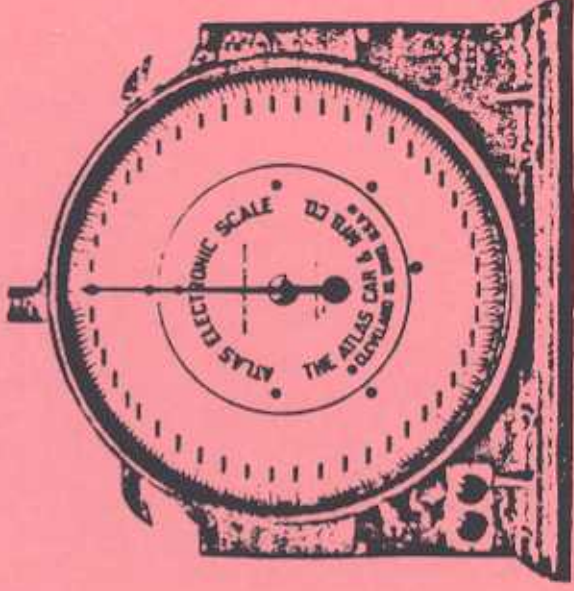
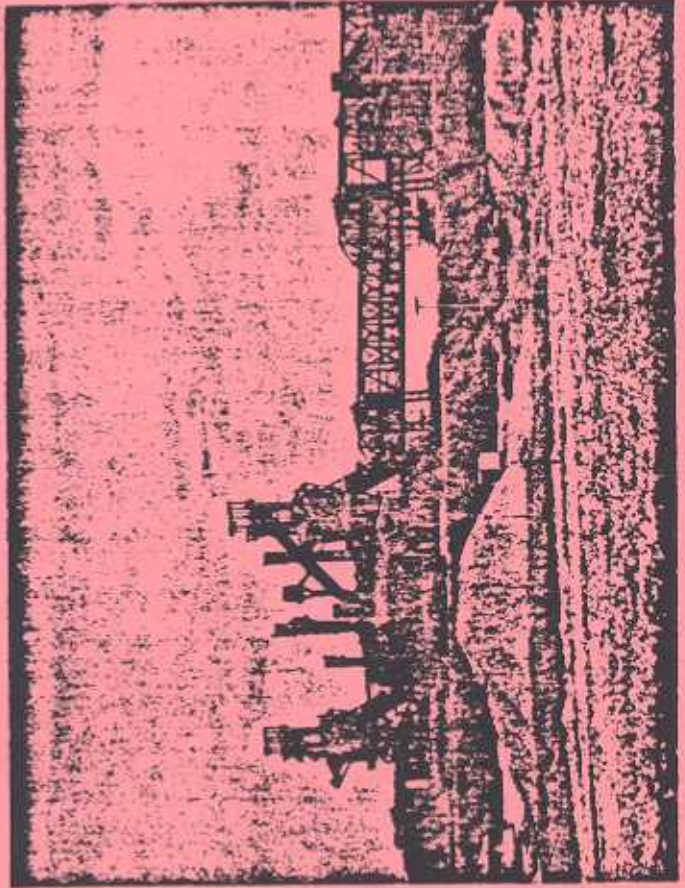




Blast Furnace Department

# STOCKHOUSE MANUAL



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## 1. SAFETY

1. While working in the stockhouse, be on alert for the moving larry cars, bobcat, dozer, etc.
2. Wear all safety apparel, including hard hat and glasses, even while running a larry car.
3. Guard against close clearances and pinch points.
4. Make sure the siren, brakes, deadman switch, etc. are in working order.
5. Make sure the skip power is turned off while people are working in the skip pit.
6. If you hear the skip cables slapping against the skip incline, something is wrong. Call your foreman right away.

EMERGENCY - 212

## 2. INTRODUCTION

This manual is intended for all larry men and helpers to inform them of the proper charging practices in the stockhouse. A good blast furnace operation requires charging raw materials in correct sequence and in proper quantities while maintaining a constant stockline. Charging the materials in the specified sequence produces layers of ore, stone and coke in the furnace. As the gases travel upwards through these layers, they reduce the iron oxide of pellets into iron.

Contrary to the general belief, the casthouse people do not make any off grade iron; they simply cast it into bottles. The off grade iron is a result of either bad materials or bad charging practices. If you put too many pellets, the furnace will go cold every time. If you don't put enough pellets, the furnace will go hot every time. If the coke scales are not weighing correctly, similar furnace disturbances will occur. When a furnace goes cold, there is not too much anyone can do except add extra coke and heat. It takes twelve hours for the coke to reach the bottom and do any good.

Catching the proper weight of each material is one of the most important functions of the larry man and helper. The cliché, "better too much than not enough" does not apply to the blast furnace charging. You should take care in shutting the bin doors at the precise time so that the scale pointer will end up right over the marker. In case of an overload, even by a thousand pounds, it must be deducted from the next load of the same material, and vice versa. Unless this is done, the furnace will show erratic iron chemistries.

Before starting to fill the larry car with material, properly position it under the bin and make sure it has come to a complete stop. Do not move the car again until the bin door has been shut

off. In other words, do not move the car while filling. If for some reason the bin door cannot be closed, do not panic. Get some help and try to close it by beating with a hammer, using a come-along, etc.

The blast furnace is an extremely efficient piece of equipment used for converting raw materials into molten metal. Its operation depends to a great extent upon proper charging by the people working in the stockhouse.

## 3. BASIC RAW MATERIALS

a. Pellets: Pellets are iron ore (iron oxide) occurring in the mines. The ores are upgraded and balled into pellets and shipped to us in boats. Some of the pellets break up into fines during the handling in boats, high-line, etc. These fines are not good for the furnace because they cause the void space in the pellets to be plugged, and in the furnace the gases cannot get around the pellets to properly reduce them.

b. Coke: Coke has a three fold purpose in the blast furnace. It supplies (a) void spaces in the furnace stack through the burden, (b) heat at the bottom of the furnace by burning with the wind, (c) reducing gases to reduce the iron oxide into iron. Unfortunately, the coke has some sulfur in it which is bad for the iron. To keep this sulfur from going into iron, we make a basic slag in the furnace.

Some of the coke gets crushed into fines during handling. The reload coke contains more fines due to additional handling. These fines can plug the void spaces in the burden. Therefore, the coke is screened in the stockhouse. Sometimes when the screens break down, they are bypassed, but long periods of bypass charging will upset the furnace.

c. Dolomite or Limestone: These are flux materials to make a basic slag in the furnace so that the sulfur is removed from the iron.

d. O.P. Slag: This is a flux material and also a source of iron and manganese. Being a waste material of O.P., it is of low cost. If you run out of O.P. Slag, your foreman can replace it with a proper amount of dolomite.

e. Scrap: Scrap is rich in iron and charging scrap increases the tonnage.

f. Other Materials: Coal, Gravel, Manganese Ore, and Olivine are sometimes charged in small quantities for special purposes. Coal is charged with or in place of coke. Gravel, Olivine, etc. are sometimes used as cleaners.

Watch for contamination: If you find pellets in bins mixed with dolomite, etc., that means someone on the highline goofed and dumped the materials in the wrong bins. This can cause the furnace to go cold. Notify your foreman immediately.

To make one ton of iron, it takes:

- 1 1/2 tons of pellets,
- 3/5 ton of coke, and
- 1/5 ton of flux.

#### 4. SCALES

The coke and larry car scales are essential in charging an exact blend of raw materials. The coke charging is automatic, but the scale weight may fluctuate from 7500 lbs. from time to time. You must observe it and regulate it with the preset knob in front of the scale. Also, the scale should read zero when the coke is dumped off. There is a zero knob in front of the scale for adjustment.

The larry car scale has pointers on the scale face for different materials. Make sure you know which pointer for what material. Also, check the zero and if it is off, have your foreman adjust it. The larry

car has four load cells in four corners and four stay bars connecting them. The load cells and stay bars should be kept free from any build ups and binds. Otherwise, inaccurate weights will be indicated on the scale face.

#### 5. SPILLAGE

Every larry man and helper must try to avoid spillage of materials. The spillage costs painful manhours and expensive downtime. After drawing a material into the larry car, make sure the bin door is closed good before moving the car. If for some reason the door cannot be closed due to a chunk in the way or a broken handle, etc., the material will fill up the larry car and stop. Do not move the car. If you move the car, the whole bin would empty itself on the floor. The door should be closed by removing the chunk or by using a come-a-long, etc. The loads on the larry car should then be split into skips to avoid spillage in the pit.

It is also important to watch the skip pits often for spillage. Make sure the area where the skip wheels come down is clear of material. This is where the skips go off the track. If you get a coke overload (that is over 8000 lbs.), split it into two skips, and adjust the preset.

#### 6. CONTROL PANELS

A) Larry Car Master Panel: Every larry man and helper should be familiar with the function and use of the following controls and lights.

1. Send up skip button - push to send up skip.
2. Charge light: On means the furnace will take charge.
3. Stop filling light: On means foreman says stop filling.
4. Auto coke on/off selector.
5. Extra coke push button.
6. Skip power run/stop selector.
7. Start skip push button.
8. Extra load push button.

## 8. A CHARGE

A charge is made up of two rounds, "A" and "B". Each round has 8 skips, so that a charge has 16 skips. As each skip of material leaves the skip pit, it is hoisted and dumped into the receiving hopper at the top. Then, as the empty skip travels down, the small bell opens to dump the material into the bell hopper, the bell hopper thus accumulates up to eight skips of materials. Then the large bell opens to dump the materials into the furnace.

Normally a round is designated as follows:

A- Round: 0 0 0 0 C C C C /

B- Round: 0 0 D S C C C C /

Each letter represents one skip of material. The letters O, D, S, C indicate the materials are ore (pellets), dolomite, slag, coke respectively. The line / indicates a large bell dump. After the A- Round has been charged, the first ore of B- Round has to be sent up before the large bell can dump. The two bells are interlocked as such so that only one of them can dump at a time to maintain a seal on the gas system. In addition, before the large bell opens, the bell hopper is pressurized and the small bell has a load over it. Before the small bell opens, the bell hopper has to be depressurized. This is done by equalizer and relief valves.

## LOADS ON THE LARGE BELL

ORE	0	ORE	0
ORE	0	DOLO	0
ORE	0	SLAG	0
COKE	0	COKE	0
COKE	0	COKE	0
COKE	0	COKE	0
COKE	0	COKE	0
*ORE	0	*ORE	0
*		*	
A ROUND		B ROUND	

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9. Charge reset push button.
10. Cancel coke switch.
11. Bell slack cable light.
12. Bell slack cable push button.
13. Stock water push button.
14. Stock water light.
15. Stock water volume selector.
16. Small bell open light.
17. Small bell close light.
18. Large bell open light.
19. Large bell close light.
20. Rt. coke fce/emerg. selector switch.
21. Rt. coke run/stop selector switch.
22. Left coke fce/emerg. selector switch.
23. Left coke run/stop selector switch.

## B) Bell Control Panel:

### PROCEDURE TO DUMP THE LARGE BELL MANUALLY

On the manual master panel:

1. Turn the selector switch to large bell (LB).
2. Turn the large bell switch to open.
3. Turn the bell transfer switch to manual. Now the tests rods will come out and the large bell will open. Notice the large bell open light come on.
4. Turn the bell transfer switch to automatic.
5. Turn the large bell switch to close.
6. Turn the selector switch to off.

## 7. INTERLOCKS

The larry car interlocks are designed to prevent any accidental discharge of larry car material into skip pit when there is no skip there. Every operator should check these interlocks at the start of the turn with an empty larry car.

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\*This last skip stays on the small bell as the large bell is dumped off.

By looking at the round and load lamps, the operator can keep track of what material will go up next.

## 9. TERMINOLOGY

Every larry car operator should be familiar with the following terminology:

- a. Reverse Charge: Coke is charged first on the large bell instead of ore. It has to be set up in the hoist house by your foreman.
- b. Split Charge: Charging coke only on one side. Make sure the automatic coke is shut off.
- c. Lean Charge: A charge with no dolomite or limestone. Send up an empty skip in place of limestone or dolomite. Charge O.P. Slag as usual.
- d. Blank Charge: A charge with no coke. Send up empty skips in place of coke.
- e. Extra Coke: Periodically, the furnace condition requires adding extra coke. This coke should be charged in a lump as extra loads. The bell hopper can only hold eight skips of coke. Therefore, the large bell should be dumped manually after each charge of eight or less extra coke.
- f. Scrap Charge: The charging of scrap into the furnaces when specified increases their tonnage. Usually 50,000 lbs. of scrap is specified, for every few charges. But because of large pieces of scrap, it may not be possible to shut off at 50,000 lbs. Write down the actual amount on the log sheet. If there are any extra cokes specified, they should then be charged and the large bell dumped manually.

g. Top Temperature: The top temperature recorder is a continuous measure of the gas temperature in the dust catcher. This should be in the range of 200 to 400 F. Top temperatures below 200 F can cause the uptakes and downcomers to cake up with wet flue dust and plug the dust catcher. The top temperature of over 600 F can cause warping and damage to furnace top and uptakes. When this temperature starts to rise, stock water should be charged into skips to lower the temperature. However, charging water when the top temperature is over 800 F can cause cracking of the bells and should be avoided. Just keep on charging at a steady pace.

h. Stockline: The stockline recorder is an instrument connected to an electric gauge rod which continuously records the level of stock inside the furnace. Besides indicating how steadily the furnace is being filled and whether the proper level is maintained, it will also indicate a hanging furnace. Before every large bell dump, the rods come out automatically. They can also be taken out manually by a switch on the scale car master panel.

A furnace is said to be "off the rod" when the stock is more than 20 feet deep and the rods cannot measure its level.

## 10. OFF GRADE IRON

The following factors in the stockhouse will produce off grade iron:

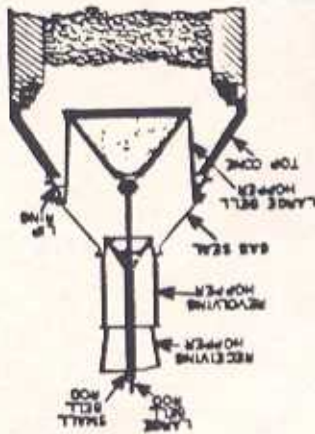
- a. Improper charge weights.
- b. Larry car and coke scales showing wrong weights.
- c. Larry car and coke scales off zero.
- d. Scale car markers set wrong.
- e. Coke weights too low.
- f. Binds and spillage around load cells of larry cars and coke hoppers.
- g. Spillage between larry car tracks causing the larry car hopper to drag and show wrong weights.
- h. Mixed materials in the bins.

11. MISCELLANEOUS

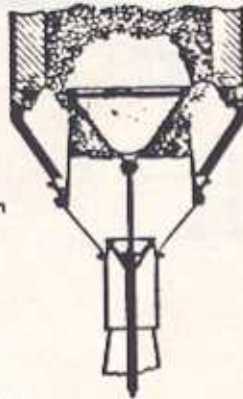
A simple advice to larry men and helpers would be "DO NOT RUSH". Rushing produces expensive mistakes. Keep charging at a steady pace. Keep track of skips through the lights on the panel. Make sure the proper skip is in the pit and a coke dump is not scheduled before dumping the larry car. One load in pit is a lot of expensive downtime. This in turn can reduce your incentive.

12. THE OPERATION OF A BLAST FURNACE TWO-BELL TOP

BOTH BELLS CLOSED READY TO  
REVERSE CHARGE CYCLE. NOTE  
THAT ROOF SUPPORTING LARGE  
BELL PASSES THROUGH HALL-  
LOW ROOF SUPPORTING SMALL  
BELL. PERMITTING INVERTED-  
BELL OPERATION OF BELLS.



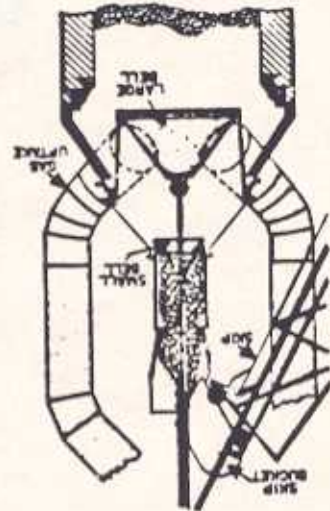
SMALL BELL CLOSED TO PRE-  
VENT ESCAPE OF GAS TO AT-  
MOSPHERE AND LARGE BELL  
OPEN TO ADMIT CHARGE TO  
THE FURNACE.



LARGE BELL REMAINS CLOSED  
WHILE SMALL BELL OPENS TO  
ADMIT CHARGE TO LARGE  
BELL HOPPER.



SMALL BELL AND LARGE BELL  
TIPPED TO DUMP CHARGE IN  
HOPPER ABOVE SMALL BELL.  
GAS FLOWING FROM TOP OF  
FURNACE THROUGH UP-TAKE  
LOCATED IN DOME TOP CORNER.



NOTES

1. The first drawing is a plan view of a building with a central square and four surrounding rooms. The central square is labeled 'A' and the surrounding rooms are labeled 'B', 'C', 'D', and 'E'. The drawing shows the layout of the building and the relative positions of the rooms.



Diagram 1: Plan view of a building with a central square and four surrounding rooms.



Diagram 2: Plan view of a building with a central square and four surrounding rooms.



Diagram 3: Plan view of a building with a central square and four surrounding rooms.

NOTES ON THE DRAWINGS

