# ID24HACKED hashing formal specification 0.99.2

In order to eliminate undefined behavior, **ID24HACKED** has the ability to hash a DeHackEd state and require additional DeHackEd patches to specify a valid hash in order to successfully load. This document describes everything required to implement DeHackEd Hashing.

A DeHackEd patch is always assumed to work with just the built-in tables, and as such a DeHackEd patch will always be processed when the engine is in its default state of zero patches loaded. If the engine has already parsed a DeHackEd patch, any further patches will fail to load unless they specify a valid hash value that matches the engine’s current state.

### DeHackEd patch loading order

As **ID24** is required to eliminate undefined behavior, the loading order of DeHackEd patches has changed from what was defined by MBF. This behavior retroactively applies to all previously published specifications.

DeHackEd patches must be parsed in the following order:

* IWAD DEHACKED entry (last found)
* For each PWAD listed in order
  + PWAD DEHACKED entry (last found)
* Each DEH file listed in order

This ensures both that the hashing function described in this document works as intended, and that any mod shipping with a DeHackEd patch doesn’t have weird bugs introduced by a user-defined DeHackEd patch.

### The hash function used

FNV-1a with 64-bit values is used to hash each required value. An initial value of 14695981039346656037 is used to begin the hashing, and a prime of 1099511628211 is used in the transformation operation.

All bytes of an integer are passed into the hash function in little endian format.

Any undefined or zero-length string values must be hashed using the value **“null”** instead of a null pointer or a zero value.

### Reading hashes from a DeHackEd file

A new field exists at the root level of a DeHackEd document: **Valid hashes**. This is a comma-separated list of has values that a DeHackEd patch is allowed to load on top of. Each hash is a 64-bit unsigned integer encoded as uppercase hexadecimal. If no patches are loaded or if the loaded hash is equal to one found in the **Valid hashes** entry, then a DeHackEd patch is considered valid and can be loaded.

**NOTE:** At the time of publishing, the Thing and Frame tables are incomplete in the officially released Doom and Doom II applications. As such, it is impossible for community generated hash values to match any hash provided. This has the effect of limiting the user to loading one DeHackEd patch at a time. This limitation will be removed in a patch in the near future.

### Data types

The following datatypes are considered in the hashing algorithm:

* Miscellaneous values
* Thing
* Frame
* Sprite
* Sound
* Weapon
* Ammo

Each item is parsed from the **in-order tables** in exactly the order they were allocated in. As objects are resolved as they are referred to in **ID24HACKED**, this means the allocation order matches the first time their index is referenced in a DeHackEd patch rather than the first time their complete definition is encountered.

Strings, cheats, and par times are not considered for hashing as these are values that by definition cannot result in undefined behaviour.

Code pointers in a Frame entry hash using their lookup mnemonic; or **“null”** if no code pointer is defined

Any undefined or zero-length string values must be hashed using the value **“null”** instead of a null pointer or a zero value.

When the **feature level** of the previous and currently loaded DeHackEd patches does not require items added at higher feature levels, these items are not considered when hashing. DeHackEd always starts off at a **Doom 1.9** feature level and will not consider feature levels defined outside of the DeHackEd parser (such as through the command line or a GAMECONF lump).

### Data processing orders

##### Miscellaneous values

| Field | Condition |
| --- | --- |
| **Initial Health** | Always |
| **Max Health** | Always |
| **Max Armor** | Always |
| **Green Armor Class** | Always |
| **Blue Armor Class** | Always |
| **Max Soulsphere** | Always |
| **Soulsphere Health** | Always |
| **Megasphere Health** | Always |
| **God Mode Health** | Always |
| **IDFA Armor** | Always |
| **IDFA Armor Class** | Always |
| **IDKFA Armor** | Always |
| **IDKFA Armor Class** | Always |
| **BFG Cells/Shot** | **Feature level** < **MFB21** |
| **Initial Bullets** | **Feature level** < **ID24** |

##### Thing

| Field | Condition |
| --- | --- |
| **Thing index** | Always |
| **ID #** | Always |
| **Initial frame** | Always |
| **Hit points** | Always |
| **First moving frame** | Always |
| **Alert sound** | Always |
| **Reaction time** | Always |
| **Attack sound** | Always |
| **Injury frame** | Always |
| **Pain chance** | Always |
| **Pain sound** | Always |
| **Close attack frame** | Always |
| **Far attack frame** | Always |
| **Death frame** | Always |
| **Exploding frame** | Always |
| **Death sound** | Always |
| **Speed** | Always |
| **Width** | Always |
| **Height** | Always |
| **Mass** | Always |
| **Missile damage** | Always |
| **Action sound** | Always |
| **Bits** | Always |
| **Respawn frame** | Always |
| **MBF21 Bits** | **Feature level** >= **MFB21** |
| **Infighting group** | **Feature level** >= **MFB21** |
| **Projectile group** | **Feature level** >= **MFB21** |
| **Splash group** | **Feature level** >= **MFB21** |
| **Fast speed** | **Feature level** >= **MFB21** |
| **Melee range** | **Feature level** >= **MFB21** |
| **Rip sound** | **Feature level** >= **MFB21** |
| **ID24 Bits** | **Feature level** >= **ID24** |
| **Min respawn tics** | **Feature level** >= **ID24** |
| **Respawn dice** | **Feature level** >= **ID24** |
| **Dropped item** | **Feature level** >= **ID24** |
| **Pickup ammo type** | **Feature level** >= **ID24** |
| **Pickup ammo category** | **Feature level** >= **ID24** |
| **Pickup weapon type** | **Feature level** >= **ID24** |
| **Pickup item type** | **Feature level** >= **ID24** |
| **Pickup bonus count** | **Feature level** >= **ID24** |
| **Pickup sound** | **Feature level** >= **ID24** |
| **Pickup message** | **Feature level** >= **ID24** |
| **Translation** | **Feature level** >= **ID24** |

##### Frame

| Field | Condition |
| --- | --- |
| **Frame index** | Always |
| **Code pointer** | Always |
| **Sprite number** | Always |
| **Sprite subnumber** | Always |
| **Duration** | Always |
| **Next frame** | Always |
| **Unknown 1** | Always |
| **Unknown 2** | Always |
| **Injury frame** | Always |
| **MBF21 Bits** | **Feature level** >= **MBF21** |
| **Args1** | **Feature level** >= **MBF21** |
| **Args2** | **Feature level** >= **MBF21** |
| **Args3** | **Feature level** >= **MBF21** |
| **Args4** | **Feature level** >= **MBF21** |
| **Args5** | **Feature level** >= **MBF21** |
| **Args6** | **Feature level** >= **MBF21** |
| **Args7** | **Feature level** >= **MBF21** |
| **Args8** | **Feature level** >= **MBF21** |
| **Tranmap** | **Feature level** >= **ID24** |

##### Sprites

| Field | Condition |
| --- | --- |
| **Sprite index** | Always |
| **Sprite name** | Always |

##### Sounds

| Field | Condition |
| --- | --- |
| **Sound index** | Always |
| **Sound name** | Always |

##### Weapons

| Field | Condition |
| --- | --- |
| **Weapon index** | Always |
| **Ammo type** | Always |
| **Deselect frame** | Always |
| **Select frame** | Always |
| **Bobbing frame** | Always |
| **Shooting frame** | Always |
| **Firing frame** | Always |
| **Ammo per shot** | **Feature level** >= **MBF21** |
| **MBF21 Bits** | **Feature level** >= **MBF21** |
| **Slot** | **Feature level** >= **ID24** |
| **Slot Priority** | **Feature level** >= **ID24** |
| **Switch Priority** | **Feature level** >= **ID24** |
| **Initial Owned** | **Feature level** >= **ID24** |
| **Initial Raised** | **Feature level** >= **ID24** |
| **Carousel icon** | **Feature level** >= **ID24** |
| **Allow switch with owned weapon** | **Feature level** >= **ID24** |
| **No switch with owned weapon** | **Feature level** >= **ID24** |
| **Allow switch with owned item** | **Feature level** >= **ID24** |
| **No switch with owned item** | **Feature level** >= **ID24** |

##### Ammos

| Field | Condition |
| --- | --- |
| **Ammo index** | Always |
| **Per Ammo** | Always |
| **Max Ammo** | Always |
| **Initial ammo** | **Feature level** >= **ID24** |
| **Max upgraded ammo** | **Feature level** >= **ID24** |
| **Box ammo** | **Feature level** >= **ID24** |
| **Backpack ammo** | **Feature level** >= **ID24** |
| **Weapon ammo** | **Feature level** >= **ID24** |
| **Dropped ammo** | **Feature level** >= **ID24** |
| **Dropped box ammo** | **Feature level** >= **ID24** |
| **Dropped backpack ammo** | **Feature level** >= **ID24** |
| **Dropped weapon ammo** | **Feature level** >= **ID24** |
| **Deathmatch weapon ammo** | **Feature level** >= **ID24** |
| **Skill 1 multiplier** | **Feature level** >= **ID24** |
| **Skill 2 multiplier** | **Feature level** >= **ID24** |
| **Skill 3 multiplier** | **Feature level** >= **ID24** |
| **Skill 4 multiplier** | **Feature level** >= **ID24** |
| **Skill 5 multiplier** | **Feature level** >= **ID24** |