

## PRINCIPLES OF GOOD FIRING

To obtain the maximum amount of heat for the production of steam, the best method of firing is to limit the amount of coal put into the firebox at one time, and to fire again only when the last charge of coal has burned away.

Although steam locomotives appear to work harder up rising gradients they also travel more slowly, and use little (if any) more steam in a given period of time, than when working more easily but travelling faster on easy gradients. This means that because the demand for steam remains fairly constant all the time the regulator is open, there is no need to increase the rate of firing to any great extent when climbing up rising gradients.

Fire sparingly - work systematically. This is the essence of good firing and has been proved conclusively not only by tests, but by analysing the way the best firemen work in practice on the road. No hard and fast rules can be laid down, because locomotives vary as much as the work they perform and the men who man them. However for the larger locomotives, the best results are found in practice to be achieved by not exceeding twelve shovelfuls at one time, and by firing no more often than is necessary for good combustion. Smaller locomotives need proportionately less at a time, but the actual rate of firing will be found by simple observation, for when too many shovels of coal are being persistently thrown into the firebox, black smoke will result, and the thickness of the firebed will increase excessively.

For all classes of locomotives the most common mistake is over-firing. Whether by large amounts of haphazardly fired, or by small amounts fired too often. Not only is valuable coal wasted as a result, but the job is also made harder it need be, because combustion is less efficient.

### The preparation of the fire

The fire should be made up in stages and immediately prior to leaving the depot, should be well burned through and showing good combustion; the firebars free from clinker and the primary air passing through quite freely from the ashpan. A careful examination of the fire should be made when backing on to the train; if there are any holes or hollow places these should be filled up. The condition of the fire prior to the start of a journey plays a very important part in the subsequent performance of the locomotive using any system of firing. The water level in the boiler should be checked to ensure that the height shows about three quarters of the glass; this will allow for additional water to be put into the boiler should the steam pressure rise so that the safety valves operate. An effort should be made by the fireman to prevent steam escaping needlessly from the safety valves as that is waste - waste of coal, water and power. He should keep his fire under observance to ensure that the boiler pressure is kept as high as possible without steam escaping from the safety valves and that there is no dense smoke emitted.

### Starting away with the train

On no account should the locomotive be fired when starting away. When the right away signal is given, the Fireman should close the firedoor proportionately. At the commencement of a journey the temperature of the firebed and brick arch are much lower than they will be at any other stage of the journey, and the object in not firing the locomotive at this time is to raise the temperature as

quickly as possible and this is done by partly closing the firedoor, thus making the greater part of the air flow through the firebed. It has to be remembered that the amount of volatiles being given off by the fire at this stage is small on account of the low temperature and it is not necessary to allow a large amount of air through the firedoor. It must be strongly impressed upon trainees that the practice of firing when starting away is a bad one, as to do so means that an open firedoor allows a large amount of secondary air to enter the fire and further reduces the already low temperature. Further, the addition of coal at this stage merely cools the fire.

After the train has started it is a good practice for the Fireman to watch the movements of his Driver and when he has notched up the gear, that is, drawn the locomotive up in expansion, it is time to fire. It has to be remembered that during this period the temperature in the firebox will have increased and the fire will almost be incandescent and this is the ideal state for Firing. The Fireman should now fire where the fire is thinnest and if the fire is being pulled into holes, these should be filled up smartly and if there are patches which are not burning properly these should be missed to allow them to burn.

He should place the coals into the firebox in that an even firebed is maintained and usually the method of firing up the sides and behind the door is a good one. He should watch the chimney and if the fire is in good order there will be in about 5 seconds after firing a light grey smoke at the chimney top which should disappear in about two minutes. When the smoke disappears it is a sign that the volatiles have been consumed and it is time to fire again. Should heavy black smoke appear at the chimney it means that incomplete combustion of the fire is taking place and the Fireman should regulate the secondary air through the firedoor.

### Firing on the journey

There is a strong belief among some Firemen that when a locomotive is climbing or about to climb a heavy gradient, it is necessary that a greater rate of firing is needed, in fact, in many cases Firemen begin to fire heavily prior to ascending the incline. The result is that a heavy black fire is on the firebed, the temperature and pressure falls and when this happens the Fireman, getting anxious, adds more coal in excessive quantities and the steam pressure falls.

Locomotives burn more coal per mile when climbing gradients than when running on the level, but since they ascend the gradient at a slower speed than that at which they travel on the level, they have more time in which to burn it. It is a mistake, therefore, to think that much more coal is required in a given space of time when travelling up rising gradients, therefore there is no need to increase the rate of any great extent. The more constant the rate of firing over the whole run the more efficient the firing, and the less the coal consumption.

It may be necessary to say a few words about the steam consumption rate. It is difficult to give a direct figure for the rate actually used, unless the locomotive is suitably equipped with a steam meter. It is, however, possible to make a calculation of steam consumption by the method of speed and the percentage cut-off. The product Speed x Cutoff is proportionate to the amount of steam used per minute. This, of course, is not strictly correct as a portion of the steam is used for other purposes, such as steam heating, injectors, brakes, etc. The following shows the steam consumption rates for various speeds and cut-offs.

<u>Speed</u>	<u>% Cut off</u>	<u>Steam Used Units</u>
80 M.P.H.	15	1,200
70 M.P.H.	17	1,190
60 M.P.H.	20	1,200
50 M.P.H.	24	1,200
40 M.P.H.	30	1,200
30 M.P.H.	40	1,200
20 M.P.H.	60	1,200
12 M.P.H.	Max.	1,200

These figures show, apart from periods when the steam is shut off, that steam consumption rates do not vary considerably, and definitely do not increase on the Up gradient. This is not the opinion held by certain Firemen who hold that an increased amount of steam is used on heavy rising gradients and, owing to this, heavy firing must take place. On tests made this has been disproved and on some of the graphs produced a decreased steam consumption was shown when ascending heavy inclines. The explanation of this is that the increase in percentage cut-off employed on a heavy rising gradient is more than compensated for by the drop in speed.

No hard and fast rules can be laid down about the exact amount of coal to be fired, and how often to fire it, because engines vary as much as the work they perform and the men who man them. However, for the larger locomotives the best results are found in practice to be achieved by not exceeding an average of twelve shovelfuls at a time, and by firing no more often than is necessary for good combustion. Smaller locomotives need proportionately less at a time.

The fire irons should only be used when absolutely necessary. If the fire should be caked, the fire-irons should be used to break it up. If there is a good depth of fire and the ash and clinker are lifted up and mixed with the red hot fuel then the ash will melt and run into the spaces between the firebars and so make things worse. If the fire does clinker, it will be necessary to break it up and this can be best done by running down the fire, as it will be easier to deal with.