

**The Essential**  
**Guide**  
**to Data Recovery**

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## YOUR DATA IS IMPORTANT



Data. It's everything and it's completely vital. Your pictures, music, videos, tax records and critical business information are all stored in digital files on your hard drive.

**Did you know that statistically you have a higher rate of data loss than being involved in a car accident?**

Most people are unaware of the effect of data loss until it's too late. Personal users may lose countless valuable files and hours of work.

So far as business users, the costs can be much higher. Data loss can cause companies to lose hours of irreplaceable work as well as money and productivity while computers are inaccessible. If the problem is dealt with effectively and the necessary precautions are carried out to backup the systems then normality can be resumed quickly.

**Did you know? ...**

- It is estimated that only 3% of the worlds information is backed up
- 70% of companies that experience data loss fold within 2 years\*
- 93% of companies that lost their data for 10 days or more due to a disaster filed for bankruptcy within one year of the disaster
- 50% of businesses that found themselves without data for this same time period filed for bankruptcy within one year of the disaster
- 34% of companies fail to test their tape backups, and of those that do, 77% have found tape back-up failures

\*Department of Trade and Industry 2003



The consequences of losing data is often catastrophic:

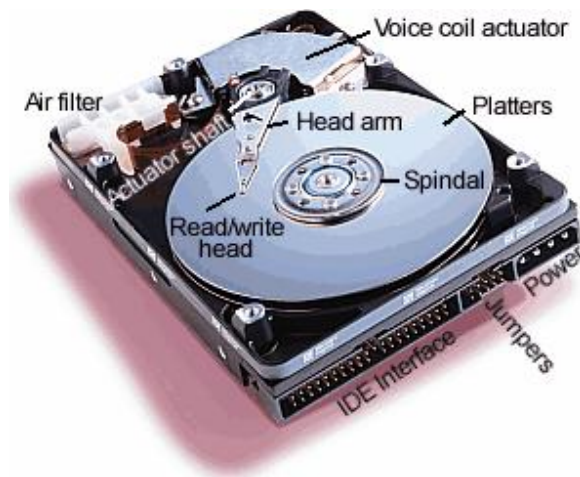
- 60% of companies that lose their data will shut down within 6 months of the disaster
- American business lost more than \$7.6 billion as a result of viruses during the first six months of 1999
- It is estimated that 15% of laptops suffer drive failure annually
- Approximately 32% of the worlds data loss is user error
- 60% of all PC's in the world will suffer a data loss annually

\*Computer Economics 2001

## 1. How a Hard Drive Works

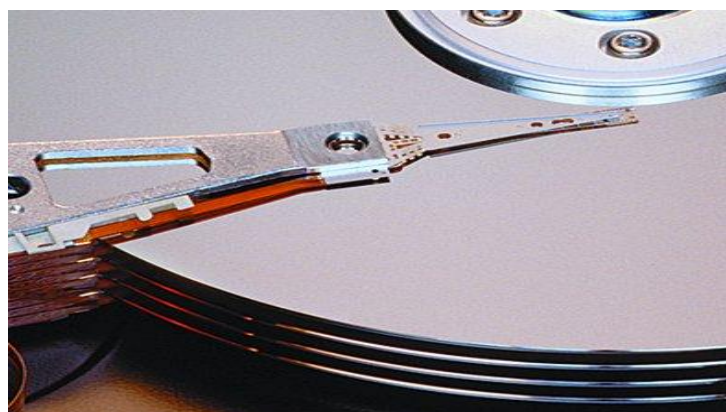
Hard drives are mechanical devices that contain moving parts. There are certain things you can do to prevent an extreme disaster, but every drive manufactured (yes, even your drive), is going to stop working one day.

A hard drive has several mechanisms that make the technology of reading and the transfer of data from the platters possible. See diagram below:



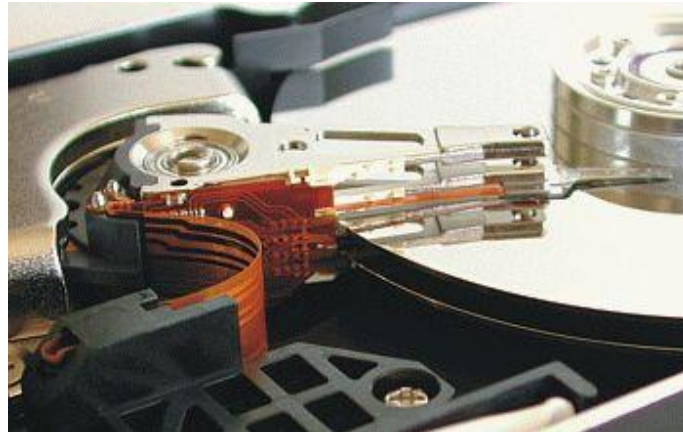
## 2. Platters

The hard drive can have one to several disks made of glass or aluminium coated with magnetic iron oxide particles. The disk(s) spins continuously and the head can travel in and out along a radius so that the head can reach any location very quickly. A typical hard drive contains several of these 3.5-inch platters, which can contain tens of billions of individual bits. The higher the density of the hard disk's platters, the more bits that can be packed into each square inch of platter real estate. A platter is segregated into tens of thousands of concentric tracks. Because a lot of information can be stored in one track, the tracks are broken down into smaller units called sectors. Each sector can hold about 512 bytes of data, or 4096 bits. Disk platters are mounted in a stacked formation on a spindle. A spindle motor turns the platters at very high speed, typically between 5,400 and 7,200 rotations per minute, but as fast as 15,000 rotations per minute (RPMs). The platters spin so that the appropriate sector or sectors containing the data can be positioned underneath one of the drive's reading heads. There's one head per platter, and all the heads move in unison.



### 3. Heads

Each head in the hard drive is mounted onto a slider, which is mounted onto an arm. A mechanical device called an actuator controls each hard drive arm. The actuator moves the arm to the correct position on the spinning platter, which puts the head in the correct position. The reading head (reading and writing heads are separate) floats about  $2/1,000,000$  of an inch above the disk surface. As it passes over the appropriate disk sectors, it interprets the magnetic pulses and converts them to electrical pulses that can be interpreted as 1s and 0s.



Although the head may look large, actually the sensitive part of the head is defined by micro lithographic methods so that the actual exposed portion of the head, which can either read or write the information on the disk, is very small comparable to the dimensions of features on a microchip! As the manufacturing technology has improved over the years they have been able to shrink this area down to smaller and smaller sizes, and that is how the hard disk memories have risen to such large figures now. In addition they have increased the density of magnetic particles on the disk, which makes the storage capacity larger. For example in 1991 the density of storage memory was about 0.13 Gbits/square inch. In 1998 it was up to around 4 Gbits (30X the density!). At the same time the lithography limit of the sensitive head area was about 4.5  $\mu$ Meters in 1991, and in 1998 was down to 0.5  $\mu$ Meters, reduced by a factor of 9. This is how the storage density of the disks is now up to 200 GB or higher.



The information is stored in circular patterns on the disk and the computer measures the location of the rings and the spatial resolution is very high, so the location of the head to find data on the disk is extremely precise.

#### 4. Causes of Data Loss

Despite technological advances in the reliability of magnetic storage, the incidence of data loss continues to rise as data storage devices are susceptible to damage from natural and human sources.



#### Consider these facts:

1. **Larger quantities of data are being stored in smaller spaces** – Today's hard drives store 500 times the data which was stored on the drives of a decade ago. Increasing storage capacities amplify the impact of data loss, making mechanical precision more critical. A slight nudge, a power surge, or a contaminant introduced into the drive may cause the head to touch the platter which can result in a head crash
2. **Data has become even more essential** – Users today store more data on their desktops and networks that is essential to their organisations and to their personal lives. Loss of essential data, by definition, can cause major business processes to stop
3. **Backup technology and practices have failed to adequately protect data** – Many users back up their data only to find their backups useless at that crucial moment when they need to restore from them. They fail because the systems are designed with a set of requirements that rely on a combination of technology and human intervention for success. Tapes, tape drives and cartridges do not always work properly, due to their dependence on mechanical perfection. Backup software can become corrupted. Users accidentally back up corrupted or incorrect information



Data loss happens for a number of reasons. It has become a major problem over the last few years as more and more digital information is being stored on media that fails. It's estimated that only 3% of the worlds information is backed up. More often than not, backups are not performed correctly – consequently leaving you with either no data or the wrong data.

**Remember that at some point everyone who works on a computer will experience data loss. It's not a question of “if” data will be lost but “when” data will be lost.**



Everyone needs a good back-up plan in place to protect them from data-loss emergencies



## 5. What are the Main Causes of Data Loss?

Factors that can cause data loss include the following:

- Hardware or system failure
- Software configuration or malfunction
- Human error
- A Computer virus
- Fire, flooding, earthquake (natural disasters)



## 6. What are Some Common Symptoms of a Data Loss Situation?

- Previously accessible data disappears
- Unusual sounds: rattling or scraping noises coming from the unit where the hard drive is located
- Non-spinning hard drive
- Non-functioning computer or hard drive i.e. it won't boot up
- Error messages that state the device is not recognised



- Re-formation of partitions
- Empty folders
- Data which is corrupt
- Drives that are inaccessible
- Power surges
- Virus attack
- Hard drive seen in the BIOS but not recognised in Windows
- Water or fire damage to the hard drive or media
- Malicious data loss/attack by employee
- Operating system upgrades
- Media/hard drive contamination



## 7. Hardware or System Failure

The potential risk of hardware failure is one of the commonest talked-about reasons to perform backups. An un-recoverable hard disk failure will make you realise just how important backups actually are. As the hard disk stores your main data and programs it is absolutely vital to back up your data.

### Symptoms include:

- 'Error' message stating that the device is not recognised
- Data that was once accessible is suddenly gone
- Scraping or rattling sound
- The hard drive is not spinning
- Computer not functioning properly

### Examples include:

- Electrical failure
- Head/media crash
- Controller failure

There are other hardware problems that can cause permanent data loss and these are difficult to pinpoint, as they don't seem like they should be responsible for the problem.

- **Memory errors** – many systems today are running without error detection or correction on their system memory, the chance of a memory error corrupting the data on the hard disk is high. Although rare, this does happen
- **Timing problems** – setting the timing for memory or cache access too aggressively, or using a hard disk interface transfer mode that is too fast for the system or device, can be a cause of data loss. This is more often than not realised too late, until after the damage has been done
- **Resource conflicts** – conflicts that result from peripherals trying to use the same interrupt requests, DMA channels or I/O addresses can be a cause of corrupt data
- **Loss of power** – losing power at the wrong time, such as when you are doing sensitive work on your hard disk, may result in the loss of countless files

Occasionally, manufacturing defects or design flaws can cause mechanical or electronic failures. Many physical problems can be traced to other root causes.

Mechanical failures can be due to device being exposed to extreme cold temperatures and/or rapid temperature change prior to use; for example powering up a notebook after being in a freezing cold car overnight and shock at being dropped, bumped or moved while operating.



**Factors that can cause a hard drive to fail:**

- Drives that get too hot may refuse to spin up because drives get 'glued' to the media by the high heat
- Mishandling (dropped or banged around)
- Electronics failures can be sudden without warning and a common time for electronics to fail is Monday morning after the drive has been powered off all weekend
- Electronics can be zapped by handling a drive when you are not properly grounded
- Heat, dust, humidity
- Operating Equipment
- Lower quality, bigger capacity drives

If you're using an NTFS file system (Windows NT, 2000 & XP), do not compress your hard drive. Compressed hard drives are more likely to become corrupted than those have not been compressed and can make data recovery more difficult and expensive.

## 8. Head Crashes

Hard drives are finely tuned, precision, electromechanical devices. A series of platters with magnetic coatings spin at a rate of between four and ten thousand revolutions per minute. Surrounding each platter is a pair of heads connected to an armature. The heads whiz in and out at speeds of over 60 miles an hour and read to and write from the platters.



Space is extremely tight. The heads operate at a distance of less than the width of a human hair off the surface of the platters. When the drive spins down or is turned off, the heads park in a special landing area. They do not touch the data surface of the moving platters, unless there is a head crash. If this is the case then this can be a bad scene. Marks are made on the surface of the platter, and debris starts flying, which can cause more damage. Head crashes can occur without warning and put your data at grave risk.

When it does occur, it's almost always too late. Important data such as the family photographs and important files are gone.

In many cases, the head crash comes silently, but when the problem is recognised, there's little time left, the damage will get bigger and bigger. The disk is rendered unusable within a short period of time.

You can temporarily stop the expansion of the error if you turn off the computer's power. Panic reaction (a quick backup, starting some diagnostic or repair software is not recommended).

Ask yourself: what kind of files are stored on the hard disk drive? How important are they? Make a list containing the name of files and folders and sort the list by priority. First the important files then the less important files and so on and so forth. The list can prove to be very helpful, if you are trying to recover the data by hand. You will know the names of the files you have to backup. Remember that time is of the essence. If you go to a professional data recovery company, the list you make is also helpful to them.

## 9. Software Configuration or Malfunction

Symptoms include:

- System messages relating to memory errors
- Accidentally emptied “recycle bin” or disappearing files
- An application won’t load
- ‘Error’ message stating data is corrupt or inaccessible



Examples of ‘Error’ messages include:

- Corruption caused by diagnostic or repair tools
- Failed backups
- Configuration complexity

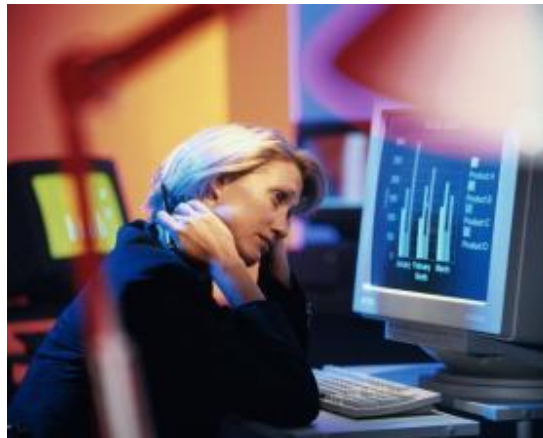
If one of the above examples occurred, then there is a chance you can initiate a hard drive recovery and get back all of your data.

## 10. Causes of Loss in Databases:

The individual media in database servers suffer from the same failure points as do drives in personal computers.

A Database environment is fragile unless supported by comprehensive and well-tested backups. It is common for devices to become corrupt beyond the scope of routine recovery methods. Failures do occur, even in the most well configured system, such as the following:

- Backup files not recognizable by the database engine
- Database locked as 'suspect' preventing access
- Deleted or dropped tables
- Accidentally deleted records
- Corrupted database files
- Damaged individual data pages
- Accidentally overwritten database files and devices



## 11. Floppy Disks

Do make sure that you keep floppy disks away from sources of magnetism. One commonly overlooked source of magnetism is mobile phones. One single electromagnetic pulse is enough to wipe a floppy with the data completely lost resulting in a floppy that is unusable.



Some typical floppy error messages include the following:

- Database format unrecognised
- The database engine cannot open the file
- Enter database password (when none was set)
- A:\ is not accessible
- Cannot read sector
- Invalid media

When you receive error messages trying to read a floppy, these are all indicative of a corrupt floppy disk.

Other sources of magnetism include metal detector scanners in airports, so make sure that if you need to take a floppy disk through an airport, to place it in the tray before you go through the scanner.

A source of physical damage is dust or debris entering the metal sleeve that protects the disks surface so make sure that you are careful not to pull the sleeve back.



## 12. Floods, Fire and Earthquake (Natural Disasters)

While floods, fires and hurricanes have visible symptoms, lightning strikes and brownouts often leave no other clue than that you will not be able to access data that was not previously there.



With physical damage, you may find that your drive is 'not found' when you attempt to reboot your computer. This can be accompanied by inactivity (no flickering) by your computer's drive light.

Whilst this may be a faulty boot or partition record, in the majority of cases it pinpoints physical damage. It is recommended to contact a hard drive recovery specialist in these circumstances.

Some physical damage is far more obvious. When your drive has been exposed to flood, earthquake or natural disaster, the recovery of your data will almost always require emergency data recovery.

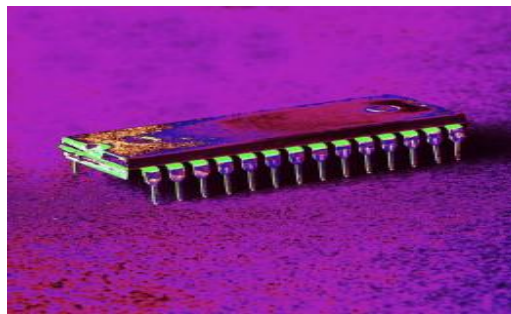
Catastrophic damage often the reason that tape is used as an offsite backup media, but sometimes tapes can be within a disaster area or be affected by flood, fire or earthquake.

### 13. Computer Virus



Symptoms include blank screen, along with strange and unpredictable behaviour, Error message stating, "File not found". Message announcing virus appears on screen.

Some examples of viruses include boot sector viruses; file infecting viruses and polymorphic viruses.



When a virus infects your computer, it may have the following effects on your computer:

- The virus may reformat your disk drive, deleting your files and programs
- The infected file can make copies of itself. This may use all the free space on your hard disk
- The virus can install hidden programs along with software. This software might then be distributed and sold from your computer
- A computer virus reduces security. So intruders can remotely access your computer or network

These symptoms are caused by or associated with a virus:

- A double extension on an attachment that you recently opened
- An email message with a strange attachment. On opening the attachment, dialogue boxes appear or system performance decreases
- An anti-virus program is disabled for no reason and it cannot be restarted
- An anti-virus program cannot be installed or it will not run
- A program disappears from the computer but you did not remove it
- New icons appear on the desktop that you did not put there or are not associated with any recently installed programs

## 14. Data Recovery

### How is Data Recovery Defined?

Data recovery is a term that relates to the extraction of the data that is stored on damaged or inaccessible media such as tapes and magnetic disks. Not all data is actually recoverable but data recovery specialists are often able to restore a large percentage of the data on damaged media. The demand for data recovery is increasing day by day and there are numerous devices and procedures to help the data recovery process. In recent years data recovery has become a vital industry as computers become more and more a part of our everyday lives.

Clientele for data recovery tends to range from individuals to large businesses. Data may become corrupt due to mechanical, electrical or viral malfunction or even deliberate act by a malicious user. The data will still be on the drive but it is unreadable by your operating system, or dependent on whether or not a more serious malfunction has occurred there may be a physical problem with the drive reading the data it has written. Data is retrievable in around 90% of data loss situations.

Data recovery cases are commonly divided up into two main categories, which we have explained below:

**Physical Data Recovery** – This is necessary when there is a physical problem with the media or plastics, which prevents the data from being read in a normal manner. This type of recovery deals with issues such as cracked or broken reels/cartridge shells, twisted tape, deteriorating magnetic coatings etc. This type of recovery can also include capturing the data from the media that has been subject to adverse conditions such as debris, water or soil. The recovery range of these types is usually high.

**Logical Data Recovery** – Logical data recovery usually the most difficult type of data recovery. The recovery of files includes recovering the data portion of a tape that was successfully recorded but which cannot be read. Other types of logical data recovery include tapes, which were written with misaligned heads as well as tapes that contain critical data and have been re-initialised by accident. All of these problems are recoverable, or at least partially recovered using different types of processes and software.



## 15. Hard Disk Recovery by Specialists

Once you get your hard disk to a recovery specialist, they will look at your drive and evaluate whether your data can be recovered as well as giving you an idea of what they think went wrong with your drive or computer. If your data can be recovered, they will give you an estimate of the time required to recover the data. The hassle of not having your computer for a few days will be outweighed by the fact that data recovery specialists can save your important files.

Bear in mind that when your computer malfunctions and you can't see your files, it doesn't mean that they have disappeared altogether. They are still on your computer, but your computer may be having trouble accessing them or experiencing trouble providing you with a means to access them. Before you think about giving up hope, take your hard disk to a recovery service where they can tell you what went wrong and whether or not you can get your files back.



## 16. How Big is the Problem?

Try searching for data recovery on Google. There are over 3 million sites and pages devoted to data recovery.

- It is estimated that 15% of laptops suffer drive failure annually
- Around 32% of data loss is user error
- 60% of all PC's in the world suffer a data loss annually

Data loss is not a minor; it's a major epidemic affecting millions of users every year.



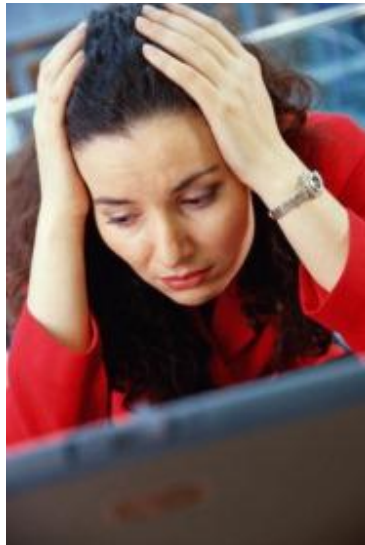
If you lost your data right now, do you think you would be able to continue without it? How would it affect you? Do you think it would be simple for you to effectively recreate it?



## 17. Data Recovery Tips

When confronted with a data loss situation, you take the risk of aggravating the damage in trying to repair or pinpoint the error yourself. Always remember to stay calm and don't panic. Data loss is very common but in nearly all cases can be recovered by a trained technician. If you do suspect that your data has been lost, we recommend taking the following action:

- Try not to panic and remain calm
- Turn off the power supply
- Do not restart the machine
- Don't reinstall any software
- Before you forget the symptoms of the failure, write them all down
- Do not try to assess the situation until you have sought professional advice
- Never use software recovery utilities to repair data in a hardware failure situation. These kinds of utilities assume that the hardware is functioning and may end up causing further damage, as well as complicating the data recovery process
- Do not write to any of the files on the device or add additional files
- Do not try to open the device, to see what's wrong – hard drives are particularly sensitive to contamination and should only be opened in a clean room environment
- Data recovery is specialised and further activity on the disk can add complexity to the process
- If possible, have the hard drive or media removed from your PC or laptop by a competent IT professional. Ensure that your media is sent via a recorded source to minimize the risk of it getting lost during delivery
- Whilst data recovery is often seen as expensive as it is labour intensive, recreating your data may prove to be as equally expensive. Also bear in mind that the turnaround time it would take to recreate your lost files is usually much faster than the time it would take to recreate your lost files from scratch



## 18. Simple Rules of Data Recovery

### a.) Always remain calm and level-headed

In a data loss situation, you need to stay calm and review and evaluate your situation. It's always natural to panic in these situations but it's best to keep a cool head. You need to write down on paper a summary of the situation with the symptoms and characteristics.

### How do I go about determining whether or not I need data recovery services?

If you believe you have a data loss situation, always make sure that you check for the following:

- Is the power connected?
- Check the configuration
- Test the unit on another computer
- Check through this guide for useful advice



### b.) Don't attempt to restart the machine

Attempting reboots and restarting the machine, which has a damaged disk, can often compound the data loss. If the headstack within your drive has been damaged, you may cause further additional damage to the platter/s of the drive, upon which your data is stored.

### c.) Back it up regularly

It is always essential to backup your systems. Each year, hundreds of businesses lose their entire data i.e. records; accounts and important customer files are lost. By backing up your data in an regular and effective manner you can ensure that you don't lose valuable work. It makes sense to increase you odds of being able to retrieve a file by having a second back up of it. Never take the attitude that it won't happen to you. It's more a matter of when it will happen to you.

#### **d.) Don't open the disk**

Hard disks are complicated pieces of equipment and under no circumstances should you ever attempt to open one. Opening a disk should only ever be done in a clean air environment such as a clean room and by qualified persons.

#### **d.) Deleted partitions**

If a partition has been deleted, do not attempt to restore it by formatting the drive as this will only result in the addition of an empty partition. This will not recover your data.



#### **d.) Setting up an alternate system**

Under no circumstances attempt to restore a backup into the original data, as there is a high chance that you might over-write some of the lost data. In these circumstances a recovery might be out of the question.

Configure another computer/server to temporarily replace the problem unit. Make sure that you restore whatever backups are available onto this unit and reconfigure it as is necessary to begin the productive work.

#### **e.) Physical maintenance**

Always make sure that you keep your computer systems in good environmental conditions. Install the correct devices to protect against power surges. Regularly clean the dust from the inside of your system and clean tape and optical drives using specialist cleaning discs and tapes. Be careful of electrostatic discharges.

#### **“I really need my data back. Is there anything I can try myself?”**

Take some sound advice based on hard experience. A failing hard disk can deteriorate very rapidly and whilst there are a few things you can try, it is possible that you can actually make things far worse by repeatedly trying to access the drive. It's the equivalent of using a stomach pump repeatedly on a patient that may have only a minor cough. The patient won't be pleased and you could actually have a fatality on your hands leaving you with severe feelings of loss and guilt that may require months of counselling. Your data could be lost forever.





If you are unable to transfer data by running it as a secondary drive, do not run it any longer than you have to. If it is crucial data just unplug the drive and get it to a data recovery expert as soon as you can - you stand a far better chance of recovering lost files that way.

**Before you send off your hard drive for data recovery:**

- Power down your equipment; any attempt to resolve the situation will invariably compound the situation and can make it that much more difficult to recover data.
- Should you hear any abnormal noises emanating from the drive bay area, this should be treated with extreme care, what you could be hearing is the heads hitting the platter surface and scattering or fragmenting your data throughout the hard drive. It is essential that you do not attempt to power up again, but contact a data recovery specialist immediately.
- Don't use homemade tools – reinstalling any operating system could mean re-writing over your hard drive and could make the situation of your damaged data much worse
- Never attempt to open the Hard Disk. A Storage medium should only be opened using advanced technology, approved by the storage manufacturer, and used by qualified engineers.

If you are going to use software for data disk recovery, make sure that it is completely valid for your problem, as software is not always effective in the majority of cases. Use of such software has its place in fairly simple cases, but in certain circumstances can result in further damage to your drive.

It is important that when you have lost data, you do not do anything rash. Your actions (including re-booting several times, using unapproved “utility software” or saving new files to your drive) greatly affect your data's recover-ability. Be assured that there are data recovery professionals who are well qualified to recover your data.

Always ensure that you are dealing with a professional emergency data recovery company.

## **“The Essential Guide to Data Recovery”**

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**For data recovery advice call:**

**0800 083 7891**