha@Rouchier.com](mailto:Sacha@Rouchier.com)

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# 1. INTRODUCTION

## 1.1 General

- A. The purpose of this document is not to give a definitive list of fan systems that **MUST** be used, merely provide data and limits of known systems in common use.
- B. The following fans and hubs have been tested and approved for use in hovercraft. Use of these fans is to be limited to a Tip speed of less than that shown in the table below.
- C. The tipspeed limits have been given for a range of fans, for convenience. As the limit is based on the actual size of the fan, users that are running close to this limit may find that they can exceed the given limit for their installation.
- D. Users must carry out the exact calculation for their installation.
- E. The fans and hubs have been tested in accordance with WHF010.
- F. This list may be upissued at any time, to add or remove fans and hubs.
- G. Any deviation in the design of the hubs or blades from those tested must be reported to the WHF and components must not be used without first obtaining approval.
- H. Drilling, boring, or machining of the hubs other than to the same specification as those tested is not permitted.
- I. Homologation is only valid when the given tip speeds and restrictions are complied with.

## 1.2 Interchangeability

- A. It is **NOT** permitted to interchange fan blades and hubs from different manufacturers.
- B. Blades and Hubs have only been tested and approved as manufacturers sets. It cannot be assumed that components will perform to the same performance levels when fitted in mixed combinations.

## 2. HOMOLOGATED MULTIWING FAN SYSTEMS

### 2.1 3H Blades

A. 3H Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size		Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes
	Code	Material					m/s	ft/s	
3 H	PAG	Glass Filled Polyamide (Nylon) (White or Grey) See 2.1B.a)	Fixed Pitch (H)	8	mm	A	168	551	2.1B
				10					
				14					
				20					

B. Restrictions

- Blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- It is recommended that all Type H PAG blades fitted to size 8, 10, 14, 20 Hubs SHOULD be fitted with additional perimeter bolts (M5 or M6) through the blade root. (See 7.1 Appendix A for example)
- The Multiwing Type H, 6 and 8 blade PPG (Glass filled Polypropylene) **Hub** SHALL NOT be used).
- The Multiwing Type H, 3 blade PAG (Glass filled Polyamide) **Hub** SHALL NOT be used).

### 2.2 3Z Blades

A. 3Z Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size		Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes
	Code	Material					m/s	ft/s	
3 Z	PAG	Glass Filled Polyamide (Nylon) (White,Black) See 2.2B.a)	Adjustable Pitch (Z)	5	mm	A	168	551	2.2B
				8					
				9					
				12					

B. Restrictions

- 3Z Blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- The Multiwing Type Z, 5 blade PPG (Glass filled Polypropylene) **Hub** SHALL NOT be used).

## 2.3 4Z Blades

A. 4Z Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size		Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes
	Code	Material					mm	m/s	
4 Z	PAG	Glass Filled Polyamide (Nylon) (White or Grey) See 2.2B.a)	Adjustable Pitch (Z)	5		A	168	551	2.2B
				6					
				7					
				8					
				9					
			12	<800	150	492	>6 Blades 2.3B.c)		
				>800	160	525			
				>1000	147	482			
						168	551	6 blades equi- spaced 2.3B.c)	

B. Restrictions

- 4Z Blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- The Multiwing Type Z, 5 blade PPG (Glass filled Polypropylene) **Hub** SHALL NOT be used).
- The Multiwing 12 Blade hub had a particularly low failure load when tested. If only 6 blades are fitted, then full clearance is given, if blades are fitted in consecutive lobes, then the lower limits must be used.

## 2.4 5Z Blades

A. 5Z Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size	Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes		
	Code	Material				mm	m/s		ft/s	
5Z	PAG	Glass Filled Polyamide (Nylon) (White or Grey) See 2.4B.a)	Adjustable Pitch (Z)	5	<800	A	135	443		
					>800		140	459		
					>900		145	476		
					>1000		150	492		
				6	N/A		168	551		
				7						
				8	<900		165	541		
					>900		168	551		
				9	<900		160	525		
					>900		168	551		
				12	<850		135	443		>6 Blades 2.4B.c)
					>850		140	459		
					>1000		147	482		
							168	551		6 blades equi-spaced 2.4B.c)

B. Restrictions

- 5Z Blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- The Multiwing Type Z, 5 blade PPG (Glass filled Polypropylene) **Hub** SHALL NOT be used).
- The Multiwing 12 Blade hub had a particularly low failure load when tested. If only 6 blades are fitted, then full clearance is given, if blades are fitted in consecutive lobes, then the lower limits must be used.

## 2.5 Hub Variations

- A. Multiwing have made changes to the hub casting in recent years, the figures used for the clearances given in the tables use the weaker of the two variants.
- B. Earlier hubs can be identified by 2 thin webs between the blade lobes, later hubs have a solid section.



Earlier Style



Later Style

### 3. HOMOLOGATED HASCONWING SYSTEMS

#### 3.1 Type L Fans

A. Type L Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size	Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes	
	Code	Material		mm		m/s	ft/s		
L	PAG	Glass Filled Polyamide (Nylon) (White) (Ref 3.1B.a)	Fixed Pitch (HF)	6	N/A	A	168	551	3.1B.b)
				8					3.1B.c)
				10					
				14					
				20					

B. Restrictions

- Type L blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- Type L White PAG blades fitted to size 6 HV Hubs SHALL be fitted with additional perimeter bolts (M5 or M6) through the blade root. See 7.1.
- Type L White PAG blades fitted to size 8, 10, 14, 20 Hubs SHOULD be fitted with additional perimeter bolts (M5 or M6) through the blade root. See 7.1.

#### 3.2 Type TMN Fans (Replaces Type M)

A. Type TMN (Type M) Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size	Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes	
	Code	Material		mm		m/s	ft/s		
TMN(M)	PAG	Glass Filled Polyamide (Nylon) (White) (Ref 3.2B.a)	Adjustable Pitch (HV)	5	< 550	A	140	459	
					550 > 770		150	492	
					>770		168	551	
				9	N/A		168	551	
				12					
16									

B. Restrictions

- Type TMN (Type M) blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.

### 3.3 Type TMV Fans (Replaces Type B)

A. Type TMV (Type B) Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size	Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes		
	Code	Material				mm	m/s		ft/s	
TMV(B)	PAG	Glass Filled Polyamide (Nylon) (White)  (Ref 3.3B.a)	Adjustable Pitch (HV)	5	< 850	A	145	476		
					850 > 1000		150	492		
					>1000		159	522		
				9	N/A		168	551		
				12	700 < 850		160	525		3.3B.b)
					>850		168	551		
				16	N/A		164	538	3.3B.c)	
							B	168		551

B. Restrictions

- Type TMV(Type B) blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- Type TMV (Type B) blades are NOT homologated for use in Size 12 Type HV hubs in ducts smaller than 700mm. Users in this range must provide satisfactory calculations to support use of the blade at the size and speed required.
- Type TMV (Type B) blades may be used blades in the 16 Blade hub with Grade A guarding upto the tip speed limits given in the table above. Use of these at greater than 164m/s requires Grade B guarding.

## 4. HOMOLOGATED WINGFAN SYSTEMS

### 4.1 Type P3H Fans

A. Type P3H Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size		Duct Size Limits mm	Guarding Category Required	MAXIMUM TIP SPEED		Notes
	Code	Material					m/s	ft/s	
<b>P3H</b>	<b>PAG</b>	Glass Filled Polyamide (Nylon) (Beige) (Ref 4.1B.a)	Fixed Pitch (H)	8	N/A	<b>A</b>	<b>168</b>	551	4.1B.b)
				10					
				14					
				20					

B. Restrictions

- Type P3H blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- Type P3H White PAG blades fitted to size 8, 10, 14, 20 Hubs SHOULD be fitted with additional perimeter bolts (M5 minimum) through the blade root. See 7.1.

### 4.2 Type P4Z Fans

A. Type P4Z Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size		Duct Size Limits mm	Guarding Category Required	MAXIMUM TIP SPEED		Notes
	Code	Material					m/s	ft/s	
<b>P4Z</b>	<b>PAG</b>	Glass Filled Polyamide (Nylon) (Beige) (Ref 4.2B.a)	Adjustable Pitch (Z)	5	>700	<b>A</b>	<b>168</b>	551	4.2B
					550 > 700		<b>155</b>	509	
					<550		<b>150</b>	492	
				7	N/A		<b>168</b>	551	
				8					
				9					
12									
16									

B. Restrictions

- Type P4Z blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- Type P4Z White PAG blades have restricted Tip Speed when used with the Size 5 HV Hub.

### 4.3 Type P5Z Fans

A. Type P5Z Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size	Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes		
	Code	Material				mm	m/s		ft/s	
P5Z	PAG	Glass Filled Polyamide (Nylon) (Beige)  (Ref 4.3B.a)	Adjustable Pitch (Z)	5	< 850	A	150	492	4.3B	
					850 > 950		155	509		
					>950		160	525		
				7	N/A		168	551		
							8	168		551
				9	160		525			
				12	>800		164	538		
					<800		164-168	538-551		
				16	N/A		B	164-168		538-551

B. Restrictions

- a) Type B blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- b) Type B blades may be used blades in the 16 Blade hub with Grade A guarding upto the tip speed limits given in the table above. Use of these at greater than 164m/s requires Grade B guarding.

#### 4.4 Type P6Z Fans

A. Type P6Z Blades are homologated in the following configurations:

Fan Blade	Material		Hub Type and Size	Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes	
	Code	Material				mm	m/s		ft/s
P6Z	PA	Glass Filled Polyamide (Black)	Adjustable Pitch (Z)	7	N/A	A	133	436	4.4B
					>1000	B	133	436	
					>1000		133-140	436-459	
				8	N/A	A	127	417	
					<1000	B	127-130	417-427	
					>1000		127-135	417-443	
	9	PAG	Glass Filled Polyamide (Beige) (Ref 4.4B.a)	Adjustable Pitch (Z)	N/A	A	132	433	
					<1050	B	132-138	433-453	
					>1050		132-141	433-463	
	12			Adjustable Pitch (Z)	N/A	A	126	413	
					<1050	B	126-132	413-433	
					>1050		126-140	413-459	

B. Restrictions

- a) Type P6Z blades of any other material or colour, do not meet homologation requirements and SHALL NOT be used.
- b) The P6Z blades can exceed the Kinetic Energy limits for guarding Category A, therefore there is a tipspeed limit to use these blades with Category A guarding, if users wish to use Category B guarding then the higher limits may be used.

## 5. OTHER VERIFIED SYSTEMS

### 5.1 General

A. The following individual installations have been verified by the WHF technical team.

### 5.2 Individual user systems

Fan Blade	Material		Hub Type and Size		Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes
	Code	Material			mm		m/s	ft/s	
AL46	N/A	Carbon / Kevlar	AL46 Hub	8	1100 only	A	168	551	None

## 6. FAN SYSTEMS TESTED FOR USE IN UNDUCTED INSTALLATIONS. (NOT PERMITTED FOR RACING)

### 6.1 General

- A. This section lists fan systems that have been tested to comply with WHF strength requirements only.
- B. Since they are for use in unducted installations, containment calculations are not relevant.
- C. The limits given in here include an additional 20% safety factor on approved tipspeed.

### 6.2 Multiwing W series Blades and Hubs

- A. The mass of the 5W and 7W blades when fitted to 8 and 10 blade hubs exceed the 3000J containment limit, they are therefore not suitable for use in the racing environment with the current construction regulations.

Fan Blade	Material		Hub Type and Size		Duct Size Limits	Guarding Category Required	MAXIMUM TIP SPEED		Notes				
	Code	Material					mm	m/s		ft/s			
5W	PAG	Glass Filled Polyamide (Black) (Beige)	W Series	8	>1100	N/A	130	426	None				
					<1100		120	294					
				10	>1125		130	426					
					<1125		125	410					
7W				PAG	Glass Filled Polyamide (Black) (Beige)		W Series	8	>1417	N/A	120	394	None
									1100-1417		110	361	
								10	>1500		120	394	
									1050-1125		110	361	

## 7. APPENDIX A:- PERMISSABLE HUB MODIFICATIONS

### 7.1 Multiwing, HasconWing and Wingfan Fixed Pitch Hubs

- A. M5 or M6 Bolts fitted through the blade root.

