



SimCoders.com

Reality Expansion Pack  
for  
Laminar Cessna C172SP Skyhawk

v4.2.3

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## Contents

<b>AIRCRAFT GENERAL DESCRIPTION</b>	<b>4</b>
<b>INSTALLATION &amp; CONFIGURATION</b>	<b>5</b>
System requirements . . . . .	5
Install the software . . . . .	5
Automatic Update of the Software . . . . .	5
Manual Update of the software . . . . .	6
Remove the software . . . . .	6
Recommended sound settings . . . . .	7
Recommended control settings . . . . .	7
<b>HARDWARE &amp; SOFTWARE COMPATIBILITY</b>	<b>8</b>
Headshake . . . . .	8
Saitek Panels . . . . .	8
XPRealistic . . . . .	8
Differential and progressive brakes for X-Plane 11 . . . . .	8
<b>USER INTERFACE</b>	<b>9</b>
Lateral Menu . . . . .	9
Maintenance Report . . . . .	10
Kneeboard . . . . .	11
Mass & Balance . . . . .	13
Walkaround . . . . .	14
Move the viewpoint while doing the walkaround . . . . .	14
Towing . . . . .	14
Move the viewpoint while towing . . . . .	15
Engine Autostart . . . . .	15
Settings Window . . . . .	16
Use Advanced Steering . . . . .	17
Smooth Brakes . . . . .	17
<b>ECONOMY SYSTEM</b>	<b>18</b>
Enable the Economy System . . . . .	18
How it works . . . . .	18
Buy/Sell Fuel . . . . .	23
Earn Money: Rewards . . . . .	23
<b>VIRTUAL REALITY &amp; VR VISORS</b>	<b>24</b>
How to activate the VR menu . . . . .	24
<b>SOUNDS SYSTEM</b>	<b>25</b>
<b>PERSISTENT AIRCRAFT AND COMPONENTS WEARING</b>	<b>26</b>
How to load a worn out aircraft . . . . .	26
How to check the components status . . . . .	26
Hobbs Time and Tach Time . . . . .	27



<b>SYSTEMS DESCRIPTION</b>	<b>28</b>
Powerplant . . . . .	28
Engine Overview . . . . .	28
Starter . . . . .	29
Induction System . . . . .	29
Fuel System . . . . .	30
Spark Plugs . . . . .	31
Exhausts System . . . . .	31
Oil System . . . . .	32
Preheater & Winterization Kit . . . . .	33
Engine Startup Tips . . . . .	33
Vacuum System . . . . .	33
Electrical Systems & Avionics . . . . .	34
Battery . . . . .	34
Alternator . . . . .	34
Lights . . . . .	34
Electrical Gyros . . . . .	34
Radio Stack . . . . .	35
Landing Gear . . . . .	35
Spring loaded nose wheel . . . . .	35
Tires . . . . .	35
Brakes . . . . .	36
<b>HUMAN FACTOR</b>	<b>37</b>
Hypoxia . . . . .	37
TUC & EPT . . . . .	37
<b>HOME COCKPITS/CUSTOM DATAREFS</b>	<b>39</b>
<b>RESOURCES &amp; HOW-TOs</b>	<b>40</b>
<b>SUPPORT &amp; CONTACTS</b>	<b>40</b>
<b>VERSION CHANGELOG</b>	<b>41</b>
<b>LICENCE</b>	<b>52</b>
End-User License Agreement for SimCoders.com Reality Expansion Pack . . . . .	52
SOFTWARE PRODUCT LICENSE . . . . .	52
LIMITED WARRANTY . . . . .	53
LibCURL EULA . . . . .	54
COPYRIGHT AND PERMISSION NOTICE . . . . .	54



## AIRCRAFT GENERAL DESCRIPTION

The Cessna 172 Skyhawk is a four-seat, single-engine, high wing, fixed-wing aircraft made by the Cessna Aircraft Company. First flown in 1955, more 172s have been built than any other aircraft.

Measured by its longevity and popularity, the Cessna 172 is the most successful aircraft in history. Cessna delivered the first production model in 1956 and as of 2015, the company and its partners had built more than 43,000. The aircraft remains in production today.

The modern avionics, the useful load and the simplicity of flying it make the Cessna 172SP a perfect airplane for both training and recreational flights.

Since the R version, the Cessna 172 has bigger fuel tanks. The extended range may reduce the number of passengers it can carry. Therefore, pilots often trade a little bit of fuel for another person onboard.



## INSTALLATION & CONFIGURATION

### System requirements

This software requires X-Plane 11.00 or superior.

The minimum hardware requirements are the same of X-Plane:

- Dual Core, 2.5 GHz or faster
- 2 GB of RAM
- A video card with at least 500 MB of VRAM.

If you use REP under Linux, there are some additional requirements:

- libstdc++6
- libgcc6

This software is designed to run on Windows, Mac OS and Linux.

In order to install this software, the **Default X-Plane 11 Cessna 172SP Skyhawk** must be installed on your system.

### Install the software

To install the software please follow this procedure.

1. Locate the C172SP Skyhawk folder inside your X-Plane installation.
2. Clone the C172SP Skyhawk folder. Call the clone such "C172SP Skyhawk REP".
3. Extract the contents of this REP package into a temporary folder
4. Take the contents of "**into-aircraft-plugins-folder**" and put them into the "**plugins**" folder of the "**C172SP Skyhawk REP**" folder
5. Take the contents of "**into-aircraft-main-folder**" and put them into the "**C172SP Skyhawk REP**" folder
6. Run X-Plane and load the C172SP Skyhawk.
7. Follow the onscreen instructions

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#### NOTE

After reloading the airplane, X-Plane may crash reporting an error related to the "master.bank" file. If that's the case, please follow the instructions stated in [this FAQ](#).

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### Automatic Update of the Software

The Reality Expansion Pack support the automatic updates via the [SkunkCrafts Updater](#) plugin. In order to activate the automatic updates you shall:

1. Install the SkunCrafts Updater plugin as stated in its user manual
2. Inside REP's zip, inside the "into-aircraft-main-folder", you find a file called **skun-crafts\_updater.cfg**. Copy such file into the C172SP Skyhawk main folder.



## Manual Update of the software

NOTE: It is not necessary to remove the older REP files. The software will take care of the update procedure.

1. Copy the "REP" folder contained in this package inside the "plugins" folder of the C172SP Skyhawk, overwriting the existing one.
2. Run X-Plane and load the C172SP Skyhawk.
3. Reload the aircraft when the automatic update is finished.

## Remove the software

To remove the software follow this procedure:

1. In the menu bar click on "Plugins"
2. Click on "SimCoders.com - REP" and choose "Disable Package"
3. Click "Ok" in the confirmation message
4. Reload the aircraft when the uninstallation procedure ends

At the end of the uninstallation procedure, the original aircraft will be restored to its mint conditions.

## Recommended sound settings

To better enjoy the Reality Expansion Pack on the C172SP Skyhawk, you should setup your sound settings like the following screenshot.

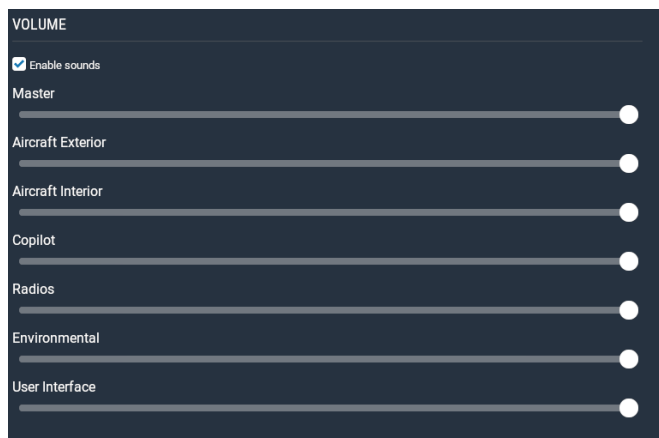


Figure 1: Recommended sound settings

For more information about the sounds, see the Sounds System chapter.

## Recommended control settings

To have a better control over the airplane axis, you should setup your control sensitivity as follows.

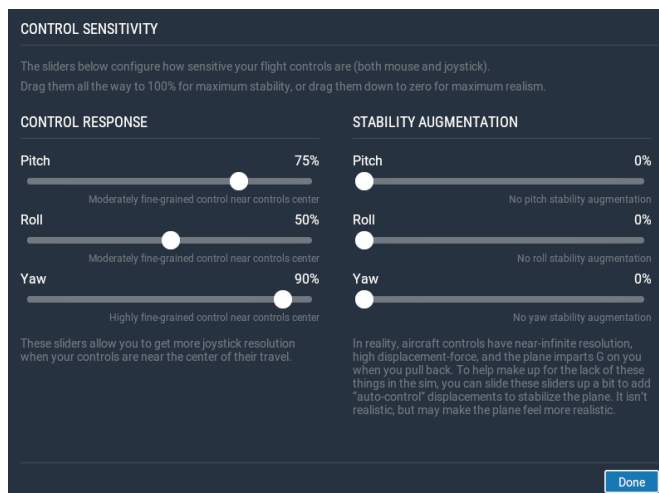


Figure 2: Recommended control settings



## HARDWARE & SOFTWARE COMPATIBILITY

### Headshake

If [HeadShake](#) v1.5 or higher is installed in your system, it will communicate with REP to improve the simulation realism.

REP will drive HeadShake to simulate the vibrations of the real engine. Using this, you will be able to run the engine at the most comfortable RPMs by simply checking the vibrations it produces.

In the same way, HeadShake will simulate the stall buffeting if the airplane in use shows that kind of behavior.

### Saitek Panels

This software is compatible with Saitek Panels. In order to use them, you should install the [XSaitekPanels](#) free plugin from Sparker.

This package already includes a INI configuration file for XSaitekPanels. Make sure you copy it inside the main folder of your C172SP Skyhawk.

### XPRealistic

The Reality Expansion Pack can be used together with XPRealistic.

You might need to disable XPRealistic's wind, touchdown and brakes sound effects as REP already provides them.

### Differential and progressive brakes for X-Plane 11

The Reality Expansion Pack detects if [Differential and progressive brakes for X-Plane 11](#) is installed in your system.

If so, REP's differential braking algorithm is disabled in favor of the custom differential brakes algorithm of the third party plugin.

## USER INTERFACE

### Lateral Menu

When loaded, REP shows a lateral menu on the left-side of the screen. The menu consists of a set of small icons.

By default, the menu partially hides itself until the mouse pointer gets near it.



Figure 3: The menu is partially hidden by default



Figure 4: The menu is shown when the mouse pointer gets closer to it

You can choose to completely hide the menu when the mouse pointer leaves it. To do so, go to "Plugins -> SimCoders - REP -> Settings" menu and tick the "Show side menu on mouse over only" option.

The lateral menu entries are available in the "Plugins -> SimCoders - REP" menu as well.

## Maintenance Report

This window is the primary way you have to check the status of your airplane and to fix all the systems that need the mechanic attention.

The report is divided on more pages. Each page relates to a different group of systems.

To act on a system, click on the entry in the "Action" column.

To switch to the previous/next page click over the flipped page corners at the bottom of the report.

Reality Expansion Pack - Maintenance Report

SC SimCoders.com  
Aircraft Maintenance Division

Maintenance Report Form

Acf. Type: *Cessna 172SP Skyhawk* Serial No: *1729308*

ENGINE STATUS

Model: *Lycoming 10-360-L2A* Time (hr): *00:00/2000*

Item	Status	Action
Cylinders	<i>Ok</i>	
Cyl. Compression (PSI)	<i>80/80 80/80 80/80 80/80</i>	
Oil Fluid	<i>SAE 50, clean, 50 hrs before change</i>	
Oil Fluid Quantity	<i>8 quarts USG (Min 5, Max 8)</i>	
Available Oil Types	<i>SAE 20W50</i>	<i>Use</i>
	<i>SAE 30</i>	<i>Use</i>
	<i>SAE 50</i>	<i>Use</i>
Oil Filter	<i>Clean, 100 hrs before change</i>	
Oil Pump	<i>Ok</i>	
Electric Fuel Pump	<i>Ok</i>	
Fuel Filter	<i>Clean</i>	
Sparking Plugs Type	<i>Default (Fouling more)</i>	<i>Switch</i>
Sparking Plugs Status	<i>Clean</i>	
Starter	<i>Ok</i>	
Vacuum Pump	<i>Ok</i>	

Page 1/4

Figure 5: The Maintenance Report window

## Kneeboard

The software come with a complete kneeboard window that contains the aircraft normal and emergency checklists together with the performance reference tables.

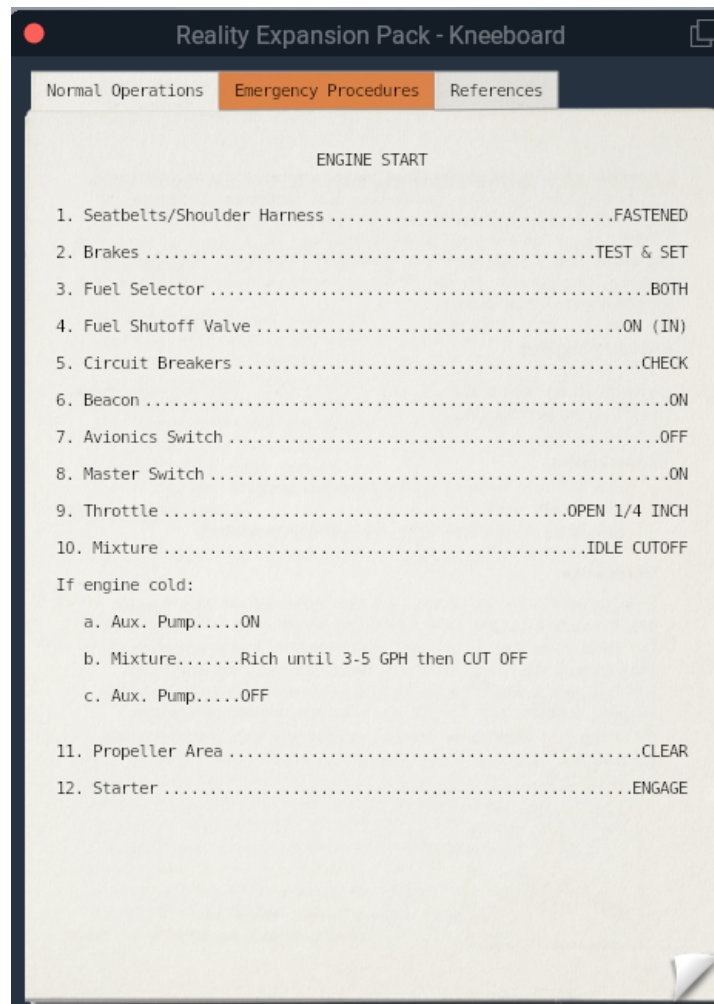


Figure 6: The Kneeboard window



### Show the kneeboard using the plugins menu

The kneeboard window may be shown by clicking on the “Plugins” menu, then “SimCoders – REP” then “Show kneeboard”.

### Manage the kneeboard using the custom commands

You can also use five different custom commands at which you can assign your custom keys or joystick buttons. The custom kneeboard commands defined by REP are the following:

Command	Description
simcoders/rep/kneeboard/toggle	Show or hide the kneeboard
simcoders/rep/kneeboard/next_section	Show the next kneeboard section
simcoders/rep/kneeboard/prev_section	Show the previous kneeboard section
simcoders/rep/kneeboard/next_page	Show the next kneeboard page
simcoders/rep/kneeboard/prev_page	Show the previous kneeboard page

## Mass & Balance

The Reality Expansion Pack provides a Mass & Balance tool to precisely load the plane.

While loading the plane, the goal is to keep the crosses inside the plot section delimited by the blue area, like shown in the screenshot below.

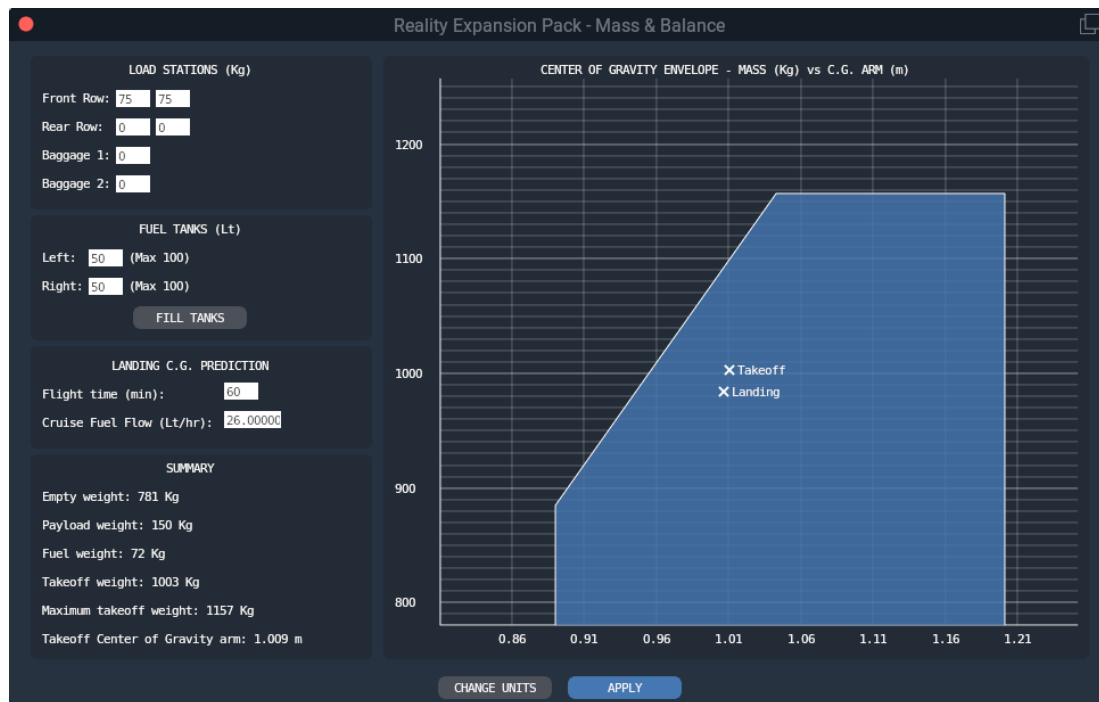


Figure 7: The Mass & Balance window

The blue area is the Center of Gravity Envelope. The mass is reported on the Y axis, the Center of Gravity Arm is reported on the X axis.

If the cross is towards the left side of the plot, it means that the center of gravity will be towards the front of the airplane, that is, the airplane will be nose heavy.

On the other hand, if the cross is on the right side of the plot, the airplane will be tail heavy.

If you overload the airplane and the cross goes outside the blue envelope, the cross becomes red, indicating that the plane is not allowed to fly.

Clicking on the "Apply" button, the selected passengers mass and fuel load will be applied to X-Plane.

The unit of measure for the airplane mass and the C.G. arm can be changed by clicking the "Change Units" button.

## Walkaround

Click on the Walkaround icon in the lateral menu to enter walkaround mode. Click again on the same icon on close the walkaround window to return in the cockpit.

During walkaround you can interact with some external systems of the aircraft using the walkaround window. Click the “Next” and “Prev” buttons at the bottom of the pre-flight checklists to move along the different pre-flight stations.

Always do the walkaround and the pre-flight inspection before each flight.

If you do not remove the tie-down and the chocks, you are not able to taxi and takeoff properly.

If you do not remove the pitot cover, you will incur in a airspeed indicator failure.

Since version 3.4.5, it is possible to toggle all the static elements - such the pitot cover and the tiedowns - using a single entry in the plugins menu or a keyboard command.

Since version 3.3, the following keyboard/joystick commands are available to control the walkaround mode.

Command	Description
simcoders/rep/walkaround/toggle	Toggle the walkaround mode
simcoders/rep/walkaround/next	Next walkaround station
simcoders/rep/walkaround/previous	Previous walkaround station
simcoders/rep/walkaround/action	Execute the action of the current walkaround station
simcoders/rep/walkaround/static_elements/toggle	Toggle the static elements

## Move the viewpoint while doing the walkaround

It is possible to move the viewpoint during towing by using the default camera commands of X-Plane. To pan the view using the mouse, keep pressed the **simcoders/rep/view/pan\_with\_mouse** command.

## Towing

REP comes with a complete towing simulation. To activate it, click on the towing icon in the lateral menu. Click the icon again to exit from the towing mode.

The towing features a 3D towing bar that will help you driving the airplane on the tarmac.

To move the airplane, push or pull the pitch axis of your joystick. Use the roll axis to turn.

Since REP simulate the force applied by a single man placed in front of the airplane, you may not be able to tow the airplane on the grass, just like in real life.

You won't be able to tow the airplane if it's tied-down or if chocks/brakes are applied.



### **Move the viewpoint while towing**

It is possible to move the viewpoint during towing by using the default camera commands of X-Plane. To pan the view using the mouse, keep pressed the **simcoders/rep/view/pan\_with\_mouse** command.

### **Engine Autostart**

The Reality Expansion Pack provides you a way to automatically start the engines.

Click on the engine autostart icon in the side menu and wait until the startup procedure is completed.

During the automatic start, REP shows a series of tips that describe the action being done.



## Settings Window

The settings windows is shown by clicking over the “Plugins -> SimCoders - REP -> Settings” menu.

### Enable the plane damages

When ticked, this option enable the plane damages.

### Show failure messages

If ticked, REP will show a message in case of a system failure. The message will explain why the failure happened and what course of action should be taken.

### Show tips

If ticked, REP will show a message in case of a system failure. The message will explain why the failure happened and what course of action should be taken.

### Show side menu on mouse hover only

When ticked, REP will completely hide the lateral menu when the mouse pointer leaves it.

### Save and restore the plane status between sessions

If ticked, REP will save the airplane status when unloaded. When the same plane and livery are loaded again, the status will be restored.

The status includes all the switches position, the fuel on-board, the loaded weights, the engine fluids quantity and quality and all the possible values that play part to the systems simulation.

The engine temperatures - such CHT and Oil Temperature - are restored accordingly to the elapsed time since the values where stored.

The status files are backed up before being overwritten. You find the backup in the output/preferences/REP folder.

### Save and restore the windows position between sessions

If checked, the Maintenance Hangar and the Keyboard windows positions are saved and restored between sessions.

### Enable hypoxia effect

When ticked, the default hypoxia effect is replaced by REP’s custom algorithm. See the Hypoxia chapter to get more information about the custom hypoxia effect.



### **Roll axis drives ground steering**

When ticked, the joystick roll axis will steer the nosewheel on the ground.

### **Use US Customary**

When ticked, REP will use the US Customary units of measure (pounds and inches).

### **Wind sound level**

Control cabin the wind sound setting the level between 0 (mute) and 100 (full).

### **Main Monitor Index**

This option is visible only if X-Plane is running on two or more fullscreen monitors. Type the index of the monitor over which REP must show its menus and windows. The minimum number you can set here is 1. The maximum number is your monitors count. Each number addresses a different monitor.

### **Enhance default stall behavior**

When ticked, REP will improve the default stall behavior in order to make it more realistic.

### **Use Advanced Steering**

Enable this option to use REP's advanced steering algorithm. You may need to disable this option if you have issues with steering with your hardware pedals.

### **Smooth Brakes**

Enable this option to smooth the brakes when applied. Instead of applying the brakes all at once, they will go from 0 to 1 in two seconds, smoothing the braking action.



## ECONOMY SYSTEM

The Reality Expansion Pack features a custom Economy System that may rewards you for your flight time and lets you pay to fix the airplane damages and do the everyday maintenance.

The Economy System features two modes of operation:

- **Standalone:** your bank account and maintenance records are locally saved to your PC. They are shared among your REPs. The system rewards you for your flight time and landing skills.
- **FSEconomy:** REP connects to the [FSEconomy](#) bank account and drains the required amount of money for maintenance directly from there. There are no rewards for your flight time as they are already provided by FSEconomy.

### Enable the Economy System

Open the Maintenance Report window then scroll to the latest page available. Click "Enable Standalone System" or "Enable FSEconomy System".

When enabling the FSEconomy System, it is required to enter an **Aircraft Key**.

The Aircraft Key is a 15 chars key provided by FSEconomy that uniquely identifies the aircraft you are flying in the FSEconomy environment.

To find the Aircraft Key:

1. Login to the FSEconomy website: <http://server.fseconomy.net/>
2. Click the main menu's "**Aircraft**" button
3. Scroll the aircrafts' list down to the plane you want to connect to REP
4. In the "Action" column, click the drop-down menu's "**Edit**" button
5. Generate/Copy the Aircraft Key in the webpage's lower-left corner

When the Economy System is enabled, the aircraft state is saved to a separated file. When you disable the Economy System, that very same file is loaded again.

Thus, there are two different aircraft states that are loaded in relation to the usage of the Economy System. One state is loaded and updated when the Economy System is disabled. The other one is loaded and updated when the Economy System is enabled.

You can switch between the two states by disabling or enabling the Economy System.

The Bank Account is shared among all your REP airplanes. That is, it possible to earn money flying an airplane and use it to fix another airplane that needed maintenance.

### How it works

Once enabled, the Economic System page in the Maintenance Report shows your current Bank Account Balance and a log of the last transactions (amount spent for maintenance and fuel or income from a flight).

Each fix or maintenance you want to do to your airplane must be first added to a quotation.

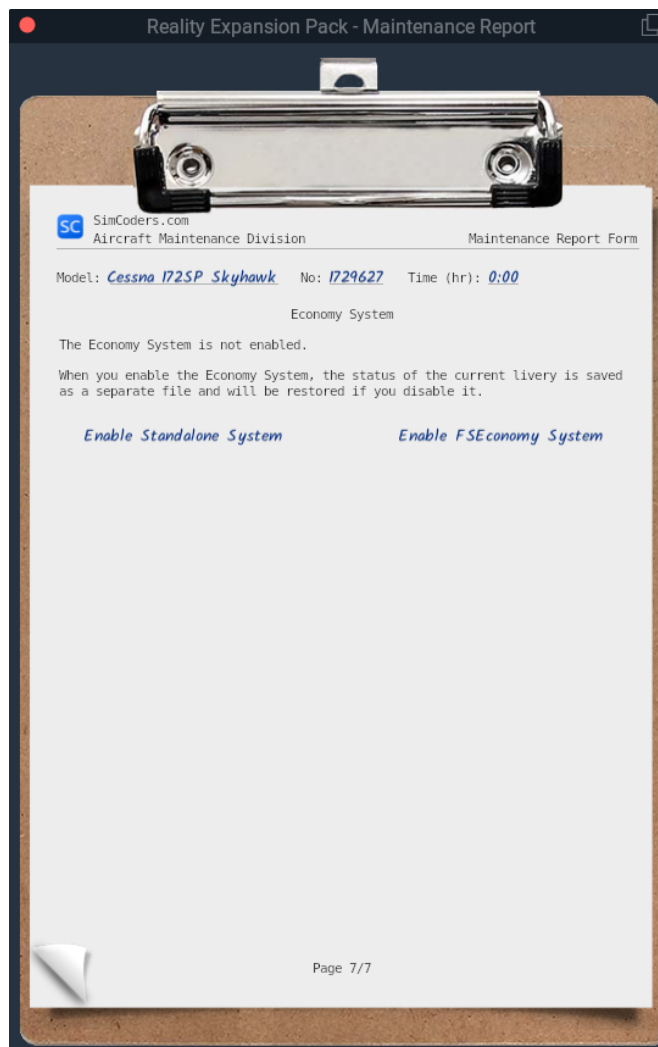


Figure 8: This is the screen that allows you to enable the Economy System



Reality Expansion Pack - Maintenance Report

SC SimCoders.com  
Aircraft Maintenance Division

Maintenance Report Form

Model: Cessna 172SP Skyhawk No: 1729055 Time (hr): 0:00

Economy System

This page will show your maintenance quotation once you select the fixes and changes to make to this aircraft. To add an item to the quotation, scroll to the previous pages and click over an "Action" cell that contains text.

Bank Account

Current balance: 8940.50\$

12 Dec 2018 16:35	Maintenance	-119.88\$
12 Dec 2018 16:32	Maintenance	-31.10\$
12 Dec 2018 16:13	Maintenance	-908.52\$

When you disable the Economy System, the status of the current livery is saved as a separate file and will be restored if you enable it again.

When you reset the Economy System, your career, the bank account and the airplane are reset.

[Disable the Economy System](#) [Reset the Economy System](#)

Page 7/7

Figure 9: This is the default screen of the Economic System

Each page of the Maintenance Report shows a table that reports the available maintenance actions.

For each action, the table reports the price and required work time.

Reality Expansion Pack - Maintenance Report

SC SimCoders.com  
Aircraft Maintenance Division

Maintenance Report Form

Model: Cessna 172SP Skyhawk No: 1729055 Time (hr): 0:00

ENGINE STATUS

Model: Lycoming 10-360-L2A Time (hr): 00:00/2000

Item	Status	Action	Price (\$)	Time
Cylinders	OK			
Cyl. Compression (PSI)	80/80 80/80 80/80 80/80			
Oil Fluid	SAE 30, clean, 50 hrs before change			
Oil Fluid Quantity	8/4 USG (5/4 - 8/4)			
Available Oil Types	SAE 20W50	Use	120	1:00 hr
	SAE 30	Use	120	1:00 hr
	SAE 50	Use	120	1:00 hr
Oil Filter #1	Clean, 100 hrs before change			
Oil Pump #1	Ok			
Electric Fuel Pump #1	Ok			
Fuel Filter #1	Clean			
Spark Plugs #1 Type	Fine Wire (More effective)	In Quote	290	20 mins
Plugs tip	Clean			
Starter #1	Ok			
Vacuum Pump #1	OK			

Bank Account (\$): 8940.50 [View Quotation](#) Quotation (\$): 290.00

Page 1/7

Figure 10: Click over one of the Action cells to put that specific action in the quotation

To add a maintenance action to the Quotation, click over its "Action" cell in the Maintenance Report. Once an action has been added to the Quotation, the "Action" cell reports "In Quote". To remove the maintenance action from the Quotation, click the "Action" cell again.

If the "Action" column is empty, it means that no actions are available at that time.

Once all the needed maintenance actions have been added to the Quotation, click over "View



Quotation” or scroll to the last page of the Maintenance Report to see the Quotation.

Reality Expansion Pack - Maintenance Report

SC SimCoders.com  
Aircraft Maintenance Division

Maintenance Report Form

Model: Cessna 172SP Skyhawk No: 1729055 Time (hr): 0:00

Economy System

This is the quotation for the changes you want to make to your airplane.

Current balance: 8940.50\$

Item	Price (\$)	Time
<u>Change Spark Plugs #1</u>	<u>290.00</u>	<u>20 mins</u>
<u>Oil Change</u>	<u>120.00</u>	<u>1:00 hr</u>
Normal Price Totals	<u>410.00</u>	<u>1:20 hr</u>
Quick Fix Totals	<u>820.00</u>	<u>0 mins</u>

[Decline](#) [Accept Normal Price](#) [Accept Quick Fix](#)

Page 7/7

Figure 11: A Quotation Example

The quotation reports two possible total prices:

- **Normal Price:** This price will be applied for a fix that will take the amount of time reported in the time column. The fixes will be done one at a time in real time. The mechanic will continue his work even when the sim is closed.
- **Quick Fix Price:** This price will be higher but will do all the actions at once in zero time.

You can accept either price or decline the Quotation, in which case no action is done and the quotation is scrapped.



## Buy/Sell Fuel

**This feature is available in Standalone Mode only.**

In the Weight and Balance window, it is possible to add/remove fuel from the fuel tanks.

Adding fuel will drain money from your bank account. Removing fuel from the tanks will result in selling it to the local airport. The selling price will be slightly lower than the local buying price.

Fuel price is based on the current country/region and varies from airport to airport and from time to time. It is possible to specify a custom fuel price in the "fuel\_prices.cfg" file found in the "Output/preferences/REP" folder of X-Plane. The file already contains an example of a custom price for two airports.

It is possible to check the fuel price in a specific airport by going to the plugins menu and click over "SimCoders - REP" -> "Check fuel price at an airport".

## Earn Money: Rewards

**This feature is available in Standalone Mode only.**

The more you fly, the more money you earn. At the end of a flight, a new Log entry is added to your Bank Account Log with the amount of money you earned.

In case you make a smooth landing, a "Soft Landing" bonus is added to your reward. The softer the landing, the higher the reward.

## VIRTUAL REALITY & VR VISORS

REP 3.4.0 introduced an experimental Virtual Reality visors support with visible windows in VR.

### How to activate the VR menu

A VR menu that lets you open the kneeboard, the tech report and all other items you find normally in the side-menu can be shown using the **simcoders/rep/vr/open\_menu** command.

This menu will be shown in VR only and will be clickable using your VR manipulators.

You find that command in the X-Plane main settings, in the Keyboard and Joystick tabs. Inside one of those tabs, click to assign a command to a keyboard key or to a joystick button, then select the **simcoders/rep/vr/open\_menu** command for that given key or button.

For more informations please read [X-Plane's user guide about assigning commands to buttons](#).

REP features some other extra commands that let you access all the features of the package using your VR controllers, if necessary.

#### NOTE

Make sure you loaded a REP airplane before looking for the command in X-Plane's settings window.



Figure 12: The Tech Report shown in VR mode



## SOUNDS SYSTEM

The Reality Expansion Pack features a custom sound system that provides immersive 3D sounds throughout the entire flight experience.

A custom sounds system has been preferred over the usage of FMOD for the following reasons:

- FMOD could be rather cumbersome from the developer's point of view, requiring more time to produce new features
- A custom engine is more flexible and can be expanded in no time providing new features
- A custom engine is more efficient as it's tailored to our needs

REP's sounds system provides advanced sounds such:

- Engine ignition
- Engine pins
- Engine exhausts effects
- Fuel pumps
- Electric Gyros
- Avionics effects
- Dynamic touch down
- Dynamic ground roll
- Dynamic wind



## PERSISTENT AIRCRAFT AND COMPONENTS WEARING

The Reality Expansion Pack features a complete **wearing system** for the **entire airplane**. That is, each component of the airplane wears out when in use and, after a certain amount of time, it may start to show some issues or fail completely.

The status of each component is saved and updated even if the sim is not running.

This is true for engine components, electrical system parts, airframe and even **flight instrumentation**.

Every component will be affected by time and by **user's handling** in different ways.

If you mistreat the engine by running it above its limits, it will get worn out, showing startup issues, combustion problems and providing less power than expected. It will completely fail over time.

The cockpit instrumentation needles will be more precise in a newly calibrated gauge rather than in an old one.

**Tap over an indicator or a bulb light to try to correct its error or fix it while in the cockpit**

### How to load a worn out aircraft

REP gives you the chance to load an aircraft that is already worn out by its past history.

To do so, go to **"Plugins -> SimCorders.com - REP -> Wear out to >"** and choose one of the following items.

- **Brand New:** this is the status of an aircraft that just left the production line. The engine is brand new and all the onboard systems were just tested.
- **Privately Owned (new):** this is an almost new aircraft that has been privately owned with care. The engine as well as the other systems will have some hours logged but no issues are in place.
- **Privately Owned (old):** this is an aircraft that has been owned privately for years. The engine as well as the other systems will have much hours logged but no issues are in place as the private owner kept the plane with good care.
- **Flying Club:** this plane has been in the hands of many pilots, some of them careless. The systems are wore out quite much and some gauges are not working as good as you would like them to do.

### How to check the components status

To check each component and fix/replace/calibrate it, use the Maintenance Report.

In there are listed all the aircraft components that can be checked by a mechanic.



## Hobbs Time and Tach Time

In the Maintenance Report you find the airframe total time (Hobbs Time) and the engine's total time (Tach Time). The two values may slightly differ after loading a brand new airplane and then flying it for a while. This is because there's an important difference in how the two times are calculated.

### Hobbs Time

In most planes, the Hobbs clock is started and stopped based on an oil pressure switch, so it starts when the engine starts, and stops when the engine is shut-down. While it's running, it just ticks off a tenth of an hour every 6 minutes, based on "regular wall clock time". So a tenth of idling on the ramp is the same as a tenth at cruise.

### Tach Time

The tach clock isn't really a clock at all, it doesn't actually measure time, it really measures engine revolutions. But it's calibrated such that a tenth of an hour of tach time is clicked off when the engine is at cruise RPM for 6 minutes. In other words, if the plane is at cruise RPM, the tach clock will be clicking off tenths of an hour at the same rate as the Hobbs clock. But if the engine is idling at an RPM speed that's half of what cruise RPM is, then the tach clock will be running at half the speed of the Hobbs clock.



## SYSTEMS DESCRIPTION

Within the Reality Expansion Pack, each system has its own life-cycle and can be damaged depending on many factors, including the pilot's behavior.

All systems can be fixed individually using the Maintenance Report or all at once using the **simcoders/rep/systems/fix\_all** command.

The following is a brief description of each system onboard.

### Powerplant

The Cessna 172SP is powered by a four-cylinders Lycoming IO-360-L2A normally aspirated, direct-drive, air-cooled, horizontally- opposed, fuel-injected engine with 360 cubic inches displacement.

This engine outputs a maximum power of 180HP at 29 inches Hg and 2700RPM with no time limitations.

### Engine Overview

The Reality Expansion Pack totally replaces the engine simulated by X-Plane with custom algorithms to the point that not a single bit of the old engine model is left in the sim.

Everything in the engine is made from scratch to provide the maximum realism. This includes the combustion model to which all the other models - such the Power Output, the Cylinders Head Temperature or the Oil Pressure - depend.

The engine now breathe air, mix it with fuel and produce a realistic combustion.

Some of the features include:

- **Correct animations and sounds:** the cylinders compression is simulated to the deepest level, enhancing the propeller movements at very low RPMs and at startup and shutdown
- **Correct power output:** the engine outputs the correct power at every RPM setting.
- **Correct fuel flow:** reaching the correct power output allows X-Plane to provide the right fuel flow at every phase of the flight, right down to the numbers.
- **Realistic startup procedure:** The engine needs to be pre-injected using the electrical fuel pump (see the operating tips)
- **Realistic engine issues:**
  - The oil type, quality and quantity affects the engine behavior.
  - The spark plugs may foul because of carbon deposits
  - Leaning the mixture at the wrong time or in the wrong way may cause damages to the engine
  - Engine preheater and winterization kit: the engine may be preheated on winter using the provided electric engine heater. If the engine is not heated correctly, it won't start or may be damaged after start.



## **Starter**

The Reality Expansion Pack replaces the default starter with a custom one.

In the “Engine Status” page of the Maintenance Report you can:

- Check the starter status
- Replace a faulty starter with a new one

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### **CAUTION**

The starter will overheat and then damage if engaged for too long. Make sure to engage the starter for no more than 30 seconds. Let it cool down between failed starts.

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## **Induction System**

The Reality Expansion Pack replaces the Manifold Absolute Pressure (MAP) algorithm of X-Plane with a custom one.

The C172SP Skyhawk engine is normally aspirated. That is, the maximum air pressure that affects the engine is the outside atmospheric pressure.

During climb, as the atmospheric pressure gets lower the maximum manifold pressure gets lower as well.



## Fuel System

### Fuel Pump

The fuel system is provided with a electrical fuel pump that can be used to prime the engine.

The fuel pump should not be used in flight unless required by the checklists.

In the "Engine Status" page of the Mainantenace Report you can:

- Check the fuel pump **status**
- **Repair** the pump in case of failure

### Fuel Injection System

The Reality Expansion Pack fully recreates the Bendix RSA Precision Flow Fuel Injection System that powers the real world C172SP Skyhawk.

This fuel injection system is provided with a Venturi that senses the amount of air that goes to the engine and so regulates the fuel flow accordingly.

With altitude, the air density reduces more than the fuel density. So this metering system still requires the pilot to lean the mixture at high-density altitude.

### Tuned Fuel Injectors

The cylinders and air induction positions lead to a different amount of air being sucked in each cylinder for a given throttle position.

That is, more air goes into the #1 and #2 cylinders than in #3 and #4. In a 6 cylinders engine, the spread between #1 and #6 is quite wide.

Factory fuel injectors deliver the same amount of fuel to each cylinder. That is, cylinder #1 runs leaner than #2. The richer cylinder is usually #5 or #6.

This spread affects the engine performance, especially when running lean of peak with only one EGT probe. Usually, leaning LOP for the hottest cylinder (#5 or #6 in a 6 cylinders, #3 or #4 in a 4 cylinders) means being widely LOP for the #1 cylinder, thus experiencing a loss of power together with a rough running engine.

In the Maintenance Report, it is possible to replace the factory injectors with tuned ones, made to properly release the correct amount of fuel based on the cylinder number. Tuned injectors allow for:

- Smoother LOP operations
- Fewer vibrations
- **Lower fuel burn of about 1 GPH**

General Aviation Modifications, Inc. is a real world manufacturer of tuned fuel injectors for many different type of fuel injected engines. For more information, please visit [GAMI's website](#).



## Spark Plugs

Each cylinder is provided with two spark plugs, one connected to the left magneto and the other connected to the right magneto.

Carbon deposits form on the spark plugs pointers if the engine is run at low RPMs with rich mixture. That is, the spark plugs foul.

To avoid fouling, always keep at least 1000RPM and aggressively lean the mixture when on ground.

A big drop in RPM during the magnetos check is a sign of a fouled spark plug.

To clean the spark plugs, set a high power setting and aggressively lean the mixture. Run the engine with this setting for about 20 seconds then recheck the magnetos.

In the "Engine Status" page of the Mainantenace Report you can:

- Check the spark plugs status
- Manually clean the spark plugs
- Change the default spark plugs with the "fine wire" type.

Fine wire spark plugs are less prone to fouling but not immune to it.

## Exhausts System

The main goal of the Exhaust System is to emptying each cylinder of spent exhaust gases.

Factory exhausts usually aren't length-tuned. That is, the length from the cylinder's outlet valve to the end of the exhaust is not the same for each exhaust tube. This causes the formation of shock waves when the exhaust gases from one cylinder hit those from another cylinder. That is, the emptying effect is lower than desired.

Using the Maintenance Report it is possible to replace the factory exhausts with tuned ones. Tuned exhausts allow for:

- ~10% more power
- Fewer vibrations
- Lower fuel burn
- Lower CHTs

Real world modifications for the C172SP Skyhawk are available at Powerflow System's. More information on [their website](#).



## Oil System

The oil system has the main role to lubricate the engine thus reducing the friction between engine components. It also helps reduce the engine temperature.

The oil system is made by:

- An **oil tank**
- A **screening filter**
- A set of **oil lines** that go to the cylinders
- An engine-driven **scavenging pump** that moves the oil from the bottom of the oil sump - below the engine - back to the oil tank
- An **oil radiator**.

The Reality Expansion Pack simulates all these components as well as the oil fluid properties.

The pilot must check the quantity and quality of the oil before each flight. This should be done during the walkaround.

In the "Engine Status" page of the Maintenance Report you can:

- Check the **type of oil fluid** in use
- Check the **quantity of oil fluid** in the oil tank
- **Change the oil** fluid type
- Check the **status of the oil filter**
- **Change the oil filter** with a new one
- Check the **oil pump status**
- Overhaul the **oil pump**

A higher grade oil - such SAE50 - is thicker than a lower grade - such SAE30 - and meant to be used in hotter climates.

The following article is a guide to choose the correct oil grade depending on the type of flight operations in progress: <https://www.simcoders.com/2016/04/18/how-to-choose-right-oil-engine>

If the oil is not changed regularly (about every 40 hours) it may get dirty and have a lower lubricant action. That is, the engine will run hotter and wear more than before.

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### NOTE

The oil pressure may get closer to its maximum value when a cold engine is first started. This is normal and do not cause any harm to the engine as long as the oil pressure gets lower during engine warmup.

Warmup the engine to ensure the correct oil temperature and pressure before applying full power for takeoff.

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### CAUTION

Using a higher grade oil in cold climates could lead to high oil pressure, thus damaging the oil system components.

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### Preheater & Winterization Kit

To engage the engine preheater, open the Maintenance Report window and activate the electrical heater by going into the "Engine Tools" section.

The electrical heater will warm up the engine (CHT) and the oil to a temperature that is suitable for startup is 30/60 minutes, depending on the outside air temperature.

A "Fast Warmup" button is available in the Maintenance Report window. Once clicked, the engine will be warmed up instantly.

Keeping the cowl plugs mounted will provide a faster and better warmup. To mount the cowl plugs, enter the walkaround mode and move to the engine checks.

If operating in very cold climates, keep the engine preheater on until the walkaround is completed and startup the engine as soon as the preheater is turned off.

The engine preheater state is kept between X-Plane sessions. If you turn on the heater and then close X-Plane, the engine will be warmed up even when the simulator is not running.

In very cold climates, the excessive flow of cool air may prevent the engine to warmup correctly after startup. To reduce the amount of air that enters the engine cowl, enter the Maintenance Report window and enable the Winterization Kit from the "Engine Tools" section.

### Engine Startup Tips

- Before starting the engine, always apply full mixture and 1 inch throttle and then switch the electrical fuel pump on for a variable time between half (warm engine) and two seconds (cold engine). After this pre-injection phase, close the throttle, set the mixture full lean and proceed with the normal engine startup.
- If the engine "pops" during the startup it means it's flooded. Just close the mixture and set the throttle full open, then engage the starter. The engine should start in few revolutions. If not, repeat the normal startup procedure.

### Vacuum System

The engine is provided with a vacuum pump used to power up the vacuum gyros.

A vacuum pump is connected to the engine via a quick-break shaft. In case of vacuum pump seizure, the shaft breaks and no harm is done to the engine.

Use the vacuum gauge to check that the vacuum pump is properly working. A normal vacuum reading is about 4 to 6 when the engine is running at cruise power.

In the "Engine Status" page of the Maintenance Report you can:

- Check the vacuum pump status
- Repair a broken vacuum pump



## Electrical Systems & Avionics

The airplane is equipped with a 28-volt, direct-current electrical system.

The system uses a battery as the source of electrical energy and a belt-driven, 60-amp alternator to maintain the battery's state of charge.

### Battery

The default battery is replaced with a battery that keep its charge between sim sessions and discharge at a realistic rate. The battery state is updated even when the simulator is not running. This means that if you leave your battery on, it will discharge even if X-Plane is closed.

In the "Electrical System & Avionics Status" page of the Mainantenace Report you can:

- Check the battery **charge**
- **Recharge** the battery
- **Disconnect** the battery poles from the electrical system

If you plan not to fly the airplane for a while, you should disconnect the battery via the Maintenance Window. This will avoid self-discharging and extend the battery life during storage.

### Alternator

The alternator switch position is saved through all X-Plane sessions. Make sure it is switched in the correct position according to the checklists throughout the entire flight.

The alternator switch operation may affect the avionics. Check the Avionics paragraph below to get more informations.

### Lights

The lights switches position are saved through all X-Plane sessions.

If the airplane is not provided with strobe lights fmod sounds, the Reality Expansion Pack adds the strobe lights sounds when the lights are switched on.

### Electrical Gyros

The Reality Expansion Pack replaces the default X-Plane electrical gyros with custom ones with a more realistic spin up/down dynamics.

The typical spin up/down sounds are reproduced when the battery switch is turned in the "On" position.

The instruments provided with an electrical gyro and therefore depending on the electrical supply are the turn/slip indicator and the standby attitude indicator, if provided.



## Radio Stack

The radio components save their own state - such as frequencies and knobs position - during X-Plane sessions.

In the “Electrical System & Avionics Status” page of the Mainantenace Report you can:

- Check the **status** of each radio
- **Fix** a faulty radio

---

### CAUTION

Never turn on or off the engine or the alternator when the avionics switch is in the “On” position. Doing so may trigger a overvoltage spike that could damage one or more avionics component.

The newer avionics such the Garmin GNS430/530 are better protected from overloads but they are not totally immune from them.

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## Landing Gear

The airplane is equipped with a tricycle fixed landing gear.

The Reality Expansion Pack introduces the following changes to the default landing gear:

- **Improved ground roll physics:** REP corrects the default behavior of X-Plane on ground in cross wind conditions, when the airplane tended to steer against the wind.
- **Custom touchdown sounds:** The touchdown sounds tone and volume are related to the touchdown speed. A harder touchdown will produce different sounds than a soft landing.
- **Brakes sounds:** Actuating the brakes produces the typical whining sound. Also the classic squeaking sounds are reproduced when the brakes are not in perfect shape.

In the “Landing Gear & Brakes Status” page of the Mainantenace Report you can:

- Check the **status** of the landing gear struts
- **Fix** a faulty strut

## Spring loaded nose wheel

The nose wheel will freely turn right or left.

The airplane direction on ground should be maintained using the brakes as well as the steering pedals.

## Tires

The Reality Expansion Pack simulates the tire status and failure basing on the landings done in the past.



A flat tire can cause the plane to yaw during the landing run or get it stuck on the ground before taxi.

In the "Landing Gear & Brakes Status" page of the Maintenance Report you can:

- Check the **status** of each tire
- **Fix** a faulty tire

## Brakes

The C172SP Skyhawk has a single-disc, hydraulically-actuated brake on each main landing gear wheel. Each brake is hydraulically connected to a cylinder attached to each of the pilot's rudder pedals.

The brakes are operated by applying pressure to the top of the rudder pedals, which are interconnected. When the airplane is parked the brakes may be activated using the parking brake switch located under the pilot's yoke.

To avoid brake failures, keep the brake system properly maintained and minimize brake usage during taxi operations and landings.

Do not apply the brakes for a long time. If the runway is long, let the plane slow down by itself.

In the "Landing Gear & Brakes Status" page of the Maintenance Report you can:

- Check the **status** of the braking system
- **Fix** a faulty brake



## HUMAN FACTOR

### Hypoxia

Hypoxia is a condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level.

As altitude is gained, the partial pressure of Oxygen gets lower and lower to the point that the human body is unable to absorb enough quantity of it to sustain life.

The symptoms of hypoxia are:

- Apparent personality change
- Impaired judgement
- Headache
- Tingling
- Increased rate of breathing
- Muscular impairment
- Memory impairment
- Visual sensory loss
- Tunnel vision
- Impairment of consciousness
- Cyanosis
- Unconsciousness
- Death

The Reality Expansion Pack simulates some of the symptoms above, such the tunnel vision, the increased rate of breathing and the muscular impairment.

### TUC & EPT

Time of Useful Consciousness (TUC) is the time available for the development of hypoxia and the pilot to do something about it. It is not the time to unconsciousness but the short time from a reduction in adequate oxygen until a specific degree of impairment, generally taken to be the point when the individual can no longer take steps to help him/herself.

Effective Performance Time (EPT) is always within and shorter than TUC. Its quantification however depends on the individual.



The following is a table that represent the EPT simulated by REP.

Altitude (ft)	EPT
10000	Few hours
15000	40 minutes
20000	10 minutes
30000	30 seconds
40000	15 seconds
45000	1-2 seconds



Figure 13: Hypoxia effect

## HOME COCKPITS/CUSTOM DATAREFS

In order to work properly, REP uses a set of custom datarefs instead of default X-Plane ones. Here you find a list of datarefs that you can use for your home cockpit.

Dateref	Type	Writable	Contents
simcoders/rep/stallwarning/on	int	No	0 = off, 1 = on
simcoders/rep/stallwarning/level	int	No	1 = low, 2 = high
simcoders/rep/cockpit2/gauges/indicators/attitude_indicator_0_pitch	float	No	Main att. ind. pitch
simcoders/rep/cockpit2/gauges/indicators/attitude_indicator_0_roll	float	No	Main att. ind. roll
simcoders/rep/cockpit2/gauges/indicators/airspeed_kts_pilot	float	No	Pilot airspeed
simcoders/rep/cockpit2/gauges/indicators/airspeed_kts_copilot	float	No	Copilot airspeed
simcoders/rep/cockpit2/gauges/indicators/altitude_ft_pilot	float	No	Pilot altitude
simcoders/rep/cockpit2/gauges/indicators/altitude_ft_copilot	float	No	Copilot altitude
simcoders/rep/cockpit2/gauges/indicators/vvi_fpm_pilot	float	No	Pilot VSI
simcoders/rep/cockpit2/gauges/indicators/vvi_fpm_copilot	float	No	Copilot VSI
simcoders/rep/cockpit2/switches/avionics_power_on	int	Yes	Avionics switch
simcoders/rep/indicators/fuel/fuel_quantity_0	float	No	Fuel kg in tank 0
simcoders/rep/indicators/fuel/fuel_quantity_ratio_0	float (ratio 0..1)	No	Fuel ratio in tank 0
simcoders/rep/indicators/fuel/fuel_quantity_1	float	No	Fuel kg in tank 1
simcoders/rep/indicators/fuel/fuel_quantity_ratio_1	float (ratio 0..1)	No	Fuel ratio in tank 1
simcoders/rep/indicators/fuel/fuel_flow_0	float	No	FF indicator
simcoders/rep/cockpit2/gauges/indicators/engine_0_rpm	float	No	RPM indicator
simcoders/rep/cockpit2/gauges/indicators/engine_0_egt	float	No	EGT indicator
simcoders/rep/cockpit2/engine/actuators/fuel_pump_0	int	Yes	Pump (0 = off, 1 = on)
simcoders/rep/engine/oil/temp_f_0	float	No	Oil temp (F)
simcoders/rep/engine/oil/temp_c_0	float	No	Oil temp (C)
simcoders/rep/engine/oil/press_psi_0	float	No	Oil press (PSI)
simcoders/rep/engine_0/CHTs_f	float[]	No	Engine 0 CHTs (f), array size depends on cylinders count
simcoders/rep/engine_1/CHTs_f	float[]	No	Engine 1 CHTs (f), array size depends on cylinders count
simcoders/rep/engine_0/egt/egt_f	float[]	No	Engine 0 EGTs (f), array size depends on cylinders count
simcoders/rep/engine_1/egt/egt_f	float[]	No	Engine 0 EGTs (f), array size depends on cylinders count



## RESOURCES & HOW-TOs

[SimCoders.com blog](#) contains tons of resources that you will find very useful when using REP.

Moreover, this is a list of How-Tos available.

- [How to lean the mixture](#)
- [How to keep the spark plugs clean](#)
- [How to choose the right oil for your engine](#)
- [How to quickly startup the engine with REP](#)
- [How to manage an emergency](#)
- [How to calculate the required fuel for your flight](#)

## SUPPORT & CONTACTS

Before asking for support please read [the FAQs we published on our site](#). They contain informations about installation troubles and general usage.

If you encounter any kind of technical problem with our software, please write to [support@simcoders.com](mailto:support@simcoders.com) providing as much informations as possible and including your X-Plane's Log.txt file.



## VERSION CHANGELOG

### V4.2.3

1. Fix: solved some windows positioning issues
2. Fix: in XP10 REP did not recognize opening a window as a paused sim state
3. Fix: in the bush version, the EGT reference needle knob didn't work
4. Fix: hobbs and tach times instruments in cockpit reported the same time
5. Improved startup behavior

### V4.2.2

1. Fix: Tach time was not shown correctly in the Tachometer
2. Fix: improved CHT algorithm with X-Plane 11.35
3. Fix: the kneeboard and maintenance windows did not save their position properly, therefore they were not shown correctly after being popped out
4. Fix: and X-Plane 11.35 bug prevented REP from reading the proper airspeed

### V4.2.1

1. No changes for this aircraft

### V4.2.0

1. **New:** Simulation of Factory and Tuned fuel injectors effects
2. **New:** More realistic fuel metering system according to real world specifications
3. **New:** Simulation of Factory and Tuned exhausts effects
4. **New:** The status file are backed up before being overwritten
5. **New:** It is now possible to save the windows position between sessions
6. Improved manifold pressure behavior

### V4.1.8

1. New: it is now possible to set the wind sound volume in REP's settings window

### V4.1.7

1. CTD fix

### V4.1.6

1. Minor Networking fix



#### **V4.1.5**

1. Increased the debug log for the Economic System

#### **V4.1.4**

1. No changes for this aircraft

#### **V4.1.3**

1. Fix: The G1000 standby altimeter always showed zero

#### **V4.1.2**

1. Fix: altimeter, vsi and airspeed indicators did not use custom datarefs anymore after Laminar changed some obj files
2. Improved EGT curve

#### **V4.1.1**

1. Improved flaps pitch down moment
2. Improved startup dynamics
3. Fix: an alternator did not save its status properly
4. Minor fixes

#### **V4.1.0**

1. **New:** FSEconomy integration with the maintenance system
2. Improved flight dynamics
3. Fix: X-Plane crashed in case of airplane crash
4. Fix: the systems' damages were updated during replay as well
5. Fix: on XP10 some message windows were not shown properly
6. Fix: on multimonitor setups the in-flight tips were shown on the wrong monitor

#### **V4.0.4**

1. Support for the Freeware Bush Pack by PropStrike Studio

#### **V4.0.3**

1. Fix: the aircraft serial number is now more randomized
2. Fix: the weight and balance traded "0Lt" of fuel when changing the passengers' masses
3. Fix: the initial status of the aircraft could not be reset properly
4. The spark plugs fouling in-flight tip is now easier to understand
5. Improved instruments behavior once weathered
6. The Tachometer Time is now only based on RPMs



7. Improved performance precision at altitude

#### **V4.0.2**

1. **New:** it is now possible to deactivate the brakes smoothing
2. Fix: the tachometer showed the wrong value in the elapsed minutes (white) band
3. Fix: the fuel selector status was not restored properly
4. Fix: fixed a crash when closing a plugin's window
5. Better gyros behavior

#### **V4.0.1**

1. Fix: some mouse clicks were not captured properly in the Maintenance Report window
2. Fix: it was not possible to properly change the oil filter using the Maintenance Report window
3. More accurate engine dynamics and flight model on XP11.30

#### **V4.0.0**

1. **New:** Economic System
2. Improved multimonitor support

#### **V3.5.11**

1. Vacuum Pump: the pump failure can be triggered using X-Plane failures menu
2. Attitude Indicator: the indicator failure can be triggered using X-Plane failures menu
3. Fix: changing livery or airport could not allow the aircraft to load its status properly
4. Fix: the flaps drag was too high in XP11.30

#### **V3.5.10**

1. Minor fixes

#### **V3.5.9**

1. The Hypoxia warning is shown only when the TUC is lower than 20 minutes

#### **V3.5.8**

1. Minor fixes

#### **V3.5.7**

1. Fix: the state loading could load incomplete data on some systems
2. Minor fixes



### **V3.5.6**

1. Better fuel flow at startup
2. It's now possible to paste the text in the licence box
3. Improved compatibility with X-Plane 11.30
4. Improved flaps pitch moment in X-Plane 11.26+
5. Fix: saving a state file could have caused a crash on some specific system configurations
6. Fix: the static elements are better managed after leaving the replay mode
7. Fix: in some cases REP was unable to retrieve the correct system time

### **V3.5.5**

1. Fix: In some cases the plugin was unable to recognize if the sim was paused or not. This could lead to some major issues, such airplane crash after leaving replay mode
2. Fix: the prop governor did not react correctly when controlled using a joystick axis
3. Fix: minor fixes to the sound engine
4. Fix: in some cases the engine temps were not updated correctly if the airplane was loaded in flight, causing the oil pump to seize
5. Fix: in some cases the liveries status were not loaded properly when changing from a livery to another of the same aircraft
6. It is now possible to disable the advanced steering algorithm
7. Minor fixes

### **V3.5.4**

1. Fix: the vacuum system may have reported a false LOW VAC warning
2. Fix: the electric system may have reported a false LOW VOLTS warning
3. Minor Fixes

### **V3.5.3**

1. Fix: fixed a compatibility issue with the sound engine
2. Fix: the parking brake lever was not properly set when parking brake was toggled using X-Plane default commands.

### **V3.5.2**

1. Fix: the new OpenAL equalizer showed some incompatibility with 3rd party plugins. This update will try to work around them and prevent crashes. A better fix will be provided in future releases.
2. Fix: the parking brake lever was not properly set when parking brake was toggled using X-Plane default commands.
3. Fix: the steering is now working properly in XP11.30+
4. Fix: the installation files were not updated in v3.5.0



### V3.5.1

1. Fix: the flaps handle did not move when the battery was off
2. Fix: the flaps motor sound was heard while checking the flaps during the walkaround
3. XP11.30 new hypoxia effect is now overridden and REP's more precise hypoxia effect is used instead

### V3.5.0

1. **New:** It is now possible to load a worn out airplane. Checkout the Persistent Aircraft and Components Wearing chapter.
2. **New:** The cockpit instrumentation wears out with time and can be fixed using the Maintenance Report
3. **New:** Hobbs Time and Tach Time are now counted separately for the airframe and the engines
4. **New:** It is now possible to move the viewpoint while in walkaround or towing mode. VR not supported yet. See the Towing and Walkaround sections for more information.
5. The static elements, such chocks and tie-downs, are now managed during replay
6. The propeller governor dynamics at low RPMs are much improved
7. Improved starter algorithm
8. Fix: Corrected a typo in the checklists
9. Fix: the radios did not correctly save the stored frequencies
10. Fix: under certain conditions, the fuel pump sounds where not stopped with the pump itself
11. Fix: a bug prevented the cylinders to fail properly and to report their compressions in the Maintenance Report
12. Fix: the hypoxia message was shown when the hypoxia was disabled
13. Fix: the oil filter get less clogged when it's past TBO
14. Fix: the autostart broke if the weight and balance configuration was changed while it was running
15. Fix: The Maintenance Report and the Kneeboard were not dimmed correctly at night

### V3.4.6

1. **New:** Automatic updates via [SkunkCrafts Updater](#) plugin
2. **New:** REP is now compatible with the [Differential and progressive brakes for X-Plane 11](#) plugin
3. Improved documentation
4. Improved gyros spin-down behavior
5. The CHT and Oil Temperature now rise faster in warm weather conditions
6. Improved ground steering
7. Improved ground effect
8. Fix: corrected the stall warning sound during flare
9. Fix: the automatic start procedure selected the wrong fuel tank
10. Fix: failures and damages were triggered while in replay mode
11. Fix: the oil pressure needle was not visible if the airplane was loaded with the engines running
12. Minor improvements



#### V3.4.5

1. **New:** It is possible to manage the static elements from the plugins menu
2. **New:** Command to toggle the static elements
3. **New:** Command to fix all systems
4. **New:** REP correctly recognizes the engine failures triggered by X-Plane
5. **Fix:** The gyros were stuck when the engine was switched off
6. **Fix:** Improved the stall behavior in XP11.20+
7. **Fix:** In the latest X-Plane versions the in-flight tip messages may have been not shown correctly
8. **Fix:** Some entries in the tech report were not clickable
9. **Fix:** Minor typos in kneeboard
10. The installer has been improved to work with all the airplane mods available over the Internet
11. More realistic hypoxia effect at lower altitudes
12. Improved documentation

#### V3.4.4

1. Minor fixes

#### V3.4.3

1. **New:** Improved engine torque algorithm
2. **New:** Improved sparkplugs fouling algorithm
3. **New:** Removed the mouse gestures to open the kneeboard
4. **New:** The checklists/mass and balance/towing mode/autostart are now accessible from the plugins menu as well as the lateral menu
5. **New:** a new command has been added to switch on the HI fuel pump
6. Improved multimonitor compatibility
7. **Fix:** oil pressure was sometimes too low
8. Minor fixes

#### V3.4.2

Internal test build – not released to the public

#### V3.4.1

1. **Fix:** missing input chars in textbox
2. **Fix:** input on multimonitor setup was not working as expected
3. Minor fixes



### V3.4.0

1. **New:** Experimental VR Support
2. **New:** SDK 3.0 (Detachable) windows
3. Improved engine model
4. Minor fixes

### V3.3.1:

1. Fix: Too rich mixture at full power
2. Minor fixes

### V3.3.0

1. **New:** 100% custom engine model to replace the internal X-Plane piston engine
2. **New:** Engine monitor enables engine fine tuning during flight
3. **New:** Improved drag model
4. **New:** Improved walkaround oil system check
5. **New:** Improved ground roll sounds
6. **New:** Improved ADI spoolup model
7. **New:** Walkaround keyboard commands
8. Minor fixes

### V3.2.1

1. Fix: Loading and unloading the plugin more times caused a crash
2. Fix: If the flight was started with engine running, the mixture was set to idle-cutoff
3. Minor fixes

### V3.2.0

1. **New:** 3D sounds
2. **New:** Advanced gyro wander
3. **New:** You can now check the pitot probe temperature during walkaround
4. **New:** Postflight walkaround
5. **New:** Lights check during walkaround
6. **New:** More informations about the cylinders status
7. **New:** The hobbs hour are now saved in the airplane state file and restored the next session
8. Improved steering algorithm
9. Better startup sounds
10. Fixed a bug that caused the cylinders to not being fixed correctly after an engine seizure
11. The landing gear failures are based on actual gravity acceleration. Now the landing on sloped strips are more realistic.
12. Fix a bug that may caused the engine to not fail when it should have
13. Minor fixes and improvements



### V3.1.1

1. **New:** The chocks and tie downs are checked before automatic start
2. **New:** The lateral menu can now be completely hidden (see the plugin settings window)
3. Alternator output set to 28V and battery to 24
4. Improved flooded engine message
5. Better compatibility with the "Start with engine running" setting
6. Fix: the label colors in some walkaround views were incorrect
7. Fix (XP11 only): the wind sound volume is controlled by the environment sounds volume
8. Minor fixes

### V3.1.0

1. **New:** Dynamic ground roll sounds
2. Minor fixes

### V3.0.0

1. **New:** reworked user interface and graphics
2. **New:** automatic startup procedure
3. Improved flight dynamics in X-Plane 11
4. Fix: some throttle quadrants did not work correctly with REP
5. Minor fixes and improvements

### V2.6.4

1. **New:** Flight dynamics improvements in both X-Plane 10 and 11
2. Fix: Minor fixes

### V2.6.3

1. Fix: The right toebrake did not couple properly with external rudder pedals
2. Fix: The oil system "Refill" button was not clickable

### V2.6.2

1. Fix: Minor fixes

### V2.6.1

1. Fix: Checklists typos
2. Fix: Improved fuel pump sounds
3. Fix: The wheel brakes may be stuck after towing
4. Fix: Improved engines doppler and distance sounds
5. Fix: Damages disabled during replay
6. Fix: Improved the joystick compatibility with the new propeller governor



#### V2.6.0

1. **New:** Custom propeller governor

#### V2.5.1

1. Fix: Corrected the toe brakes algorithm

#### V2.5.0

1. **New:** Improved torque effect
2. **New:** Improved CHT and Oil Temperature algorithm
3. **New:** Oil temperature tips
4. **New:** Improved hypoxia effect & algorithm
5. **New:** Fuel & Oil check in walkaround mode
6. Minor Fixes

#### V2.4.0

1. **New:** Spark plugs dynamics:
  - The spark plugs get fouled when the engine runs at low RPMs
  - The default spark plugs can be replaced with the fine-wire ones
2. **New:** Hypoxia can now be disabled in the settings panel
3. **New:** The engine may be damaged by wrong ROP/LOP operations
4. Minor Fixes

#### V2.3.0

1. **New:** Hypoxia simulation
2. **New:** Oil filter simulation: need to replace it at every oil change
3. **New:** Oil pump damage simulation
4. **New:** Fuel filter simulation: need to replace it after TBO
5. **New:** Vacuum pump casual failure simulation
6. **New:** More realistic engine priming dynamics
7. **New:** Improved W&B simulation during flight
8. Fix: Minor bug fixes

#### V2.2.1

1. Fix: the installer did not apply some changes correctly

#### V2.2.0

1. **New:** Simplified installation
2. Fix: The analog and digital fuel flow gauges were not reporting the correct fuel flow under certain circumstances
3. Fix: Minor fixes



### V2.1.0

1. **New:** Engine pre-heating and winterization kit
2. **New:** The avionics settings are restored after reloading the airplane
3. **New:** Better compatibility with other plugins that manage the state of the airplane (such as X-Bookmark)
4. **New:** The sounds volume is controlled by the Carenado volume knob
5. **New:** The lateral menu is dimmed at night
6. **Fix:** More realistic ground physics
7. **Fix:** The oil system is now reporting the correct oil quantity
8. **Fix:** Minor fixes

### V2.0.3

1. **Fix:** The cowl flaps lever cannot be moved using the mouse wheel
2. **Fix:** The kneeboard images were cutted and not shown correctly

### V2.0.2

1. **New:** Improved cylinders physics
  - The CHT temperature is now provided by a custom algorithm
2. **New:** Improved oil system
  - The oil temperature is now provided by a custom algorithm
  - The oil temperature and pressure depends also on oil quantity and quality
3. **New:** Improved touchdown sounds
4. **Minor Fixes**

### V2.0.1

1. **Fix:** It was not possible to enter the walkaround mode if the "Cold and Dark" option was disabled
2. **Fix:** Typos in the towing tips
3. **Fix:** The Walkaround checklists were not correctly visible on smaller screens.

### V2.0.0

1. **New:** Custom interactive walkaround and pre-flight procedures.
2. **New:** Custom airplane towing system
3. **New:** More advanced engine physics (especially for engine startup)
4. **New:** More complex damages system for the avionics, the engine and the landing gear such as:
  - Oversquare operation of the engine is not always allowed
  - The tire are damaged if the brakes are active on touchdown
5. **New:** More in-flight tips
6. **New:** Custom menu that provides an easy access to REP's features
7. **New:** Stall buffeting effect (improved if HeadShake 1.5+ is installed)
8. **Minor changes** to the sounds system



9. Minor changes to the graphics system
10. Bug fixes

### V1.0.2

1. **New:** Correct steering and ground roll physics, especially in cross wind conditions.
2. **New:** The Weight & Balance tool now predicts the C.G. position at landing.
3. **New:** HeadShake and REP integration to better simulate the engine vibrations of the TSIO-520 (Headshake v1.5 or higher required).
4. **Fix:** Improved compatibility with Saitek products.
5. **Fix:** Minor fixes.

### V1.0.1

1. **New:** A tip is shown if the pilot is managing the plane's system in the wrong manner.
2. **New:** Some failures (such the avionic's) are behaving in a more realistic way.
3. **New:** The parasite roll moment incorrectly reproduced by X-Plane is reduced.
4. **New:** The flooded engine behavior is now more realistic. If flooded, the engine may actually starts with closed mixture.
5. **New:** Engine manufacturer and model in the Hangar window.
6. **New:** Better oil color report in the Hangar window.
7. **New:** Added the "About" menu.
8. **Fix:** Sometimes, the joystick mixture axis was not correctly recognized.
9. **Fix:** Cranking a running engine does not reduce the engine's RPM anymore.
10. **Fix:** Cranking a running engine does not cause an avionics failure anymore.
11. **Fix:** The pilot altimeter's barometer was rendered incorrectly.
12. **Fix:** The propeller joystick axis was not working as expected.
13. **Fix:** The oil pressure was too high during flight.
14. **Fix:** Minor changes to improve performance and correct typos.

### V1.0.0

1. Initial Release



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