



# **Firebird's nbackup tool**

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## Introduction

*nbackup* is a new backup utility that comes with Firebird 2.0. It offers possibilities not present in *gbak* - Firebird's pre-existing backup tool - but doesn't replace the latter. Both programmes have their strengths and weaknesses; they will likely coexist for some time to come.

## nbackup features - an overview

With *nbackup*, you can perform two different groups of tasks:

1. Making and restoring of both full and *incremental* backups. An *incremental backup* only contains the mutations since some specific previous backup.
2. Locking the main database file so you can subsequently back it up yourself with copying or backup tools of your own choice. In this mode, *nbackup* doesn't back up anything; it just creates the conditions under which you can safely make the backup yourself. There's a provision for restoring here, too.

Both modes can operate on an active database, without hindering connected users. The backup created will always reflect the state of the database *at the beginning of the operation*. In these respects *nbackup* doesn't differ from *gbak*.

### Advantages of nbackup

- *Both modes*: high speed (as high as hardware and OS will allow), because *nbackup* doesn't look at the actual data. In backup mode the contents are written more or less blindly to the backup file.
- *Backup/restore mode*: time and disk space savings, because you don't need to make a full backup every time. This can make a huge difference with databases in the gigabyte range.
- *Lock/unlock mode*: total freedom in your choice of backup, copy, and/or compression tools.

### Limitations of nbackup

- *nbackup* will not sweep and compact your database the way *gbak* does.
- You can't change the database owner with an *nbackup* backup/restore cycle, like you can with *gbak*.
- *nbackup* can't make *transportable backups*, that is: backups you can restore on an incompatible platform or under another server version.
- At this moment, *nbackup* should not be used on multi-file databases.
- *nbackup* can only back up local databases.

We'll discuss *nbackup*'s various functions extensively in the following sections.

## Making and restoring backups

To begin with: `nbackup.exe` is located in the `bin` subdirectory of your Firebird folder. Typical locations are e.g. `C:\Program Files\Firebird\Firebird_2_0\bin` (Windows) or `/opt/firebird/bin` (Linux). Just like most of the tools that come with Firebird, `nbackup` has no graphical interface; you launch it from the command prompt (or from within a batch file or application).

### Warning

Under heavy-load circumstances in some environments, `nbackup` 2.0.3 and below may cause problems that will lead to deadlocks or even corrupted databases. While these problems aren't common, they are serious enough to warrant upgrading to Firebird 2.0.4 or higher if you want to use `nbackup` comfortably.

## Full backups

### Making full backups

To make a full database backup, the command syntax is:

```
nbackup [-U <user> -P <password>] -B 0 <database> [<backupfile>]
```

For instance:

```
C:\Data> nbackup -B 0 inventory.fdb inventory_1-Mar-2006.nbk
```

Comments:

- The parameter `-B` stands for backup (gee!). The *backup level* 0 indicates a full backup. Backup levels greater than 0 are used for incremental backups; we'll discuss those later on.
- Instead of a database filename you may also specify an alias.
- Instead of a backup filename you may also specify `stdout`. This will send the backup to standard output, from where you can redirect it to e.g. a tape archiver or a compression tool.
- The `-U` (user) and `-P` (password) parameters may be omitted:
  - if you're logged on as superuser (`root`, `Administrator`...), or
  - if the environment variables `ISC_USER` and `ISC_PASSWORD` are set.

For clarity and brevity, these parameters are not used in the examples.

- The different parameters (`-B`, `-U` and `-P`) may occur in any order. Of course each parameter should be immediately followed by its own argument(s). In the case of `-B` there are three of them: backup level, database, and backup file - in that order!
- If the `-B` parameter comes last, you *may* leave out the name of the backup file. In that case `nbackup` will compose a filename based on the database name, the backup level, and the current date and time. This can

lead to a name clash (and a failed backup) if two backup commands of the same level are issued in the same minute.

### Warning

Do *not* use nbackup for multi-file databases. This can lead to corruption and loss of data, despite the fact that nbackup will not complain about such a command.

### A word on the inner workings

Note: What follows here is not necessary knowledge to use nbackup. It just gives a rough (and incomplete) image of what happens under the hood during execution of nbackup -B:

1. First of all, the main database file is locked by changing an internal state flag. From this moment on, any and all mutations in the database are written to a temporary file - the difference file or *delta file*.
2. Then the actual backup is made. This isn't a straight file copy; restoring must be done by nbackup as well.
3. Upon completion of the backup, the contents of the delta file are integrated with the main database file. After that, the database is unlocked (flag goes back to "normal") and the delta is removed.

The functionality of steps 1 and 3 is provided by two new SQL statements: ALTER DATABASE BEGIN BACKUP and ALTER DATABASE END BACKUP. Contrary to what the names suggest, these statements do *not* take care of making the actual backup; rather, they create the conditions under which the main database file can be safely backed up. And to be clear: you don't need to issue these commands yourself; nbackup will do that for you, at the right moments.

### Restoring a full backup

A full backup is restored as follows:

```
nbackup [-U <user> -P <password>] -R <database> [<backupfile>]
```

For instance:

```
C:\Data> nbackup -R inventory.fdb inventory_1-Mar-2006.nbk
```

Comments:

- You don't specify a level for a restore.
- When restoring, the -R parameter *must* come last, for reasons that will become clear later.
- If the specified database file already exists, the restore fails and you get an error message.
- Here too, you may omit the name of the backup file. If you do, nbackup will prompt you for it.

### Bug

In Firebird 2.0.0, this "interactive restore" feature is broken, leaving you with an error message and a failed restore. Fixed in 2.0.1.

## Incremental backups

### Warning

The incremental backup facility is entirely broken in Firebird 2.1. A fix is foreseen for version 2.1.1.

## Making incremental backups

To make an incremental (“differential”) backup we specify a backup level greater than 0. An incremental backup of level  $N$  always contains the database mutations since the most recent level  $N-1$  backup.

Examples:

One day after the full backup (level 0), you make one with level 1:

```
C:\Data> nbackup -B 1 inventory.fdb inventory_2-Mar-2006.nbk
```

This backup will only contain the mutations of the last day.

One day later again, you make another one with level 1:

```
C:\Data> nbackup -B 1 inventory.fdb inventory_3-Mar-2006.nbk
```

This one contains the mutations of the last *two* days, since the full backup, not only those since the previous level-1 backup.

A couple of hours on we go for a level-2 backup:

```
C:\Data> nbackup -B 2 inventory.fdb inventory_3-Mar-2006_2.nbk
```

This youngest backup only contains the mutations since the most recent level-1 backup, that is: of the last few hours.

### Note

All the [comments](#) that have been made about full backups also apply to incremental backups.

### Warning

Again: do not use nbackup for multi-file databases.

## Restoring incremental backups

When restoring incremental backups you must specify the entire chain of backup files, from level 0 through the one you wish to restore. The database is always built up from the ground, step by step. (It is this stepwise adding until the database is restored that gave rise to the term *incremental backup*.)

The formal syntax is:

```
nbackup [-U <user> -P <password>]
        -R <database> [<backup0> [<backup1> [...] ] ]
```

So restoring the level-2 backup from the previous example goes as follows:

```
C:\Data> nbackup -R inventory.fdb inventory_1-Mar-2006.nbk
        inventory_3-Mar-2006.nbk inventory_3-Mar-2006_2.nbk
```

Of course the line has been split here for layout reasons only - in reality you type the entire command and only hit **Enter** at the end.

Comments (in addition to the [comments with restoring a full backup](#)):

- Because it is not known beforehand how many filenames will follow the `-R` switch (as we don't specify a level when restoring), nbackup considers all arguments after the `-R` to be names of backup files. It is for this reason that no other parameter (`-U` or `-P`) may follow the list of filenames.
- There is no formal limit to the number of backup levels, but in practice it will rarely make sense to go beyond 3 or 4.

### ***Non-connecting links***

What happens if you accidentally leave out a file, or specify a series of files that don't all belong together? You could imagine that you specify `inventory_2-Mar-2006.nbk` by mistake instead of `inventory_3-Mar-2006.nbk` in the above example. Both are level-1 backup files, so in both cases we get a nice “0, 1, 2” level series. But our level-2 file is incremental to the level-1 backup of 3 March, not to the one of 2 March.

Fortunately such a mistake can never lead to an incorrectly restored database. Each backup file has its own unique ID. Furthermore, each backup file of level 1 or above contains the ID of the backup on which it is based. When restoring, nbackup checks these IDs; if somewhere in the chain the links don't connect, the operation is cancelled and you get an error message.

## ***Suppressing database triggers (Firebird 2.1+)***

Firebird 2.1 introduced the concept of *database triggers*. To keep these database triggers from firing during an nbackup run, a new switch was added to nbackup: `-T`. It can only be used by the database owner and SYSDBA. Notice that the corresponding switches in gbak and isql are called `-nodbtriggers` (we love diversity).

## ***A practical application***

An nbackup-based incremental backup scheme could look like this:

- Each month a full backup (level 0) is made;
- Each week a level-1;
- A level-2 backup daily;
- A level-3 backup hourly.

As long as all backups are preserved, you can restore the database to its state at any hour in the past. For each restore action, a maximum of four backup files is used. Of course you schedule things in such a way that the

bigger, time-consuming backups are made during off-peak hours. In this case the levels 0 and 1 could be made at weekends, and level 2 at night.

If you don't want to keep everything for eternity, you can add a deletion schedule:

- Level-3 backups are deleted after 8 days;
- Level-2s after a month;
- Level-1s after six months;
- Full backups after two years, but the first one of each year is kept.

This is only an example of course. What's useful in an individual case depends on the application, the size of the database, its activity, etc.

## Read on?

At this point you know everything you need in order to make and restore full and/or incremental backups with nbackup. You only need to read any further if you want to use backup tools of your own choice for your Firebird databases (see [Locking and unlocking](#)), or if you want to override the default name or location of the delta file (see [Setting the delta file](#)).

If you have no craving for any of that: good luck in your work with nbackup!

## Locking and unlocking

If you prefer to use your own backup tools or just make a file copy, nbackup's lock-unlock mode comes into view. “Locking” means here that the main database file is frozen temporarily, not that no changes can be made to the database. Just like in backup mode, mutations are directed to a temporary delta file; upon unlocking, the delta file is merged with the main file.

As a reminder: nbackup.exe lives in the bin subdir of your Firebird folder. Typical locations are e.g. C:\Program Files\Firebird\Firebird\_2\_0\bin (Windows) or /opt/firebird/bin (Linux). There's no GUI; you launch it from the command prompt (or from within a batch file or application).

## Locking the database and backing up yourself

A typical session in which you make your own backup goes as follows:

1. Lock the database with the `-L` (lock) switch:

```
nbackup [-U <user> -P <password>] -L <database>
```

2. Now copy/backup/zip the database file to your heart's content, with your own choice of tools. A simple file copy is also possible.
3. Unlock the database with `-N` (uNlock):

```
nbackup [-U <user> -P <password>] -N <database>
```

The last command will also cause any mutations - which have been written to the delta file - to be merged into the main file.

The backup you made contains the data as they were at the moment the database was locked, regardless how long the locked state has lasted, and regardless how long you may have waited before making the actual backup.

### Warning

What goes for backup/restore also applies to the lock/unlock switches: do not use them on multi-file databases. Until things have changed, don't let nbackup loose on multi-file databases at all!

## Restoring a backup made after “nbackup -L”

An copy of a locked database is itself a locked database too, so you can't just copy it back and start using it. Should your original database get lost or damaged and the self-made copy needs to be restored (or should you wish to install the copy on another machine), proceed like this:

1. Copy/restore/unzip the backed-up database file yourself with the necessary tools.
2. Now unlock the database, *not* with the `-N` switch, but with `-F` (fixup):

```
nbackup -F <database>
```

Why are there two unlock switches, `-N` en `-F`?

- `-N` first sees that any changes made since the locking by `-L` are merged into the main database file. After that, the database goes back into normal read/write mode and the temporary file is deleted.
- `-F` only changes the state flag of the self-restored database to “normal”.

So you use:

- `-N` after having *made* a copy/backup yourself (to reverse the `-L` issued earlier);
- `-F` after having *restored* such a backup yourself.

### Note

It is a bit unfortunate that the last switch should be called `-F` for Fixup. After all, it doesn't fix anything; it only *unlocks* the database. The `-N` (uNlock) flag on the other hand performs not only an unlock, but also a fixup (integration of mutations into the main file). But we'll have to live with that.

## Under the hood

Note: This section doesn't contain any necessary knowledge, but provides some extra information which could deepen your understanding of the various switches.

**nbackup -L** does the following:

1. Connect to the database;
2. Start a transaction;
3. Call ALTER DATABASE BEGIN BACKUP (this statement has been discussed in the [extra information on nbackup -B](#));

4. Commit the transaction;
5. Disconnect from the database.

**nbackup -N** follows the same steps, but with “...END BACKUP” in step 3.

**nbackup -F** works as follows:

1. The restored database file is opened;
2. Within the file, the state flag is changed from locked (nbak\_state\_stalled) to normal (nbak\_state\_normal);
3. The file is closed again.

#### Note

nbackup -F operates purely on file level and can therefore even be performed without a Firebird server running. Any *-U* or *-P* parameters added to the command will be completely ignored.

## Setting the delta file

By default, the delta file lives in the same directory as the database itself. It also has the same name as the database file, but with `.delta` appended. There is usually no reason to change this, but it can be done if need be – though not via `nbackup` itself. Make a connection to the database with any client that allows you to enter your own SQL statements and give the command:

```
alter database add difference file 'path-and-filename'
```

The custom delta file specification is persistent in the database; it is stored in the system table `RDB$FILES`. To revert to the default behaviour, issue the following statement:

```
alter database drop difference file
```

#### Notes

- If you specify a bare file name with `ADD DIFFERENCE FILE`, the delta will likely *not* be created in the same directory as the database, but in the current directory as seen from the server. On Windows this may e.g. be the system directory. The same logic applies to relative paths.
- The entire directory path must already exist. Firebird doesn't attempt to create any missing directories.
- If you want to change your custom delta specification, you must first `DROP` the old one and then `ADD` the new one.

## Appendix A: Document history

The exact file history is recorded in the manual module in our CVS tree; see [http://sourceforge.net/cvs/?group\\_id=9028](http://sourceforge.net/cvs/?group_id=9028)

### Revision History

0.1	21 Oct 2005	PV	First edition.
1.0	1 Dec 2006	PV	Removed “beta” reference in edition info. Changed warning against specifying backup file names interactively with nbackup -R. Removed “(or will be)” from first sentence in Document History. Changed C:\Databases to C:\Data in the examples, just to keep the lines from running out of the shaded <screen> areas in the PDF. Added section <i>Setting the delta file</i> , and changed section <i>Read on?</i> accordingly.
1.1	5 May 2008	PV	<i>Making and restoring backups</i> : Added warning about heavy-load risks with nbackup 2.0.0–2.0.3. <i>Restoring a full backup</i> : Corrected wrong statement that nbackup will overwrite an existing database if there are no active connections. Changed italic text about interactive restore failure to a Note and mentioned its fix in 2.0.1. <i>Incremental backups</i> : Inserted warning that incremental backups are broken in 2.1. <i>Suppressing database triggers (Firebird 2.1+)</i> : New section. <i>Read on?</i> : Fixed typo (you -> your).

## Appendix B: License notice

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