Firefly-Class Medium Transport
Cargo Handling Manual

Introduction:

This manual is designed to familiarize Supercargo and Flight Crew with the freight loading and hauling characteristics of the Firefly Medium Transport Vessel. The Firefly-class MTV is a superbly designed middleweight cargo carrier ideally suited for tasks ranging from fast courier service to deep-space haulage. Personnel experienced in the handling and transport of freight – particularly in smaller vessels such as the Type A2 Shuttle – will have no trouble adapting to the mild demands of the Firefly, due to its advanced computerized flight control and unique Thrust Stabilization System (TSS).

Nevertheless; the proper handling of freight and control of a loaded craft must be taken into consideration – there is little room for error when flying a fully loaded spacecraft. All pilots are well advised to study this manual and operate the craft within the described parameters.

Firefly MTV Control and Handling Systems

The Firefly MTV employs a number of unique systems designed to make cargo haulage and loaded flight control as user-friendly as possible. These systems are described here.

Eze-Rack[tm] Freight Control System

The Firefly MTV's cargo bay has been designed to accept the latest Blue Sun Intermodal mobile freight skids. As such; the MTV's patented Eze-Rack[tm] freight control system consists of two major subsystems: the Modular Control System and the Mass Alignment System.

Intermodal Control System

This is Eze-Rack's standard freight attachment system; consisting of a floor-mounted grid of locking grooves and the skid control arm; which physically moves the cargo in and out of the cargo bay. The grooves mate with studs on the bottom of the freight skids; locking them into place when in flight to insure a safe, secure cargo. For the flight crew; little needs to be done with the cargo other than extending and retracting the arm when required. As an additional bonus, Eze-Rack has added a secondary attachment point to the cargo bay; allowing the Firefly to carry a Mule to assist in freight operations.

Mass Alignment System

This system works specifically with the Blue Sun Intermodal mobile freight skids. Each Blue Sun skid has its own weight scale and upon loading automatically calculates its center of gravity. Upon attachment and retraction into the Firefly MTV; the MAS collects this data, then adjusts the position of the skid inside the bay using rams inside the locking grooves. This insures the vessel's center of gravity remains within the safe operating limits of the Firefly TSS. This process is entirely automatic, and needs no input from human operators.

Firefly Thrust Stabilization System (TSS)

The Firefly MTV takes its propulsion from two laterally mounted rotating engine nacelles. Since only two engines provide an unbalanced thrust arrangement; the Firefly employs the latest Thrust Stabilization System to compensate for the potential instability. The Firefly's TSS collects data from the FRS and flight control systems; comparing attitude and position against the expected standard. It will then make small corrections via the engines' rotation system and nacelle microvanes; balancing the craft. What this means for the pilot is that the craft behaves in a completely stable, predictable and balanced manner.

Blue Sun Intermodal[tm] GS-103C/F Ground Effect Skid

The heart of the Firefly's freight-handling versatility lies in its use of the Blue Sun GS-103 GES.

The GS-103 GES

The GS-103 is a fully self-contained and mobile ground effects vehicle, with its own power supply, computers and sensor suite. Life support is also provided for working in non-Earthlike conditions, by means of a spacesuit hookup in the operator's console. The standard cargo skid (GS-103C) provides limited mobility on the ground, and may be moved either with its own onboard engines or by towing via a Mule. The F model of the GS-103 is designed to carry fuel for ground and orbital resupply; and as such also includes a sophisticated fuel transfer system and dual-power RCS jets inside the skid bed. Both the C and F models are supported by an advanced Ground Effect repulsor system which permanently holds the vehicle at a rock-steady 0.75m height above ground, and can support up to 400,000Kg before failure. Since this figure far exceeds the Firefly's lifting power, it is unlikely the GES will ever need to be loaded to the fail point.

Skid Loadout Types

For the purposes of this package; there are several types of preloaded and adjustable skids for the pilot to choose from. Each has a particular task. When preparing for your flight, pay close attention to the purpose, weight and maximum load of the available skids in order to choose the best one for your mission.

Cargo Skid 1: Configurable empty skid.

Filename: QJFFSC1
Empty Mass: 2000Kg.
Max. Cargo mass: Configurable
Purpose: Return of empty skids; or carrying of any cargo.

Use: This is simply an empty GS-103C, which can be loaded with any cargo a player sees fit to place on it. In the above example; it's carrying a heavy space station module. In order to carry your own cargo; you must do the following:

- Open the scenario file of the mission you wish to fly. Either place or locate your skid with the filename listed above. You will notice in the kid's parameters a series of X,Y and Z points – these are the adjustable attachment point parameters. Wee will return to these in a moment.
- Next, place your cargo onto the skid using the following parameters:

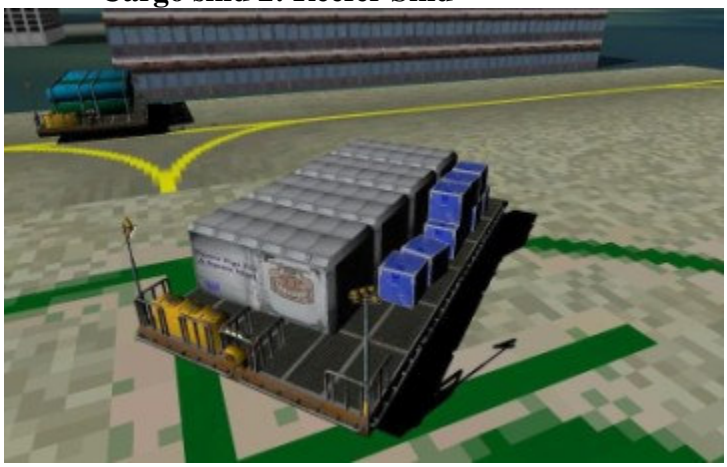
```
XXXX:xxxx
  ATTACHED 0:0,Cargo_1
END
```

Where XXX is the name of your cargo, and xxxx is its filename; just like any ship.

- Test the load's position by starting the scenario and visually inspecting it. If it is not placed to your satisfaction, return to the scn file. Adjust the skid's attachment point parameters until the load rests where you want it. X is its left-right position, Y is its up-down position and Z it's front-back.

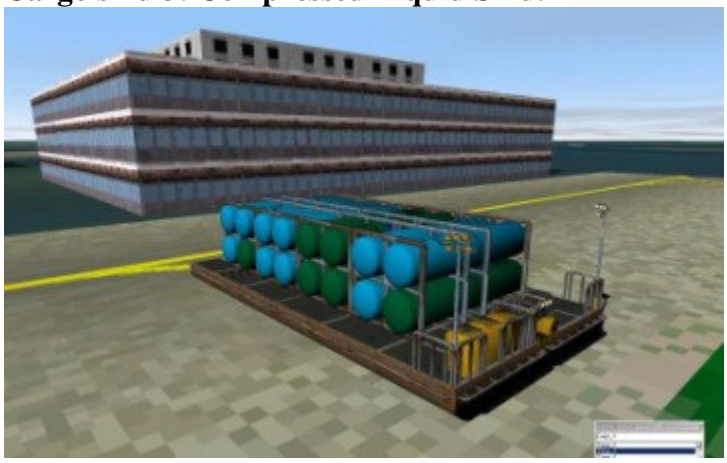
- If you require, you can release the cargo from the skid at any time using the J-key. **Note: If the cargo is a small self-propelled ship; make sure the carried ship has fuel in the .scn file before you attempt to release it or it won't get very far. ☺**

Cargo skid 2: Reefer Skid



Filename: QJFFSC2
Empty Mass 5578kg
Fuel Mass 200kg
Max Cargo Mass 125000kg
Purpose: Fresh foodstuffs and other refrigerated goods.

Cargo skid 3: Compressed Liquid Skid.



Filename: QJFFSC3
Empty Mass 5527kg
Fuel Mass 200kg
Max Cargo Mass 175000kg
Purpose: Oxygen, Hydrogen, Acetylene and other compressed liquids.
WARNING: Dangerous goods and HAZMAT protocols must be followed when transporting this skid.

Cargo Skid 4: Light Preload

Filename: QJFFSC4
Empty Mass 3200kg
Fuel Mass 200kg
Max Cargo Mass 134123kg
Purpose: Light resupply to smaller bases and outposts.

Cargo Skid 5: Heavy Preload

Filename: QJFFSC5
Empty Mass 6347kg
Fuel Mass 200kg
Max Cargo Mass 270000kg
Purpose: Standard shipping and large-scale resupply to large bases and stations.

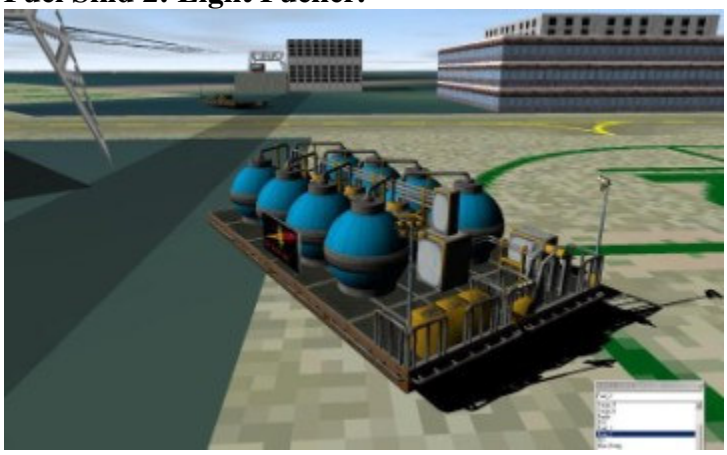
Cargo Skid 6: Bulk Container

Filename: QJFFSC6
Empty Mass 5000kg
Fuel Mass 200kg
Max Cargo Mass 312000kg
Purpose: Heavy transport of bulk dry goods, machinery, equipment etc. Also exploration and colonization packages.

Fuel Skid 1: Heavy Fueller.

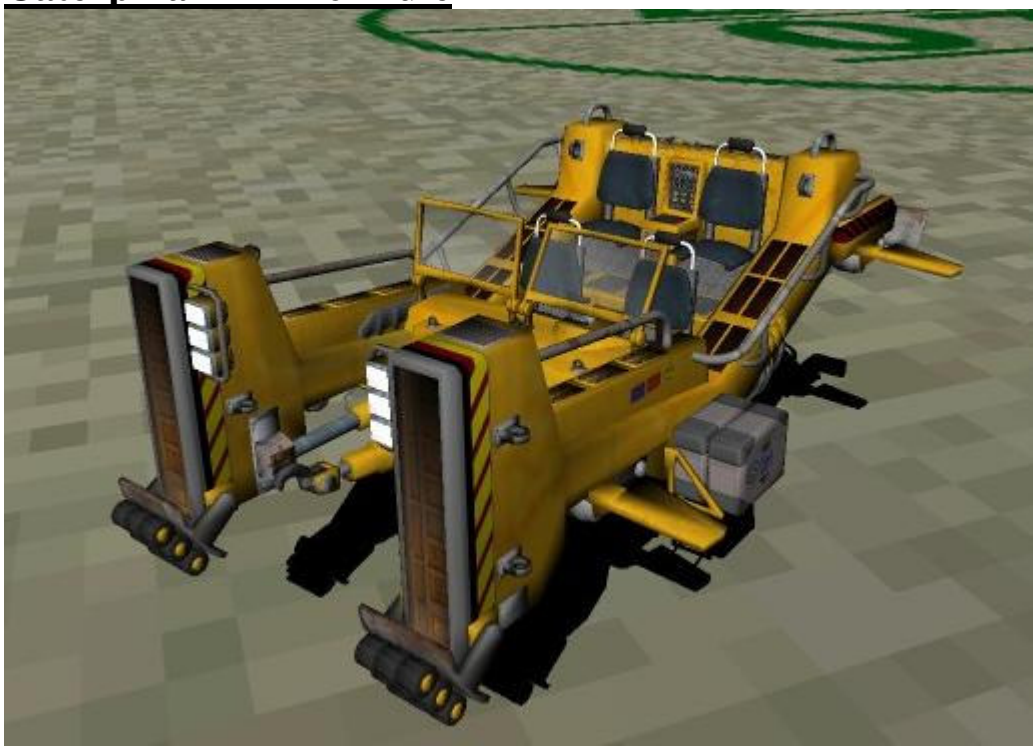
Empty Mass 8250kg
Fuel Mass 250000kg
Purpose: Large-scale refueling and fuel transport (Deep-space freighters, stations, major bases.)
Use: The F model of the GS-103 carries RCS clusters to enable it to operate in space. The clusters are dual-power, meaning they have two different power settings for use when the skid's tanks are empty of full. Use Low power for empty tanks, and High power for full tanks. The keys to adjust the power settings are J for low power, and K for high power. When the RCS is at High power; the indicator on the control panel will light up blue. Both Fuel Skid 1 and Fuel Skid 2 have this feature.

Fuel Skid 2: Light Fueller.



Empty Mass 9857kg
Fuel Mass 125000kg
Purpose: General spacecraft refueling operations.

Caterpillar ™ D-76 Mule



The latest in a long line of rugged, reliable industrial and construction equipment, the D-76 Mule is a solid, dependable ground-effect freight shifter no spaceport should be without. The D-76 is equipped with construction-grade repulsors and high-torque motivators to easily shift the heaviest loads. It mounts a single male-end attachment between two heavy front-end buffers to safely connect to any freight that needs moving.

Since the Mule carries a male-end attachment point and *not* a female-end, it cannot be mounted to the Firefly's main cargo-bay attachment point. In order to carry a Mule onboard; the Firefly also mounts a secondary female-end attachment specifically for the D-76.

Operating the D-76

The Mule's basic control suite is the same as any ground effects vehicle – it can turn, accelerate, reverse and slide sideways. In addition, it's connecting rig can be controlled from inside the cab, by use of the 'G' and 'J' keys. G ('Grab') attaches the load to the Mule, while J ('Jettison') releases it. In order to safely connect cargo, one must first line the Mule up with the skid, then drive slowly forward until the attachment points contact. The gear can then be closed, locking the skid. Refer to the image below.

Step 1: Align the Mule's angle up with the skid by placing the bottom of the driver's window with the front edge of the skid **(A)**
Step 2: Align the Mule's position with the skid by lining the HUD marks up with the skid's holographic alignment indicator. **(B)**
Step 3: Slowly advance until the attachment points meet.
Step 4: Engage connecting rig by pressing G.

Loading and Maximum Weights

In order to insure safe handling of the loaded Firefly, it must be properly loaded to within safe limits. **Failure to follow safe loading parameters voids all manufacturers'**

warranties. Firefly United will not be held accountable for any damage received from improperly loaded flight.

Weights and Definitions

Firefly Mass: 109000kg.
Shuttle Mass: 20151kg.
Mule Mass: 4000Kg.

Name	Definition	Payload Mass	Total Mass	Description
MOW	Maximum Operating Weight	240000	354210	Maximum mass the vessel can lift in a 1G environment while maintaining safety standards. This is the maximum legal mass of the vessel.
MTO	Maximum Takeoff Weight	250000	364201	Maximum mass the vessel can lift in a 1G environment.
MTO/TA	Maximum Takeoff with Thruster Assist	275000	389201	Maximum mass the vessel can lift using thrusters in Translation mode to assist. NOTE: This is an extremely unsafe and dangerous operation. Do not attempt except in extreme emergency.

Calculating Maximum Load

The Firefly can carry tremendous loads into space, but care must be taken to insure the vessel isn't overloaded prior to flight. Since many of the GS-103 skids may be preloaded up to or exceeding the MTV's maximum weight; it is easy to overload if one is careless. In order to insure the vessel is not overloaded; calculate your mass as follows:

1) Decide which takeoff weight you wish to use. (For normal operations, this will be MOW or less.)
2) Determine which equipment (Mule, shuttles, etc.) will be carried on board.
3) Calculate the Total Useable Mass by subtracting the mass of your equipment from the vessel's payload mass.
4) Enter the Total Useable Mass into the cargo skid's CMASS line.

Example: I wish to carry a load of supplies to a mining outpost on the Moon. This is a regular run, so full safety measures will be taken. This means I must load my Firefly to no greater than MOW, and carry shuttles as an escape system. I also need to carry a mule to unload the skid once I arrive. Therefore, my calculations work as follows:
The weight of a shuttle is 20,151kg. The weight of the Mule is 4000kg. Thus, two shuttles and a Mule come to a total mass of 44302kg. Maximum payload for MOW is 240000kg. I therefore subtract 44302 from 240000 to get a total useable mass of 195698kg. I input 195698 into the skid's CMASS line, so it looks like this:

Cargo_6:QJFFSC6
STATUS Landed Earth
POS -80.6750045 28.5224063

HEADING 225.47
PRPLEVEL 0:1.000
NAVFREQ 0 0 0 0
XPDR 0
CMASS 195698.0000

Once the skid, shuttles and Mule are all loaded aboard the Firefly, the MTV's total mass will equal 354210, or MOW.

A fully-loaded Firefly closing up for takeoff.

Flight Notes

Even when fully loaded, the Firefly-class MTV is a stable, confident vessel to fly. That being said; any craft designed for freight will have considerable differences between its unloaded and loaded flight characteristics. In the case of the Firefly; the great inertia and weight of its full payload – 240 tonnes – can catch unwary pilots and cause the spacecraft to crash if not properly handled. This section will detail several aspects of flight which a pilot will need to be aware of.

Hover-Flight

'Hover-flight' is the term given to a craft that is relying strictly on the power of its engines for lift. The operational parameters are: Engines at Hover, altitude 500ft. AGL or less, airspeed 100km/h or less.

A Firefly-class MTV operating in Hover-flight.

Hover-flight is the riskiest and most difficult flight mode to fly in; and the risks are compounded when the spacecraft is fully loaded. Nevertheless; it is the one flight mode which is *always* encountered twice in every planetary flight – during takeoff and landing.

Flying in Hover-flight.

Thanks to the Firefly's state-of-the-art flight control systems and TSS, even a fully loaded Firefly is easy to handle. However, the great inertia and vertical thrust of the vehicle can cause problems which the pilot should be aware of.

First, be advised the spacecraft is designed to be operated at weights **no greater** than MOW (refer to Table of Weights and Definitions). During hover-flight, all lift comes from the engines and there is very little room for error. Since the engines are pointed straight down, even a small roll angle can cause enormous lateral movement as the engines push the ship sideways. Worse; since the engines are needed to support the craft; attempting to compensate by rolling the ship in the opposite direction of the slide can cause the vessel to lose altitude rapidly. Due to the great weight of the payload; the ship may not have enough thrust to recover from a downward slide.

With the ship at MOW; the engines have enough power to safely control the craft in hover-flight; with an adequate margin of safety. Pilots will find the vessel very heavy on the controls, and will see a tendency to 'fall off' from a stable hover. The ship will turn and slide quickly in the direction of any rolling or pitching movement. Though the controls are heavy; pilots are advised to keep a light control on the stick; using small corrections to keep the vessel hovering in a stable attitude. Pilots are also advised to think

ahead; planning their manoeuvers well ahead of time to account for the ship's inertia. Once the weight and inertia is accounted for; pilots will find the Firefly at MOW to be comfortable to fly at low speeds.

Overloaded craft

Though Firefly United does **not** endorse or allow overloaded flight, we accept that sometimes it is necessary for cargo pilots to overload their craft. Overloaded craft – up to and including craft at MTO – are extremely difficult to fly in Hover-flight; since all of the engines' power is being used to support the spacecraft. In order to enter Hover-flight with a spacecraft at MTO, pilots must select Level function of the autopilot, switch the RCS thrusters to Translation mode, and use the thrusters to manoeuver the craft laterally.

Ships at MTO/TA are impossible to manoeuver in hover flight; since the RCS thrusters are being used to lift the craft. Any roll at all is fatal; and translating the ship to forward flight is a very tricky, nerve-wracking exercise.

Translation to Forward Flight

Though it may not look it; the Firefly does have a very inefficient lifting body design. It provides lift – though also great drag – and will cruise in atmosphere. There are two methods of translation: Pitch Translation and Vector Translation.

Pitch Translation

Once takeoff is achieved, a pilot translates to forward flight by pitching the nose over; using the thrust of the engines to accelerate the craft forward. Care must be taken that the nose is not pitched too far; or the craft will quickly sink and crash. On average, a pitch of -10 to -15 degrees is more than adequate. Once forward flight is established and the Flight Path Indicator on the HUD is visible in the forward view, the pilot brings the nose back up to +20 degrees, continuing his acceleration by vectoring the engines aft. During the translation phase; care must be taken that the FPI does not drop below the horizon line. Since the object is to gain height; it is recommended the pilot vectors the engines aft at a rate which keeps the FPI on the 20 degree line of the pitch ladder (In other words, maintaining an AoA of 0). At a speed of about 200kias, there is enough body lift for the engines to be safely rotated to 'Main' position.

This is the normal, easiest mode of translation; most commonly used with craft loaded up to MOW.

Vector Translation

Once liftoff is achieved and the gear retracted, the pilot keeps the nose level and very gradually vectors the engines aft. The spacecraft will begin to slide forward. Care must be taken that the engines are not rotated too quickly – the Firefly is a heavy craft and accelerates slowly. Too much aft thrust too early will cause the vessel to sink and crash. Once an acceptable forward speed is achieved – about 100kias, the pilot can bring the nose up to +20 degrees and climb out. As before; the spacecraft's engines can be fully rotated aft at approximately 200kias. Vector Translation is a bit trickier than Pitch Translation, though that is largely up to the preference of the pilot. However, Vectored Translation is much safer to use when launching overloaded craft.

Escape Manoeuvers

With a fully loaded Firefly; escaping from Earth's atmosphere can be a tricky business. The spacecraft's drag does not allow for any great speed while low in the atmosphere; and the great weight of the payload prevents the craft from easily accelerating out of the gravity well. With the ship loaded to MOW; the Firefly is capable of two escape strategies: Suborbital Climb and Direct Ascent.

Suborbital Climb

This escape manoeuver is used when the ship is making point-to-point suborbital flights between bases on Earth's surface. Since horizontal movement is required; a direct ascent cannot be used. Suborbital climb works as follows:

- After translating to forward flight, raise the nose to 45 degrees.
- Trim the spacecraft to hold that attitude. Trim will have to be adjusted as the ship accelerates.
- As the vessel escapes the atmosphere, vectored thrust will be required to maintain climb. Keep a close eye on the FPI and airspeed indicator in the HUD to insure both altitude and airspeed keep climbing.
- Once the vessel reaches 100kms. Altitude, the FFD may be used in brief bursts to accelerate the craft to the desires velocity. WARNING: For safety and environmental reasons, FFD may NOT be used at altitudes of less than 100kms.

Direct Ascent

Direct Ascent is still the easiest method of escaping the Earth's gravity well; and is the recommended escape manoeuver for destinations other than Earth's surface.

- After translating to forward flight, raise the nose to 45 degrees.
- Stabilize the craft, and insure positive climb both in airspeed and altitude.
- Once an altitude of 10kms is reached, SLOWLY raise the nose to 90 degrees – straight up.
- Use small movements to insure the FPI remains fixed on 90 degrees. (The FPI. NOT the nose.)
- Continue the climb until the vessel reaches 100kms altitude, with a minimum velocity of 1,500 m/s
- The vessel can now be rotated to its desired destination, and the FFD activated.

Use of Firefly and Super Firefly Drive

'FFD' and 'SFFD' are in fact misnomers. In reality, the FFD operates in two modes: Normal, and a 'Stepdown' mode similar to the main engines. However; since the Firefly Mk1 was originally equipped only with a stepped-down Drive; 'FFD' and 'SFFD' are commonly accepted terms for pilots and this manual.

For unloaded craft; use of the SFFD is **not recommended**. With acceleration in excess of 1400G, the onboard Inertial Dampers may not be able to withstand such sustained acceleration. By referring to the operation and maintenance manual; one will note the accepted limit of the Industrial Gravitics ES-138 Inertial Damping System is 762G sustained; with 1912G shock recovery. Therefore; using SFFD with an unloaded Firefly is a risky manoeuver. If one intends to do so; Firefly United accepts no liability for injury, death and lost or damaged spacecraft. That said; we understand pilots *will*

attempt such a manoeuver despite our warning; so to maximize your chance of survival, do the following:

- Behind Electrical Access panel 14B, switch IDS Safety Switch 11 to 'Test'
- On Flight Engineer's console left; switch IDS control switches 1-3 to 'on', then once telltales are green, to 'Ins/Ovr' (Inspection Override).
- Behind Computer panel 01, locate IDS Flight Safety circuit breakers 1-6 and select 'TRIP'.
- On pilot's main panel, switch IDS on MFD3 to M/C (Max Compensate).

The IDS will now operate at maximum power. Warning: Remain strapped into flight couches while the IDS is in this configuration. Attempting to move while under max IDS can cause nausea, vertigo and blurred vision. Risk of injuries such as broken ankles and concussion is high.

For loaded craft, use of FFD and SFFD is easy and intuitive. FFD will not accelerate the craft to interplanetary speeds unless one has a *lot* of time; so use the FFD for orbital operations – such as rendezvous with an orbital station – and SFFD for achieving interplanetary speed. WARNING: Loaded craft have a very slow rotation rate under RCS; so use caution when employing the FFD for orbital work. Turning retrograde takes a *long* time, so if a pilot is not careful, he can easily overshoot his target.

In order to accurately plan an acceleration and deceleration pattern while under SFFD, this is the easiest sequence:

- Determine what velocity will be required for the planned trip. For short flights – from the Earth to the Moon for instance, no more than 300km/s is required. For longer flights, such as Earth – Venus, select 3000 as a good velocity. For long flights like Earth-Mars; 15,000km/s will be necessary.
- Using Attitude MFD or Orbiter's Planetarium Mode, line up on your target. Don't bother with plotting a transfer; aim *straight* at your destination.
- Burn until your selected speed is reached. This can take a *lot* of burns. (Refer to the 'Fuel Reconstitution' section, next.)
- Once the desired speed is reached; note the distance – in RAD on the Orbit MFD – from your planet of origin. Mark this distance down. This is your *acceleration distance*.
- Wait. A long time, if necessary.
- Turn retrograde well before arrival at your destination. There's nothing to see anyway.
- Switch Orbit MFD's reference body to your destination.
- Once your distance – in RAD – to your target reaches your acceleration distance, burn to a stop relative to your target.

This process is rough and not at all scientific but it works well.

Fuel Reconstitution

(Note: This is a bit of a cheat within Orbiter, but given the parameters of a science fiction ship; it can be excused. Besides; there is not enough fuel onboard the Firefly to give a really good interplanetary speed for loaded craft; so I had to find some way around the fuel restriction.)

The Firefly Drive operates by collecting fuel from the ship's main tanks; converting it to high-density plasma and compressing it to critical mass. Once critical mass is reached and the Drive takes on its trademark glow; small amounts of plasma can be leaked out of the Drive, sent back through the converters and reconstituted as normal fuel. This is an extremely difficult and risky process; and causes tremendous wear on the converter assemblies' catalytic chambers. Nevertheless; the value of what is essentially free fuel cannot be overstated. (Though few engineers enjoy scraping down the chambers and relining the walls twice a month.)

In order to reconstitute fuel from the Drive, do the following:

- Using Fuel MFD set the pump mode to Cross-feed.
- Set the Target tank to Tank 1.
- Set Source tank to Tank 4.
- Set Pump speed to Medium. (It won't accept High).

Fuel will be slowly reclaimed from the Drive.

Re-Entry

Re-entering Earth's atmosphere with a loaded Firefly is a fairly easy process; but it is highly dependant on how you set your DRAG setting in the scenario file. As a result, I cannot give you accurate information on reentry procedures. However if you, like me, set your DRAG to 1.0; insure your descent is a) as shallow as possible and b) begins no later than 1000kms from your destination starport. Attempt to keep your deceleration at -3g; at an approximate altitude of 45kms. Once the vessel has slowed to below 1500m/s, descend to 15kms and let the spacecraft slow to 500m/s. Rotate engines to MAIN, and cruise to your destination. You should be within 10kms of your target.

Approach and landing

Translating from forward flight to hover-flight is a tricky process, but easy enough once you get the hang of it. Maintain a forward speed of 500m/s until within 10kms of your destination. Kill the engines, and let yourself slow to 250m/s @2000m altitude. When within 2kms of the starport, switch engines to Hover, engage the airbrakes then rotate them forward slightly with the 6 key; so they provide braking as well as lift.

Apply power, and carefully watch the FPI and airspeed. Keep the FPI centered on the horizon, or slightly below to maintain a cautious descent. Once the spacecraft has dropped to 150m/s @ 1000m altitude, rotate engines to Hover.

From here, there are two options: fully manual control or AP assist.

Manual Approach

Manual approach with a loaded Firefly is difficult; but very satisfying if you get the hang of it. Once you achieve hover-flight; use pitch, thrust and **very small amounts** of roll to approach your landing point. Fly the ship to the pad like a very heavy helicopter; drop gear and land. Keep a very close eye on your FPI – pan the view to keep it in sight if necessary. With even small amounts of roll; the FPI will shoot of to one side or another so be prepared to respond swiftly to any lateral movement of the FPI. This takes a lot of practice, but its well worth the effort. It's easy enough with an empty craft, but if you can do this well while at MOW, this is pilotage worth bragging about.

AP Assist

Once you achieve hover-flight, level the spacecraft and hit Level AP. Switch RCS to Translation and use aft thrusters to slow to 50m/s. (Alternatively, you can use small amounts of vectored thrust to brake.) Once 50m/s is reached, switch RCS to Rotation and rotate the craft to the desired heading for landing. Warning: keep an eye on the FPI during the rotation. *Don't* let it drop or climb away on you – keep it on the horizon line.

Once you've reached your landing heading, kill rotation and switch back to Translation RCS. (Remember to re-establish Level AP.) Use thrusters to align your Firefly with the landing pad, then drop gear and slowly allow the ship to sink to the pad. Upon touchdown, kill the AP and shut down engines.

Conclusion

The preceding manual has been my own poor attempt to add to the magnificent work of the Firefly design team. As test pilot for the Cargo Weight mod; I enjoyed myself immensely testing and working the kinks out of the new mod; and I thank Jon deeply for allowing me to help. This manual contains much that is fictional, but hopefully adds a 'pseudo-reality' to this wonderful virtual craft. I sincerely hope you enjoy flying the ship, and hope this manual helps you bring your own Firefly to life.

Cheers!

David R. 'Staiduk' Organ, c.t.m.
Organ.20@Rogers.com