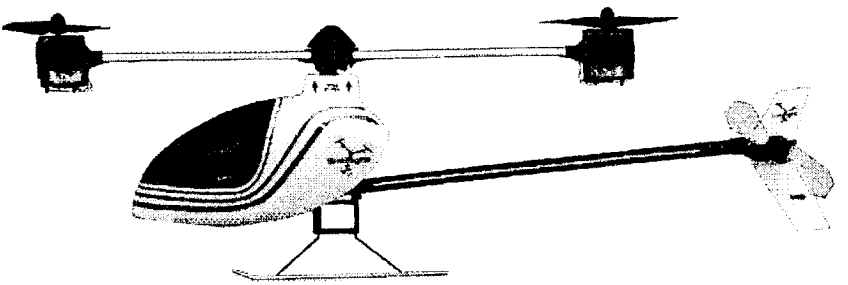
Hoverfly



Instructions
and
Maintenance Manual

Snelflight

Issue 1.3

CONTENTS

IMPORTANT NOTICE

Hoverfly is not a toy. It is an engineered model which although light in weight is capable of causing damage or injury if operated irresponsibly, primarily due to contact with the three thrust propellers. Avoid flying close to people or pets.

It may start up violently if the instructions contained in this manual are not followed, or if a fault occurs. To be sure of avoiding damage or injury always hold the centre of the rotor (keeping clear of the propellers) when switching on the mains power.

The motors become hot in use; to avoid injury do not touch until cool.

Unplug from the mains supply when not in use. Do not use in the wet.

Note: Hoverfly is designed for trouble free flying, but its useful life will be considerably extended if a little routine maintenance is carried out from time to time. See section 14 for details.

1. INTRODUCTION

Congratulations on purchasing your Hoverfly.

Please take the time to read at least as far as and including section 11, **Your First Flight**, before you do anything else.

The Hoverfly is a new concept in model helicopters, and works differently from all previous products whilst retaining all the flying and handling characteristics of conventional models. It is primarily intended for flying indoors. Choose the largest space available to you which is free from obstructions. Flying out of doors is not recommended until the pilot has gained some experience, and then only on a dry, completely windless day.

2. PACKING LIST

This Manual: Please read it carefully before attempting to fly the model.

The Helicopter: It comes with its thin command line already attached.

Power supply: This is the unit with the moulded mains plug attached. It converts power from the mains into 36V d.c. to power the model.

Electrocyclic Control Processor (ECP) (*otherwise known as Control Interface Unit*):

This is the smaller black box, with three electrical connectors. It connects to the trainer socket of a radio control transmitter, and converts its signal into a form suitable for the Hoverfly.

Signal leads (2): These are used to connect the ECP to a suitable R/C transmitter. One lead is fitted with a 3.5mm jack, and is suitable for JR and Sanwa transmitters. The other lead has a DIN plug, and is suitable for Futaba and Hitec transmitters.

Decals and stripes: For you to customise your Hoverfly.

Trainer undercarrige: Two lightweight tubes to attach to the skids whilst learning to fly.

Large tailfin (Model H100 only): Recommended for beginners. Fits in place of the normal fin and reduces random tail movements.

Pull-through: Hook for threading the tail drive belt during maintenance.

Patch module J: Required for use with JR and Sanwa transmitters.

Patch links (4): Required when using non-standard transmitter.

Deflector vanes (3): Rotor attachments to optimise handling characteristics for learner pilots.

3. ADDITIONAL ITEMS REQUIRED.

The only additional item required is a control unit of the type normally used for radio control of models. The radio frequency section is disabled when used with the Hoverfly. If you are intending to move on to larger helicopters when you have qualified using the Hoverfly you may decide to invest in a transmitter with more features than the minimum listed below.

Minimum transmitter specification.

- Four control channels with two twin-axis (gimballed) joysticks.
- Fitted with a trainer (buddy box) socket, using PPM (pulse position modulation) signalling.
- Reversing switches on at least the first four channels.
- The transmitter should preferably use either the Futaba, JR, Hitec or Sanwa systems. Hoverfly will work with many others but the set-up procedure is more complicated.

4. HANDLING THE HOVERFLY.

The Hoverfly itself should always be held by the centre of the rotor, grasping it from above by the green printed circuit disc immediately below the rotor hub. Do not lift by the black dome, which pulls off easily. Alternatively, it can be held by the black plastic chassis frame, immediately above the undercarriage. On no account should it be held by the body or tail boom.

Carefully lift the helicopter out of the box and place it on the floor. Lay out the control line, taking care to avoid kinking it, guiding it away from the model rearward to ensure it will not foul the undercarriage or tail. ***Do not allow the line to become kinked. Sharp bends will weaken it and must be avoided. (See also section 14L).***

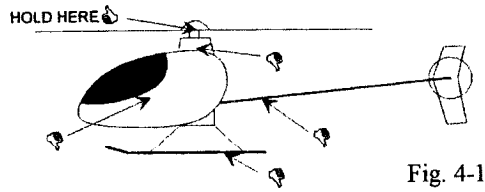


Fig. 4-1

If you are a newcomer to model helicopters, we suggest you read section 12 entitled 'Helicopter Principles' before carrying on.

5. CONNECTIONS & SETTING UP

In order to ensure that the Hoverfly controls will work correctly with the particular type of transmitter being used, both the Electrocyclic Control Processor (**ECP**) and the transmitter itself have to be set up correctly. This process is simplified if one of these standard transmitter types is used:

FUTABA HITEC JR SANWA

Most other types will also work; the full set-up procedure is included here.

Connecting the transmitter to the Hoverfly system.

The transmitter communicates with the Hoverfly by way of an interface unit, the Electrocyclic Control Processor (ECP), which is the small black box with electrical sockets at each end. This unit interprets the signal from the transmitter and uses it to control the amount of power sent to each of the motors on the Hoverfly. By varying the power levels in the right combinations, all the flight control functions of a conventional helicopter are created.

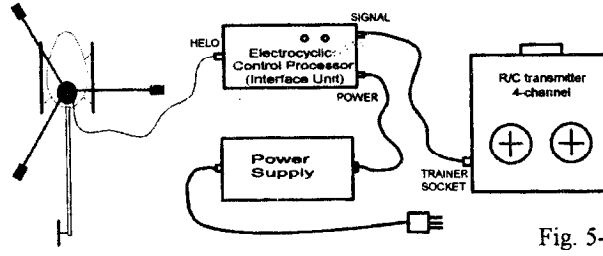


Fig. 5-1

The transmitter connects to the ECP by means of a signal lead, of which two types are supplied with the Hoverfly. These leads allow connection of the four standard types of transmitter. The lead is used to connect the transmitter trainer socket to the Signal socket on the ECP. For Futaba and Hitec transmitters, use the lead with the six-pin DIN plug; for JR and Sanwa transmitters, use the lead with the 3.5mm jack plug.

NOTE ON SANWA TRANSMITTERS: A number of Sanwa transmitters use a six-pin DIN socket, instead of a 3.5mm jack socket. These will NOT work using the apparently matching lead supplied, because Sanwa needs different wiring in the DIN plug. A suitable lead is available as an option; please ask your dealer.

NOTE ON NON-STANDARD TRANSMITTERS: Most other types of transmitter can be used. If your transmitter has a 3.5mm jack socket for trainer cord connection, it is likely that it will work with the matching lead included with the Hoverfly. However, if your transmitter has a six-pin DIN socket, we recommend that you do not attempt to use the matching lead supplied. This is because some of the pins are connected together inside the DIN plug, and the transmitter may be damaged if these pins happen to carry electrical signals which conflict. If your transmitter has a trainer cord connector other than a 3.5mm jack, we recommend that you contact Snelflight for advice. We can arrange to supply a suitable lead in most cases.

Once a suitable lead has been obtained, the equipment should be connected up as in Fig. 5-1, **with the exception of the Hoverfly itself, which should not be connected at this time.**

Because the transmitter connects directly to the ECP, no radio communication is necessary. This greatly increases the transmitter's battery life, and eliminates frequency conflicts and interference problems. It is therefore important to make sure that the transmitter's radiofrequency section is shut off while it is used with the Hoverfly. With some transmitters, the act of plugging in the trainer cord automatically switches on the transmitter, whilst simultaneously turning off the radiofrequency circuitry. If this happens, the main power switch should be left in the off position. With other units, the power switch must be turned on, but the radiofrequency section should be disabled by removing the crystal.

The following settings and checks should now be made.

a) Signal Mode Selection: If your transmitter offers PCM as well as PPM signalling, switch it to PPM. PCM-only transmitters **cannot** be used with the Hoverfly.

b) Servo Travel: If your transmitter has adjustable servo travels, set the first four channels to 100% in both directions of throw.

c) Switch on the mains supply: The red Power light should illuminate on the ECP.

d) Switch on the transmitter (if not automatic): The green Signal light should illuminate on the ECP after approximately 2 seconds delay.

Now switch everything off. (Remember that some transmitters remain on until the trainer plug is removed).

6 CHANNEL ASSIGNMENT

WARNING: NEVER SWITCH ON THE POWER WHILST THE HOVERFLY IS CONNECTED UNLESS YOU ARE SURE THAT THE CHANNELS ARE PROPERLY CONNECTED AT THE PATCH SOCKET. ESPECIALLY, DO NOT SWITCH ON OR ATTEMPT TO FLY WITH SOME CHANNELS UNCONNECTED. UNCONNECTED CONTROL FUNCTIONS WILL HAVE UNDEFINED VALUES, AND WILL BEHAVE UNPREDICTABLY. THE HOVERFLY MAY START UNEXPECTEDLY. BE CAREFUL!

The Hoverfly has four flight control functions; Collective, Elevator, Aileron and Rudder. Each of these will be associated with one of the four axes of joystick movement provided on the transmitter (Fig 6-2). The position of each joystick at any moment is sent to the ECP by means of four seperate transmitter channels, one for each flight control function. On any transmitter, these will always be the first four channels, regardless of the total number of channels the transmitter has. In a traditional radio-controlled helicopter, these channels emerge from the radio receiver on separate sockets, to which the control servos are connected. It is of course important to connect each servo to the correct channel, so that each aircraft control surface is moved by the correct joystick.

The Hoverfly, on the other hand, has no receiver or servos. In order to allow each channel to be connected to the correct flight control function, a **Channel Patch Socket** is provided inside the ECP. This has eight electrical terminals, giving access to the four transmitter channels and flight control functions separately. By connecting these terminals to each other, transmitter channels can be assigned to control functions in any desired order, so as to allow for the various channel patterns used by different manufacturers.

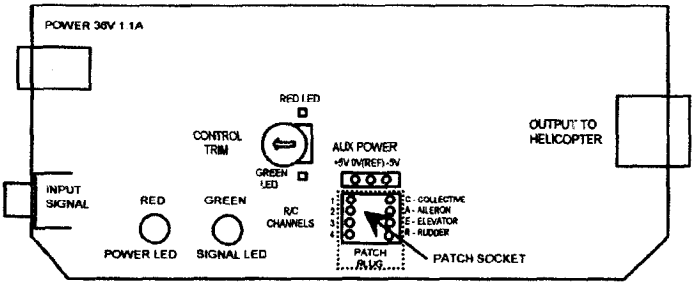


Fig. 6-1

To gain access to the Channel Patch Socket, it is necessary to open the ECP. Please refer to section 14-M for instructions on how to do this. Fig. 6-1 shows the location of the Patch Socket.

Two plug-in Patch Modules are included with the Hoverfly, which push directly into the Patch Socket. These modules allow immediate channel assignment for the standard transmitter types listed above. If your transmitter is not one of these types, then please move on now to section 7.

Hoverfly is factory fitted with an F-type Patch Module for use with Futaba and Hitec transmitters. If necessary this can be carefully pulled out and replaced with the other

(J-type) module, which will set up the Hoverfly for JR and Sanwa transmitters. This module will be found in the Accessories Pack in the Hoverfly box. Take care to plug the module in the right way round. **Always switch off the power before changing modules. (For Patch Module details, see section 16.)**

***Note to experienced pilots**: These modules set up the Hoverfly for Mode 2 (throttle on the left) format. If you are used to any other joystick layout, please refer to Section 7.*

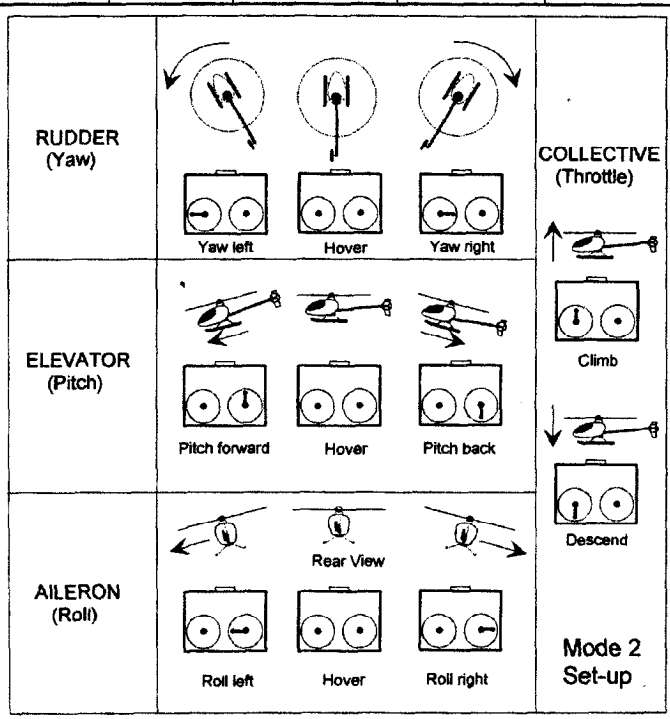
Setting the Servo Reverse switches.

After assigning each channel to the correct control function, it is necessary to set the correct direction of movement for each channel. This is done by means of the transmitter servo reverse switches. These must be set according to the table below:

These settings are also printed on the channel patch modules.

Channel	Futaba	Hitec	JR	Sanwa
1	Normal	Normal	Reversed	Reversed
2	Normal	Reversed	Reversed	Reversed
3	Normal	Reversed	Reversed	Reversed
4	Normal	Normal	Reversed	Reversed

Fig. 6-2



7. *NON-STANDARD TRANSMITTERS*

ASSIGNING CHANNELS

SETTING THE TRANSMITTER SERVO REVERSE SWITCHES

(You may skip this section if you are using a standard transmitter.)

If your transmitter is not one of the standard types for which the Patch Modules can be used, it will be necessary to determine the correct channel assignments and to patch them manually. Fortunately, the ECP has facilities which make this process fairly straightforward. In addition, if you wish to use a joystick layout other than Mode 2, then this procedure will allow you to set up the Hoverfly in the manner you wish.

The Accessories Pack contains four short lengths of black wire, which will be used to connect the Patch Socket terminals in the required combination for correct operation. They will be used to link the transmitter channel terminals, which are in a row on the left side of the Patch Socket (Fig 6-1), to the flight control function terminals, which are on the right side of the Patch Socket. The wires can be crossed over one another, so that any channel can be connected to any flight control function.

To help determine which channel to assign to each flight control function, there are two small indicator LEDs, one located on each side of the Control Trim Adjuster (Fig 6-1). These LEDs are connected to the Rudder (R) terminal, and light up to indicate when the rudder control is moved. When the rudder is driven to the left, the red LED will light. When the rudder is driven to the right, the green LED will light.

Using these LEDs, it is easy to determine which transmitter channel is associated with a particular joystick axis of movement. Having done so, this channel can then be connected to the desired flight control function terminal, so that this function will be controlled by the chosen joystick axis. The procedure is as follows:

(ALWAYS SWITCH OFF THE POWER WHILST CHANGING PATCH SOCKET CONNECTIONS. TAKE GREAT CARE WHEN THE POWER IS ON, BECAUSE DAMAGE TO THE ELECTRONICS CAN EASILY OCCUR IF ANYTHING METAL TOUCHES THE CIRCUIT BOARD OR COMPONENTS.)

Channel patching and reversing switch setting.

Remove the factory fitted patch module from the patch socket.

Connect up as shown in Fig 5-1. **Do not connect the Hoverfly command lead yet. Do not switch on yet.**

Centre the ECP control trim adjuster.

A. Patch channel 1 to the rudder terminal (R). Switch on.

B. Move each joystick in turn from end to end and note which axis operates the LEDs.

C. Use the table below to determine the correct setting for the transmitter reversing switch. Switch off.

D. Re-patch channel 1 to the desired function for this joystick (i.e from 1, to C,A,E or R).

Note: if R is the desired function for channel 1, remove the patch link so that the rudder function is available for the remainder of the tests. Fit this link at the end of the procedure.

Repeat steps A to D for channels 2,3 and 4.

All the joysticks are now connected to the desired controls on the helicopter.

Once the correct settings have been determined, you should record them for future reference. Blank patch diagrams are included in section 16 for this purpose.

Stick	Direction	Function	LED
Collective	Forward	Increase	Red
	Backward	Decrease	Green
Aileron	Left	Left	Red
	Right	Right	Green
Elevator	Forward	Nose down	Red
	Back	Nose up	Green
Rudder	Left	Left	Red
	Right	Right	Green

8. *Setting Control Trims (Neutral Positions).*

The final adjustment required is to set the control trim, so that each function is at neutral when the joysticks are centred. There is a single adjustment inside the ECP for this purpose, which sets the trim coarsely for all four channels at the same time.

To set this control, the equipment should be connected up as in Fig 5-1, **with the exception of the Hoverfly itself which should not be connected at this time**. When everything is connected up, switch on the transmitter and the power to the ECP. After a couple of seconds, both indicator lights should be lit. Extra care should be taken from now on, because the ECP is open, and its electronics can easily be damaged if anything metal touches the circuit board whilst the power is on.

The trim control is located close to the Channel Patch Socket (Fig 6-1). Next to it on the circuit board are two small indicator LEDs, one of which will probably be lit. Before setting the control, ensure that all the transmitter joysticks and trim adjusters are centred, including the collective control, which does not self-centre. Now, using a small screwdriver, slowly turn the ECP trim control in the direction of the indicator light that is lit. While turning the control, at some point the light will go out. The other light will come on if the control is turned further still. At the correct setting, both lights will be off. (If there is no resonse from the control, check that the transmitter is switched on and properly connected).

At this stage, the whole set-up can be checked by moving the rudder control (left hand joystick) from side to side. As it is moved left, the red trimmer LED should come on. As the stick is moved right, the green LED should come on. If this test fails, then all the connections should be checked carefully, and the set-up procedure done again.

If all is well, unplug the power from the ECP and switch off the transmitter. Since all settings are now complete, the ECP cover should be carefully replaced (Section 14-M).

9. BEFORE YOUR FIRST FLIGHT.

Before attempting to fly the Hoverfly for the first time, it is very important to familiarise yourself with its controls and general behaviour. If you are an experienced pilot, we suggest that you do run through this section, in order to get to know the features unique to the Hoverfly. This section also allows you to check that the Hoverfly is operating properly before attempting a flight. New pilots should examine Fig 6-2 carefully, to familiarise themselves with the controls.

Connect up the equipment as in Fig 5-1. Turn on the transmitter, and set all the trim tabs to their central positions. Set the collective stick to zero, which will normally be in the fully back position. Plug in the power supply, but DO NOT turn on the mains yet.

Now pick up the Hoverfly, holding it by the green rotor hub disc, just below the central dome. Your grip should feel firm but comfortable. Ensure that nothing lies in the path of the propellers, then switch on the mains.

The red light will illuminate on the ECP, followed by the green light after about 2 seconds. The Hoverfly may give a momentary twitch, but if it does more than this, then something is wrong. For example, the collective channel reverse switch could be set the wrong way, in which case the Hoverfly would start up at full power! This is the reason for caution the first time it is turned on. If the motors do start up, switch off the power again and check your set-ups carefully.

NOTE: *When switching off the Hoverfly, ALWAYS turn off the ECP power before the transmitter. Some transmitters, especially older types, generate a random signal during turn-off. This signal can make the Hoverfly start up momentarily if its power supply is still connected, possibly causing damage.*

If all seems to be well, it is time to try out the controls a little. While still holding the Hoverfly, slowly advance the collective stick. The main propellers should start to spin, and the tail rotor may also turn. Adjust the rudder trim tab (below the left joystick) to stop the tail rotor for the moment. DO NOT ALLOW THE TAIL ROTOR TO TURN FAST FOR MORE THAN A FEW SECONDS OR MOTOR DAMAGE MAY RESULT. Now keep advancing the collective stick, and notice how the propellers speed up. As they get faster, you will begin to feel their thrust. Advance the collective all the way, listening to the sound created at different settings. You should not, however, let the motors run at full power for longer than about 15 seconds.

Now back off the collective until the motors are running slowly. Hold the Hoverfly horizontally, so that the fuselage is free to steer below the rotor. Now move the rudder trim tab to the left a couple of clicks, so that the tail rotor turns slowly. It should be turning counter-clockwise when viewed from the left of the aircraft, and will now be roughly trimmed for flight.

Now you can try out the rudder control. Move the rudder stick slowly to the left. The tail rotor will speed up, and the Hoverfly will start to steer to the left. If you push the stick further to the left, the rate of steer will increase, all the way to a rapid pirouette. Now centre the stick again. Pushing the stick to the right will have a similar effect, except that the tail rotor will reverse direction, steering the Hoverfly to the right.

If you have a gyro fitted try it out now to see how it works. With the main motors running slowly, gently push the tail boom with one finger, so as the steer the Hoverfly to the right. The gyro will respond, speeding up the tail rotor in an attempt to prevent the aircraft from turning. Pushing the tail the other way will have a similar effect. Push it a little harder, and you will notice quite a firm effort against you. This is how the gyro

prevents random tail movements during flight. The aircraft will tend to remain pointing in the same direction, except when steered by a pilot joystick command.

Having familiarised yourself with these controls, bring the collective back to zero. All the propellers will stop, and the gyro will stop responding. Stand the Hoverfly on the floor in front of you. Advance the collective stick just a little, until the propellers start to rotate. Move it forwards a couple more clicks, and the rotor should start to revolve. Do not advance the collective any further at the moment. The rotor should turn easily, and will freewheel a little after the motors stop. Now try moving the rudder stick while the Hoverfly is standing on the ground, main motors running slowly. If you have a gyro fitted, you will notice that a very small amount of stick movement causes the tail rotor to run at full speed. This is because the stick movement acts as a *demand signal*, a request to the gyro to make the aircraft steer at the selected rate. The gyro then attempts to provide the requested rate of steer, by driving the tail rotor. Because the aircraft is standing on the ground, it cannot move, and hence the gyro tries its best without success! If you have no gyro, the response on the ground will be much like its response in flight; the tail rotor will simply go faster the further you push the joystick.

You are now almost ready to attempt your first flight. However, in accordance with good flying practice, it is important to carry out a few pre-flight checks (Section 10).

ACCESSORIES FOR BEGINNERS

Large Fin (applies to model H100 Hoverfly, without gyro, only).

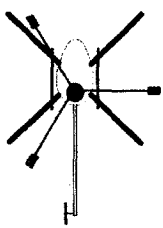
Hoverfly is difficult to control when fitted with the standard fin unless a yaw gyro is installed (standard on model H101). A large fin is supplied to use instead of the standard fin.

Prepare the fin by cutting round the printed outline and folded as illustrated alongside.

Fit it in place of the standard fin - see section 14-J for details of fin fitting.

Trainer Undercarriage

To aid the stability at take-off and landing two black tubes are supplied for forming a wide undercarriage.

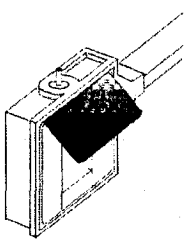


Pass one tube through the hole in the other to form a cross. Attach this to the standard skids using adhesive tape.

Deflector Vanes

Three small vanes are supplied for attachment to the main motors. The effect is to increase the rotor speed and hence the stability of the Hoverfly, making flying much easier for beginners.

Cut out the vanes and attach them to the motors as shown:



Tuck the vane between the top of the motor and the black plastic moulding as shown. Bend it down approximately 30 degrees (all vanes should be at the same angle).

10 PRE-FLIGHT CHECKS

Before any flight, you should do the following:

a) Check that canopy, undercarriage and tailboom are all seated securely in place, and that the tailfin is vertical. The boom can be gently twisted to correct the latter.

b) Check that the Hoverfly stands up straight on the ground. If not, gently adjust the undercarriage. If the aircraft stands crooked, it will tend to topple over during take-off.

c) Check that the collective stick is fully back, then turn on the transmitter, then the power. Bring up the collective slightly, check that all the motors run, and that the rotor revolves freely. Move the rudder stick to ensure that the tail rotor is operating.

In addition, after maintenance, a crash or a heavy landing, do the following:

d) Inspect the main motors to ensure they are properly seated.

e) Check that the command line (inside the body) is securely plugged in.

f) Check that the tail rotor retainer boss (the small plastic plug that holds the tail rotor onto the drive pulley) is pushed fully home. This often comes loose in a crash, preventing the tail rotor from being driven properly.

g) Hold the Hoverfly by the rotor hub, and advance the collective a little. Move the rudder stick, and check that the aircraft steers in the correct direction. ***Incorrect steering direction can be caused by incorrect belt fitting, or by plugging in the tail motor electrical connector the wrong way round. If a gyro is fitted, a rapid pirouette will result, because the gyro response will reinforce rather than counteract tail movements. It is important to find out about this before attempting to fly!***

Tip: Beginners frequently crash. To facilitate frequent pre-flight checks you may prefer to fly without the canopy fitted. This is satisfactory if the tailboom is pushed 25mm forward in its grommets to correct the balance of the Hoverfly. (Remove the tailboom completely from the chassis before attempting to move the grommets.)

11. YOUR FIRST FLIGHT

If you are a beginner, we strongly recommend that you read the whole of this section before actually flying. If you are an experienced pilot, please read through the next couple of paragraphs, which outline take-off technique for the Hoverfly.

For your first flights, choose a room with as much unobstructed space as possible. Do not attempt to fly outdoors. Place the Hoverfly on the floor, about 1.5 - 2 metres (say 6 feet) from the ECP and facing away from you. Position yourself just behind the ECP and make yourself comfortable. After a final check to ensure the command line will not snag on the undercarriage or foul the tail, advance the collective about one quarter. Wait while the rotor gets up speed, then continue to advance the collective slowly, to just

below the half-way position. Allow time for the rotor to speed up while doing this. THIS IS VITAL. The Hoverfly will blast off instantly if you advance the collective far enough, but it will be unstable and impossible to control until the rotor is up to speed.

When revved-up and ready, advance the collective smartly to achieve lift-off. With most transmitters, the Hoverfly will leave the ground when the collective is just above the central position. It will be tempting to linger at this point, trying to hover an inch off the floor so as to prevent damage if you crash. Even experienced helicopter pilots do this! Unfortunately, the Hoverfly is *much* harder to control when this close to the ground, because of ground effect. It will tend to skitter across the floor at high speed, until it bumps into something. Be bolder, and give the collective a burst at take-off to get the aircraft about 18 inches off the floor straight away. Be ready to reduce the collective almost immediately to prevent the Hoverfly hitting the ceiling! Learning how to do this, so as to leave to the ground, reach a safe height, and then to hold it there requires practice. Fortunately, the Hoverfly is robust, and will withstand a lot of bumping about.

Once in the air, it will immediately become apparent that the Hoverfly does not stay there by itself. In addition to controlling the height, you must learn how to use the rudder control to keep it pointing in the direction you want, which will generally be away from you. At the same time, you also have to learn to use the all-important cyclic controls, which allow you to guide the aircraft in the air or to keep it hovering in one place. The cyclic controls are operated by the right hand joystick (mode 2). Moving this stick will cause the Hoverfly to tilt in the direction of stick movement, which in turn will cause it to move in that direction, quickly! To keep it hovering, you must learn to use this joystick to compensate for the aircraft's random movements. It is a little like balancing a broom handle on your hand, though unfortunately, rather harder to learn. The most common problem is one of over-control, followed by over-compensation, and so on. The result is a furious oscillation, ending in a crash. Be gentle on the controls. Small movements are all that are required to hover.

The cyclic controls operate in relation to the aircraft itself. This means that the aircraft will tilt towards *its* left when the cyclic joystick is pushed to the left, etc. This gets very confusing when the Hoverfly is facing you, or nose-in. This is why it is important to learn to keep the aircraft pointing away from you as early as possible. Nose-in flying can wait until you have learned the basics.

Learning to fly will be much easier at the start if you can have an experienced pilot help you. In particular, your helper will be able to trim the Hoverfly accurately, so that the controls are all truly at neutral when the joysticks are centred. The set-up procedure trims the aircraft well enough to fly, but it is only approximate. A well-trimmed aircraft is easier to learn on.

Now practice, practice, and practice. Have fun, and Good Luck!

Note: Balance the rotor for smoother flight - see section 14F.

Care of the command line - section 14L, and routine maintenance - section 14G.

12. HELICOPTER PRINCIPLES

Conventional helicopters generate lift by means of the rapidly moving rotor blades. The blades are shaped as aerofoils, and give the machine it's name; 'helico', meaning rotary, and 'pter', meaning wing. The blades are set at an angle to the horizontal, so that they create thrust as they turn, like a giant propeller. The angle of inclination of the blades is referred to as their pitch, and can be changed by the pilot using the helicopter's flight controls. Overall lift is controlled by changing the pitch of all the blades simultaneously. This is referred to as collective control, and allows the pilot to cause the aircraft to climb or descend.

Directional control is achieved by varying the pitch of each blade as it travels around its circular path, so that more lift is provided on one side of the rotor disc than on the other. This is referred to as cyclic control, and allows the pilot to tilt the aircraft in any desired direction. For example, in order to make the helicopter tilt forwards (as if to dive), the pitch of each blade will be reduced as it enters the front semicircle, and increased as it enters the rear semicircle. More lift will then be generated at the rear than at the front, causing an imbalance which tilts the whole aircraft. As this happens, the aircraft will begin to move forwards, because the overall lift force is no longer acting straight upwards, but is inclined towards the front. This is how a helicopter achieves forward flight. The controls of a helicopter allow the pilot to tilt the aircraft from side to side (roll) as well as from front to back (pitch), and any combination of the two, giving total freedom of movement. Constant adjustment of these controls allows the pilot to keep the machine exactly horizontal, and thus to hover. The mechanism that achieves these control functions is complex, and involves numerous mechanical linkages and push-rods, as well as a special tiltable bearing called the swash-plate. In the case of models, servos are needed in addition, to provide physical actuation of the control mechanisms.

It is important to realize that a helicopter does not hover or fly by itself, but requires continuous adjustment of the controls to keep it in a stable attitude in the air, and at the desired height. The skill required to do this has to be learned, and is fundamental to helicopter flying. However, a helicopter derives a good deal of stability from the rotating blades, which act as a giant gyroscope. This slows down its rate of response to a speed at which a human pilot can control it, with practice!

The rotor of a helicopter is generally driven by an engine mounted in the fuselage, by means of a large central drive-shaft. In order to make the rotor turn, the engine has to push against its mountings. This means that the engine is actually trying to turn the helicopter fuselage just as hard as it is turning the rotor itself. This unwanted turning force is referred to as a 'torque reaction'. In order to prevent the fuselage from spinning, a helicopter is fitted with a tail rotor, which is simply a propeller mounted sideways on the tip of the tail, which pulls against the turning force from the engine. The tail rotor thrust can be changed, by varying the pitch of its blades. This control allows the pilot to steer the aircraft in the horizontal plane, an action referred to as 'yaw'. It has a similar effect as the rudder on a ship, except that it works even when the aircraft is stationary in the air.

Learning to use this control to keep the helicopter pointing in a desired direction is a further challenge for a new pilot. It has to be done whilst at the same time keeping control over the other axes of movement, which requires great concentration for a beginner. Because the pilot of a model is not actually inside the aircraft, confusion tends to result when the machine is pointing towards him/her. The aircraft's left hand side becomes the pilot's right hand side, and vice versa. The pilot has to be constantly aware of this in order to remain in control.

13. OVERVIEW OF THE HOVERFLY

The Hoverfly uses a radically new approach to generate lift and control, to achieve a flight performance which closely resembles real helicopters and conventional radio controlled models. It is very lightweight, and employs an extremely slow rotor speed, making it very safe, and ideal for indoor operation.

Unlike a conventional helicopter, the Hoverfly uses small rotor-tip propellers to generate its lift. Each propeller is driven by a separate motor, and the main rotor turns only for the sake of stability, driven by the propellers. This approach has a number of advantages over conventional designs:

1) The propeller speeds can respond very rapidly to changes in the electrical supply. This allows cyclic control to be provided by changing the propeller speeds at the appropriate moments during each revoluton of the main rotor. This is a purely electrical function, not requiring any mechanics; the need for a swash plate and servos is entirely eliminated. The result is an extremely small, lightweight and mechanically simple aircraft.

2) A large proportion of the aircraft mass is in the 3 motors, mounted at the rotor tips. This large rotating mass makes the aircraft very stable, even at low rotor speeds. The stability mimics much larger models effectively, while the low rotor speed makes the model comparatively safe, and gives a realistic 'scale' appearance in flight.

3) The drive that turns the main rotor is provided by the tip mounted propellers, rather than from within the fuselage. There is consequently no torque reaction created, which allows the tail rotor to be very simple and low-powered. The tail rotor provided on the Hoverfly is a fixed-pitch propeller and is needed only for yaw control (steering). It turns in either direction, to allow for both directions of yaw.

14. MAINTENANCE

Note: Tail rotor maintenance should be done after every two hours flying - see 14G.

A. DISASSEMBLY

1. Pull off the plastic dome from the rotor shaft.
2. Slide the rotor retaining spring off the rotor shaft. This may be quite tight, but it can be levered up from the rotor hub by straddling the shaft just below it with the blades of a small pair of scissors. Twisting the spring against the direction of the coils will also loosen it during withdrawal. Be careful not to lose it!
3. Carefully lift off the rotor.
4. The bottom lip of the canopy is pulled in at the front by a plastic strap. This prevents the canopy from lifting off at the front. To remove the canopy, pull it gently off its foam mounting at the top of the mainframe. Lift it over the shaft, and slide it forwards to clear the yaw motor.
5. Remove the undercarriage by pulling it downwards out of the mainframe. The command line passes through the undercarriage, so it has to be passed along to the end in order to free it.
6. Unplug the lead to the yaw motor (at the top of the mainframe).
7. Push the boom downwards until the two mounting grommets are released from the mainframe clips. Withdraw the boom carefully, guiding the yaw motor through the mainframe.
8. Unplug the command line connector inside the mainframe.

B. REASSEMBLY

This is basically steps 1 to 8 above, in reverse order. Pay attention to the following:-

Step 8. One limb of the command line plug has a flat end. This carries a white spot, which aligns to the white spot on the alignment lug at the edge of the socket.

Step 7. Before fitting the boom assembly, ensure the grommets are correctly positioned. They should lie just outside the white rings on the boom. The command line should pass on the right hand side of the boom. Ensure the fin and yaw motor are upright (motor on top of the boom, tail propeller on the left).

Step 6. The yaw motor connector plug carries a white spot, which aligns to the white spot on the socket.

Step 5. When fitting the undercarriage, pass the command line through the loop between the crosswires and the right hand skid.

Step 4. When fitting the canopy, engage the front first, then ease the top over the shaft and onto the mainframe foam mounting.

Step 3. Fitting the rotor requires some care to ensure that the commutator brushes do not get damaged. Slide the rotor onto the shaft, manoeuvring it so that the three brushes lie against the shaft symmetrically. Ensure that the upper brush is on the correct side of the

shaft as the rotor is lowered. Do not allow the rotor to seat fully until the three brushes have been lifted on to the commutator. Use a small hook (the head of an ordinary pin will do) to lift each brush on to the commutator. (Do not over-bend the brush wires in doing this.) When all the brushes are in place, allow the rotor to fall fully into place.

Step 2. Lift the upper brush onto the retaining spring as it is fitted. Do not push the retaining spring too hard onto the top of the rotor. The rotor must rotate freely. We recommend leaving about 0.25mm clearance.

C. MAIN MOTOR REPLACEMENT

Do not attempt to do this unless you are confident of your soldering ability.

1. Unsolder the two wires from the motor terminals using an iron with a small tip.
2. Pull off the push-fit propeller. (See section E below)
3. Lift the top of the plastic bracket off the upper motor boss, and ease it over the shaft. Gently prise the base of the motor free from the bracket, and withdraw it upwards.
4. Fitting the motor is the reverse of the above. The outer plastic retaining band can be bent out of the way during motor fitting, then replaced squarely round the side of the motor afterwards. Ensure that the electrical terminal marked 'MABUCHI' is located towards the centre of the rotor. The blue wire connects to this terminal. Carefully re-solder both wires and dress them against the rotor.

D. ROTOR REPAIR

If the rotor is damaged it is recommended that the complete rotor assembly is replaced. However if a repair is attempted pay particular attention to the following, to minimise aircraft wobble during flight.

1. The lateral tilt of the motor must be 5 degrees counter-clockwise when viewed towards the centre of the rotor. The radial tilt should be minimal, but equal for all three motors.
2. Ensure the integrity of the rotor plane is maintained accurately.
3. Ensure that the length of each arm (measured from the centre of the rotor to the motor shaft) is identical for all three arms.

E. PROPELLER REMOVAL AND RE-FITTING

The propellers are a tight push-fit onto the motor shafts. To remove, the motor should be grasped at the sides between thumb and forefingers, so as to clamp the armature, preventing the motor from turning. The propeller can now be twisted back and forth whilst pulling it in order to remove it. Re-fitting is done in much the same way, taking care to offer it up to the motor shaft as squarely as possible.

WARNING: THE MOTORS MAY BE HOT AFTER RUNNING FOR SOME TIME.

F. BALANCING

Although the Hoverfly comes ready to fly, flight performance can be improved by fine balancing of the rotor and propellers. Balancing the rotor will reduce the amount of aircraft 'wobble' experienced during flight, especially at hover. Balancing the propellers will reduce noise and sympathetic buzzing from the airframe. It can also

increase climbout performance. A truly well balanced Hoverfly will fly silky smooth, and is a delight to watch. Balancing is straightforward, and is largely a matter of trial and error. One of the great features of the Hoverfly is its ability to fly when badly out of balance and trim; this allows for safe experimentation.

Propeller Balancing: This is best done first, since it will have an influence on the rotor balancing process. The propellers will be balanced by applying small pieces of adhesive tape to the blades. The procedure is as follows:

1. Set up the Hoverfly so that it is ready to fly.
2. With the Hoverfly resting on the floor, hold it firmly by one of the rotor arms, taking care to keep your fingers out of the way of the propeller. Now gently bring up the collective to around hover speed. Listen to the sound, and note the amount of vibration felt in the rotor arm. Now lower the collective to zero.
3. Using leftover tape from the decal stripes, cut a piece about 6mm square and stick it to one of the propeller blades on the arm you were holding. Position it centrally across the blade, about 5mm from the tip.
4. Now repeat the above vibration test. It will generally be obvious straight away whether you have improved or worsened the balance.
5. If the vibration has increased, simply move the tape to the other blade and try again. If it has lessened, you should experiment a little with the position and size of the piece of tape, to get the best result. Moving the tape inwards will reduce its effect, whilst making it larger will increase the effect. A well balanced propeller will feel quite smooth, and will not 'buzz' as it speeds up. Remember that some vibration will be felt from the other, un-balanced propellers. Having found the right size and position of tape, you may want to move it to the underside of the blade, out of sight.
6. This process can be repeated for the other two propellers. Since propellers in the same batch tend to be very similar, it is often good enough just to copy the first balance solution.

   NOTE: The tape supplied for the stripes is ideal, because it won't 'creep' when exposed to the centrifugal force of spinning. Other tapes will work, but many will gradually move with use.

Rotor Balancing: If the Hoverfly wobbles in flight, this can be corrected by the careful balancing of the rotor. The rotor will be balanced by adding small pieces of 'Blu Tac' to the ends of the arms, on a trial and error basis. The correct solution is usually one of two possibilities:

a) If one of the arms is a bit light, adding weight to it will fix the wobble.

b) If one of the arms is a bit heavy, adding weight to the other two arms will fix the wobble.

Some points to note:

a) You will never need to add weight to all three arms.

b) When two weights are needed, they can usually be roughly equal.

c) The level of precision required is not very great. It really isn't hard to make a big difference!

d) Wobble is actually caused by several interrelated factors, which create a composite effect which is addressed by adding weights. Dynamic imbalance is one of them. However, wobble will also be caused by slight inaccuracies in motor alignment (especially radial slant), distorted rotor geometry (don't let the rotor get wet), and chipped propellers. A wobble sometimes occurs after a rebuild, due to imperfect carbon

brush contact. This will generally cure itself after a minute or two in the air.

e) If you are a beginner, or if you fly wild and crash a lot, it really isn't worth being too fussy. You could buy a second rotor, for special occasions!

The balancing procedure is as follows:

1. With a pencil, number each of the rotor arms for easy identification.
2. Fly the Hoverfly, and note the amount of wobble present.
3. Roll out a small ball of 'Blu Tac', 5-6mm in diameter. Stick it to the outer edge of motor 1.
4. Fly the Hoverfly again. Note if the wobble has improved or worsened.
5. If the wobble has worsened, try moving the 'Blu Tac' to motor 2 and try again, etc.
6. Once you've found the right motor, you can try adding weight to a second motor for further improvement. It is often best to divide the first weight in half between the two motors.
7. You can also try different amounts of weight. 5-6mm diameter is a good start, but do experiment.
8. When you are happy with the balance, you can move the 'Blu Tac' to the inside edge of the motor. The plastic bracket has a convenient recess under the rotor arm where it can be hidden.

G. TAIL MAINTENANCE

Although robust, the tail mechanism does require regular maintenance in order to keep it working well. It will experience heavy use and rapid speed changes, especially if a gyro is used. In particular, the belt is prone to wear. In-flight tail rotor failures will often lead to a crash; therefore, we recommend the following after every two hours flying time:

1. Remove the undercarriage, unplug the yaw motor (this can be reached with the canopy in place, just!), and unclip the tailboom from the mainframe. Remove it completely.
2. Using a pointed tool, un-hook the belt from the motor pulley, and remove it from the other end.
3. Check that both rear pulleys turn freely, and apply a **tiny** amount of light vegetable oil to the bearing area, between each pulley and the bracket. Use a scalpel blade or similar tool. Remove the tail propeller by prising out its retaining plug. Apply a small drop of oil next to the top of the bearing pin inside the propeller mounting turret. Take great care not to get oil in the pulley grooves, and carefully remove any that does.
4. The belt can be re-used once. Before replacement, it should be thoroughly powdered with talc. Sprinkle some into a dish, and rub the belt around in it. At every second overhaul, the belt should be renewed.
5. Re-insert the belt (see H below).
6. Re-assemble the Hoverfly, and test the tail before flying. Especially, ensure that the direction is correct. (See Fig 14-1)

Note: Never run the tail motor unloaded (without the belt and propeller fitted). Over-revving and damage may result.

Tip: After a while, especially in warm conditions, the tailboom may droop. This can be cured by twisting it through 180 degrees. Having done so, turn the end fittings around

also, so that the whole tail unit becomes inverted. Take care to rotate the ends the same way, to avoid twisting the belt.

H. BELT INSERTION

1. Attach the tailboom lightly to a tabletop with tape (or get a helper to hold it). The motor end should be on your left, and the propeller uppermost.
2. Pass the special Belt Insertion Tool into the motor end of the boom, in front of the motor pulley, hooked-end first and uppermost (Fig 14-1). When it comes out of the other end, position the hook next to the near edge of the large pulley, as illustrated.
3. Now lay the belt in the groove of the large pulley, drawing it rearward through the hook in the tool. Hold it loosely extended with your right hand. With your left hand, pull the belt into the boom with the tool, allowing the front strand to run into the small pulley groove. Keep slight tension on it all the way, letting go with your right hand at the final moment, to allow the belt to fall into the large pulley groove.

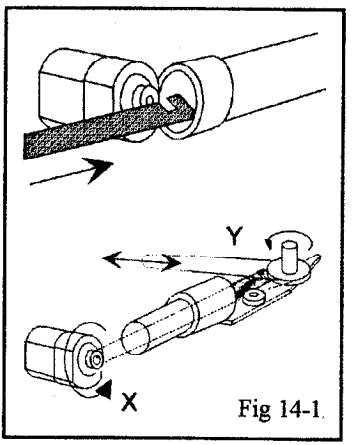


Fig 14-1

4. When the hook emerges from the left hand end, lower the rear strand of belt over the rim of the motor pulley. Use the hook to manoeuvre the belt into place. The belt should now be aligned as in the diagram.

Take care not to twist the belt while pulling it through the tube.

Check that the direction of rotation is correct before flying. See diagram above - turning the motor pulley in direction X should cause the tail pulley to rotate as Y.

I. TAIL PROPELLER REPLACEMENT

Carefully pull out the propeller retaining plug to release the propeller. Press this through the new propeller, and re-insert, pushing it fully home.

J. TAILFIN REPLACEMENT

The fin may be removed by prising off its retaining bar.

K. TAIL PULLEY REMOVAL AND RE-FITTING

1. Each rear pulley is held in place by a shaft pin, on which it runs. This pin can be seen on the small pulley, but is hidden inside the larger pulley. The pins push-fit into the bracket.
2. Remove either pulley by prising it carefully away from the bracket.
3. To re-fit, the pin should be pressed into the bracket hole until its tip is flush with the other side. This is easy if the bracket is held against a flat surface.
4. To re-fit the large pulley, the tail rotor must be removed to gain access to the pin. The pin can be pushed with a screwdriver or similar blunt tool.

L. CARE OF THE COMMAND LINE

The command line is vital to the Hoverfly. It carries no less than 9 separate electrical signals, on 14 thin strands. It is quite robust, but requires care in handling. Please note

the following:

1. The two possible failures are broken strands, and short circuits between strands. Both can be caused by careless use.
2. Kinks will weaken the wire. Be very careful to remove all loops when unwinding it, **before** they get pulled tight. Run the wire between thumb and forefingers to straighten it before flying. After use, wind the line onto the spool provided, starting from the Hoverfly end, so that twists can fall out. Alternatively, make a really large spool (30cms or more), to keep twists to a minimum.
3. Be careful to avoid letting the line drag over sharp metal corners, such as electrical equipment cases. This can scrape the insulation from the wires.
4. If the strands separate, twist them together again.
5. Take care to keep the command line from catching in the propellers or rotor. If it gets wound around the rotor shaft, switch off the power **immediately**. Remove the rotor if necessary to untangle the strands from the brushgear.
6. Do not use the Hoverfly if the command line gets wet. Allow it to dry thoroughly first.
7. If a command line short circuit occurs, the ECP will usually switch itself off for protection. To reset it, unplug the power briefly.

M. OPENING AND CLOSING THE ECP CASE.

1. The ECP case splits into a top and a bottom section. To separate, hold it by the lower half, and squeeze the sides firmly. The top half will then lift off.
2. To close, offer up the top half squarely, and in line with the bottom. Snap the two halves together gently.

NOTE: The case has two locating pins in opposite corners of each section, which engage with holes in the other half. These break easily. Please take care when closing.

N. TROUBLESHOOTING TIPS.

1. Excessive tail wagging. Possible causes:

a). Rotor retaining spring is too far down. *See section 4-B.*

b). Excessive gyro gain. *Reduce the blade pitch of the tail propeller.*

15. *FINISHING TOUCHES.*

A. DECALS, AND WINDOW.

1. To fit the window, firstly cut around the moulded outline to remove the excess material.
2. Grooves on the canopy show how to align the window. Hold it in place with a piece of the white tape provided, to create a windowframe effect.
3. Hold down the rear corners with a small amount of water-based glue, or with transparent tape. Excess from the decal sheet is ideal.
4. Stripes can be added to the canopy and tail as desired. The tape provided will stretch to turn through tight curves, without peeling off.

5. The decals can be cut out and applied as desired. They peel and stick, and do not come off easily.

   NOTE: The canopy is most easily decorated by removing it. To avoid the need to disassemble the Hoverfly for this purpose, you may wish to purchase a spare canopy and decorate that, especially if you are a beginner. The decorated canopy can be substituted when you have learnt to fly.

B. ROTOR SPAR COVERING

A sheet of iron-on film is supplied for this. The wires can be covered, or removed before applying the film.

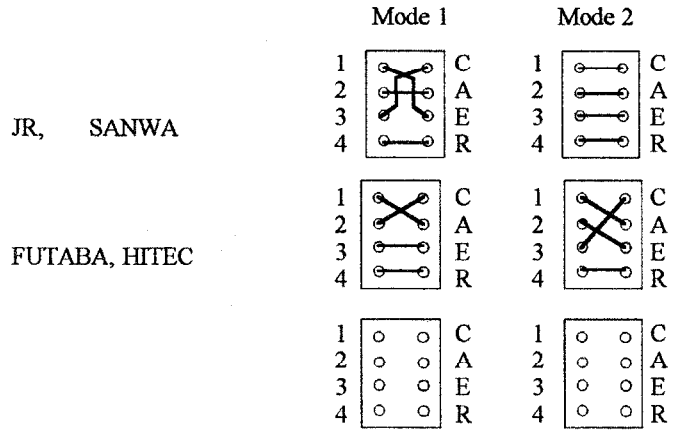
1. Remove any excess glue from the spars and sand them lightly.
2. Cut a piece of film 110 x 21 mm. Check the length against the spar.
3. Remove the backing sheet. Starting on the bottom surface (top, if you are covering the wiring) apply the film using a modeller's iron at 130 degrees C.
4. Iron the film onto each surface in turn, finishing with an overlap.
5. Shrink the film with the iron at 160 degrees C.

16. PATCH DIAGRAMS

The patch diagrams below show how to connect up the patch socket for Mode 1 (throttle on right) and Mode 2 (throttle on left) operation for each of the four standard types of transmitters.

The patch modules supplied with Hoverfly provide the Mode 2 connections shown below. The corresponding Mode 1 connections should be patched as shown using the four wire links supplied.

The blank diagrams are for you to record your set-up if you are not using a standard one.



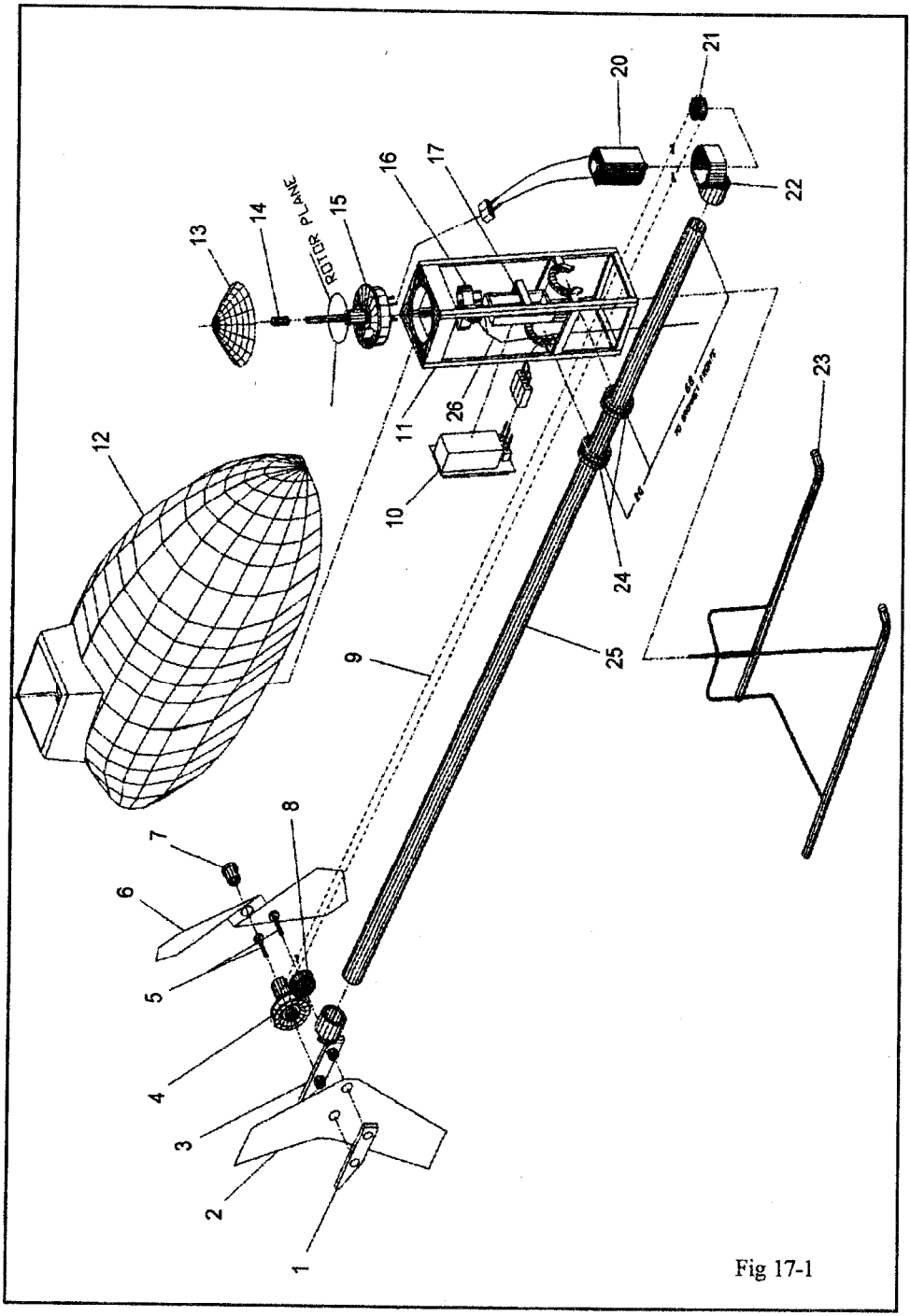


Fig 17-1

17. SPARES

Part No.		Description Fig 16-1
ROTOR		
1001		Rotor, complete with motors
1002		Rotor (hub, arms, motor-mounts), precision jig assembled
5103		Heat shrink (sheet)
7201(4)		Rotor brushes (set of 4)
PROP65(3)		Propeller (matched set of 3)
SH030		Main motor
TAIL BOOM ASSEMBLY		
1005		Complete assy, with yaw motor
3004	20	Yaw motor, with plug
5010	22	Motor bracket
5011	3	Tail bracket
5012	1	Fin retainer
5013	8	Idler pulley
5014	21	Motor pulley
5015	4	Tail pulley
5016(2)	5	Pulley shaft pins (2)
5018	7	Tail rotor retainer
5019(2)	24	Grommets (2)
5101	2	Tail fin
5102	6	Tail rotor
8202	9	Drive belt
BOOM	25	Boom tube, with location marks

Part No.		Description Fig 16-1
CONTROL UNIT		
1003		Control interface unit
4004		Patch plug F (Futaba, Hitec Tx)
4005		Patch plug J (JR, Sanwa Tx)
7302(4)		Patch link (set of 4)
OTHER PARTS		
2101	23	Undercarriage
3001	26	Helicopter command line
3002		Signal lead (phono to 3.5mm jack)
3003		Signal lead (phono to 6 way DIN plug)
5003	13	Dome cap
5005/7	11/15	Mainframe with commutator
5125	12	Body (with brace)
5128		Window
6303	14	Spring collar (Rotor retainer)
DECALKIT		Red/white stripes and decals sheet
G100	10	Gyro, with instructions
SA66-C154		Power supply
ACCESSORIES		
5104		Pull-through hook
8001		Instruction manual

For spares, contact your supplier, or in case of difficulty apply to:-

Snelflight Ltd
Churchill House
57 Jubilee Road
Waterlooville
Hants
PO7 7RF

Tel:- 02392 258999
Fax:- 02392 251333