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Coal preparation plant — Principles and conventions for flowsheets

Ateliers de préparation du charbon — Principes et conventions concernant les schémas de traitement

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

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.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 27 has reviewed ISO Recommendation R 924 and found it technically suitable for transformation. International Standard ISO 924 therefore replaces ISO Recommendation R 924-1969 to which it is technically identical.

ISO Recommendation R 924 was approved by the Member Bodies of the following countries :

Australia	Germany	South Africa, Rep. of
Austria	India	Spain
Belgium	Iran	Switzerland
Bulgaria	Japan	Thailand
Canada	Korea, Rep. of	Turkey
Czechoslovakia	Netherlands	United Kingdom
Denmark	New Zealand	U.S.S.R.
Egypt, Arab Rep. of	Poland	Yugoslavia
France	Romania	

No Member Body expressed disapproval of the Recommendation.

The Member Body of the following country disapproved the transformation of ISO/R 924 into an International Standard.

Czechoslovakia

Printed in Switzerland

Coal preparation plant — Principles and conventions for flowsheets

0 INTRODUCTION

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

1 SCOPE AND FIELD OF APPLICATION

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

2 TYPES OF FLOWSHEET

In order to cover the various stages leading to the final design of a plant, two types of basic flowsheet are needed. The first type, or **process flowsheet,** is required to indicate the main operational steps within the plant, such as screening, cleaning, storage, etc. This flowsheet should also indicate the quantities of coal or product with which the plant must be capable of dealing at various points. The second type, or **equipment flowsheet,** should indicate the types of plant to be employed for the specific operational steps and may incorporate any changes made subsequent to the preparation of the process flowsheet.

For convenience, two examples of flowsheets are attached to illustrate the application, in a process flowsheet (figure 1) and an equipment flowsheet (figure 2) respectively, of the principles and conventions given herein. It is emphasized, however, that these are examples only, which may serve as a guide, and are not intended to establish a standard format or layout to cover all cases.

More detailed flowsheets are likely to be required as further progress is made and, where washing of the coal is involved, flowsheets will be required to illustrate the water or medium circuit and the quantities of water or medium involved at the several parts of the plant. These and other specialized flowsheets are not dealt with at present, but it is assumed that as far as appropriate the same principles and conventions would be applied in them as in the basic process and equipment flowsheets.

3 GENERAL PLAN OF FLOWSHEET

A standard flowsheet should be arranged so that the process steps go by stages in a horizontal direction. At the present time, both horizontal and vertical arrangements are in use, but many flowsheets are neither exclusively horizontal nor exclusively vertical. In order that flowsheets may be more quickly and clearly understood, they should follow a single pattern and, after considering examples of the possible alternatives, it is recommended that the horizontal arrangement be adopted.

4 GROUPING OF PROCESS OPERATIONS AND PRODUCTS

The normal stages of preparation of coal, from the point of entry of the raw coal into the plant to the final points of disposal of the products, can be divided into a number of process steps. It is recommended that the following six categories be used as headings :

1) Pretreatment of feed coal

2) Cleaning

3) Subsequent treatment of products (to include separation of solids from water)

4) Product blending and storage

5) Characteristics of products

6) Destination of products

These headings are set out along the top of the page, so that all operations coming within the scope of any one heading are shown in the space below it. In certain cases, it may be desirable to use an additional column for the separation of solids from water instead of including this under "subsequent treatment of products". In the equipment flowsheet it may be convenient to indicate loading arrangements under heading 4) and to omit headings 5) and 6); this procedure has been followed in the sample flowsheet attached.

5 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. It is, therefore, recommended that the following conventions be adopted :

1) The raw coal entering the plant should be shown at the top left-hand corner of the flowsheet.

2) 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 larger size should be given first (for example 80–50 mm, 3 mm–0). Similarly, where possible, a vertically descending order should be used for cleaned coal, middlings and reject (or discard).

3) On the process flowsheet, the processes should be indicated by rectangles, roughly equivalent in size and elongated vertically or horizontally as most convenient to the draughtsman, except that storage should be indicated by squares. Identification of the processes should be written within the rectangles or squares, for example "thickening", "screening". Plant-units should not be indicated until the equipment flowsheet is prepared. It may also be convenient to adopt the following symbols in the process flowsheet :

4) On the equipment flowsheets, the machines or items of plant should be indicated, as far as possible, by standard symbols[1] which minimize the use of written descriptions. The symbols are standardized as to form, but not as to size, and a sense of proportion should be applied in their reproduction.

5) Lines indicating flow of materials should be horizontal or vertical only. They should 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 re-treatment within the installation should leave from the right side, pass upwards and then proceed from right to left to join the line of entry to the re-treatment operation.

6) Full lines should be used to indicate the flow of materials, except that, where two or more alternative routes are provided, all except the main flow should be indicated by broken lines. These flowlines should be appreciably thinner than the lines forming the squares and rectangles on process flowsheets, and the symbols on equipment flowsheets.

7) Spots should be used to indicate junctions of flowlines. Where there is no junction of materials, the lines should simply cross. The direction of flow of material should be indicated by arrows.

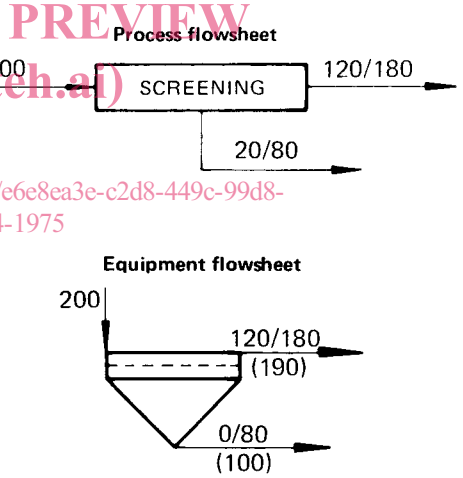
8) If the divisions between categories of process steps are indicated by vertical lines, care should be taken to distinguish them from the flowlines.

9) Code numbers referring to particular items of plant should not normally be used on the basic flowsheets. In subsequent flowsheets, or where it is desired to show them on the basic flowsheets, the numbers should be enclosed in circles.

10) 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 buildings should be indicated by characteristic lines, for example chain dotting.

11) A standard method of expressing capacity should be adopted. Detailed recommendations on this subject are given in the annex.

The figures for design (guarantee) capacity should be written above the horizontal flowlines and those for mechanical maximum capacity below them, without any interruption of the lines. Should it be necessary to show capacities on vertical flowlines, the figures for design (guarantee) capacity should be written on the left-hand side of the lines and those for mechanical maximum capacity on the right-hand side. To avoid the possibility of confusion, the figures for mechanical maximum capacity should be written in parentheses. Where maximum and minimum rates are given for design capacity, these may be separated by an oblique stroke or by a dash. Examples are as follows :



12) Sizes of material should be indicated by the addition of "mm" after the appropriate figures. Figures without further qualification should be used for rates (tons per hour), but quantities (tons) should be indicated by "T" ('tonnes' by "t").

1) See ISO 561, *Coal preparation plant – Graphical symbols.*

ANNEX

EXPRESSION OF CAPACITIES ON FLOWSHEETS

A.0 INTRODUCTION

It is well recognized that considerable variations are likely to occur in the rate of supply of the coal to a coal preparation plant; variations also occur in its quality because of changes in the size distribution and proportion of impurity. The object of definitions of capacity is to make possible, at all stages from the inception of a project to the final design of a plant, a clear understanding of the load conditions throughout the plant which, in the later stages, will be associated with performance guarantees.

A.1 DEFINITIONS OF CAPACITY

The following definitions are reproduced from ISO/R 1213/I, *Vocabulary of terms relating to solid mineral fuels – Part I : Terms relating to coal preparation :*

A.1.1 nominal capacity : A notional figure expressed in mass per hour used in the title of the flowsheet and in general descriptions of the plant, applying to the plant as a whole and to the specific project under consideration. It may be taken as representing the approximate mass of feed expected to be supplied to the plant during the hour of greatest load.

A.1.2 design (guarantee) capacity : 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.

A.1.3 peak design capacity : 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.

A.1.4 mechanical maximum capacity : 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.

A.2 NOTES ON DEFINITIONS

A.2.1 Nominal capacity

It is not possible to define the nominal capacity of individual machines except 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 limit) and the proportion of "middlings" material. The capacity of a screen depends upon the proportion of nearsize material and, for a raw coal, on 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.

A.2.2 Design (guarantee) capacity

The ability of any item of plant to achieve its guaranteed results depends upon the rate of the feed and the proportions of its components, both of these factors being liable to fluctuation during commercial operation. It is impossible, at present, even to contemplate any international standardization of guarantees of performance of efficiency; these need to be framed to suit the circumstances. Nor is it possible to lay down standard conditions for an acceptance (guarantee) test; these too, depend upon circumstances; and the guarantee finally agreed between the parties will 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 (guarantee) test. It will not usually be possible to enter all such details on the flowsheet. The flowsheet should, nevertheless, give capacities and rates of flow and it is proposed, therefore, to state the maximum rate of supply of the feed material (expressed conventionally in tons per hour) 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 would be defined), the results being guaranteed only between these limits.

Any additional limits on the extent and duration of fluctuations in the feed, or any further qualifications of the guarantee or conditions of test would be incorporated in the guarantee.

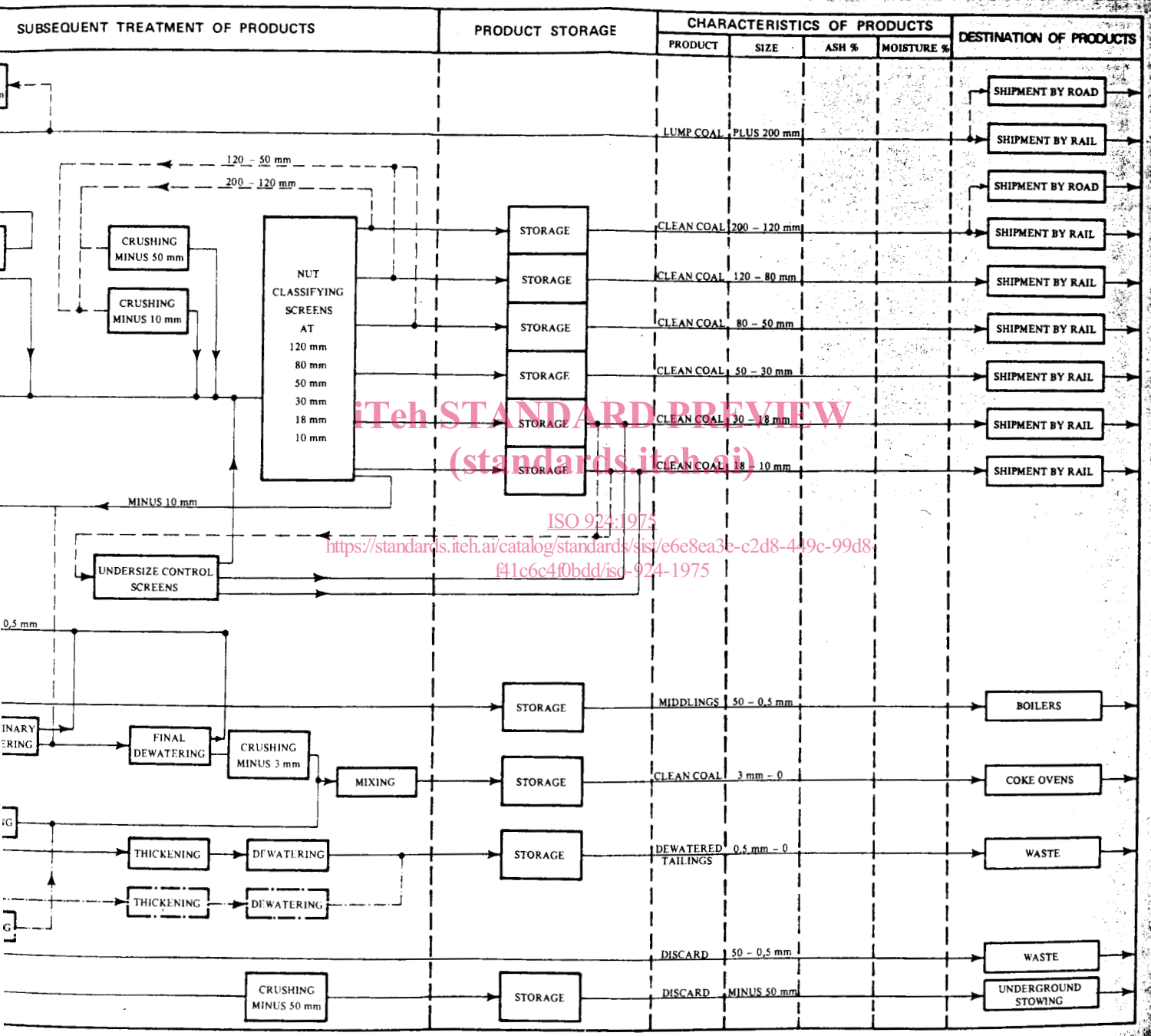
In many cases it may be desirable to indicate a design capacity even though no question of guarantee arises, in order to facilitate the selection of suitable equipment.

A.2.3 Peak design capacity

Usually the plant, or specific items of equipment within it, will be required, from time to time, to accept coal at rates of supply above those covered by the guarantee of results. This excess coal must continue to be handled without blockage or mechanical breakdown of the plant, in order not to interrupt the working of some other part of the entire enterprise (for example not to stop the transportation of coal from underground). Thus it is desirable to state the rates of supply (capacities) at which particulars items of equipment will continue to function, without necessarily giving the guaranteed results.

A.2.4 Mechanical maximum capacity

It is also desirable to state the maximum capacities of those items which handle materials (for example conveyors, pumps, crushers), but which are not subject to individual guarantees of performance. Mechanical maximum capacities for such items would usually be shown on the flowsheet in tabular form or be stated in a separate document.



mple of process flowsheet

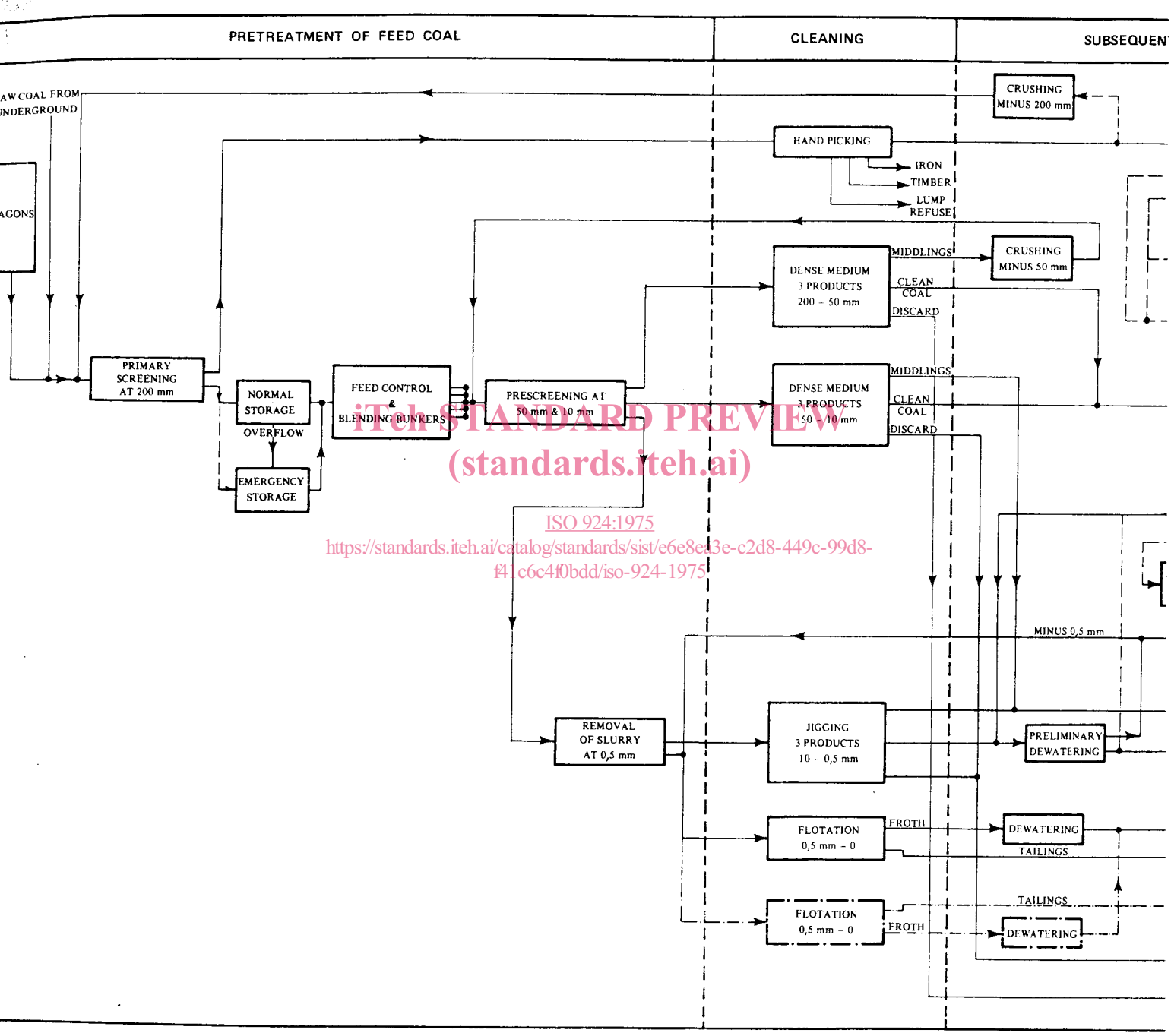


FIGURE 1 – Example of proce