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Central Heating Plant Coal Use Handbook

Volume 2: Coal Specifications Troubleshooting Guide

by
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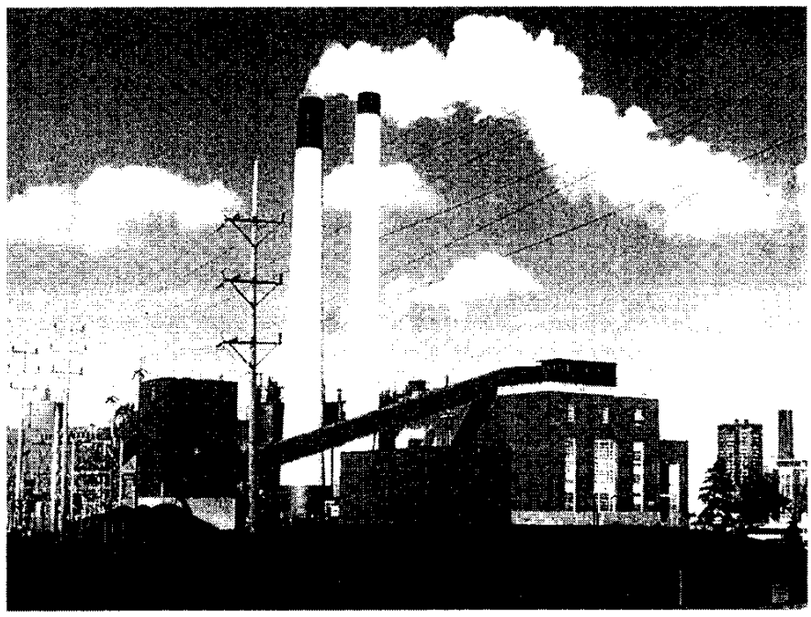

The mechanisms involved in the combustion of coal are so complex that it is often difficult for central energy plant personnel to quantify the impact of coal quality on boiler operating and maintenance costs. Since many Department of Defense (DOD) installations employ coal-fired central energy plants, the U.S. Army Construction Engineering Research Laboratories (USACERL) was tasked with developing a Coal Use Handbook for use at DOD installations.

This Handbook provides comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications. The Handbook is tailored for military installation industrial-sized coal-fired central energy plants. Each section focuses on a different aspect coal quality: developing coal quality-based procurement specifications, measuring and monitoring coal quality throughout the coal use cycle, or identifying and solving boiler coal quality-related problems. The handbook is published in two volumes:

- Volume 1: Technical Reference
- Volume 2: Coal Specifications Troubleshooting Guide.

Volume 1 is designed as a reference and guide for operations, management, and procurement personnel involved in using coal as a boiler plant fuel. Volume 2 provides logic diagrams to help diagnose and correct 490 specific boiler system problems.

Foreword

This study was conducted for HQ AFCESA/RA under Military Interdepartmental Purchase Request (MIPR) No. E8787L253. The technical monitor was Freddie Beason, AFCESA/CESE.

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1 Introduction

1.1 Background

The mechanisms involved in the combustion of coal are so complex that it is often difficult for central energy plant personnel to quantify the impact of coal quality on boiler operating and maintenance costs. Since many Defense (DOD) installations employ coal-fired central energy plants, the U.S. Army Construction Engineering Research Laboratories (USACERL) was tasked with developing a Coal Use Handbook for use at DOD installations.

The two-volume handbook provides comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications. The information is tailored for military installation industrial-sized coal-fired central energy plants. This volume contains logic diagrams to help diagnose and correct 490 specific boiler system problems.

1.2 Objective

The objective of this study was to gather and publish comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications.

1.3 Approach

This Handbook is designed as a reference and guide for the operations, management and procurement personnel involved in using coal as a boiler plant fuel. The *Central Heating Plant Coal Use Handbook, Volume 2: Coal Specifications Troubleshooting Guide* is composed of three chapters and six appendixes. This volume provides central heat plant operations personnel with a means to diagnose and correct operating and performance problems with boilers and boiler auxiliary equipment that are a direct consequence of as-fired coal quality.

Chapter 2 contains a discussion of the guide's objectives, assumptions and limitations, and organization. Chapter 3 focuses on a discussion of coal quality-related problems. The appendixes to the guide contain logical diagrams to help operations personnel recognize, diagnose, and correct coal quality-related problems that may occur in the following types of coal-fired systems:

- overfeed stoker-fired boiler system
- spreader stoker-fired boiler system
- underfeed stoker-fired boiler system
- top-feed static grate stoker-fired boiler system
- pulverized coal-fired boiler system
- atmospheric fluidized bed boiler system.

1.4 Scope

This handbook provides quality specifications for anthracite, bituminous, subbituminous, and lignite coals. The information presented in the handbook is generalized and does not supersede the instruction manuals that accompany specific equipment.

1.5 Mode of Technology Transfer

It is recommended that the *Central Heating Plant Coal Use Handbook* be distributed to installations with coal fired heating plants, and to procurement personnel at DOD fuel supply centers.

1.6 Metric Conversion Table

The following metric conversions are provided for standard units of measure used throughout this report:

1 ft	=	0.305 m
1 sq ft	=	0.093 m^2
1 sq in.	=	6.45 cm^2
1 cu ft	=	0.028 m^3
1 lb	=	0.453 kg
1 gal	=	3.78 L
1 oz.	=	29.57 mL
1 psi	=	6.89 kPa
°F	=	(°C × 1.8) +32
1 Btu	=	1.055 kJ

2 Troubleshooting Guide Overview

2.1 Purpose

This Coal Specifications Troubleshooting Guide (TSG) addresses identification and solution of coal quality-related problems encountered in operation of military heat plant coal-fired boilers and heaters. (Note that a distinction is frequently made between boilers, which produce steam, and heaters, which produce hot water. However, this Guide uses the term boiler to designate both central heat plant boilers and heaters). Specific TSG objectives are to:

- Provide central heat plant operating personnel with a means to accurately diagnose boiler and boiler auxiliary components operating and performance problems that are a direct consequence of as-fired coal quality. This requires application of procedures for discriminating between operating and performance problems that are due solely or partly to coal quality and problems due to other causes.

- Once a coal quality-related problem is identified, provide plant operating and/or coal purchasing personnel with guidance on how to alter future coal quality specifications to eliminate the identified coal quality problem.

The TSG consists of a short, report-style introduction that describes the general application of troubleshooting procedures, and six Appendixes that deal in detail with specific potential coal quality problems for the following generic boiler types:

- Overfeed Stoker
- Spreader Stoker
- Underfeed Stoker
- Top Feed Static Grate
- Pulverized Coal
- Atmospheric Fluidized Bed Combustor (AFBC).

Throughout the TSG, each boiler type is commonly referred to as a "system" to indicate that the Guide addresses all potential coal quality affected components

associated with an integrated coal-fired central heat plant, and not just the boiler in isolation. The TSG is intended for use with the following types of coal:

- bituminous
- subbituminous
- lignite.

To facilitate in-plant use by operating personnel and applications validation, the TSG has been developed around a series of potential coal quality problem troubleshooting logic diagrams. Each logic diagram deals with a specific boiler system and a specific problem that could be caused by poor coal quality, for example, firing of coal in which one or more coal quality measures is not within specification. The TSG contains 490 such logic diagrams.

A key aspect of each TSG logic diagram is the differentiation between specific operating problem caused by poor coal quality, and problems with causes unrelated to coal quality, such as operation of system components outside of design conditions. Development of diagnostic procedures to resolve such problems-cause differentiation was the most challenging part of TSG development. It remains an area requiring real feedback from actual TSG application. Because of this, it is recommended that the TSG be validated by limited in-plant testing before general release.

The TSG structure and specifically the troubleshooting logic diagrams were developed with the concept of the development of a military central heat plant coal quality specification expert system in mind. Once fully validated, the logic diagrams could easily become a key component of such an expert system.

2.2 Assumptions and Limitations

A typical military heat plant is comprised of many components supplied by a wide range of equipment manufacturers. Wherever practical, this TSG separates individual components into generic classes, ignoring specific manufacturers and models. Due to this simplification, the TSG must be used in conjunction with appropriate operations and maintenance manuals for boilers and boiler components. This TSG is not intended to replace operations and maintenance manuals. The user should view this TSG simply as a tool to identify and resolve coal quality-related problems at the boiler component level.

The TSG assumes that:

1. The central heat plant boilers and their auxiliaries can operate stably at design conditions when as-fired coal is within design specifications.
2. The instrumentation on boilers and auxiliaries functions properly and is calibrated.
3. The central heat plant facility conducts a quality assurance and quality control program for the preparation and analysis of as-fired coal samples.
4. The central heat plant is equipped with properly designed, operated, and maintained as-fired coal samplers, and these samplers are periodically inspected and bias tested by qualified personnel. Any detected sampler problems or sampling biases are promptly corrected.
5. Laboratory analysis of coal is conducted in strict accordance with recommended analytical procedures.

Quality information is the key element in evaluating coal-related boiler problems. Hence, in applying this TSG, the importance of having accurate coal quality information cannot be overemphasized.

2.3 Troubleshooting Guide Organization

This Chapter will familiarize the user with the TSG organization. Each of the six coal-fired boilers covered in the TSG are addressed in separate Appendixess, each having three subsections: "System Description," "Component/Symptom Identification," and "Operation/Coal Quality-Logic Diagrams." All six boiler systems have separate system descriptions, component/symptom identification tables, and TSG logic diagrams. However, are share such common information as coal quality analytical procedures, terminology, references, and bibliography.

2.3.1 System Description

The beginning of each boiler type section includes a general description of that particular boiler system, typical components comprising this system, and the general operation of the system. These systems are simplified and only include the major components that make up a typical system.

2.3.2 Component/Symptom Identification

Following each coal-fired boiler system description is a block flow diagram illustrating major system components. For example, Figure 1 shows the block flow diagram

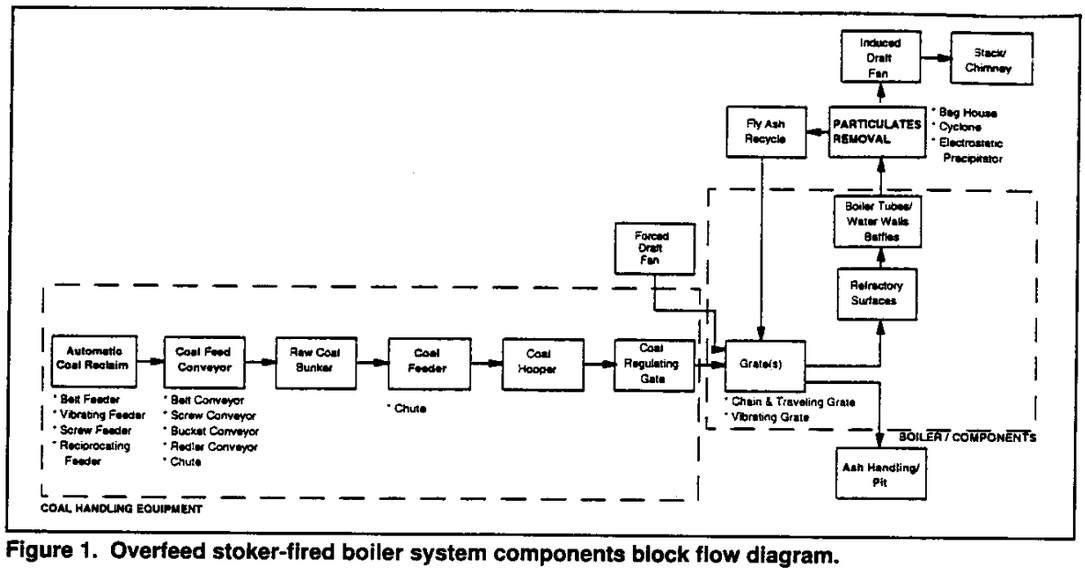

Figure 1. Overfeed stoker-fired boiler system components block flow diagram.

for the overfeed stoker-fired boiler system (as seen in Appendix A, Figure 1-3). The block flow diagram flows from left to right, starting with automatic coal reclaim equipment, which leads to the boiler and finally to the stack/chimney. Items listed next to or under various blocks illustrate particular types of components in the boxes. For example, the coal feed conveyor could be one of the following generic (common) types:

- belt conveyor
- screw conveyor
- bucket conveyor
- redler conveyor
- chute.

Following the system block flow diagram is a component/symptom identification table that identifies typical symptoms (problems) that may be encountered in the components identified in the block flow diagram. Figure 2 (as seen in Appendix A, Figure 1-4) shows the three components/symptoms identification tables for an overfeed stoker boiler. The left side of a table lists typical components required for an overfeed stoker system and the top lists typical symptoms (problems) that may be encountered in these components. For example, if pluggage occurs (defined as little or no coal flow) in the coal feed conveyor and the system uses a screw conveyor, the TSG user would follow the component across and pluggage down as illustrated by the arrows in Figure 3. This results in identification of Figure 4 (also in Appendix A, Figure 1-26). Once the figure number of the troubleshooting logic diagram has been identified, the user goes to that figure and follows the logic diagram.

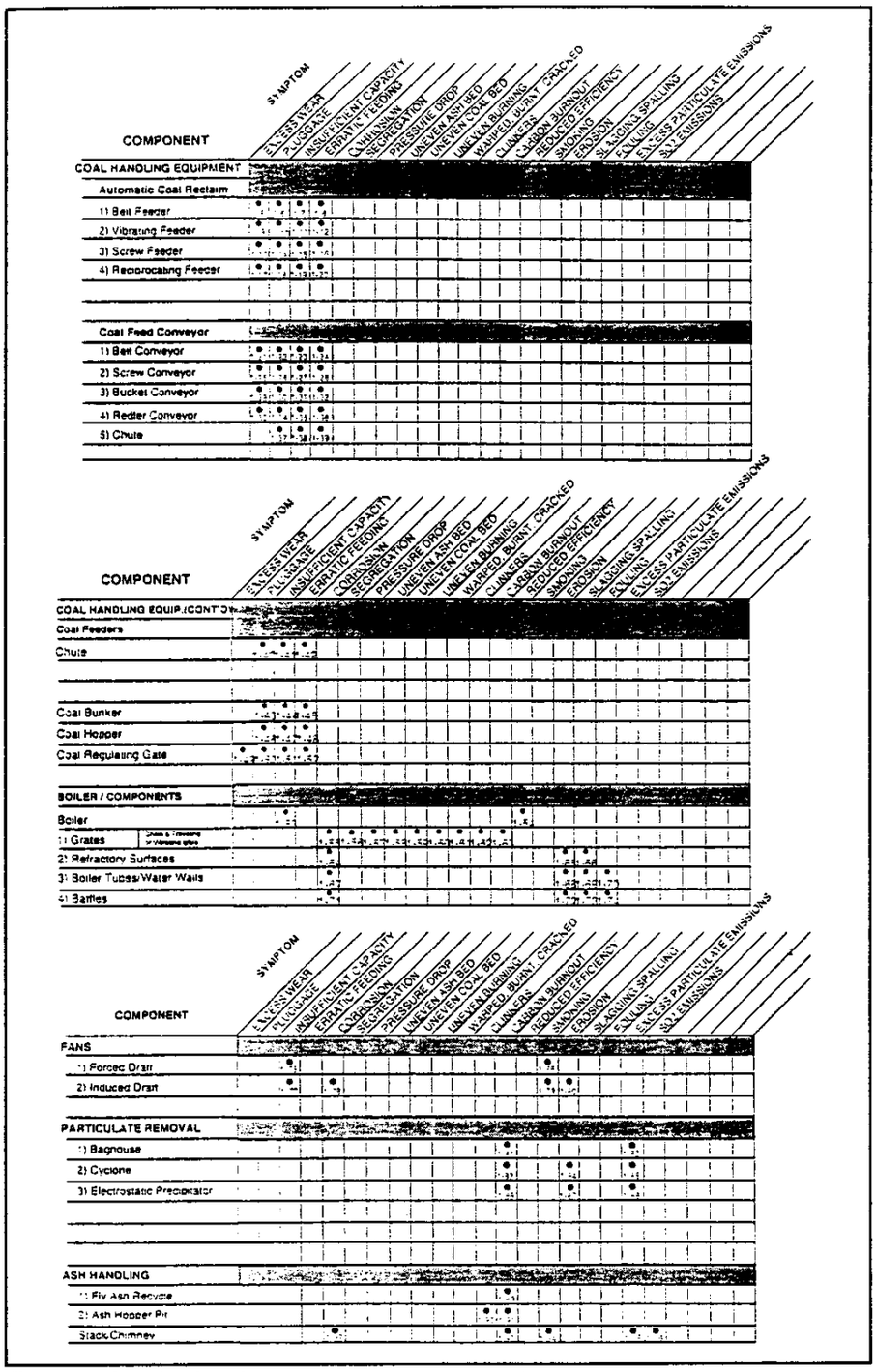

Figure 2. Overfeed stoker—component symptom tables.

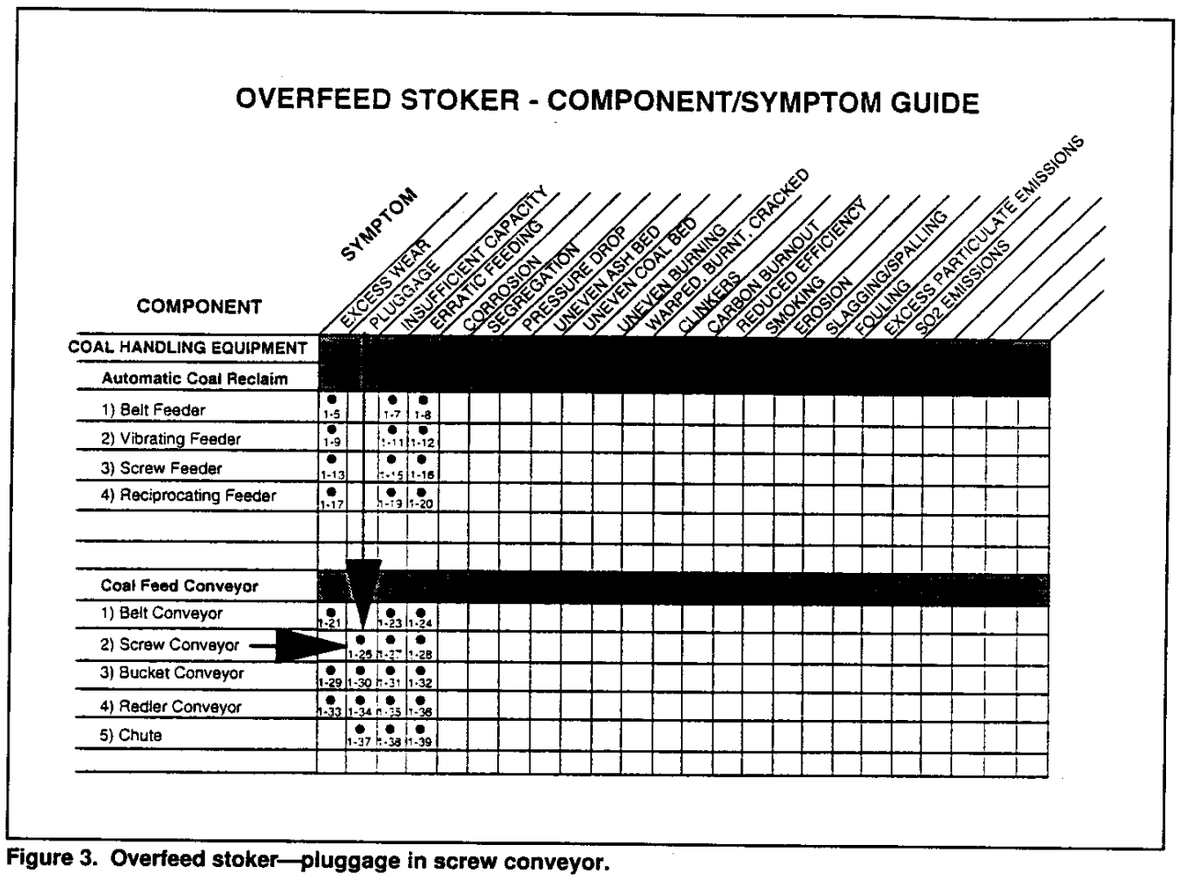

Figure 3. Overfeed stoker—pluggage in screw conveyor.

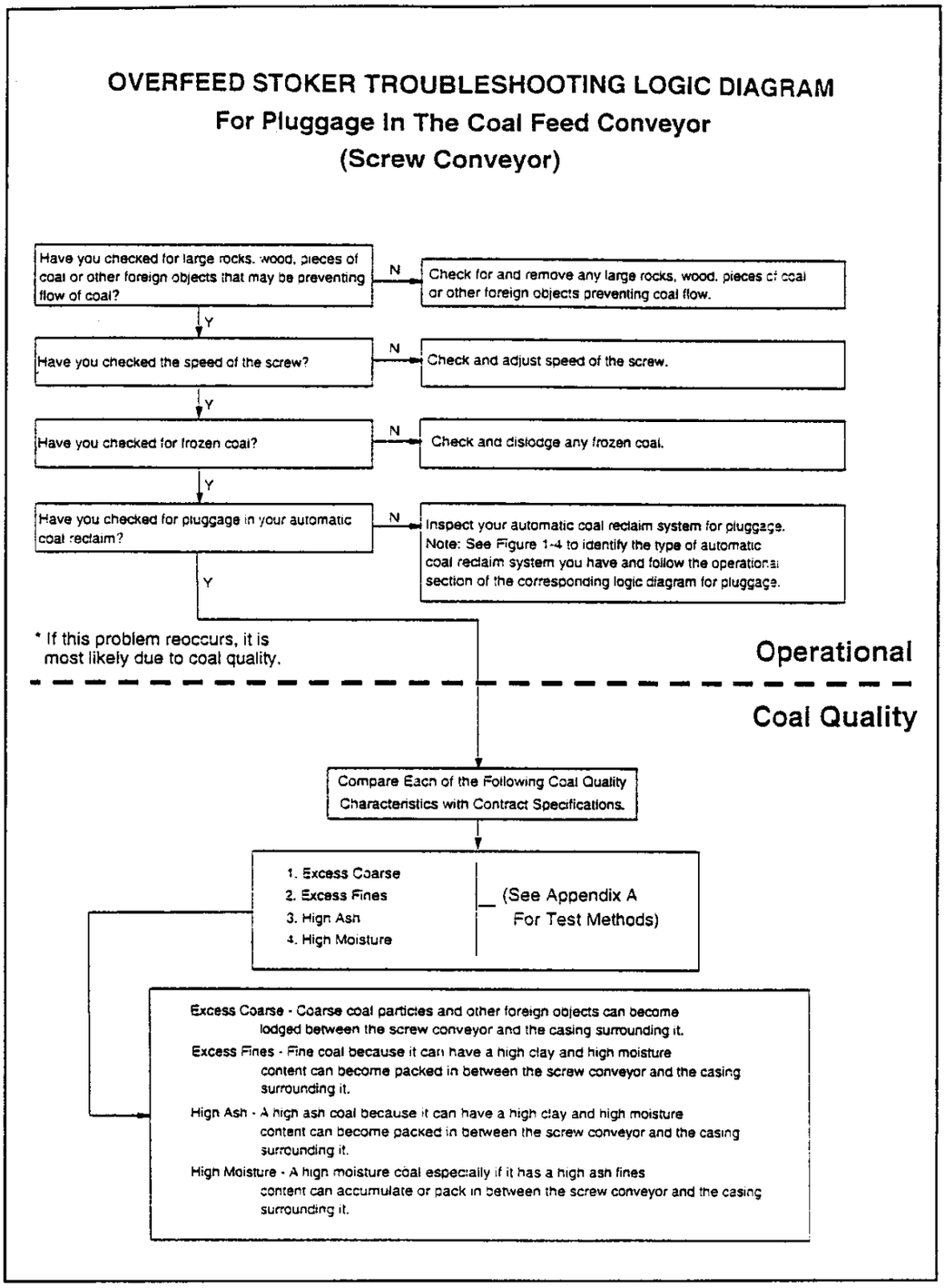

Figure 4. Pluggage in the coal feed conveyor.

2.3.3 Operation/Coal Quality—Logic Diagrams

Logic diagrams are "yes and no" type questions that determine if a problem is operational or coal quality related and solutions to those problems. For example, Figure 5 shows a component/symptom guide to isolate coal feed screw conveyor pluggage in overfeed stokers.

Operational problems should be addressed first. Once all operations have been checked, the user should go to the coal quality of the logic diagram. (In Figure 4, the operational part is above the dashed line and the coal quality part is below the dashed line.) The logic diagrams also discuss possible solutions and procedures once a coal quality problem has been located.

Following the Figure 4 logic diagram from top to bottom, the TSG user would answer the following questions in order:

1. Have you checked for large rocks, wood, pieces of coal or other foreign objects that may be preventing flow of coal? If there is blockage then you must remove any large rocks, wood, pieces of coal or other foreign objects preventing the coal flow. If there is no blockage, then proceed down to the next box.
2. Have you checked the speed of the screw? If the answer is no then you must check the speed of the screw conveyor and adjust it, if necessary. Proceed down to the next box if you have already checked and adjusted the speed of the screw and you still have a pluggage problem.
3. Have you checked for frozen coal? If you find frozen coal in your screw conveyor you must heat it. If this still does not solve your pluggage problem, then proceed down to the next box.
4. Have you checked for pluggage in your automatic coal reclaim? If you have already checked coal reclaim for pluggage and there is no pluggage, proceed down to the logic diagram to the coal quality part. Assume the answer is no, you have not checked your automatic coal reclaim for pluggage. Next, you would refer back to the component/symptom identification table (Figure 2) to identify the type of automatic coal reclaim system that you have. Assume you have a vibrating feeder as an automatic coal reclaim, then you would follow the Vibrating Feeder component to Pluggage, as illustrated by the arrows in Figure 5. This identifies the logic diagram that appears in Appendix A, Figure 1-10 (reproduced here as Figure 6).

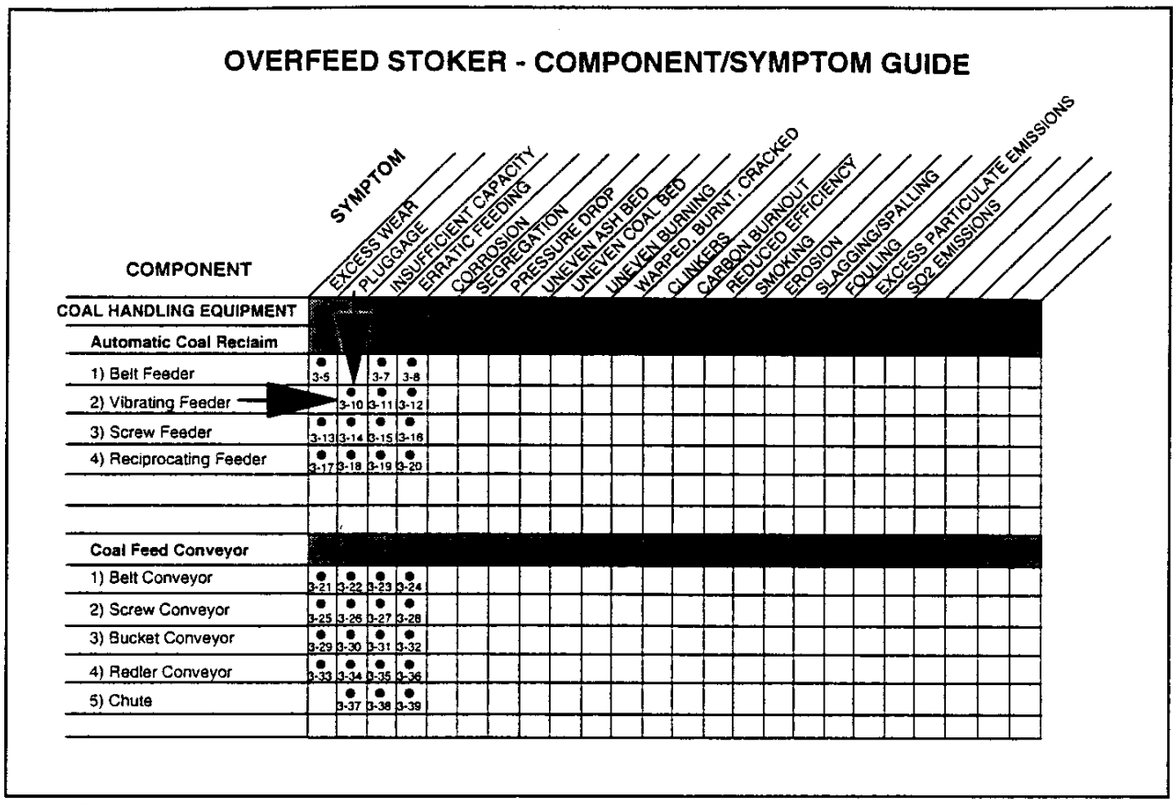

Figure 5. Overfeed stoker—pluggage in vibrating feeder.

Again, following the logic diagram from top to bottom, the user would answer the following questions in order:

1. Have you checked the intensity of vibrations being sent by the feeder?
2. Have you checked for broken or worn out springs?
3. Have you checked for fine damp coal packed in the feeder?
4. Have you checked for large rocks, wood, or pieces of coal lodged in the feeder?

If the answer to all four questions is yes, the vibrating feed is assumed to not be plugged. Since this is the answer for the last question in the Screw Conveyor Logic diagram (Figure 4), the user would return to the Screw Conveyor logic diagram. Since now all Screw Conveyor logic diagram questions are answered yes (Y), the user proceeds to the coal quality part of the logic diagram.

The coal quality measures identified in the coal quality part of Figure 4 are listed in order of likelihood of causing the problem. A representative coal sample would be obtained and analyzed for these measures.

Appendixes A to F contain information regarding each specific boiler system. Following the appendixes, information common to each of the boiler types is listed: typical boiler and auxiliary equipment definitions, abbreviations and acronyms, and references.

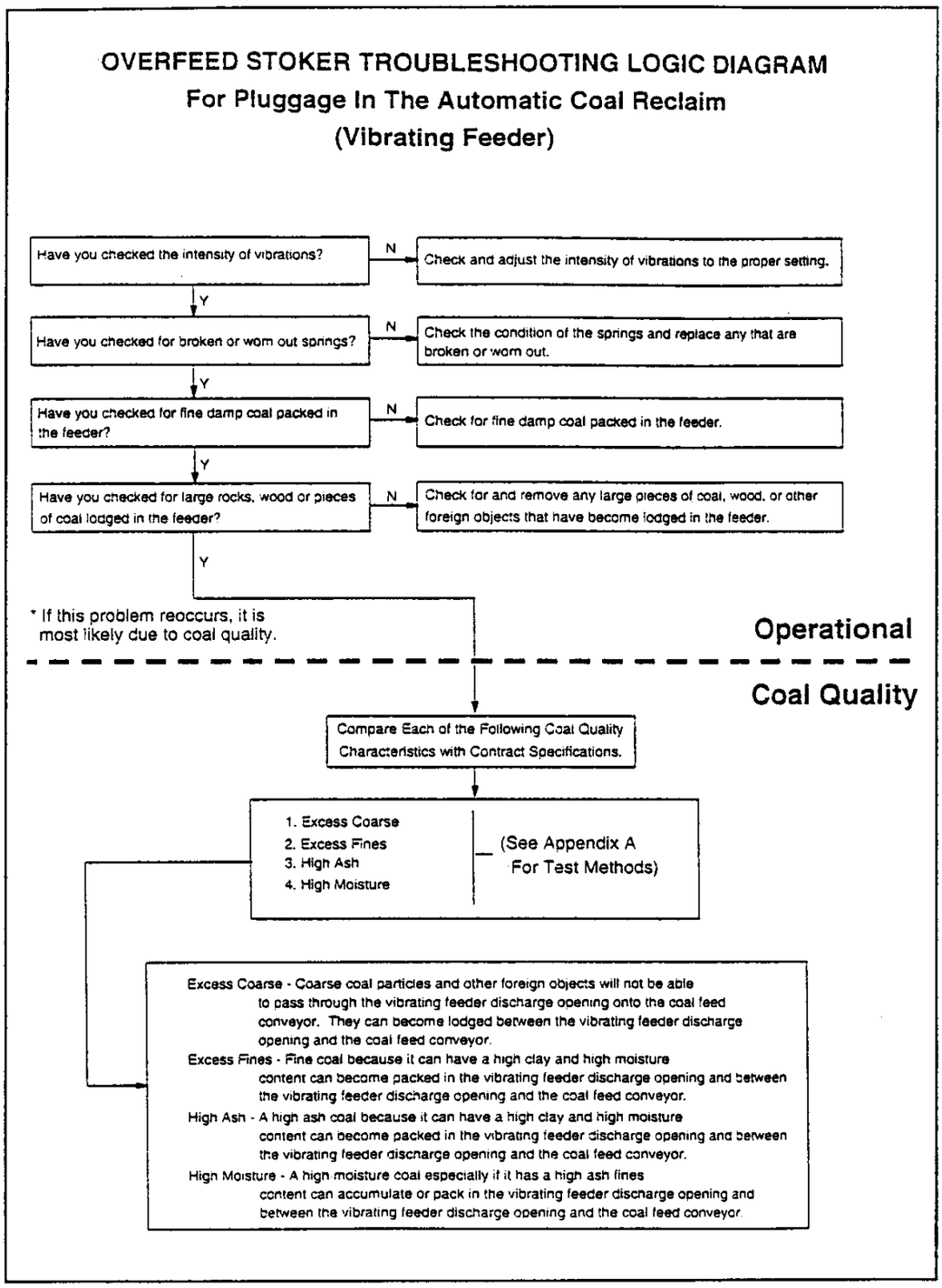

Figure 6. Pluggage in the vibrating feeder.

3 Coal Quality Related Problems

3.1 Coal Quality Definitions

Coal quality is defined in terms of properties such as size consist, heating value, moisture content, sulfur content, ash content, and ash-producing mineral impurities (clay, shale, slate, quartz, and pyrite). Unique to different coal types, these properties affect the following parameters used to measure power plant performance:

- capacity
- heat rate (efficiency)
- availability
- maintenance.

Typically, plant management strives to optimize plant performance by minimizing operating costs. The following operating costs are affected by coal quality:

- coal costs (which are a function of coal quality)
- transportation costs
- plant operating and maintenance costs
- plant performance costs (availability, efficiency, and capacity).

Additional costs associated with the purchase of higher quality coals must be at least offset by savings in transportation costs, operating and/or maintenance costs, and/or improved plant performance. Unfortunately, these trade-offs are difficult to quantify given the small amount of data available on the affect of coal quality on hoppers, grates, boiler tubes, fans, etc. Coal quality may affect plant operations and performance in ways that are still unknown, and most importantly, there is still difficulty in accurately measuring coal quality.

This TSG uses the following coal properties to measure coal quality:

- moisture content
- ash content
- sulfur content
- heating value

- volatile matter
- size consist (specifically coarse and fine sizes)
- free swelling index
- free alkali
- fixed carbon
- ash fusion temperatures
- abrasion
- flyash resistivity
- chlorine content
- flyash erosivity
- hardgrove grindability index
- relative free quartz.

Generating steam or hot water by firing coal that does not meet design specifications can cause many problems. For example:

1. *Moisture.* Moisture can increase coal transportation costs. Moisture allowed to freeze can reduce capacity and cause pluggage in coal storage bunkers and hoppers. Moisture can cause erratic feeding from stoker feeder mechanisms. During combustion, moisture trapped in the coal is vaporized reducing furnace performance.
2. *Ash.* Ash constituents existing in poorly adjusted furnace temperatures can cause clinkering on grates, as well as slagging, fouling, corrosion, and erosion of boiler components such as refractory surfaces, boiler tubes and water walls, and forced and induced draft fans. Tuyeres (grate openings), on the other hand, depend on a covering of ash to protect them from furnace heat. Low ash coal may not provide adequate protection for these surfaces, resulting in outages and excessive maintenance.
3. *Sulfur.* Sulfur can corrode boiler components. In many situations, it must be removed to meet environmental regulations.
4. *Volatile Matter.* Volatile matter affects flame temperature. Excess volatile matter can cause furnace smoking. Molten ash generated by excess volatile matter can cause slagging on heat transfer surfaces. Low volatile matter coal can increase operating costs by requiring oil or gas co-firing to maintain ignition.
5. *Size Consist.* When fired using a poorly adjusted air supply, a coal containing a high percentage of fine particles can lead to carbon carry-over in the flyash, combustible heat loss, burnt stoker grate links, and a pressure drop across the grate.

6. *Ash Fusion Temperatures.* Ash fusion temperatures describe the temperatures at which ash particles liquefy. Molten ash particles adhere readily to heat transfer surfaces, causing slagging and fouling.
7. *Grindability.* Grindability affects pulverizer capacity and auxiliary power consumption.

Improving coal quality can:

- reduce coal transportation and handling costs
- decrease plant maintenance
- reduce plant sulfur dioxide and particulate emissions
- increase power plant efficiency and availability
- reduce heat cost.

Noted that these coal quality benefits can only be realized after an operator has determined that problems encountered in the plant are in fact due to the quality of purchased coal and not to the manner in which the plant is being operated (i.e., insufficient air, poorly adjusted dampers, improper grate speed, improper coal regulating gate setting, etc.).

3.2 How To Diagnose Coal Quality Problems

On discovering a problem in plant operations, the operator should check to see if the plant is operating within design conditions and if the coal quality meets design specifications (as listed in the plant operating manual). If both conditions hold true, the operator should refer to this TSG.

The following example demonstrates proper use of this guide. Suppose the plant operator senses a steam pressure drop and reacts by increasing the stoker coal feed rate to increase heat generation. The operator then notes that the temperature within the furnace actually drops. Furthermore, on visual inspection of the furnace, the operator sees only a small amount of burning coal on the grate. The operator is likely to suspect that the problem is due to an inadequate coal supply reaching the boiler.

At this point, the operator should refer to the TSG's Component/Symptom Tables that correspond to an overfeed stoker fired boiler (Figure 2). Using these tables, the operator should match the symptom to the likely component and proceed to the figure number indicated (Figure 3). The operator is directed to the operational part of a logic diagram that formalizes his inspection of the coal feed conveyor for

pluggage (see Figure 4). The series of questions posed in the diagram focus are by no means exhaustive, but they can serve to help isolate the source of the problem. Throughout the investigation, the operator is encouraged to refer to operations manuals as well as to check other operating parameters that may be causing or worsening the problem.

If the problem still persists after completing the operational part of the logic diagram, the TSG assumes the problem to be coal quality related. The operator should then proceed to the coal quality portion of the logic diagram. Here the operator is presented with a list of coal quality characteristics ordered according to the likelihood of that quality is causing the specific problem. The operator should sample the coal and, in addition, obtain a representative coal sample for lab analysis (either by a commercial or in-house lab). In some cases, it may be more economical to analyze a sample for more than one characteristic. For example, instead of requesting a moisture analysis only, the operator may request a Proximate Analysis, which tests for moisture, volatile matter, fixed carbon, heating value, and ash content.

3.3 How To Solve Coal Quality Problems

The results of the lab analysis of the coal should be checked against the coal quality specifications in the plant's coal contract. For example, if the contract calls for delivered coal to have an ash content of 5 percent (minimum) to 10 percent (maximum), and the lab analysis indicates 8 percent ash, then delivered coal meets the contract specifications. This procedure of sampling, lab analysis, and cross-referencing these results with contract specifications should be followed for each coal quality characteristic. For each coal quality characteristic not meeting contract specifications, the operator is advised to inform the supplier that delivered coal is of unacceptable quality.

If it turns out that all coal quality characteristics meet contract specifications, but problems still persist, the operator should consider that the problem may be caused by coal quality variability. Coal quality variability describes the degree to which the measures of coal quality vary among the particles of a single coal sample. Because coal tests estimate average values, it is possible for a coal sample having a large variability to satisfy coal quality specifications and still cause operating problems. For example, if an isolated batch of coal having a higher than average moisture content enters the feeder as a group, it might cause the feeder to plug. Coal quality variability can usually be detected by repeat sampling and analysis. Multiple tests increase the likelihood that some of the results will depart significantly from the others. However, in certain situations, it is difficult to detect coal variability. In

such situations, special sampling (and sometimes special analytical) techniques are required. If coal quality variability is a potential problem, it is recommended that outside help be obtained from fuel specialists. Such information can be obtained from USACERL, or from commercial coal laboratories.

If coal specifications are satisfied and the coal quality variability is acceptable, then the operator should consult the boiler manufacturer regarding proper coal specifications.

4 Conclusion

This study has gathered and presented comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications.

The two-volume handbook provides comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications. The information is tailored for military installation industrial-sized coal-fired central energy plants. Volume I is designed as a reference and guide for the operations, management, and procurement personnel involved in using coal as a boiler plant fuel. This volume contains logic diagrams to help diagnose and correct 490 specific boiler system problems.

Glossary

Absolute pressure: Pressure above zero pressure, the sum of the gauge and atmospheric pressures.

Acid dew point: The temperature at which an acid in vapor form condenses into liquid form. specifically sulfuric acid in flue gas leaving an FGD system.

Agglomerating: The characteristic of a coal that causes coking on the fuel bed during volatilization.

Air distributor: A plate, grid or pipe containing either perforations, nozzles, or bubble caps, which serves as a means of evenly distributing combustion/ fluidizing air to support a fluidized bed.

Air-fuel ratio: The ratio of the weight, or volume of air to fuel.

Air preheater or air heater: A heat exchanger that transfers heat from a high temperature medium such as hot gas, or steam, to an incoming air stream.

(a) **regenerative air preheater**: A heat exchanger having heat exchanger surface that is alternatively exposed to hot exhaust gas and incoming ambient air. Heat is absorbed from the outgoing hot gas stream and subsequently released from the same surfaces to the incoming air stream.

(b) **recuperative air header**: A static air header in which the air and gas flows are separated by the heat transfer medium.

(c) **tubular air header**: contains bundles of heat transfer tubes that allow either fluid to flow through the tubes while the other fluid flows around and between the tubes.

(d) **plate air header**: An air header containing passages formed by spaced plates through which heat is transferred from a flowing heating medium to an air stream.

Air, saturated: Air that contains the maximum amount of water vapor that it can hold at its temperature and pressure.

Air-transport system: A fuel transport system using air as the conveying medium.

Analysis, proximate: Analysis of solid fuel stating moisture content, volatile matter, fixed carbon, heating value and ash content expressed on a percent by weight basis.

Analysis, ultimate: Chemical analysis of a fuel stating carbon, hydrogen, sulfur, nitrogen, chlorine, oxygen, and ash content expressed on a percent by weight basis.

Anthracite coal: A high ASTM ranked coal with dry fixed carbon 92 percent or more and less than 98 percent; and dry volatile matter 8 percent or less and more than 2 percent on a mineral-matter-free basis.

Arch firing: Method of firing in which burners are placed in a furnace arch and directed downward.

Arch-furnace: A horizontal structure extending into the furnace, to serve as a deflector of the gases and act as a radiant reflector.

Arch -roof: A structure composed of refractory, or combination of refractory and water tubes, enclosing the furnaces combustion chamber at the top.

As-fired fuel: Fuel in the condition as fed to the fuel burning equipment.

Ash: The incombustible inorganic matter in the fuel; i.e., the mass remaining after all combustible matter has been consumed.

Ash-bed: A layer of refuse left on grates or deposited on a furnace floor after the fuel is burned.

Ash fusion (temperatures): The temperatures at which a cone of coal or coke ash exhibits certain melting characteristics. See ASTM-DI857.

Ash gate: A gate or valve through which refuse is removed from an ash pit or soot hopper.

Ash pit: A pit or hopper located below a furnace where refuse is accumulated and from which it is removed at intervals.

Ash: The incombustible solid matter in fuel.

Ash-free basis: The method of reporting fuel analysis whereby ash is deducted and other constituents are recalculated to total 100 percent.

Baffle: A plate or wall for deflecting gases or liquids.

Bag filter: A device containing one or more cloth bags for recovering particles from the dust laden gas or air that is blown through.

Baghouse: An air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags usually made of glass fibers.

Balanced draft: The maintenance of a fixed value of draft in a furnace at all combustion rates by control of incoming air and outgoing products of combustion.

Banking: Burning solid fuel on a grate at rate sufficient to maintain ignition only.

Banking (live): Burning solid fuel on a grate in a boiler at a combustion rate just sufficient to maintain normal operating pressure under conditions of no steam/water load demand.

Barley: Anthracite coal size: No. 3 (Barley): through 3/16-in., over 3/32-in. round mesh screen.

Base/acid ratio: Total weight of the basic constituents in coal ash divided by the total weight of the acid constituents. Bases normally considered are the oxides of iron, sodium, calcium, magnesium and potassium. Acids are silicon, aluminum and titanium.

Base load: Base load is the term applied to that portion of a station or boiler load that is practically constant for long periods.

Bed material: Granular particles that compose the fluidized bed.

Bed moisture: The moisture in coal when in the seam.

Bin system: A system in which fuel is pulverized, stored in bins, and subsequently withdrawn through feeders to the burners in amounts sufficient to satisfy load demands.

Bituminous coal: ASTM coal classification by rank on a mineral-matter-free basis and with bed moisture only.

Low Volatile: Dry fixed carbon 78 percent or more and less than 86 percent; and dry volatile matter 22 percent or less and more than 14 percent.

Medium Volatile: Dry fixed carbon 69 percent or more and less than 78 percent; and dry volatile matter 22 percent or less and more than 31 percent.

High Volatile (A): Dry fixed carbon less than 69 percent and dry volatile matter more than 31 percent: Btu value equal to or greater than 14,000 moist, mineral- matter-free basis.

High Volatile (B):: Btu value 13,000 or more and less than 14,000 moist, mineral-matter-free basis.

High Volatile (C): Btu value 11,000 or more and less than 13,000 moist, mineral-matter free basis commonly agglomerating, or 8,300 to 11,500 Btu agglomerating.

Blowdown: Removal of a portion of boiler water for the purpose of reducing solids concentration, or to discharge sludge.

Blower: The fan used to force air through a pulverizer or to force primary air through an oil or gas burner register.

Boiler: A closed vessel in which water is heated, steam is generated, steam is superheated, or any combination thereof, under pressure or vacuum by the application of heat. The term does not include such facilities that are an integral part of a continuous processing unit but shall include units supplying heating or vaporizing liquids other than water where these units are separate from processing systems and are complete within themselves.

Watertube: A boiler in which the tubes contain water and steam, the heat being applied to the outside surface.

Bent tube: A watertube boiler consisting of two or more drums connected by tubes, practically all of which are bent near the ends to permit attachment to the drum shell on radial lines.

Horizontal: A watertube boiler in which the main bank of tubes are straight and on a slope of 5 to 15 degrees from the horizontal.

Scotch boiler: A cylindrical steel shell with one or more cylindrical internal steel furnaces located (generally) in the lower portion and with a bank or banks (passes) of tubes attached to both end closures.

In Stationary Service, the boilers are either of the Dry-Back, or Wet-Back Type (See Boiler Dry-Back and Boiler Wet-Back). In Marine Service, the boilers are generally of the Wet-Back Type (See Boiler Wet-Back).

Boiler convection bank: A group of two or more rows of tubes forming part of a water boiler circulatory system and to which heat is transmitted mainly by convection from the products of combustion.

Boiler efficiency: The ratio of the net energy output of the boiler fluid divided by the input of the primary energy source(s).

Boiler, high-pressure: a boiler furnishing steam at pressure in excess of 15 pounds per square inch (psi) (103 422 Pa) or hot water at temperatures in excess of 250°F (121°C) or at pressures in excess of 160 psi (1 103 168 Pa).

Boiler, high-temperature hot water: A water heating boiler operating at a pressure exceeding 160 psig (1 103 168 Pa) or temperatures exceeding 250°F (121°C).

Boiler horsepower: The evaporation of 34 ½ lbs (15.648 kg) of water per hour from a temperature of 212°F (100°C) into dry saturated steam at the same temperature. Equivalent to 33,472 Btu/hr (35291 203.20 joule).

Boiler, low-pressure hot-water and low-pressure steam: A boiler furnishing hot water at pressures not exceeding 160 psi (1 103 168 Pa) or at temperatures not more than 250°F (121°C) pr steam at pressures not more than 15 psi (103 422 Pa).

Boiler slag screen: A screen formed by one or more rows of widely spaced tubes constituting part of, or positioned in front of, a watertube boiler convection bank, and functioning to lower the temperature of the products of combustion and to serve as an ash cooling zone.

Boiler wet-back: A baffle provided in a firetube boiler or water leg construction covering the rear end of the furnace and tubes, and is completely water cooled. The products of combustion leaving the furnace are turned in this area and enter the tube bank.

Bone coal: Coal from that part of a seam that has a very high ash content. In connection with anthracite, any material that has 40 percent, or more, but less than 75 percent fixed carbon.

Breeching: A duct for the transport of the products of combustion between parts of a steam generating unit and the stack.

Bridgewall: A wall in a furnace over which the products of combustion pass.

Bridging: The accumulation of ash and slag partially or completely blocking spaces or orifices between heat absorbing tubes.

British thermal unit: The mean British Thermal Unit is 1/180 of the heat required to raise the temperature of 1 lb of water from 32°F to 212°F at a constant atmospheric pressure. It is about equal to the quantity of heat required to raise 1 lb of water 1 °F. (251.9957 calories or 1054.35 joule).

Broken coal: Anthracite coal size-through 4 3/8-in., over 3 1/4-in. round mesh screen.

Brown coal: A former coal classification according to rank now included in lignite B.

Bubbling bed: A fluidized bed in which the fluidizing velocity is less than the terminal velocity of individual bed particles where part of the fluidizing gas passes through the bed as bubbles.

Buckwheat: Anthracite coal size: No. 1 (Buckwheat): through 9/16-in., over 5/16-in. round mesh screen.

Burner: A device for the introduction of fuel and air into a furnace at the desired velocities, turbulence and concentration to establish and maintain proper ignition and combustion of the fuel.

(a) **automatic burner**: A burner that stops and starts automatically.

(b) **burner, automatically ignited**: A burner having its main fuel automatically turned on and ignited (See section L).

(c) **burner, manually ignited**: A burner having its main fuel turned on only by hand and ignited under supervision (See section L).

(d) **burner, forced draft**: A burner where air for combustion is supplied above atmospheric pressure.

(e) **burner, natural draft type**: A burner that depends principally upon the natural draft to induce the air required for combustion.

Burner windbox: A plenum chamber around a burner in which air pressure is maintained to insure proper distribution and discharge of secondary air.

Burner windbox pressure: The air pressure maintained in the windbox or plenum chamber.

Bus section: The smallest portion of the precipitator that can be independently de-energized (by subdivision of the high voltage system and arrangement of support insulators).

Bypass temperature control: Control of vapor or air temperature by diverting part or all of the heating medium from passing over the heat absorbing surfaces, usually by means of a bypass damper.

Caking: Property of certain coals to become plastic when heated and form large masses of coke.

Calcium sulfate: A solid, relatively insoluble material, with a chemical formula of CaSO4, the by-product of some FGD systems, normally formed by oxidation of Calcium Sulfite. Commonly produced as Calcium Sulfate Dihydrate, $CaSO_4 . 2H_2O$, also known as gypsum.

Calorific value: The number of heat units liberated per unit of quantity of a fuel burned in a calorimeter under prescribed conditions.

Calorimeter: Apparatus for determining the calorific value of a fuel.

Capacity: The manufacturers stated output rate over a period of time for which the boiler is designed to operate.

Capacity factor: The total output over a period of time divided by the product of the boiler capacity and the time period.

Carbon (Element): The principal combustible constituent of most fuels.

Carbonization: The process of converting coal to carbon by removing other ingredients.

Carbon loss: The unreleased chemical energy due to incomplete oxidation of the carbon in the fuel.

Carbon residue: The quantity of the carbonaceous material remaining after the volatile compounds are vaporized.

Carryover: The chemical solids and liquid entrained in the steam leaving the boiler.

Chain grate stoker: A stoker that has a moving endless chain as a grate surface, onto which coal is fed directly from a hopper.

Chimney: A brick, metal or concrete stack.

Cinder: Particles of partially burned fuel from which volatile gases have been driven off, which are carried from the furnace by the products of combustion.

Cinder-catcher: Apparatus for separating and collecting cinders from the products of combustion (see also Flyash Collector, Dust Collector, or Precipitator).

Cinder-return: Apparatus for the return of collected cinders to the furnace, either directly or with the fuel.

Clinker: A hard compact congealed mass of fuel matter fused in the furnace, usually slag.

Clinkering: The formation of clinkers.

Clinker grinder stoker: One in which the refuse is discharged into a pit containing at the bottom, one or more grinding rolls that are continuously or intermittently operated to produce a positive discharge of crushed refuse to the ash pit.

Coal: Solid hydrocarbon resulting from the decomposition of vegetal material under the influence of time, temperature, pressure and micro-organisms.

Coal-burner: A burner for use with pulverized coal.

Collecting system: The grounded portion of the precipitator to which the charged dust particles are driven and to which they adhere.

Collecting surfaces: The individual elements that make up the collecting system and that collectively provide the total area of the precipitator for the deposition of dust particles.

Collecting surface rapper: A device for imparting vibration or shock to the collecting surface to dislodge the deposited particles or dust.

Collecting surface area: The total flat projected area of collecting surface exposed to the active electrostatic field (length x height x 2 x number of gas passages).

Collection efficiency: The weight of dust collected per unit time divided by the weight of dust entering the precipitator during the same unit time expressed in percentage.

Collection efficiency: The percentage of sulfur dioxide collected by an FGD system, calculated by dividing the weight of sulfur dioxide collected by the system by the weight of sulfur dioxide entering the system and multiplying by one hundred percent. Also extends to particulate collection.

Combustible: The heat producing constituents of a fuel.

Combustible in ash: Combustible matter in the solid ash resulting from the incomplete combustion of fuel.

Combustible loss: The unreleased chemical energy due to incomplete oxidation of the combustible matter in the fuel.

Combustion chamber: An enclosed space provided for the combustion of fuel.

Commercial boiler: A boiler that produces steam or hot water primarily for heating in commercial applications with incidental use in process applications. Commercial boilers come in a wide range of types, sizes, capacities, pressures and temperatures. They may also be supplied for more than one application.

Complete combustion: The complete oxidation of all the combustible constituents of a fuel.

Convection: The transmission of heat by the circulation of a liquid or a gas such as air. Convection may be natural or forced.

Convection heating surface: Heating surface over or through which hot combustion gases flow to transfer heat primarily by convection. (See Heating Surface, Section G.).

Corrosion: The wasting away of metals due to chemical action in a boiler usually caused by the presence of H_2, O_2, CO_2, an acid or strong alkalies.

Cyclone: A stationary centrifugal type separator used to separate pulverized fuel from pulverizer air in storage system.

Cyclone collector: A device that uses centrifugal force to pull large particles from polluted air.

Cyclone furnace: Specialty furnace for high intensity heat release. So named because of its swirling gas and fuel flows.

Damper: A device for introducing a variable resistance for regulating the volumetric flow of gas or air.

(a) **butterfly type**: A single blade damper pivoted about its center.

(b) **curtain type**: A damper, composed of flexible material, moving in a vertical plane as it is rolled.

(c) **flap type**: A damper consisting of one or more blades, each pivoted about one edge.

(d) **louvre type**: A damper consisting of several blades, each pivoted about its center and linked together for simultaneous operation.

(e) **slide type**: A damper consisting of a single blade that moves substantially normal to the flow.

Damper loss: The reduction in the static pressure of a gas flowing across a damper.

Damper control: See Bypass Temperature Control.

Design load: The load for which a steam generating unit is designed, usually considered the maximum load to be carried.

Design pressure: The pressure used in a design of a boiler for the purpose of determining the minimum permissible thickness or physical characteristics of the different parts of the boiler.

Design steam temperature: The temperature of steam for which a boiler, superheater or reheater is designed.

De-slag: The removal of slag that has adhered to heat absorbing surfaces.

Dew point: The temperature at which condensation starts.

Direct-fired boiler: Commonly used to denote a boiler and furnace fired by pulverized coal directly from the pulverizing mills.

Draft: The difference between atmospheric pressure and some lower pressure existing in the furnace or gas passages of steam generating unit.

Draft loss: The drop in the static pressure of a gas between two points in a system, both of which are below atmospheric pressure, and caused by resistance to flow.

Dry ash: Non-combustible matter in the solid state, usually in granular dust form.

Dry, ash free basis (daf): The method of reporting fuel analysis with ash and moisture eliminated and remaining constituents recalculated to total 100 percent.

Dry bottom furnace: A pulverized-fuel furnace in which ash particles are deposited on the furnace bottom in a dry, non-adherent condition.

Dry, fuel basis (d): The method of reporting fuel analysis with moisture eliminated and other constituents recalculated to total 100 percent.

Dry, mineral-matter-free basis (dmmf): The method of reporting fuel analysis with moisture and ash, plus other mineral matter eliminated and remaining constituents recalculated to total 100 percent.

Dry steam: Steam containing no moisture. Commercially dry steam containing not more than one half of one percent moisture.

Dulong's formula: A formula for calculating the approximate heating value of solid fuels from the ultimate analysis.

Dust collector: A device designed to remove flyash in dry form from flue gas (See also Cinder-Catcher and Flyash Collector.).

Dust loading: The weight of solid particulate suspended in an air (gas) stream, usually expressed in terms of grains per cu ft, grams per m^3 or lb/1000 lb of gas.

Economizer: A heat recovery device designed to transfer heat from the products of combustion to boiler feedwater.

Efficiency: The ratio of output to the input. The efficiency of a steam generating unit is the ratio of the heat absorbed by water and steam to the heat in the fuel fired.

Electrostatic precipitator (Esp): An air pollution control device that imparts an electrical charge to particles in a gas stream causing them to collect on an electrode.

Entrainment: The conveying of particles of water or solids from the boiler water by the steam.

Erosion: The wearing away of refractory or of metal parts by the action of slag, flyash or soot blower jet streams.

Erosion: Wearing away due to mechanical action.

Excess air: Air supplied for combustion in excess of that theoretically required for complete oxidation.

Fabric filter: A cloth device that catches dust and particles from industrial or utility emissions.

Fan: A machine consisting of a rotor and housing for moving air or gases at relatively low pressure differentials.

Fineness: The percentage by weight of a standard sample of a pulverized material that passes through standard screen of specified mesh when subjected to a prescribed sampling and screening procedure (ASTM D 197).

Fines: Commonly the percentage of coal that passes through a 1/4-in. screen.

Fixed ash: The portion of the ash derived from the original vegetation including all intimately contained minerals.

Fixed carbon: The carbonaceous residue less the ash remaining in the test container after the volatile matter has been driven off in making the proximate analysis of a solid fuel.

Flue gas: The gaseous products of combustion in the flue to the stack.

Flue gas desulfurization (fgd): A method of controlling sulfur dioxide emissions by removing the sulfur compounds from the flue gas after combustion.

Fluidized: The act of blowing air or gas through a bed of finely divided solid particles at such a velocity that the particles separate and behave much like a fluid.

Fluidized bed: A process where a bed of granulated particles are maintained in a mobile suspension by an upward flow of air or gas.

Fluidized bed boiler: A boiler using a fluidized bed combustion process.

Fluidized bed combustion: A process where a fuel is burned in a bed of granulated particles that are maintained in a mobile suspension by the forward flow of air and combustion products.

Flyash: Suspended ash particles carried in the flue gas.

Flyash collector: A device designed to remove flyash in dry form from the flue gas. (See also Dust Collector or Cinder-Catcher.).

Forced draft fan: A fan supplying air under pressure to the fuel burning equipment.

Fouling: The accumulation of solid matter in gas passages or on heat absorbing surfaces that results in undesirable restrictions to the flow of gas or heat. The entrapment of incombustible ash particles in the solidified (condensed) mineral matter adhering to tube surfaces.

Free ash: Ash that is not included in the fixed ash.

Grindability: A characteristic of a coal relating to the ease of its pulverization. The grindability index of a standard selected coal was given the factor 100. Coals harder to grind have a lower index number. The index is a factor in pulverizer selection.

Hardness: A measure of the amount of calcium or magnesium salts in a boiler water. Usually expressed as grains per gallon or ppm as $CaCO_2$.

Heat exchanger: A vessel in which heat is transferred from one medium to another.

Hemispherical temperature: A fusion temperature at which a standard ash cone when heated in accordance with a prescribed procedure (ASTM-1857) has fused down to a hemispherical lump at which point the height is one-half the width of the base (H=1/2W).

Higher heating value: The total heat obtained from the combustion of a specified amount of fuel that is at 60 °F when combustion starts, and the combustion products of which are cooled to 60 °F before the quantity of heat released is measured.

Hopper: A charger or bin used for holding coal or refuse.

Hopper capacity: The total volumetric capacity of hoppers measured from a plane 10 in. below high voltage system to hopper outlet flange.

Ignition arch: A refractory arch, or surface, located over a fuel bed to radiate heat and promote continued ignition.

Ignition temperature: Lowest temperature of a fuel at which combustion becomes self-sustaining.

Incomplete combustion: The partial oxidation of the combustible constituents of a fuel.

Induced draft fan: A fan supplying air under pressure to the fuel burning equipment.

Industrial boiler: A boiler that produces steam or hot water primarily for process applications for industrial use with incidental use for heating. Industrial boilers cover a wide range of sizes, capacities, pressures, and temperatures. They may also be supplied for more than one application (cogeneration, etc.).

Lignite A: A coal of low ASTM ranking with calorific value limits on a moist, mineral-matter-free basis between 6,300 and 8,300 Btu/lb.

Lignite B: A coal of lowest ASTM ranking with calorific value limits on a moist, mineral-matter-free basis less than 6,300 Btu/lb.

Lime: Calcium oxide (CaO), a chemical used in some FGD systems that is mixed with water from calcium hydroxide ($Ca(OH)_2$).

Limestone: Calcium carbonate (CaCO3), a chemical used on some FGD systems.

Liquid slag: Slag in a fluid state.

Load: The actual instantaneous output rate of a boiler.

Load factor: See Capacity Factor.

Maximum continuous load: See Capacity.

Maximum continuous rating: See Capacity.

Mechanical draft: The negative pressure created by mechanical means.

Mineral-matter-free basis (mmf): The method of reporting coal analysis whereby the ash plus other minerals that are in the original coal are eliminated and the other constituents recalculated to total 100 percent.

Moisture: Water in the liquid or vapor phase.

Moisture and ash-free basis: Method of reporting coal analysis: Dry, Ash Free Basis.

NOx emissions: NO and NO_2 constituents in the boiler exiting flue gas.

Opacity: The degree to which emissions reduce the transmission of light and obscure the view of an object in the background. Usually defined as a percentage between zero and 100 percent. At zero percent, light is completely unobstructed and at 100 percent, light is completely obstructed. (Opacity numbers with respect to boiler emissions are not intended to include the effect of condensing water vapor).

Overfire air: Air admitted to the furnace above a matrix of burners for promoting staged combustion firing, thus reducing NOx formation.

Overfire air fan: A fan used to provide air to a combustion chamber above the fuel bed.

Particulate loading: See dust loading.

Particulates: Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in the air or emissions.

Pneumatic conveying: The transportation of fuel through a conduit by air.

Precipitator: A single precipitator is an arrangement of collecting surfaces and discharge electrodes contained within one independent housing.

Precipitators: Air pollution control devices that collect particles from an emission source by mechanical or electrical means.

Preheat air: Air introduced with the fuel at the burners.

Primary air: Air introduced with the fuel at the burners.

Pressure drop: The difference in pressure between two points in a system.

Primary air fan: A fan to supply primary air for combustion of fuel.

Products of combustion: The gases, vapors, and solids resulting from the combustion of fuel.

Proximate analysis: See Analysis, Proximate.

Pulverized fuel: Solid fuel reduced to a fine size, such as 70 percent through a 200 mesh screen.

Pulverized-fuel feeder: An apparatus for the controlled delivery of pulverized fuel from a storage bin.

Pulverizer: A machine that reduces a solid fuel to a fineness suitable for burning in suspension.

(1) **High Speed (over 800 rpm)**

(a) **impact pulverizer**: A machine wherein the major portion of the reduction in particle size of the fuel to be pulverized is effected by fracture of larger sizes by sudden shock, impingement, or collision of the fuel with rotation members and casing.

(b) **attrition pulverizer**: A machine wherein the major portion of the reduction on particle size is by abrasion, either by pulverizer parts on coal, or by coal on coal.

(2) **Medium Speed (between 70 and 300 rpm)**

(a) **roller pulverizer**: A machine having grinding elements consisting of conical or cylindrical rolls and a bowl, bull-ring mating rings, or table, any of which may be the rotating member, the fuel to be pulverized being reduced in size by crushing or attrition between the rolls and the rings.

(b) **ball pulverizer**: A machine in which the grinding elements consist of one or more circular rows of metal balls arranged in suitable raceways, wherein the fuel to be pulverized is reduced in size by crushing and attrition between the balls and raceways.

(3) **Low Speed (under 70 rpm)**

(a) **ball or tube pulverizer**: A machine having a rotating cylindrical or conical casing charged with metal ball or slugs and the fuel to be pulverized, reduction in particle size being effected by crushing and attrition due to continuous relative movement of the charge on rotation of the casing.

Pulverizer air: Air passed through a pulverizer to dry and convey the pulverized fuel to the burners in direct-fired systems, or to cyclones in storage systems (Gas is sometimes used for the same purpose in storage systems).

Pulverizer exhauster: A fan connection to the outlet of a pulverizer and used to draw pulverizer air through a pulverizer and in some cases to augment the pulverizer air by addition of primary air.

Rated capacity: See Capacity.

Refractory: A concrete like material having the ability to retain its physical shape when subjected to high temperatures.

Refractory baffle: A baffle of refractory material.

Refractory wall: A wall made of refractory material.

Rice: Anthracite coal size: No. 2 (Rice): through 5/15-in., over 3/16-in. round mesh screen.

Screw feed: A means of introducing fuel by rotation of a screw.

Scrubber: An apparatus for the removal of solids and objectionable materials from gases.

Secondary air: Combustion air supplied to the furnace to supplement the primary air.

Slag: Molten or fused solid matter.

Slag blower: See Soot Blower.

Slag viscosity: Flow characteristics of coal slags in the plastic region.

Smoke: Small gas borne particles of carbon or soot, less than 1 micron (0.001 mm) in size, resulting from incomplete combustion of carbonaceous materials and sufficient in number to be observable.

Smoke: Particles suspended in air after incomplete combustion of materials containing carbon.

Softening temperature: The temperature at which a standard ash cone fuses down to a spherical mass in which the height is equal to the width of the base when heated in accordance with a prescribed procedure (ASTM D-1857).

Soot: Unburned particles of carbon derived from hydrocarbons.

Soot blower: A mechanical device for discharging steam, air or water to clean heat absorbing surfaces. May be either a fixed-position rotary unit, a retractable soot blower, or a wall blower.

SOx: A notation meaning oxides of sulfur.

Spalling: The breaking off of the surface refractory material as a result of internal stresses resulting from an excessive temperature gradient.

Stack: A vertical conduit that discharges combustion products into the atmosphere. Also known as a chimney or smokestack.

Sub-bituminous coal: An intermediate rank coal between lignite and bituminous with more carbon and less moisture than lignite:

A. Btu 10,000 or more and less then 11,500
B. Btu 9,500 or more and less than 10,500
C. Btu 8,300 or more and less than 9,500.

Superheater: A group of tubes that absorb heat from the products of combustion to raise the temperature of the steam passing through the tubes above its saturation temperature.

(a) **convection superheater**: A superheater so arranged and located to absorb heat from the products of combustion mainly by convection.

(b) **radiant superheater**: A superheater so arranged and located to absorb heat by radiation.

(c) **baretube superheater**: A superheater in which all of the heating surface consists of the external surface of the tubes.

(d) **fin superheater**: A superheater made up of elements with extended surface.

(e) **girth superheater**: A superheater of a horizontal return tubular boiler in which the superheater elements are wrapped partially around the shell.

(f) **interbank superheater**: A superheater located in a space between the tube banks of a bent tube boiler.

(g) **interdeck superheater**: A superheater located in a space between tube banks of a straight tube boiler.

(h) **intertube superheater**: A superheater the elements of which are located between tubes of a boiler convection bank.

(I) **overdeck superheater**: A superheater located above the tube bank of a straight tube boiler.

Surface moisture: That portion of the moisture in the coal that comes from external sources as water seepage, rain, snow, condensation, etc.

Tempering moisture: Water added to certain coals that, as received, have insufficient moisture content for proper combustion on stokers.

Total moisture: The sum of inherent moisture and surface moisture in coal.

Ultimate analysis: See Analysis, Ultimate.

Underfire air: Combustion air delivered to a furnace through openings in furnace wall(s) located below main fuel/combustion air burner openings. Applied to influence thermal NOx development.

Volatile matter: Those products given off by a material as gas or vapor, determined by definite prescribed methods.

Water cooled baffle: A baffle composed essentially of closely spaced boiler tubes.

Water cooled wall: A wall cooled by watertubes.

Windbox: A chamber below the grate or surrounding a burner, through which air under pressure is supplied for combustion of the fuel.

Windbox pressure: The static pressure in the windbox of a burner, firing system or stoker.

Abbreviations and Acronyms

ABMA	American Boiler Manufacturers Association
AFBC	Atmospheric Fluidized Bed Combustion
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
ASTM	American Society for Testing and Materials
B&W	Babcock and Wilcox
DOD	Department of Defense
CE	Combustion Engineering
CERL	Construction Engineering Research Laboratory
EPRI	Electric Power Research Institute
FSI	Free Swelling Index
HGI	Hardgrove Grindability Index
PC	Pulverized Coal
TSG	Troubleshooting Guide
RFQ	Relative Free Quartz

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The mechanisms involved in the combustion of coal are so complex that it is often difficult for central energy plant personnel to quantify the impact of coal quality on boiler operating and maintenance costs. Since many DOD installations employ coal-fired central energy plants, the U.S. Army Construction Engineering Research Laboratories (USACERL) was tasked with developing a Coal Use Handbook for use at Department of Defense (DOD) installations.

This Handbook provides comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications. The Handbook is tailored for military installation industrial-sized, coal-fired central energy plants. Each section focuses on a different aspect coal quality: developing coal quality-based procurement specifications, measuring and monitoring coal quality throughout the coal use cycle, or identifying and solving boiler coal quality-related problems. The handbook is published in two volumes:

Volume 1: Technical Reference

Volume 2: Coal Specifications Troubleshooting Guide.

Volume 1 is designed as a reference and guide for operations, management, and procurement personnel involved in using coal as a boiler plant fuel. Volume 2 provides logic diagrams to help diagnose and correct 490 specific boiler system problems.

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