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Coal preparation plant — Principles and conventions for flowsheets

*Ateliers de préparation du charbon — Principes et conventions relatifs aux schémas
de traitement*

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Reference number
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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 924 was prepared by Technical Committee ISO/TC 27, *Solid mineral fuels*.

This second edition cancels and replaces the first edition (ISO 924 : 1975), of which it constitutes a technical revision.

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Introduction

At various stages in the design of a complete plant, it is necessary to illustrate by flowsheets the process steps covering the operations to which the raw coal will be subjected in the preparation plant. In order that these may be more readily and universally understood, it is desirable that flowsheets should conform to a standard pattern and that various conventions should be well understood and adopted.

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Coal preparation plant — Principles and conventions for flowsheets

1 Scope

This International Standard sets out principles and conventions for use in the preparation of basic process and equipment flowsheets for the design of a coal preparation plant.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 561 : 1974, *Coal preparation plant — Graphical symbols*.

ISO 1213-1 : 1982, *Solid mineral fuels — Vocabulary — Part 1: Terms relating to coal preparation*.

3 Definitions and symbols

For the purposes of this International Standard, the definitions in ISO 1213-1 and the symbols in ISO 561 apply.

The following definitions from ISO 1213-1 are repeated for information only:

NOTES

1 The reference figures given in parentheses after each term are those taken from ISO 1213-1 : 1982.

2 In order to meet the needs of this International Standard, the definitions are completed by comments given in notes to the definitions.

3.1 coal preparation (3.1.01): Collectively, physical and mechanical processes applied to coal to make it suitable for a particular use.

3.2 basic flowsheet (3.3.07): A block diagram of the various stages in the treatment of the raw coal.

3.3 process flowsheet (3.3.08): A basic flowsheet indicating the main operational steps within the plant, the movement of the various materials between the steps and the final products obtained, and often also the average mass flow at various points in the plant.

3.4 equipment flowsheet (3.3.09): A diagram indicating, preferably by symbols, the units of plant used in the various operational steps carried out within a coal preparation plant.

3.5 nominal capacity (3.3.01): A notional figure expressed in mass per hour used in the title of a flowsheet and in the general description of a plant, applying to the plant as a whole and to the specific project under consideration.

NOTE — It is only possible to define the nominal capacity of individual machines in relation to a particular set of clearly specified conditions. For example, the capacity of a jig of given dimensions depends upon the size distribution of the coal (not only upon its upper size limits) and the proportion of "middlings" material. The capacity of a screen depends upon the proportion of nearsize materials and, for a raw coal, upon the dampness of the coal. Consequently, nominal capacities should only be applied to complete plants and to general descriptions relating to specific projects. The nominal capacity of the plant will usually be less than the sum of the design capacities of individual units contained in the plant and will always be less than the sum of the mechanical maximum capacities.

3.6 operational capacities (3.3.02): Figures given on a flowsheet to indicate quantities per unit time passing various points in the plant, taking account of fluctuations in the rate of supply and composition (as to size and impurity content).

NOTE — The figures given on flowlines are derived from design capacity figures and include combinations of design capacity figures at product junction points.

3.7 design capacity (3.3.03): The rate of feed, defined by limits expressing the extent and duration of load variations, at which specific items of plant subject to a performance guarantee must operate continuously and give the guaranteed results on a particular quality of feed.

NOTES

1 The ability of any item of plant to achieve its guaranteed results depends upon the rate of feed and the proportions of its components, both of these factors being liable to fluctuation during commercial

operation. It is not possible to lay down standard conditions for any acceptance tests as these also depend upon circumstances. The guarantee finally agreed upon between the parties should generally deal with any limit as to the duration or extent of fluctuations in the rate and quality of the feed and the rate of discharge of the products during any acceptance test. It is usually not possible to enter all such details on the flowsheet, but it should nevertheless give capacities and rates of flow. Therefore, it is proposed to state the maximum rate of supply of the feed material to the particular item of equipment, and also the maximum and minimum rates of production of the products from it (so that variations in the composition of the feed and, to some extent, variations in the rate of feed are defined), the results being guaranteed only between these limits.

2 Any additional limits on the extent and duration of fluctuations in the feed, or any further qualifications of the guarantee or conditions of test, will be incorporated in the guarantee document. In many cases it may be desirable to indicate a design capacity, even though no question of guarantee arises, in order to facilitate the selection of suitable equipment.

3.8 peak design capacity (3.3.04): A rate of feed in excess of the design capacity which specific items of plant will accept for short periods without necessarily fulfilling the performance guarantees given in respect of them.

3.9 mechanical maximum capacity (3.3.05): The highest rate of feed at which specific items of equipment, not subject to performance guarantees, will function on the type and quality of feed for which they are supplied.

NOTE — It is desirable to state the maximum capacities of equipment handling materials (e.g. conveyors, pump, crushers), which are not subject to individual guarantees of performance. Mechanical maximum capacities for such items should usually be shown on the flowsheet in tabular form or be stated in a separate document.

4 Types of basic flowsheet

In order to cover the various stages leading to the final design of a plant, two basic flowsheets are needed, one based on the process and the other on the equipment.

Examples of process and equipment flowsheets are shown in figures 1 and 2 respectively. It is emphasized, however, that these flowsheets are included for information only and may be altered to suit the parties concerned. However, in the interests of standardization, it is recommended that the examples shown in figures 1 and 2 be followed, unless it is essential to do otherwise.

NOTE — More detailed flowsheets are likely to be required as planning proceeds, for example, where cleaning of the coal is involved. It may also be necessary to illustrate the water (or other medium) circuits and indicate the quantities at various parts of the plant. These and other specialized flowsheets are not dealt with in this International Standard but it is assumed that insofar as is appropriate the same principles and conventions would be applied in them as in the basic process and equipment flowsheets.

5 Grouping of operations and products

In order to prepare a flowsheet it is necessary that the preparation process be subdivided into a number of headings, so that stages coming within the scope of a particular heading are

grouped together. The stages from the point where the raw coal enters the plant to the disposition of the products can normally be summarized under the following headings:

- a) pretreatment of feed coal;
- b) cleaning;
- c) subsequent treatment of products (including separation of solids from water);
- d) storage and loading of products;
- e) characteristics of products;
- f) destination of products.

NOTE — In certain cases it may be desirable to indicate in the equipment flowsheet the destination of products under d) and to omit e) as shown in figure 2.

6 Conventions for use on flowsheets

It is necessary that certain conventions be adopted to avoid risks of confusion and to ensure that the standard flowsheets are simplified as far as possible. The following conventions shall be adopted.

- a) The raw coal entering the plant shall be shown at the top left-hand corner of the flowsheet.
- b) As far as possible, the flowsheet should be arranged so that the size of products decreases from the top downwards. Where size ranges are shown, the largest size shall be given first (for example $-125 \text{ mm} + 16 \text{ mm}$, $-16 \text{ mm} + 0,5 \text{ mm}$ and $-0,5 \text{ mm} + 0$). Similarly, where possible, a vertically descending order should be used for cleaned coal, middlings and discard.
- c) Lines indicating flow of material shall be horizontal or vertical only. They shall enter the squares, rectangles or symbols from the top or left side and leave from the bottom or right side, giving in general a left to right flow, except that lines indicating products for retreatment within the installation shall leave from the right side, pass upwards and then proceed from right to left and joint the line of entry to the retreatment operation. Where more than one flow enters or leaves an item of plant, the number of entry and exit arrows shall be varied accordingly.
- d) Junctions of flowlines shall be indicated by spots. Where there is no junction of materials the lines shall cross. As an alternative to this method, loop cross-overs may be used and for uniformity it is recommended that the loops should be either in the horizontal or vertical planes and all on the same side of the flowlines.
- e) Sizes of material shall be indicated by the addition of "mm" after the appropriate figures and figures without qualification shall be used for rate in tonnes per hour, but quantities (for example bin capacities) shall be appropriately indicated by mass using "t" for tonnes.
- f) A standard method of expressing and defining capacities should be adopted. It is recognized that considerable variations are likely to occur in the rate of supply of a coal to a preparation plant and that variations also

occur in the quality because of changes in the size distribution and proportion of impurity. The object of defining capacities is that at all stages, from the inception of a project to the final design, there should be a clear understanding of the load conditions throughout the plant which will be associated with performance guarantees in the later stages.

The standard capacities should be indicated on flowsheets in the following manner:

- 1) the nominal capacity should only be used in the title of the flowsheet;
- 2) the design capacities relating to particular processes or items of equipment in the flowsheet should be written above horizontal lines or to the left of vertical lines. Where maximum and minimum rates are given for design capacity, these may be separated by an oblique stroke or a dash;
- 3) the mechanical maximum capacities relative to particular items of equipment in the flowsheet should be written in parentheses below horizontal lines or to the right of vertical lines.

In the process flowsheet, the only figures noted should be the upper limits of design capacities which are written above the horizontal flowlines or to the left of vertical flowlines. Examples of capacity figures are shown on the flowsheets in figures 1 and 2.

g) If the divisions between categories of process steps are indicated by vertical lines as in figures 1 and 2, then care shall be taken to distinguish them from the flowlines, for example by a thicker line.

h) On the process flowsheet the processes and stages shall be indicated by rectangles, roughly equivalent in size and elongated vertically or horizontally, whichever suits the originator. The identification of the processes and stages shall be written the rectangles, as shown in the example of process flowsheet in figure 1. Plant symbols should not be used in process flowsheets.

i) On the equipment flowsheets, the machines or items of plant should be indicated as far as possible, by standard symbols (see ISO 561) which minimize the use of written descriptions. If a written reference is necessary, then it is recommended that this briefly indicates the size and number of units corresponding to the appropriate symbol.

j) The lines forming the rectangles on process flowsheets and the symbols on equipment flowsheets shall be shown by thick full lines and the product flow by slightly thinner full lines. The flowlines for other minor circuits such as fluid only shall be distinguished by relatively thinner full lines.

k) Code numbers referring to particular items of plant should not normally be used on a process flowsheet. If it is appropriate to show them on an equipment flowsheet, the numbers should be made distinct from other figures and, for example, could be enclosed in circles.

l) Many plants are designed so that, at some future time, they may be extended or a separate operational stage (for example froth flotation) may be added. When it is desired to illustrate such an extension or addition, the appropriate plant and circuits should be indicated by characteristic lines, for example chain dotting.

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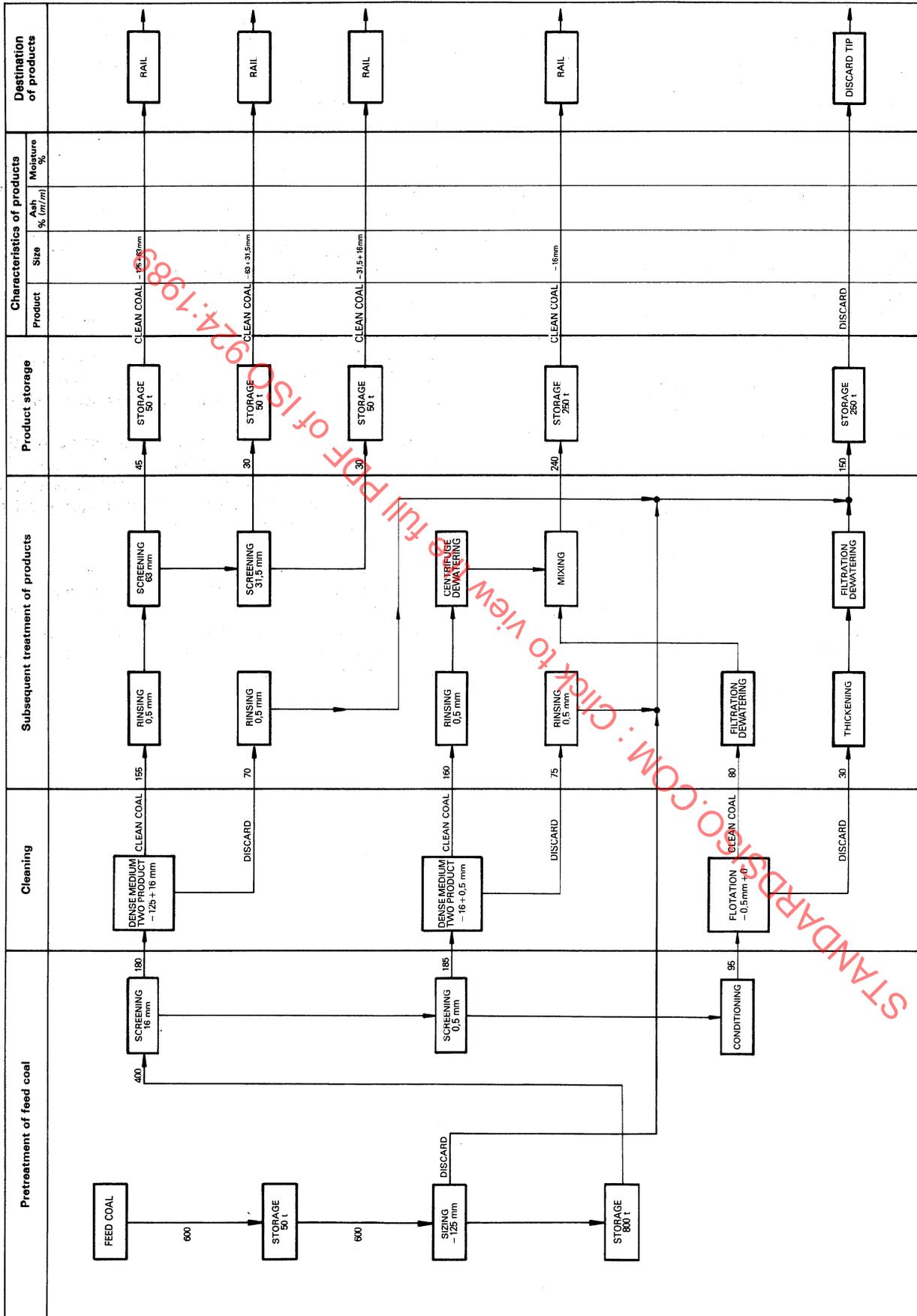


Figure 1 — Example of process flowsheet

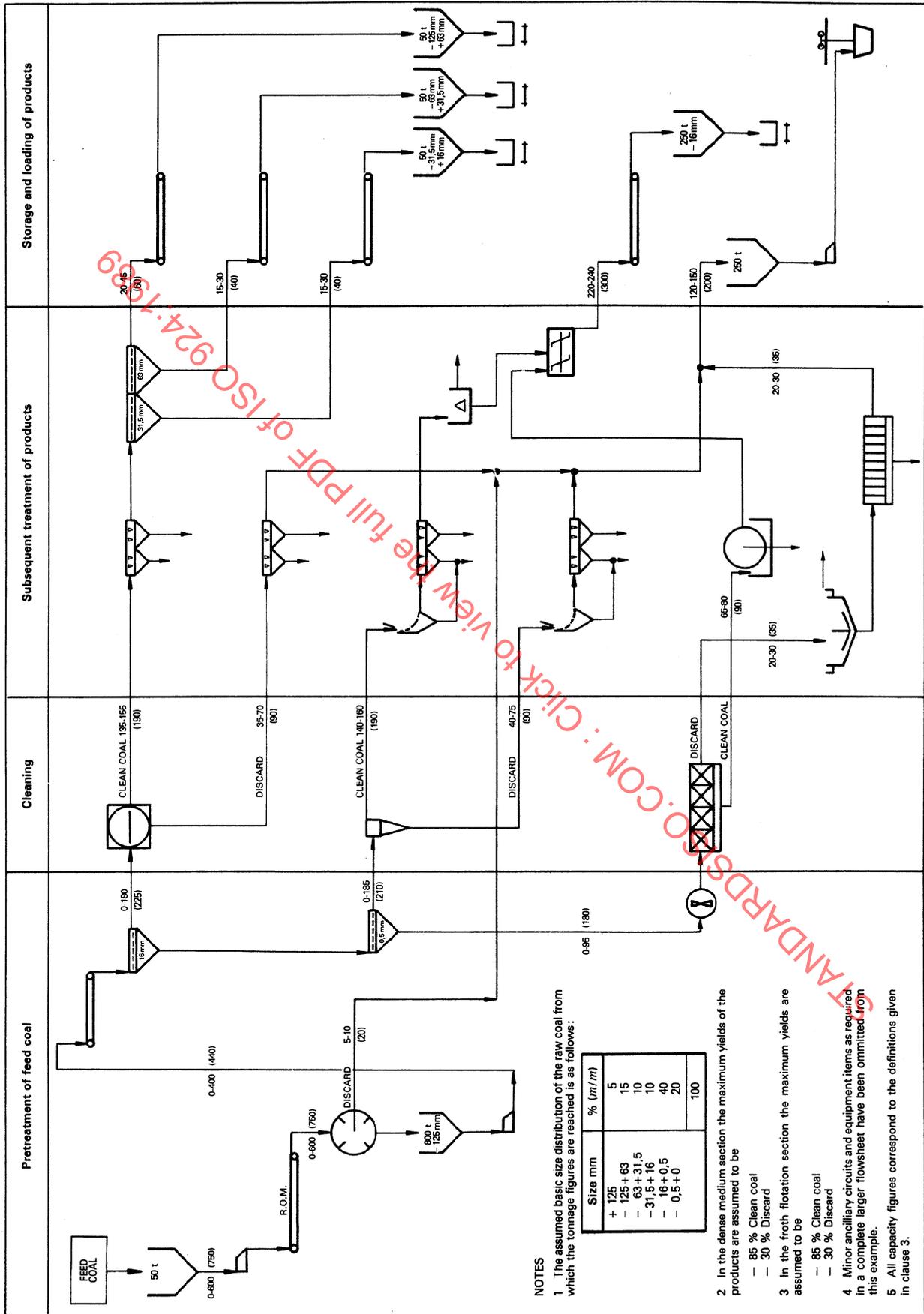


Figure 2 — Example of equipment flowsheet