GT3 Gas Turbine Prototype

Contents

 Release Version 1.0

Introduction

Thank you for purchasing the English Electric GT3 Gas Turbine Prototype Add-on for Train Simulator.

One of the more unusual locomotives ever built the GT3 is nevertheless part of British railway history and points to the continued search for efficiency and power as post war Britain looked to replace their vast fleet of steam locomotives.

The Train Simulator version was born in a similarly unusual fashion when a friend sent us a picture saying “Have you ever seen this?” We hadn’t and after reading up as much about it as we could and becoming fascinated by the whole project it was decided to try and build it for Train Simulator. Getting hold of anything more than basic details proved difficult, there being a lack of pictures available (especially for the cab and inner tender) but after much searching and purchasing of some original technical documents we had everything required to recreate this unique experience.

The operation of the locomotive and the sounds it makes are equally unique to Train Simulator and we hope you get as much enjoyment from driving this oddity as we have had in researching and recreating it.

All the best,
Victory Works

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Features

- Simple and Expert driving modes
- Xbox controller support
- Highly detailed model of the GT3 Gas Turbine Prototype and tender
- Accurate simulation of the EM27L two-shaft Gas Turbine
- Synchronised compressor fan
- Custom sound including a matching specification turbine
- Heat haze exhaust effect
- Complete cold start sequence with “one click” automated demonstration
- User selectable head code
- Fully modelled 3D cab with all operable controls, including:
    - Gas turbine compressor RPM and oil temperature dials
    - Individual head code and reverse light switches
    - Forward and reverse sanders
    - Opening doors and windows
    - Tender interior containing heating boiler
- Worn Mk1 maroon coaches used for testing load pulling
- 5 scenarios for the Woodhead route covering all types of service testing
- 10 Quick Drives (including Hot and Cold starts)
- Fictional “What If” British Railway Blue livery
    - 2 Quick Drives (Hot and Cold start)

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Background

The GT3 was part of a programme for the development of Gas Turbine locomotives started in the late 1940's before nationalisation began. Designed by English Electric engineer J. O. P. Hughes, construction of the GT3 began in the early 1950's at their Vulcan Foundry works in Newton-le-Willows.

At the time the railway infrastructure was already in place to support a fleet of steam locomotives and this coupled with a desire to minimise the number of changes as the locomotive developed and make use of the existing tools for machining lead to the GT3's rather odd design choice of a 4-6-0 wheel arrangement with a single driving cab at the rear of the locomotive, much like a steam engine. Meanwhile other engines were being conceived with a cab at each end, removing the need for locomotives to be turned at the end of a journey and this was to prove the future of locomotive layout design.

The power unit of the GT3 was an equally peculiar choice, selecting to use a mechanical transmission of the gas turbines power output to the wheels of the locomotive. Gas turbines are most efficient when they are running at high speed and this is the opposite of the stop and start nature of a majority of rail services. Gas turbine electric locomotives store the excess power and can be made more efficient for this purpose. The other primary advantage of a gas turbine is its light weight compared to combustion engines of a similar power – the EM27L turbine in the GT3 was so light in fact that the frames were 3 times thicker than those on a similarly sized steam locomotive simply to add weight to the locomotive so it could have the required traction.

The 2700hp EM27L Gas Turbine was a two-stage gas turbine with a mechanical gearbox driving directly to the wheels. The first stage turbine, known as the Compressor Turbine, is started using an electric motor which disconnects when the turbine reaches idle speed and can retain its own rotation. The exhaust gases of the Compressor Turbine spin the second stage Power Turbine, having no direct linkage to the first, and it is the Power Turbine that is connected via a 20.325:1 gearbox (fitted with a reversing gear) to the centre driving wheels of the locomotive. The other 4 driving wheels are connected to these via the traditional rod system seen in steam locomotives.

Continuing its steam locomotive heritage the GT3 also had a traditional tender which contained 2000 gallons of fuel oil and also a vertical boiler with 1765 gallons of water

to supply it. The boiler was heated using the hot exhaust gasses expelled from the Power Turbine.

The GT3 was surprisingly quiet in the driving cab, the high pitched turbine noise being greatly reduced by sound insulation in the bulkhead. Externally the loudest sound was heard by standing close to the front sides where a reverberating thump could be heard very clearly as the air intakes sucked in massive quantities of air.

After static testing at Rugby the GT3 was run on the Great Central Main Line and the West Coast Main Line including the famous Shap incline. Its power was never in doubt and the GT3 outperformed both a BR Type 4 diesel and a Duchess Coronation to the summit of Shap during its 5000 miles of mainline testing.

The GT3 was part of the Marylebone Rolling Stock Exhibition of 1961 to celebrate the 50th Anniversary of the Institute of Locomotive Engineers and was examined by the Duke of Edinburgh.

However due to the limitations already listed and the clear choice of using diesel and electric traction for the future of British Railways the GT3 was withdrawn and returned to Vulcan Foundry in 1962, being scrapped at nearby Salford in February 1966 – towed there by, rather ironically, a BR standard steam locomotive.

Specifications:

English Electric GT3 Gas Turbine Prototype

Total Built: 1
Build Date: 1951-1962
Scrapped: 1966 at Salford
Weight: 79t 16cwt
Length: 68' 1/2"
Height: 13’
Driver Diameter: 5’ 9”
Wheelbase: 55’ 4”
Power Source: EM27L Gas Turbine
Power Output: 2,750 hp
Tractive Effort: 38,000 lb/f
Maximum Speed: 90 mph
Brake Type: Vacuum
Tender Capacity: Fuel Oil 2000 gallons, Water (for the heating boiler) 1765 gallons

Scenarios

5 career scenarios are included for the Woodhead Route Add-On.

GT3. 1] Taking To The Tracks
Wednesday July 31st 1957
After many years of design and static testing the GT3 Gas Turbine Prototype is finally ready for network trials.
Having been moved from the Vulcan Foundry at nearby Newton-le-Willows, take charge at Manchester London Road and make a simple test run up to the new Woodhead Tunnel pulling a support coach and a Class EM1 (which will not be providing any power) in case of engine failure.

GT3. 2] The Need For Speed
Saturday August 17th 1957
The GT3 has been moved through Woodhead Tunnel and is waiting at Dunford Bridge station. The objective is to test the GT3's speed under load by pulling 5 Mk. 1 coaches from Dunford Bridge to Sheffield Victoria.

GT3. 3] Heavy Load
Thursday September 5th 1957
Test the maximum load of the GT3 by driving from Sheffield Victoria to Penistone pulling 15 Mk1 coaches up the steep gradients.

GT3. 4] All Stops
Thursday November 28th 1957
A test run investigating fuel efficiency on a stopping passenger service. Run from Penistone to Manchester London Road calling at all stations.
Gas turbines are only efficient when running at high speed so data is needed to measure how poorly fuel is used on a traditional stop/start passenger run.

GT3. 5] A Glimpse Of The Future?
Friday January 17th 1958
With the project running out of funding and with interest waning in gas turbine technology there is one last chance to prove the concept can work.
Maintaining a tight timetable drive a high speed passenger service from Manchester London Road to Sheffield Victoria, simulating passenger stops at Godley Junction and Penistone.

Control Modes

There are 2 ways to drive the GT3 Gas Turbine Prototype.

Simple Mode

This is selected using the menu in Train Simulator and provides a simple stop/go, forwards/backwards set of controls via the simulators built in HUD.

Expert Mode

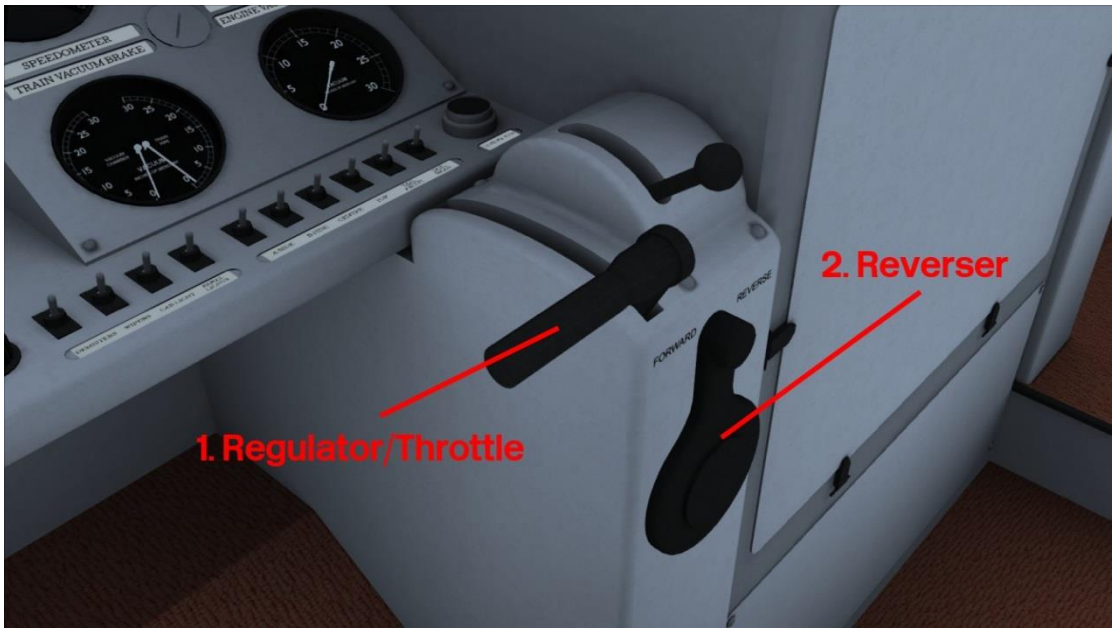
This is selected using the menu in Train Simulator. The locomotive will operate with more complex controls and can be driven using the F4 HUD or an Xbox controller.

AI

The GT3 can also be used as an AI service when creating your own scenarios. However it has been set up so that it will never be randomly selected as a service on any Quick Drive scenario as there was only ever one built.

Driving Controls

Listed below are the controls available when driving the GT3 Gas Turbine Prototype in Expert mode.



1. Regulator/Throttle

This controls the amount of fuel injected into the compressor turbine which in turn drives the power turbine which is connected, via a gearbox, to the wheels.

See Background section above for a description of how the two-stage gas turbine operates.

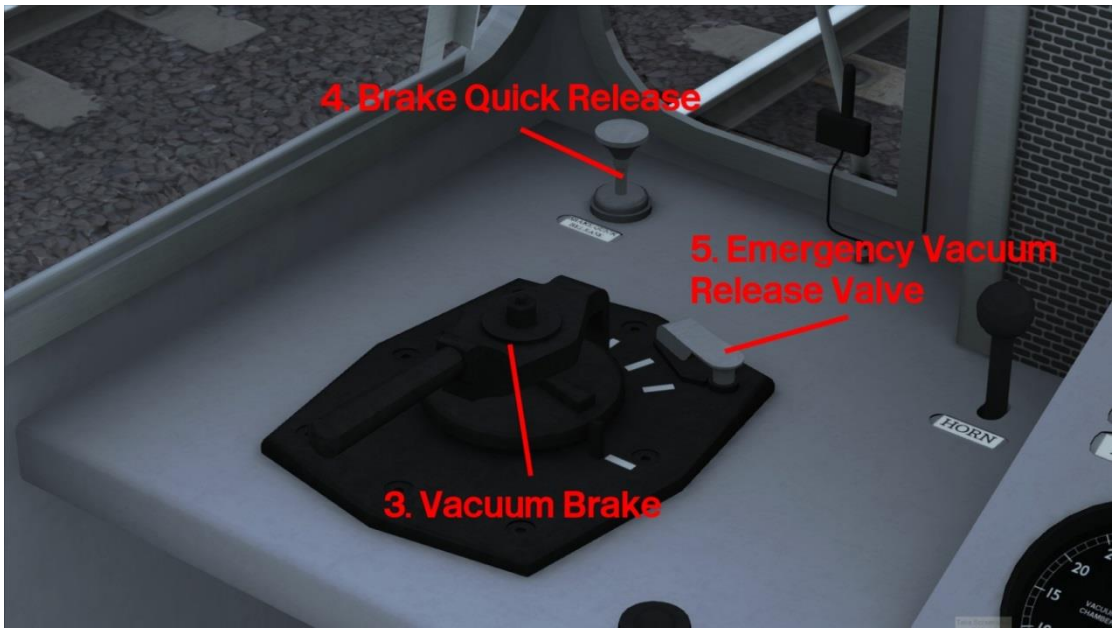
Keys: A, D

Note: Due to the excessive strains that can be placed on the Power Turbine the GT3 is limited to a maximum speed of 90mph. If this speed is exceeded the fuel flow to the turbine is automatically cut.

2. Reverser

The reverser controls the gearbox which allows forward or reverse travel.

Keys: W, S



3. Vacuum Brake

The GT3 has a 21lb/inch^2 vacuum brake to be used with the rolling stock of the time which was all vacuum fitted for use with steam locomotives.

The brake has 4 notches: *Release* is used to release the brakes, *Running* holds the brake pressure steady, *Apply* applies the brakes slowly and *Full Service* quickly.

To create the required vacuum the GT3 is fitted with an Exhauster and an Ejector. In *Release* the exhauster is used from full braking up to 10.3lb/inch^2 where the ejector continues to 21lb/inch^2.

Keys: ‘ (apostrophe), ; (semicolon)

4. Brake Quick Release

A brake quick release control is fitted which can be operated when the brake is set in Release or Running. This operates both the exhauster and ejector (see above) at the same time allowing the brakes to be released much faster.

Key: B

5. Emergency Vacuum Release Valve

This control is the emergency release which will destroy the vacuum in the brake system and force the brakes to come on at their maximum strength.

Key: Backspace

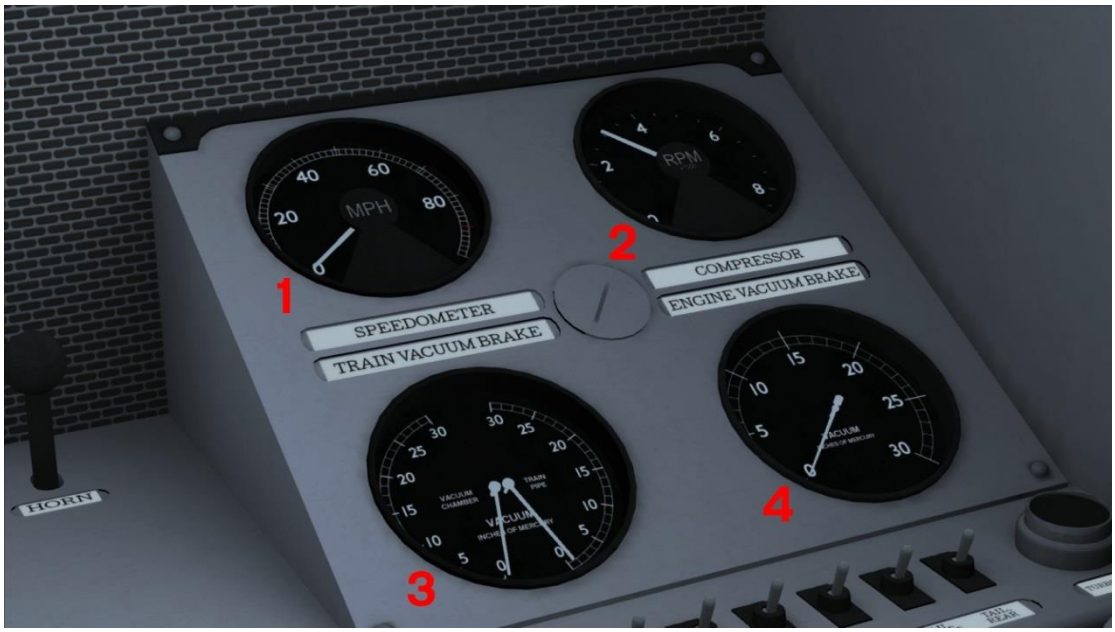
6. Sanders

Sand can be placed onto the track in front of the driving wheels to provide extra traction when the rails are slippery due to wet or icy conditions. There are 2 sander control levers at the left of the driver's seat, for forward and reverse travel.

Key: X

7. Horn

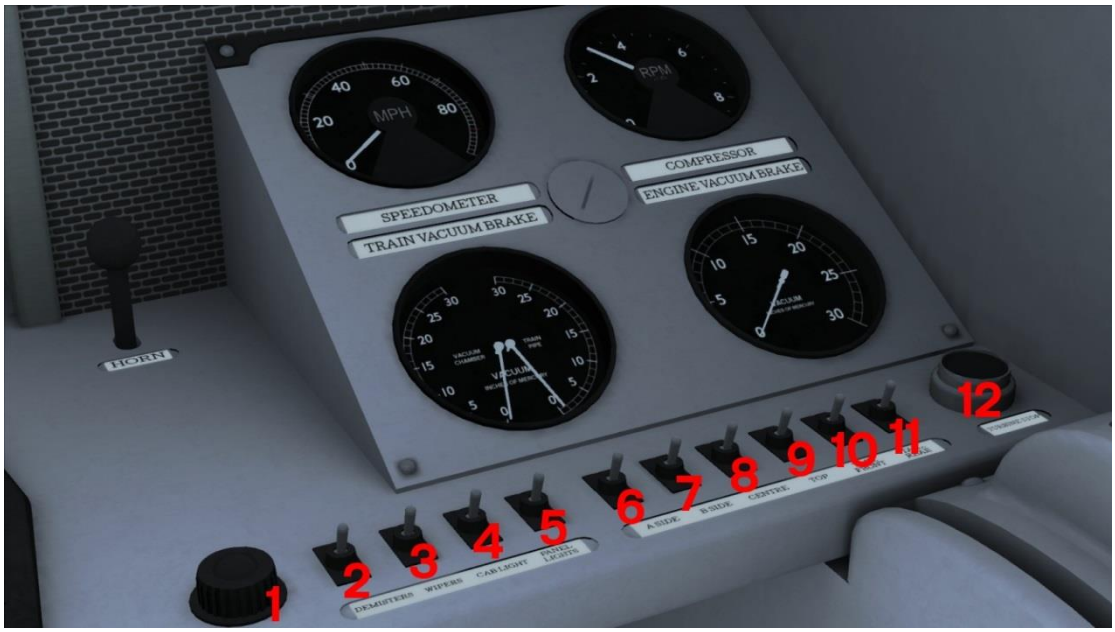
Key: Space



8. Driver's Panel

The Driver's panel has four dials

1. Speedometer, showing the speed of the locomotive
2. Compressor RPM, showing the speed of the compressor turbine
3. Dual Vacuum Gauge, showing the pressure in the train brake system
4. Vacuum Gauge, showing the pressure in the locomotive brake system



9. Driver's Desk

The driver's desk has a rotary switch, a bank of 10 on/off switches and a large push button.

1. Dimmer, sets the brightness of the panel backlights – Keys: Shift I, Ctrl I
2. Demister, activates the front window demisters - required if the windows are closed and the weather is cold
3. Wipers, activates the windscreen wipers – Key: V
4. Cab Light, activates a light in the ceiling of the cab – Key: L
5. Panel Lights, activates lights on all of the dials (brightness is controlled by the dimmer, see 1 above) – Key: I
6. A-Side light (see below)
7. B-Side light (see below)
8. Centre light (see below)
9. Top light (see below)
10. Tails lights, Front (see below)
11. Tail lights, Rear (see below)
12. Turbine Stop, performs an emergency shut down of the gas turbine engine

10. Headlights and Head code setting

The GT3 has a standard British head code system of 4 discs – Top, Left, Centre and Right – with associated lights for each.

The default setup is left and right sides showing (Express Passenger train) however these can be toggled on and off using the following controls:

Top – Ctrl + Numpad 1

Left (A Side) – Ctrl + Numpad 2

Centre – Ctrl + Numpad 3

Right (B Side) – Ctrl + Numpad 4

The associated light for each can be turned on using the relevant switch on the driver's desk (see controls 6 to 9 in the **Driver's Desk** section above).

In addition there are 2 switches for Tail Lights (see controls 10 & 11 in the **Driver's Desk** section above), which are mounted on the front of the locomotive (for running in reverse) and the rear of the tender for when the locomotive is running light engine.

You can set any of the above using the switches or you can use the default Train Simulator Headlight control (H, Shift H keys) as follows:

Off: Forward running AB head code, no lights
1: Forward running AB head code, lights on
2: Reverse running no head code, lights on

If you use the Headlight control the tender will detect whether anything is coupled to it and only show rear lights if there is not.

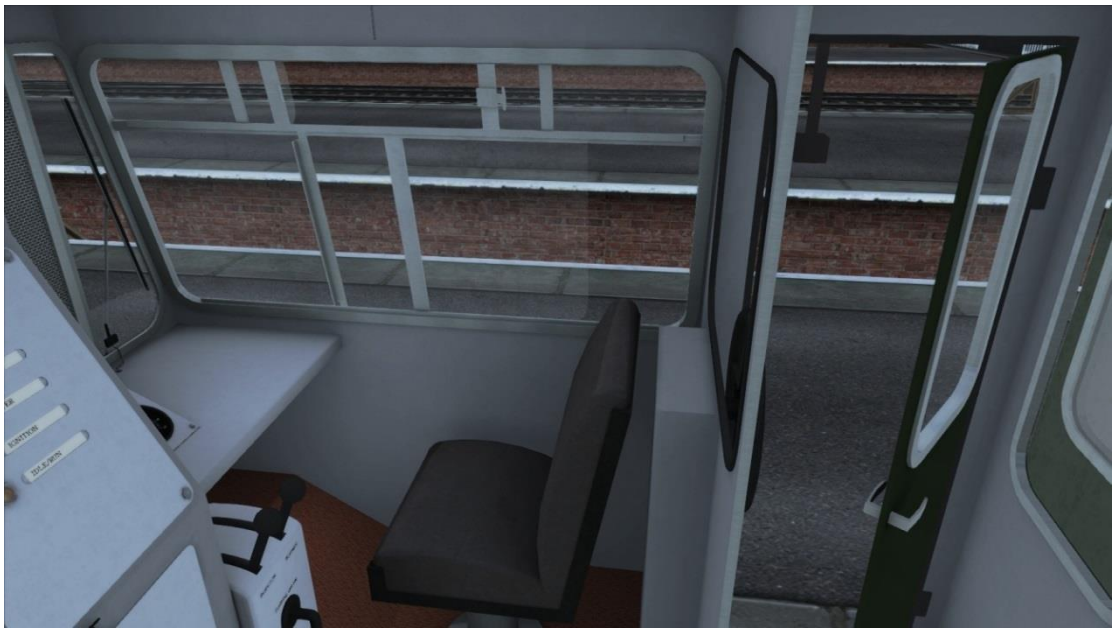
Keys: H, Shift H, Ctrl + Numpad 1-4

11. Second man's Desk

The GT3 was designed to be driven with a second man (standard practice at the time, it usually being a fireman on a steam locomotive) and a desk on the right side of the cab has the following dials and controls.

1. Fuel pressure dial, showing the pressure of the fuel being passed into the compressor turbine (controlled by the regulator/throttle)
2. Lubricating Oil
3. Compressor Oil Temperature
4. Inlet Oil Temperature
5. Power Turbine Oil Temperature
6. Sump Oil Temperature

There are also two lever controls (7 and 8) used to operate the steam heating boiler located in the tender. In the real GT3 these controlled the injection of cold water into the boiler and the burner which heated the boiler using exhaust gases from the turbine. These do not have any function in Train Simulator.



12. Doors and Windows

The cab doors can be opened and closed as can the large side windows and also the smaller side vent windows. If you close all of the windows in cold weather you should be sure to turn the front window demisters on.

13. Centre Panel Turbine Controls

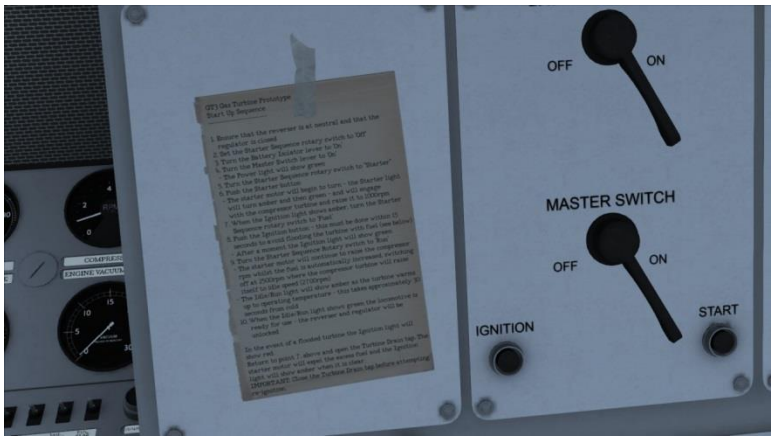
See the next section **Cold Start** for use of these controls.

Cold Start

It is possible to perform a complete cold start sequence on the GT3 when using a Quick Drive or when creating a new scenario.

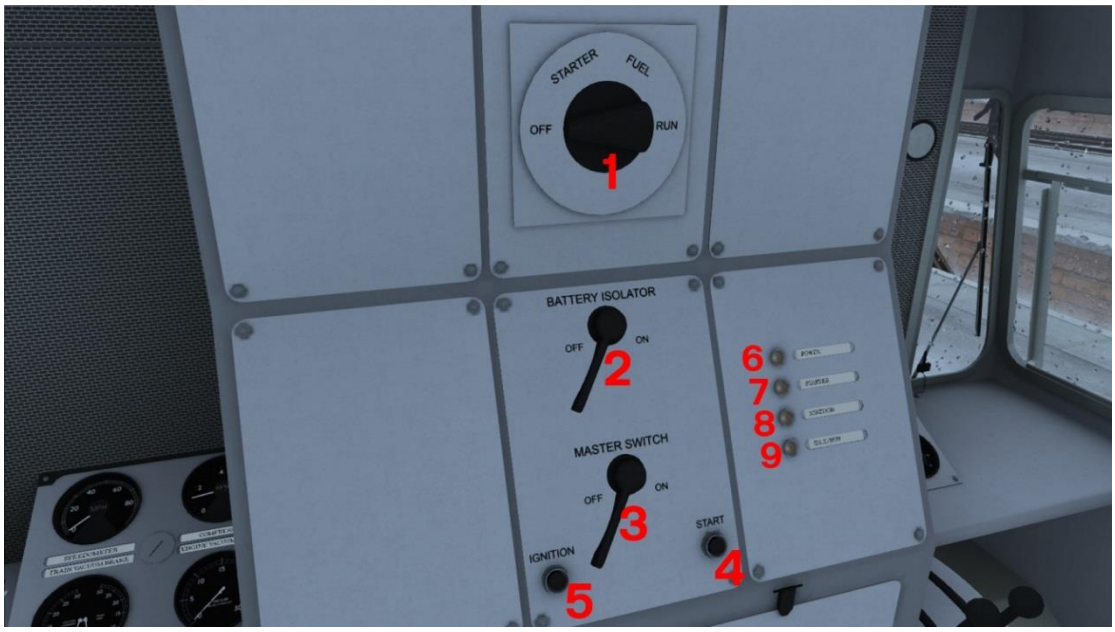
Selecting a GT3 with a name ending with *(Cold Start)* will provide a locomotive that is completely shut down and will need to be started before it can move.

The following information shows how to step through the start-up sequence. You can show or hide a helper checklist on the left side of the centre control panel using keys Ctrl-H.



You also have the option to make the second man perform the start-up sequence for you. This is done by clicking the green key icon on the F4 HUD or pressing the Z key. He will run through the sequence step by step allowing you to observe from inside and outside. Note that toggling this off will shut down the locomotive completely (including the electrics).

The following controls on the centre panel are used to start the GT3.

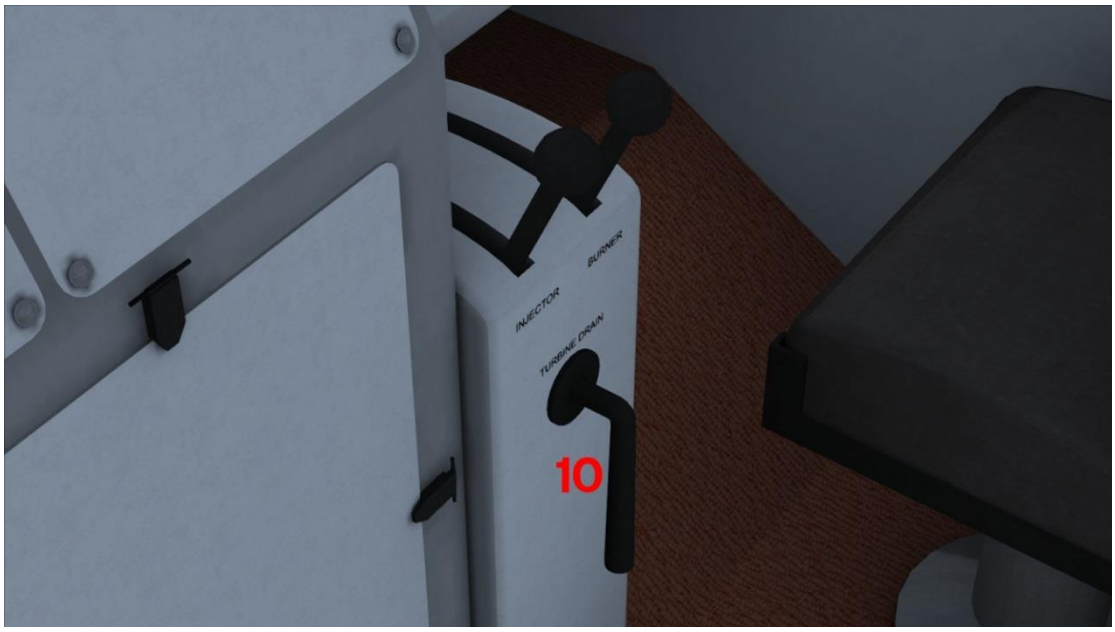


1. Starter Sequence rotary switch
2. Battery Isolator lever
3. Master Switch lever
4. Start button
5. Ignition button
6. Power light
7. Starter light
8. Ignition light
9. Idle/Run light

Manual Start-up Sequence

1. Change the cab view to the central position so you can see the centre console clearly.
2. Turn the Battery Isolator lever (2) to “On”.
3. Turn the Master Switch lever (3) to “On”.
    - The Power light (6) will turn Green.
4. Turn the Starter Sequence rotary switch (1) to “Starter”.
5. Push the Start button (4).
    - The Starter light (7) will turn Amber.
    - After 10 seconds the starter motor will begin to turn – the Starter light (7) will turn Green. The starter will engage with the compressor turbine and raise its speed to 1000 RPM – this can be observed on the Compressor RPM dial on the driver’s panel.
6. When the compressor reaches 1000 RPM and the Ignition light (8) turns Amber, turn the Starter Sequence rotary switch (1) to “Fuel”.
7. Push the Ignition button (5). Note: This must be done within 15 seconds or you will be in danger of flooding the turbine. If this happens then the Ignition light (8) will turn Red – see below to resolve this.
    - After ignition occurs the Ignition light (8) will turn Green.
8. Turn the Starter Sequence rotary switch (1) to “Run”.
    - The starter motor will continue to raise the compressor RPM whilst the fuel is automatically increased, switching off at 2500 RPM where the compressor will become self-powering and will raise itself to the idling speed of 2700 RPM.
    - The Idle/Run light (9) will turn Amber as the turbine warms up to operating temperature – this takes approximately 30 seconds from cold.
9. When the Idle/Run lights (9) turns Green the locomotive is ready for use – the reverser and regulator/throttle will be unlocked.

In the event of a turbine flood



If the Ignition light (8) turns Red this means that too long a time has elapsed between adding fuel to the ignition chamber and it being ignited.

To resolve this:

1. Turn the Starter Sequence rotary switch (1) to “Starter”.
2. Open the Turbine Drain tap (10).
    - The starter motor will continue to spin the turbine and eject the unburnt fuel. Once clear the Ignition light (8) will turn Amber.
3. **IMPORTANT:** Close the Turbine Drain tap (10).
4. You can resume the start-up sequence from point 6 above.

Modification Policy

You are free to create modifications (including but not limited to re-skins, sound updates, “enhancement” packs, etc.) within the guidelines of Dovetail Games current policies (for example, no inclusion of 3D model files) however if they are made public then they must be provided **free of charge**. They can be hosted on a site that asks a nominal membership fee for quicker downloads (e.g. UK Train Sim) but cannot be sold in any way without the express permission of Victory Works.

If you wish to discuss terms for selling modifications please contact us via email at victoryworks@live.co.uk

To summarise – free mods are fine, as long as they adhere to DTG’s current policies. If you wish to sell mods then you **MUST** get permission first.

Acknowledgements

I would like to thank the following people for their help and encouragement during this project:

- Simon Hall for creating the superb turbine simulation and for all of his technical advice
- Stuart Galbraith for his advice, critique and for introducing us to this oddity
- DOM107 (UKTrainSim) for his Blender exporter
- “The Secret Forum” for their critique and constant encouragement
- Everyone at Dovetail Games
- My wife for all her support and my father for instilling in me a love of steam trains from an early age