

Appendix D: Top-Feed Static Grate Stoker-Fired Boiler System Descriptions and Troubleshooting Diagrams

This TSG Appendix deals with identifying and solving potential coal quality-related problems that may be encountered in the top feed static grate stoker-fired boiler system. A general description of the system is included, but is limited to describing the system currently operating at the Fliegerhorst Heating Plant, manufactured by Kewanee Boilers of the United States, and at the Baumholder Heating Plant manufactured by Robey of Lincoln Ltd., West Germany.

This Appendix includes a generalized block flow diagram of a complete overfeed stoker-fired boiler system that:

- identifies the specific components comprising the major subsystems of an overfeed stoker-fired boiler system
- logically presents the flow of coal, flue gas, and ash through the system
- helps determine the existence and location of subsystems and specific components comprising the system.

Following the block flow diagram is a component/symptom table that serves to identify:

- typical symptoms (problems) that may be encountered in the system
- the various components shown in the block flow diagram affected by these symptoms
- the logic diagram to determine whether the problem is due to operational procedures or to out-of-specification coal.

The Troubleshooting Logic Diagrams for this Appendix are presented next. However, before proceeding, the reader is encouraged to read Chapter 2 to understand the structure of each Appendix and how to apply these logic diagrams to diagnosing coal quality-related problems. The Glossary, List of Abbreviations, and References preceding the Appendixes should resolve any questions that arise regarding terminology and laboratory procedures.

D1 System Description

D1.1 The Fliegerhorst Heating Plant

The Fliegerhorst Heating Plant consists of four identical units manufactured by Kewanee Boilers in the United States. The recorded thermal design of each boiler is approximately 5.86 MW, with a total plant capacity of 23.45 MW. The units are three-pass, fire-tube, wet back boilers with an allowable working pressure of 10 bars (145 psig).

Delivered coal is normally unloaded directly into a hydraulically activated, tilting Kipp bunker for direct feed to the boiler day bunkers or, alternately, to adjacent garage-type coal storage enclosures. The coal storage facilities consist of six enclosed but open-front sectionalized garage bins, with an aggregate capacity of approximately 800 metric tons. It is possible to by-pass the tilting Kipp bunker and pneumatically convey coal from the garage bins to the boiler day bunkers. Coal is unloaded with moveable, inclined, vibratory conveyors and flexible hose connections to the pneumatic conveying system.

Coal stored in the Kipp bunker is pneumatically conveyed to two 6-ton/day bunkers located above each boiler. Coal is withdrawn from the bottom of a day bunker with a speed-controlled auger, is pneumatically conveyed to a cyclone separator on top of the boiler, and then is fed to a fixed grate via an integral drop tube and a cast iron cone, which distributes the coal onto a stationary grate. As the coal level in 1-day bunker drops, a level probe is activated to switch to the reserve bunker and refill the now-empty bunker. Alternate filling and emptying of the bunkers is carried out under automatic control. The coal feed rate is controlled automatically to respond to firing-rate changes by:

- preadjusting the variable-speed feed augers from the day bunkers
- automatically activating the pneumatic conveying system supplying coal to the cyclone separator.

The control variable is boiler steam operating pressure.

Ash is removed from the boiler hearth by manual hand-ranking. The ash is raked into standard ash dollies at the front of each boiler and is manually wheeled outside the building, where it is dumped onto the ground for truck disposal. Ash-removal procedures involve a systematic shutdown of the forced-air and coal-feed systems prior to opening the hearth door.

A forced-draft fan mounted on the front and top of each boiler supplies both primary and secondary combustion air. Control dampers regulate the split, with secondary air passing down the outside of the coal feed drop tube and primary air moving through a wind box and the underside of the hearth grates. The boilers are operated under positive pressure (about 0.25 to 0.30 psig). The boilers as presently installed do not have any means of adjusting the amount of excess air provided to the boilers for combustion. The amount of excess air is pre-set by the size of the orifice plate through which the air is supplied.

Flue gas is withdrawn from the combustion chambers and passes through a multi-cyclone dust collector (one for each boiler). Flyash and grit collected in the multi-cyclone units are screw conveyed into dedicated pneumatic conveyors for reinjection into the combustion chambers of individual boilers. Flue gas is withdrawn from the multi-cyclone dust collectors by induced draft fans and discharged to the atmosphere through individual boiler chimney stacks. The induced-draft fans supply the energy necessary for operating the multi-cyclone dust collectors.

D1.2 The Baumholder Heating Plant

The Baumholder Heating Plant consists of four identical 5.814 MW units manufactured by Robey of Lincoln Ltd. The total plant capacity is 23.256 MW. The units are three-pass, combined flame/smoke-tube wet-back boilers with an allowable working pressure of 10 bars (145 psig).

Coal is delivered into the coal yard by train and is tipped from a coal hopper in the yard, conveyed to the roof of the heating plant by a vertical chain-conveyor system, and dropped into a horizontal chain-conveyor system that moves the coal into day bunkers. The capacity of each day bunker is 325 metric tons, sufficient for 7 operating days at full load. There is a coal-weighing system at the intersection of the vertical and horizontal conveyors.

Coal is moved from each day bunker by a screw conveyor and pneumatic conveyor system (controlled in accordance with the desired boiler load) through the steam and water area of the system to the center of the fixed grate of each boiler, where the distributor mechanism feeds coal evenly throughout the grate.

Ash is removed from the boiler hearths manually into a filling bin, from which it is passed through a slag breaker for size reduction. The ash is then moved via a bucket wheel sluice into an ash bunker.

Primary air is directed to the underside of the grate by a blower located on one side of the boiler. Secondary air is introduced into the coal-feed conveyor and directed downward onto the grate, thus developing a slight overpressure within the furnace. Regulation of primary and secondary air is accomplished through an automatic control system on the blowers.

The flue gases are passed through a cyclone dust collector and then into the stack via an induced-draft fan and breeching system. The fine particulates separated in the dust collector are returned to the furnace by means of a pneumatic conveying system.

D2 Block Flow Diagram

The stoker-fired boiler system has been divided into 15 specific subsystems or components (the performance of which can be significantly impacted by coal quality) sequentially arranged to show:

- coal flow through the coal handling equipment
- flue gas flow through the boiler/components, flyash recycle, the induced draft fan, and chimney/stack
- ash discharge to the ash dollies.

These specific components are identified in Figure 4-1. The first five components have been grouped collectively under a category entitled coal handling equipment. The coal handling equipment includes all components that process the coal from its delivery on site to the cyclone separator. It includes equipment that, depending on plant design, may include:

- coal reclaim systems such as belt feeders, vibrating feeders, screw feeders and reciprocating feeders
- coal feed conveyors such as belt conveyors, screw conveyors, bucket conveyors, redler conveyors, pneumatic conveyors, and chutes
- components that store the coal such as bunkers and hoppers
- the cyclone separator that distributes the coal onto the grate.

The next four components have been loosely grouped under the category entitled Boiler/components. Again, it includes equipment that, depending on plant design, may include:

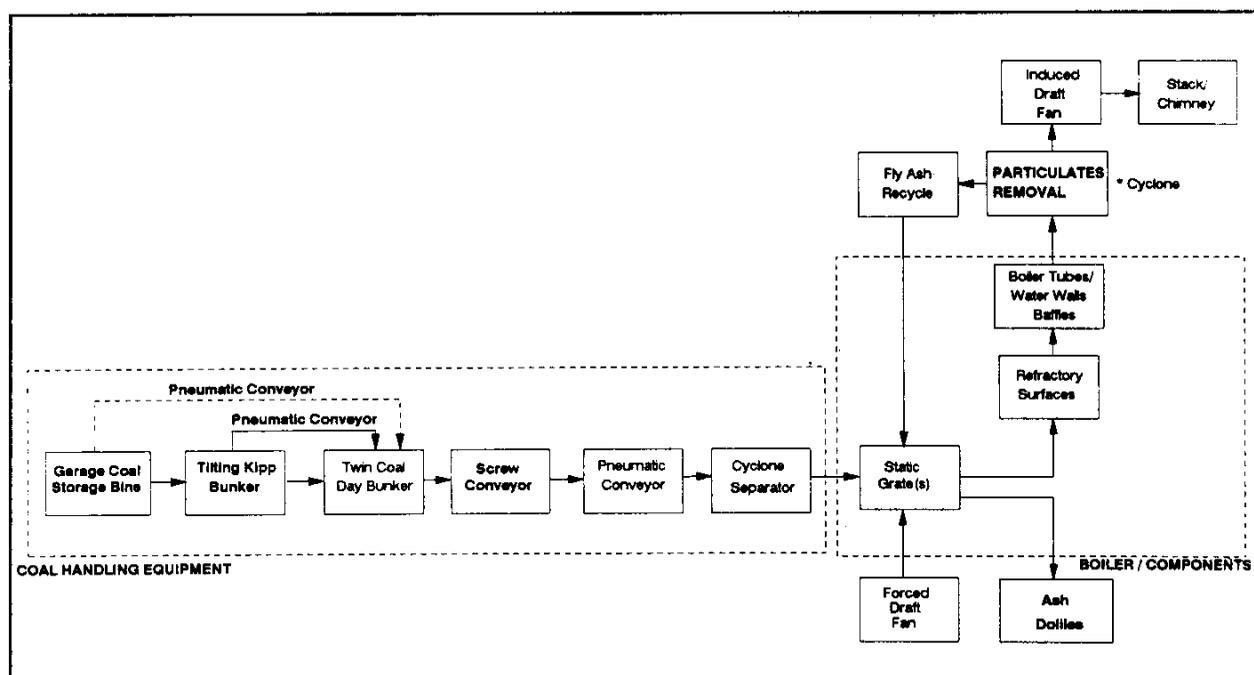


Figure 4-1. Top feed static grate stoker-fired boiler system components block flow diagram.

- forced draft fan
- grates—specifically stationary
- refractory surfaces
- heat transfer surfaces (boiler tubes, water walls and baffle).

The next two blocks represent the flyash recycle and the particle removal subsystem. Three particulate removal options separately or in combination will be considered: cyclones, electrostatic precipitators, and baghouses.

The next subsystem identified in the block flow diagram is the fan subsystem. Top-feed static grate stoker-fired boiler systems use a number of fans to move air and flue gas. The major fan types addressed in the guide include:

- forced draft (FD) fans, which supply undergrate air
- induced draft (ID) fans, which withdraw flue gas from the furnace and balance furnace pressure.

All the fans can be impacted by changes in coal quality.

The final subsystems addressed in the Guide include those components supplied to handle ash. Specific components include the chimney/stack and the ash hopper/pit.

D3 Troubleshooting Logic

The component/symptom guide table (Figure 4-2) serves to identify:

- Typical symptoms (problems) that may be encountered in top-feed static grate stoker-fired boiler systems. These symptoms are arranged horizontally along the top of the table
- The various components shown in the block flow diagram affected by these symptoms. These components are listed down the left hand side of the table in the same logical fashion as they are arranged in the block flow diagram
- The logic diagrams.

The remainder of this Appendix consists of 53 logic diagrams, arranged by component and by all the symptoms that can affect that component.

I-2 (Part 1): TOP FEED STATIC GRATE STOKER - COMPONENT/SY

COMPONENT	EXCESS WEAR	PLUGS SYMPTOM	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLUNKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO ₂ EMISSIONS
COAL HANDLING EQUIPMENT																				
Coal Bunker	•	•	•																	
Automatic Coal Reclaim																				
Screw Feeder	•	•	•	•																
Coal Feed Conveyor																				
Pneumatic Conveyor	•	•	•	•																
Cyclone Separator	•	•	•	•																
BOILER / COMPONENTS																				
Boiler		•													•					
Static Grate					•	•	•	•	•	•	•	•	•	•						
Refractory Surfaces					•											•	•			
Boiler Tubes/Water Walls					•											•	•	•		
Baffles					•											•	•	•	•	

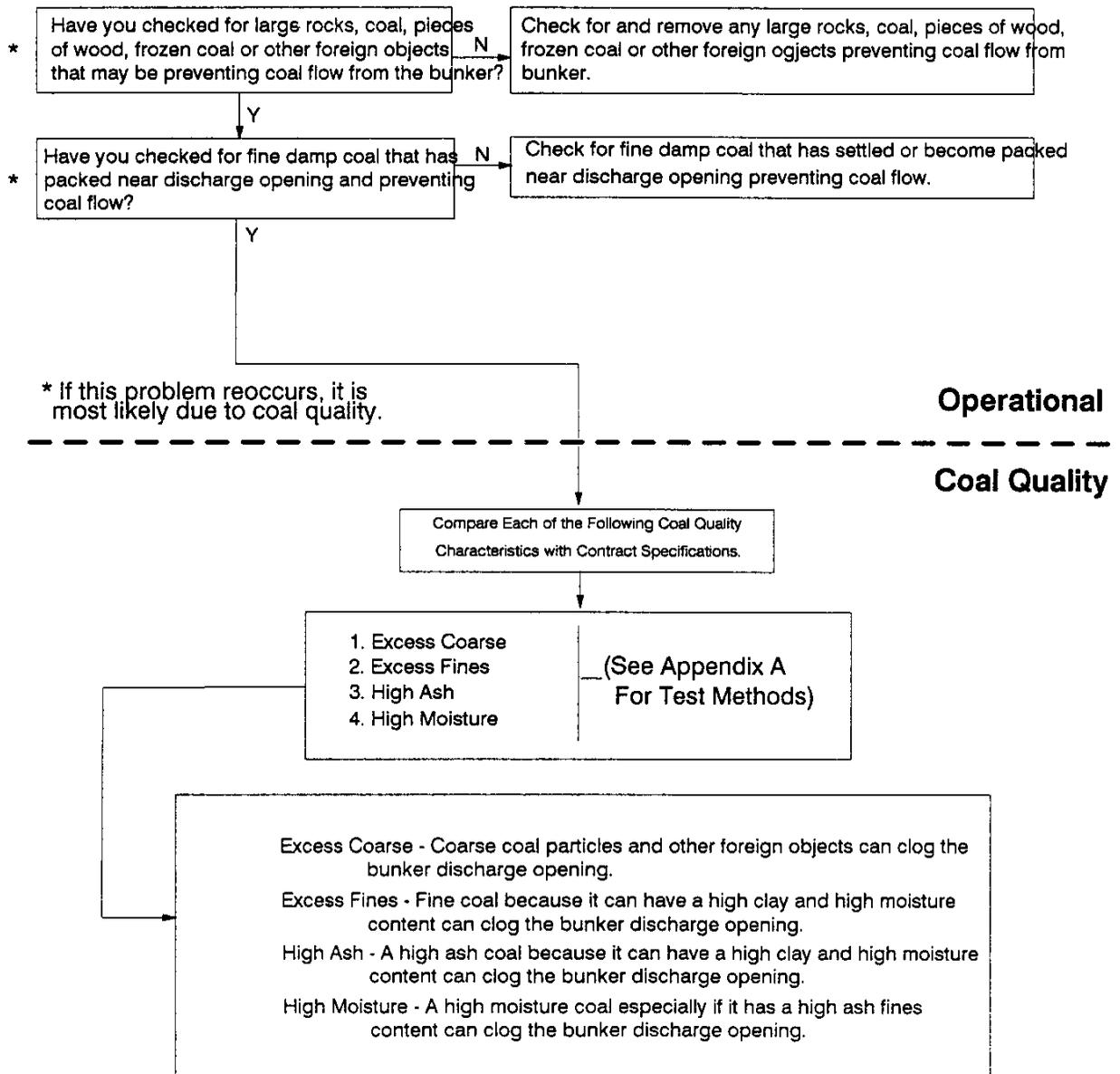
Figure 4-2. Top feed static grate stoker—component symptom guide (part 1).

FIGURE 4-2 (Part 2): TOP FEED STATIC GRATE STOKER - COMPONENTS/SYMPTOM GUIDE

COMPONENT	EXCESS WEAR	PLUGGAGES/SYMPTOM	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/FALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
FANS																				
1) Forced Draft		● 4-39												● 4-40						
2) Induced Draft		● 4-41		● 4-42										● 4-43	● 4-44					
PARTICULATE REMOVAL																				
Cyclone												● 4-45		● 4-46				● 4-47		
ASH HANDLING																				
1) Fly Ash Recycle													● 4-48							
2) Ash Dollie												● 4-49	● 4-50							
Stack/Chimney				● 4-51								● 4-52		● 4-53				● 4-54	● 4-55	

Figure 4-2. Top feed static grate stoker—component symptom guide (part 2).

**FIGURE 4-3: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
for Pluggage In The Coal Bunker**



**FIGURE 4-4: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Bunker**

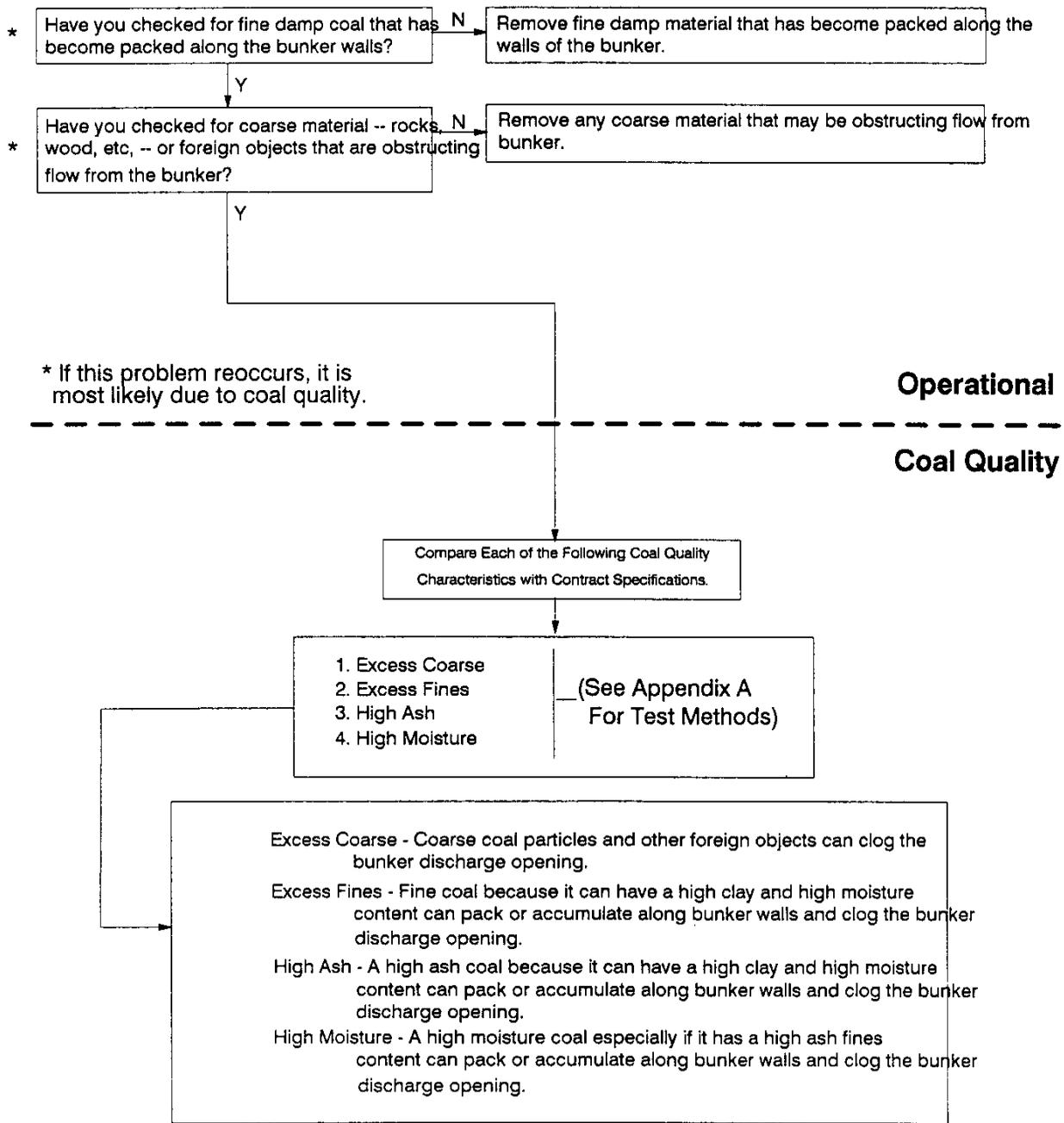


FIG4-4N/1

**FIGURE 4-5: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Bunker**

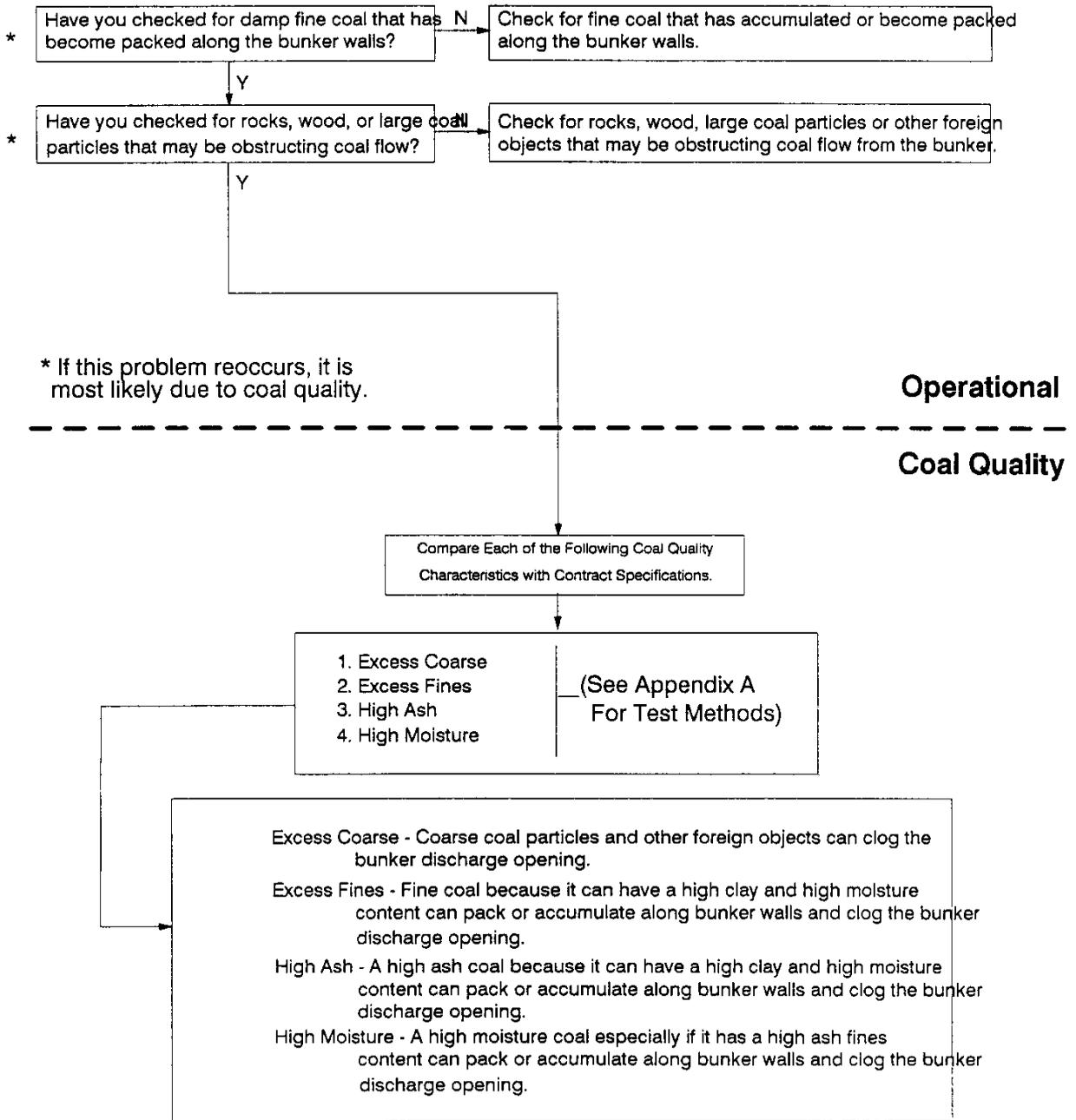
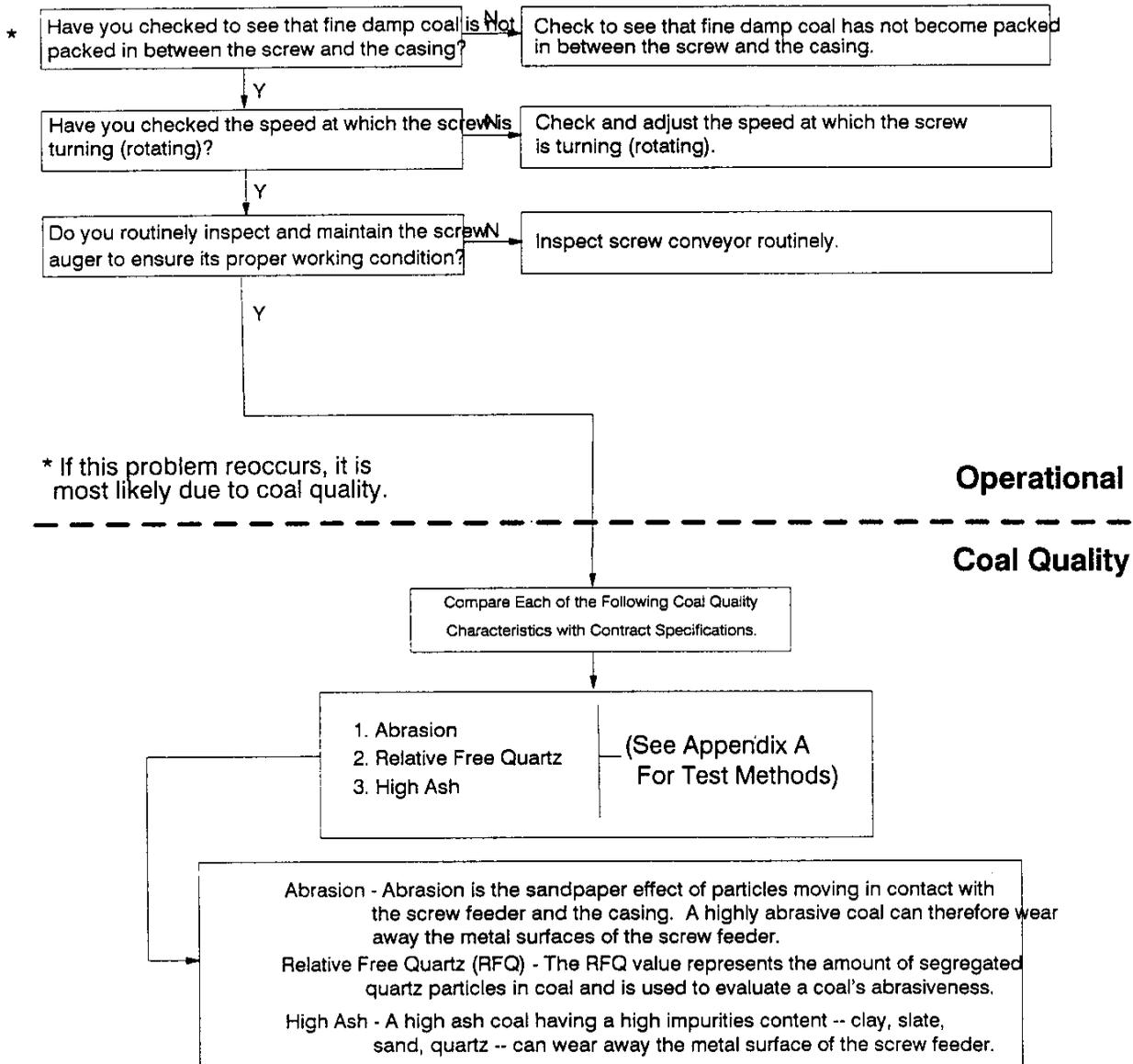
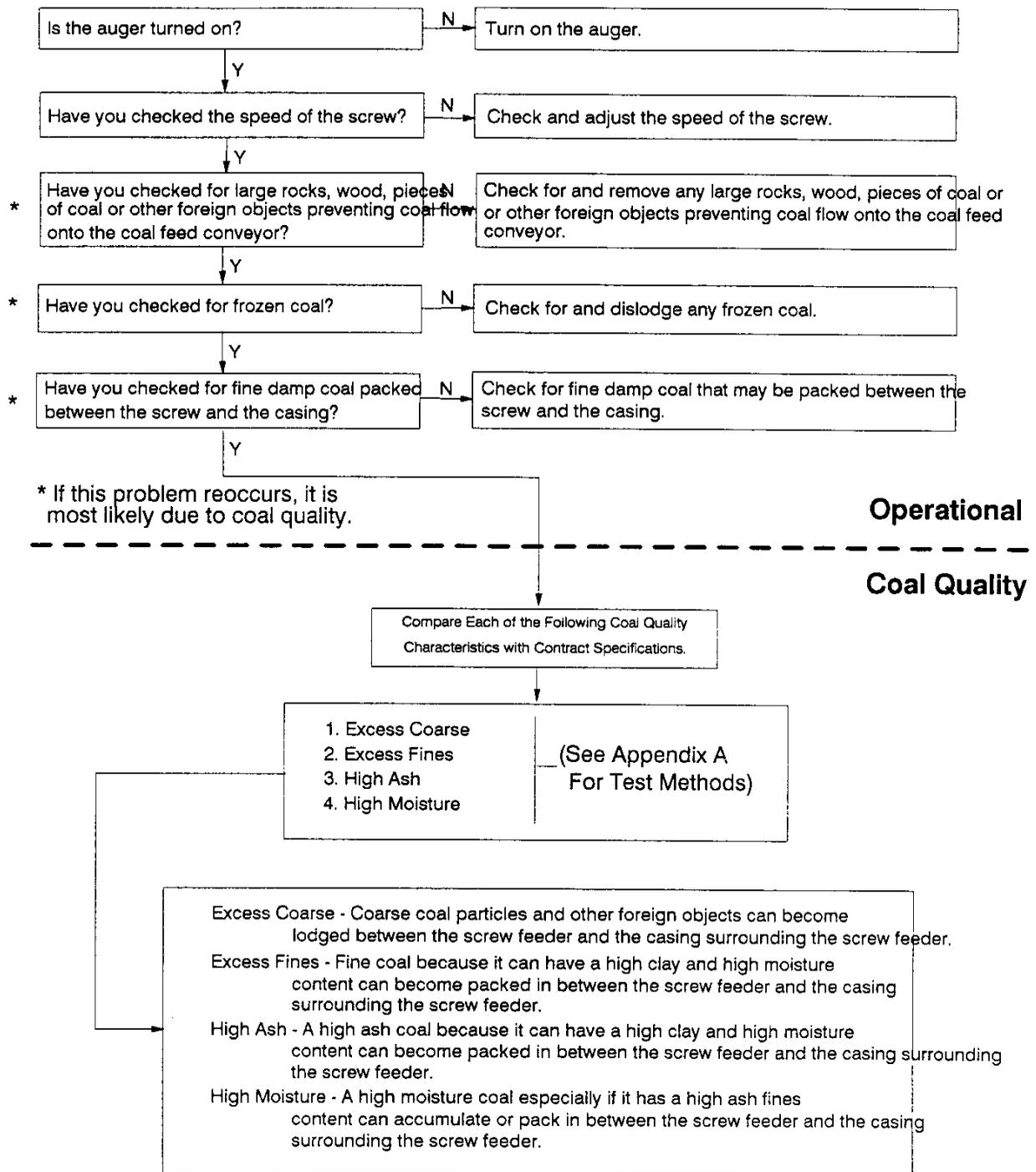


FIGURE 4-6: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Screw Feeder)



**FIGURE 4-7: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim
(Screw Feeder)**



**FIGURE 4-8: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim
(Screw Feeder)**

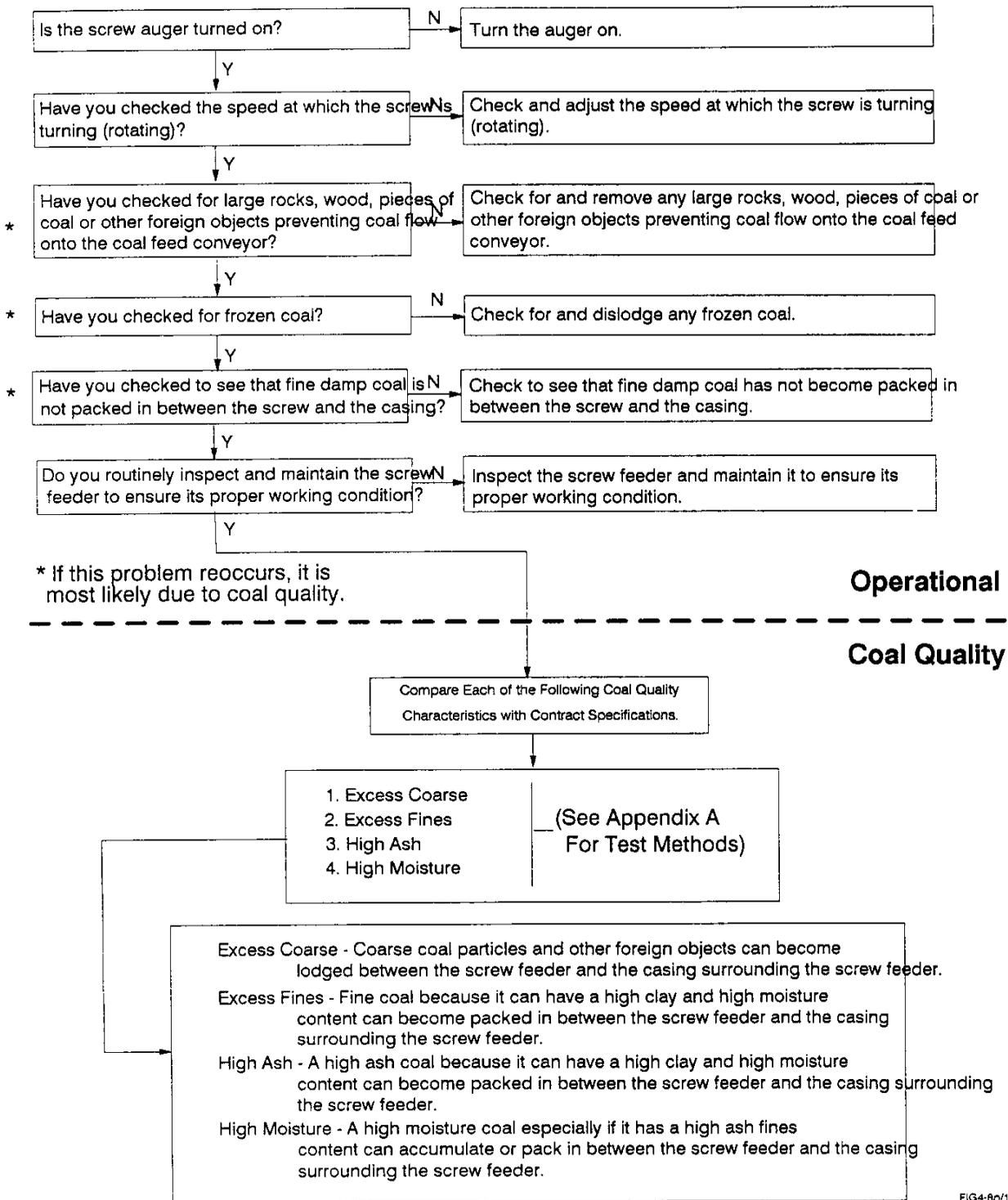


FIG4-8a/1

**FIGURE 4-9: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feed From The Automatic Coal Reclaim
(Screw Feeder)**

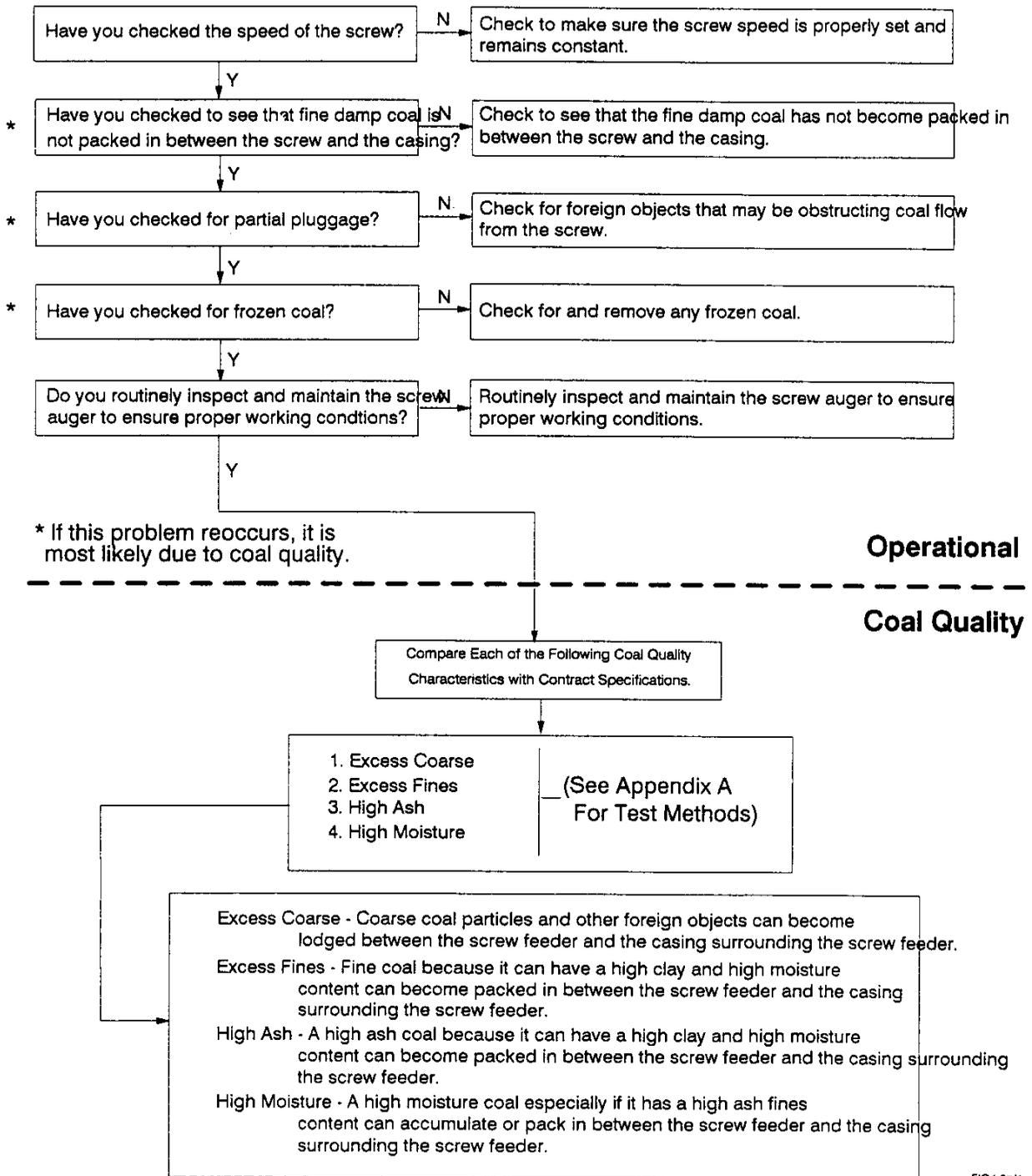


FIG4-9n/1

**FIGURE 4-10: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
for Excess Wear In The Coal Feed Conveyor
(Pneumatic Conveyor)**

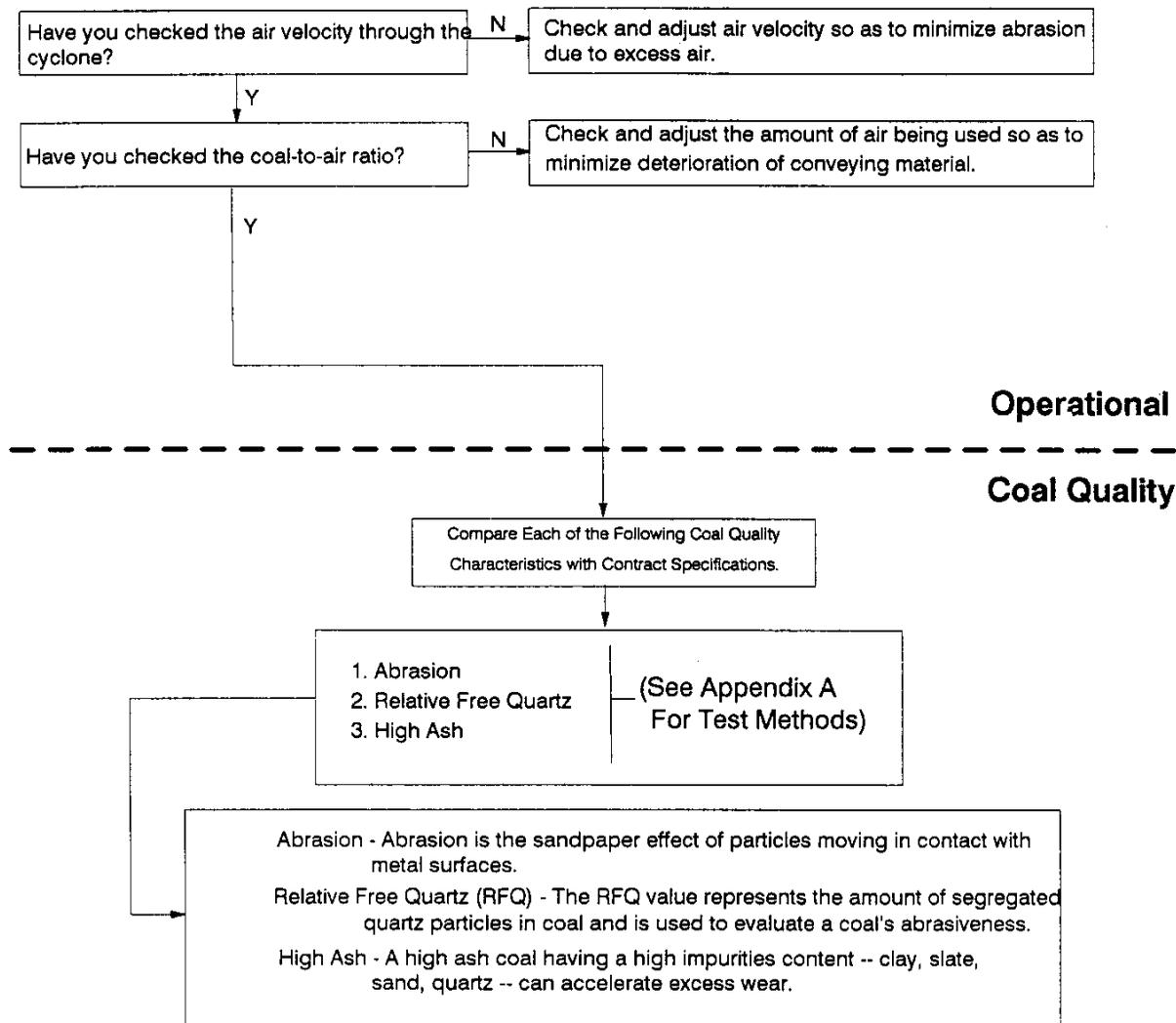


FIG4-10n/1

**FIGURE 4-11: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage Of The Coal Feed Conveyor
(Pneumatic Conveyor)**

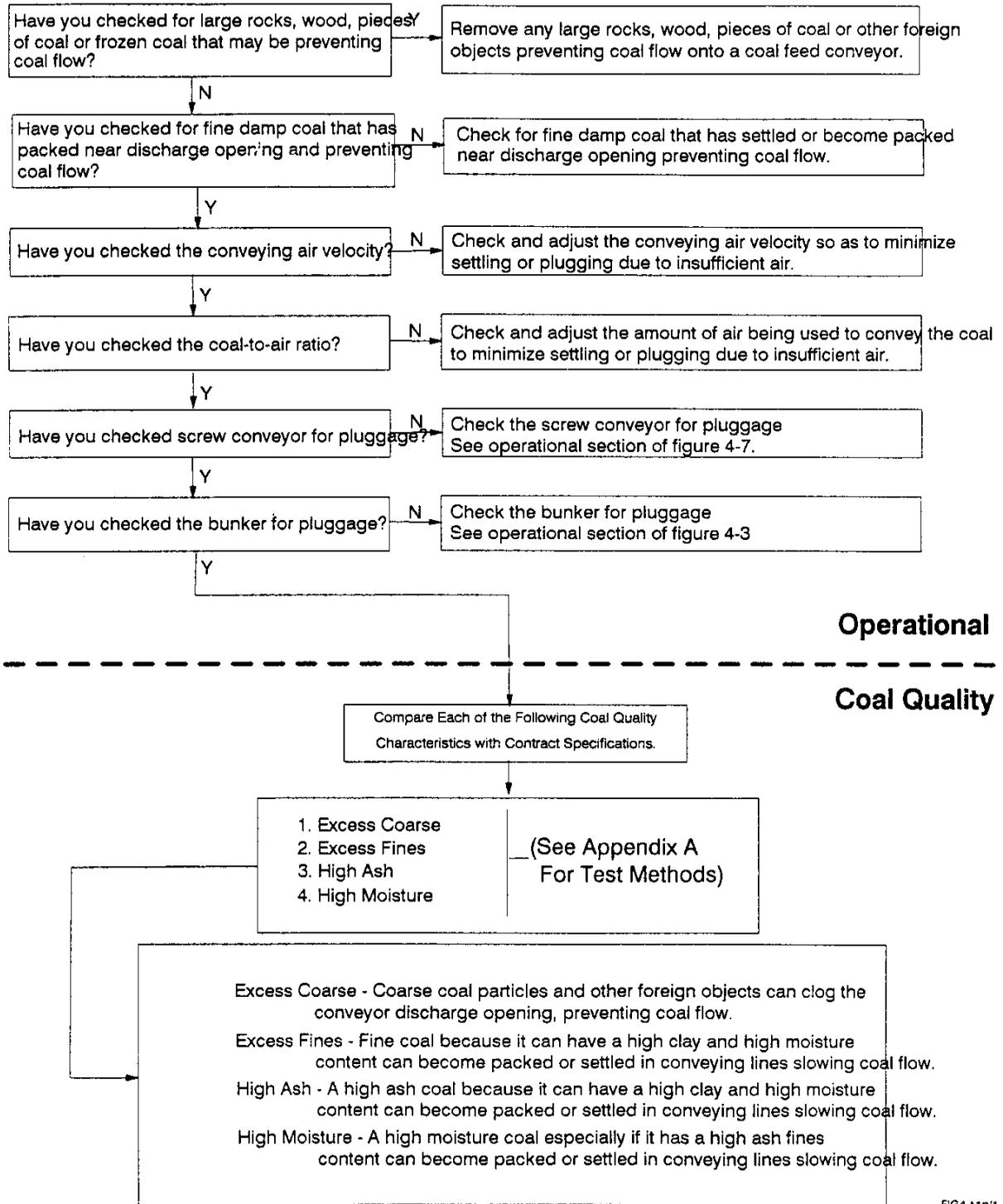
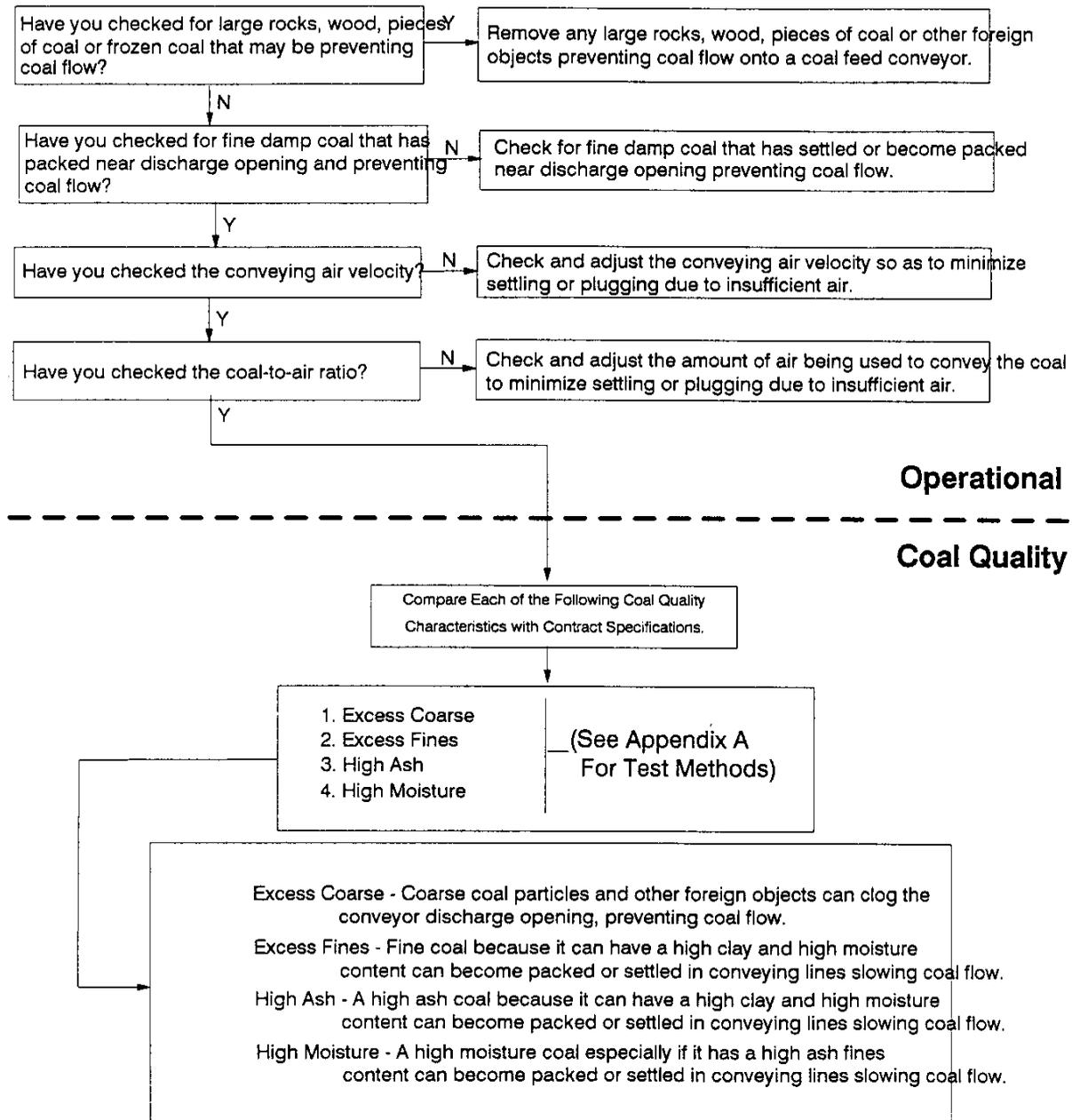
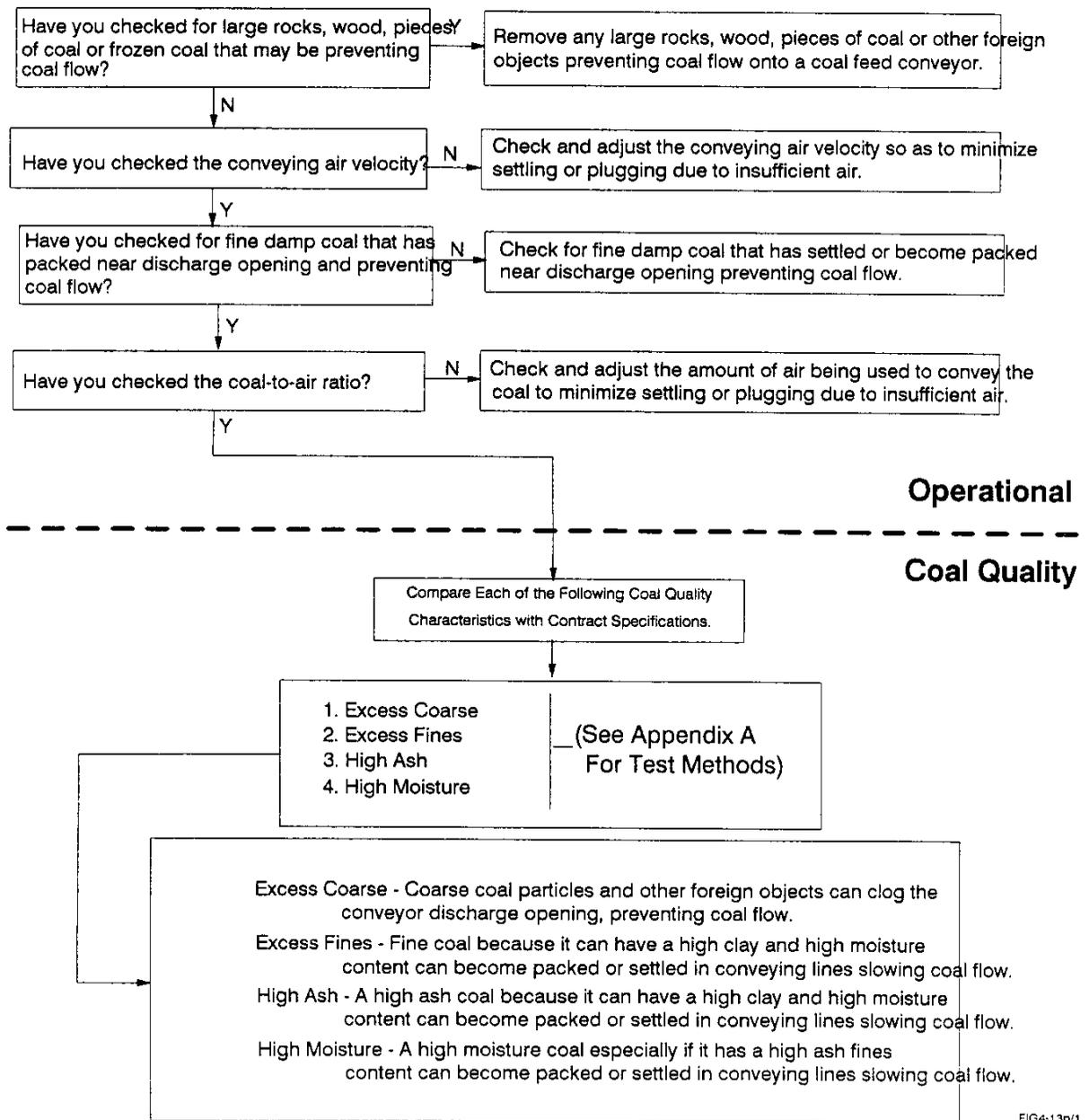


FIG4-11/1

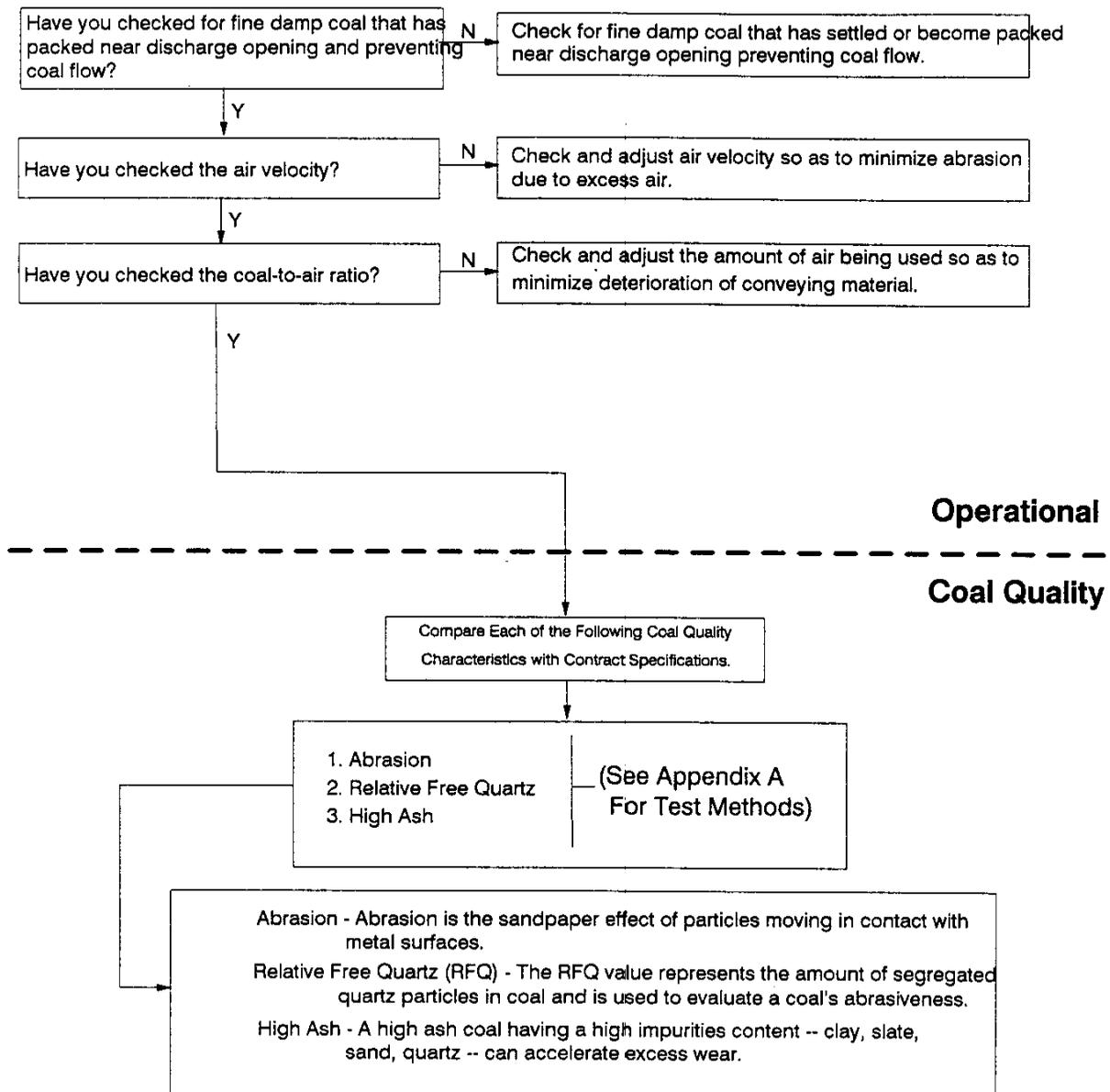
**FIGURE 4-12: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor
(Pneumatic Conveyor)**



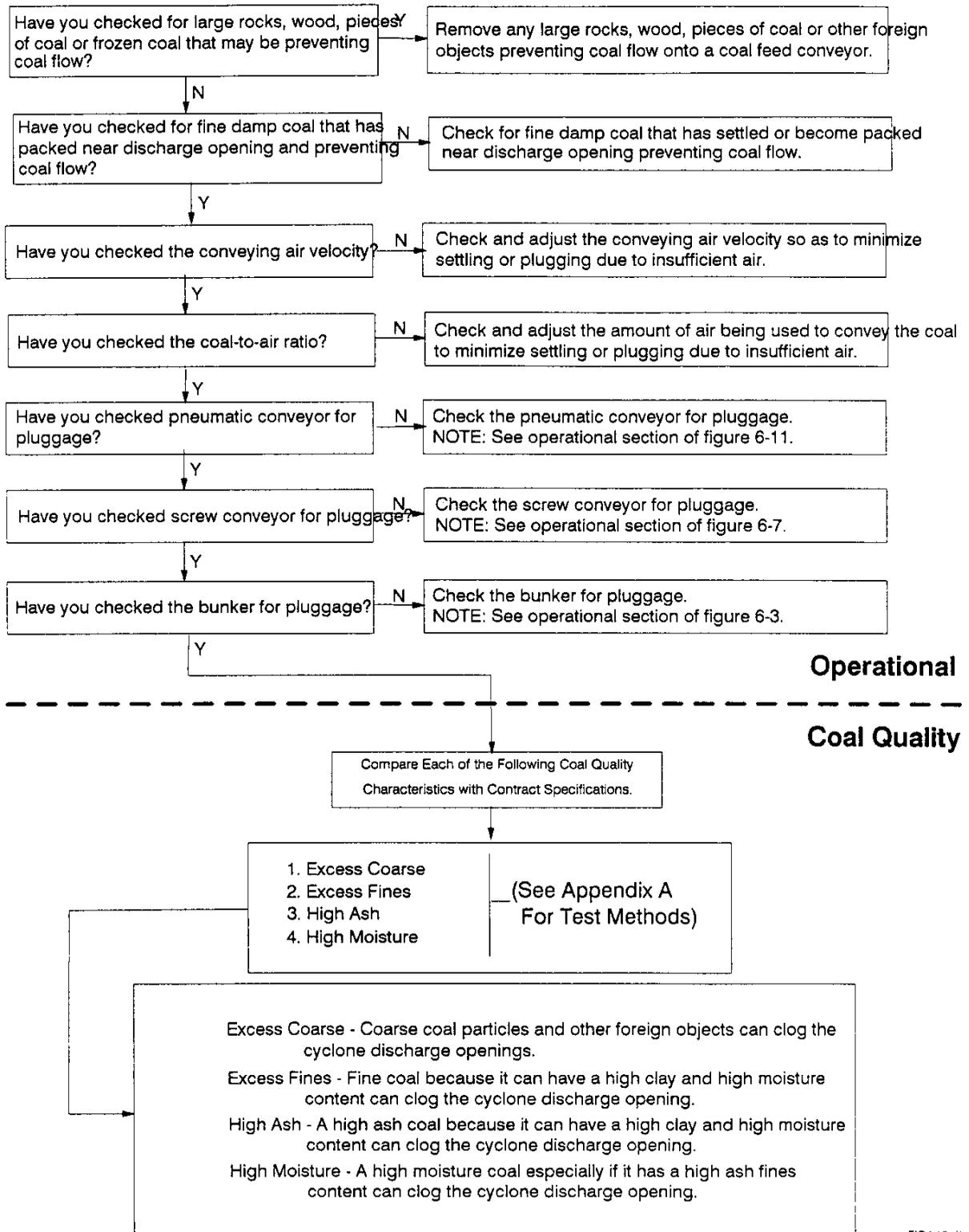
**FIGURE 4-13: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding Of The Coal Feed Conveyor
(Pneumatic Conveyor)**



**FIGURE 4-14: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
for Excess Wear In The Coal Feed Conveyor
(Pneumatic Conveyor)**



**FIGURE 4-15: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage Of The Cyclone Separator**



**FIGURE 4-16: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Cyclone Separator**

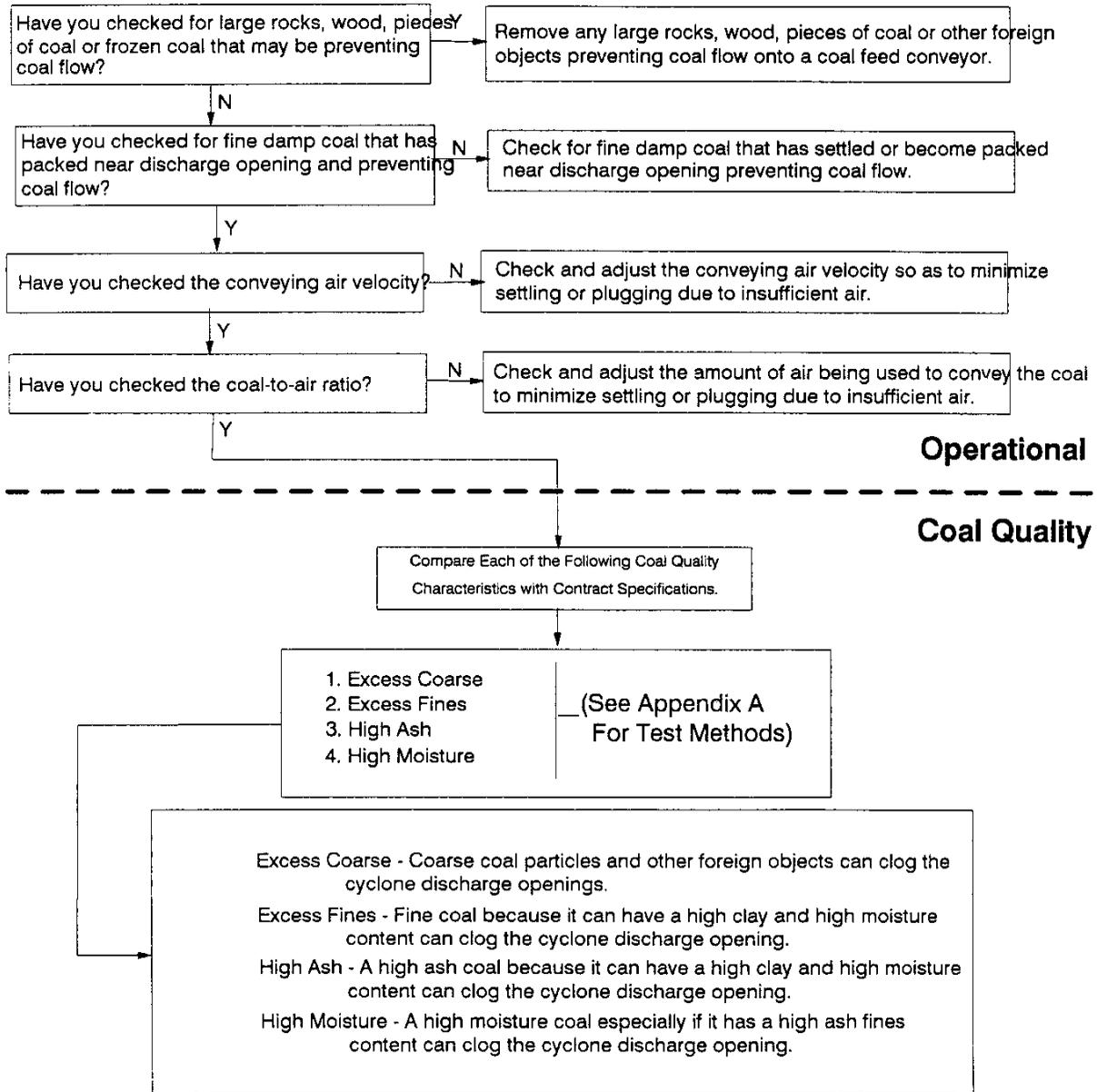


FIG4-16n/1

**FIGURE 4-17: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding Of The Cyclone Separator**

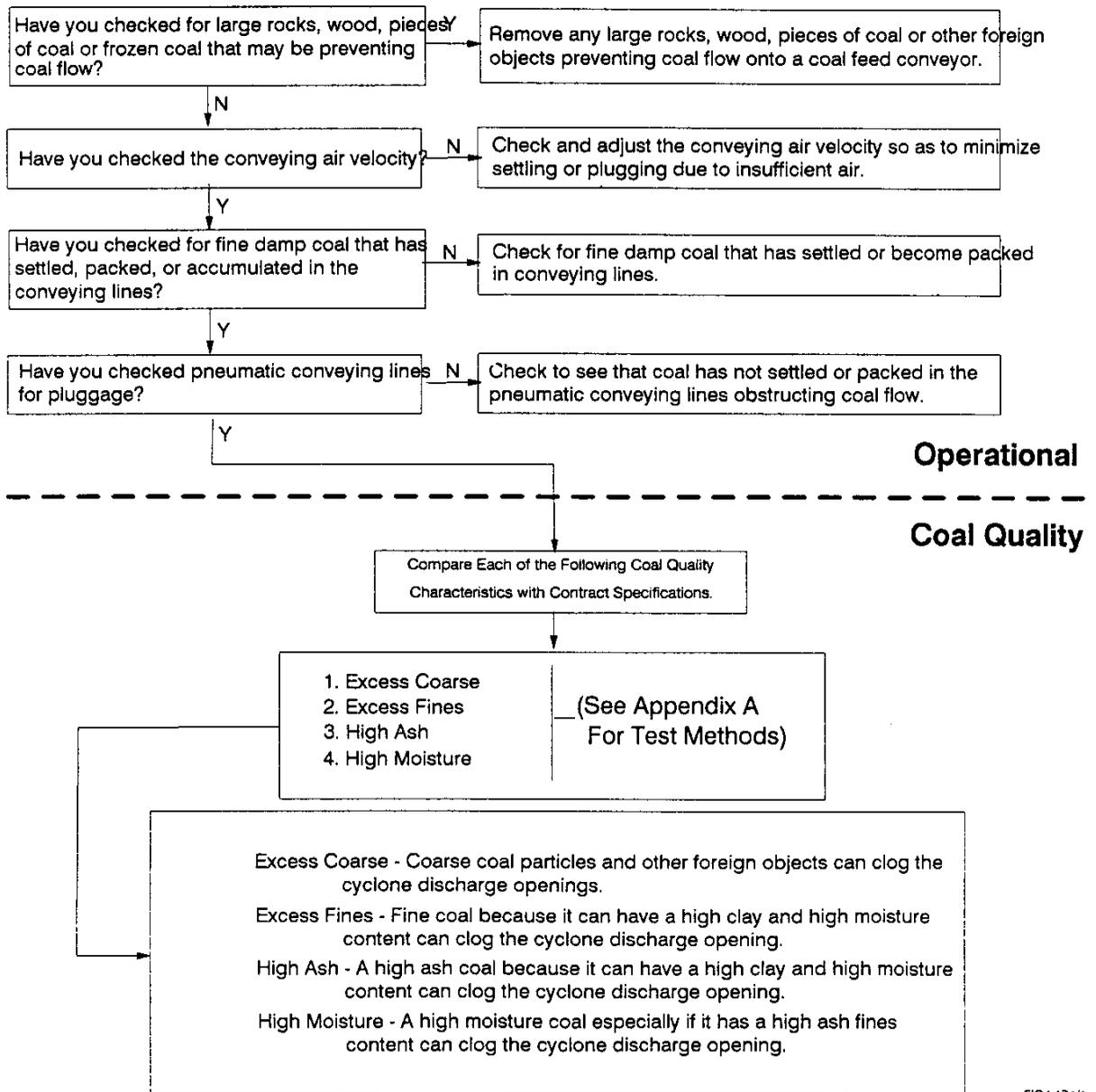
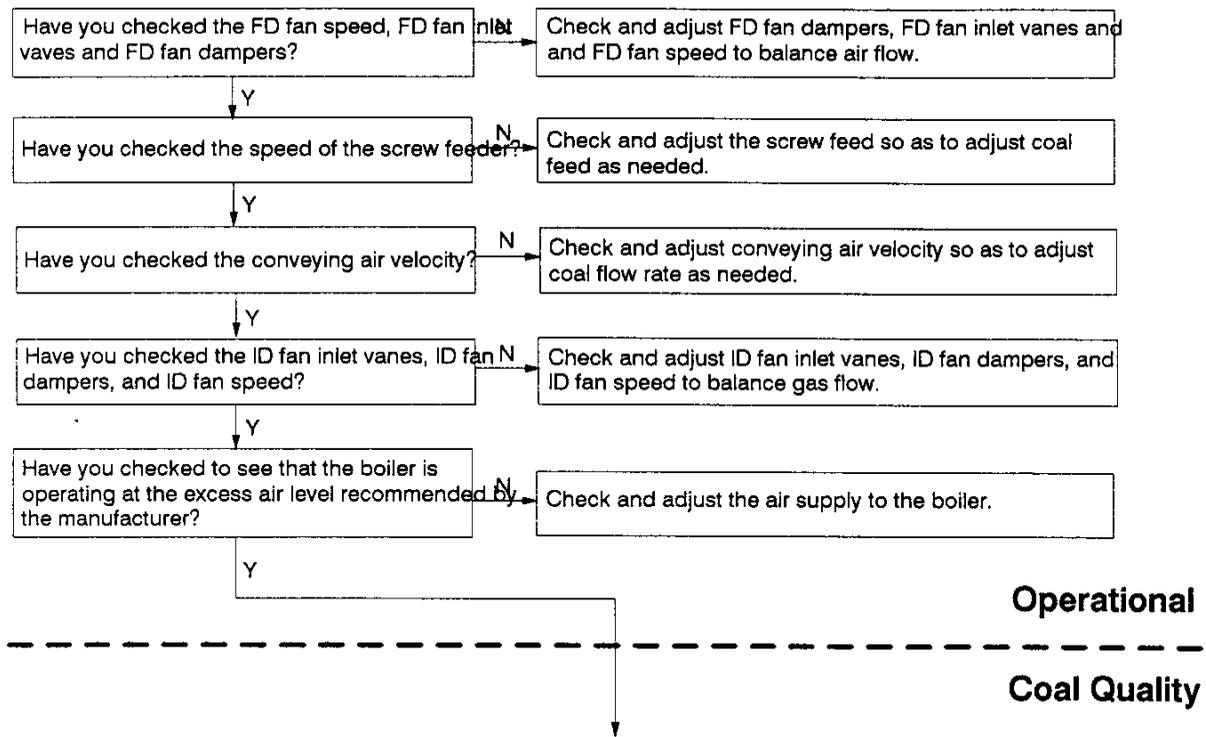


FIG4-17/v1

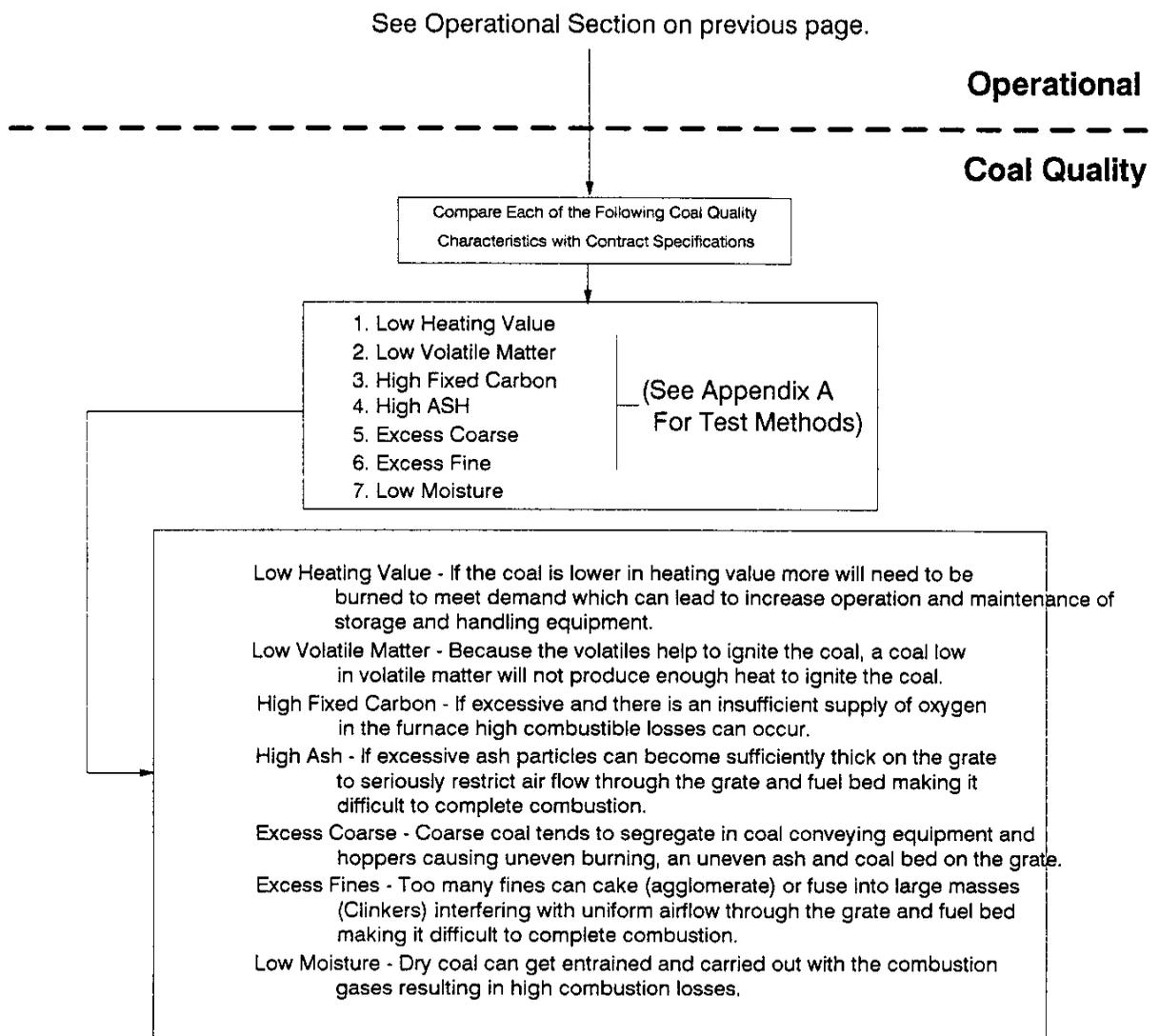
**FIGURE 4-18: TOP FEED STATIC GRATE STOKER TROUBLE SHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Boiler)**



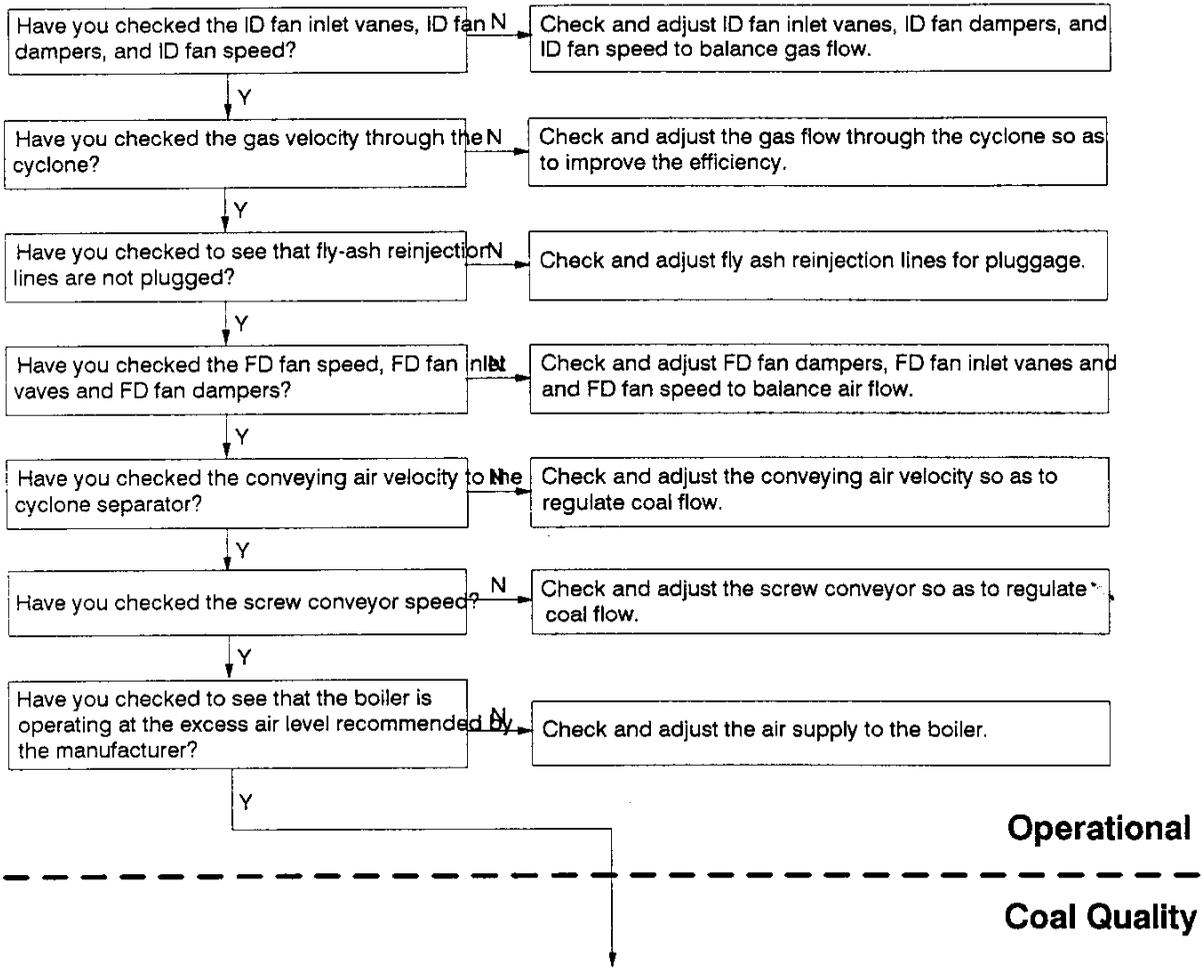
See next page for Coal Quality Section.

FIGURE 4-18 (continued): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load (Boiler)



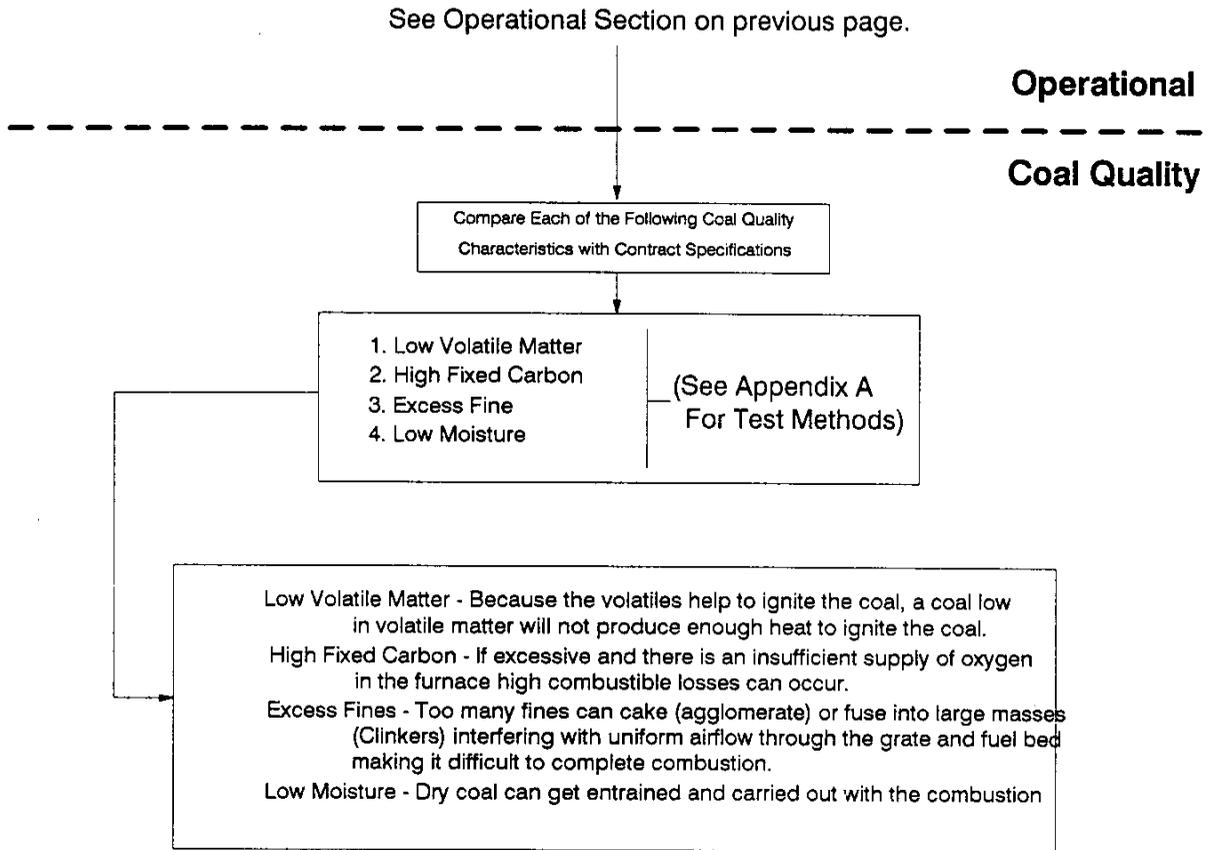
**FIGURE 4-19: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Reduced Boiler Efficiency**



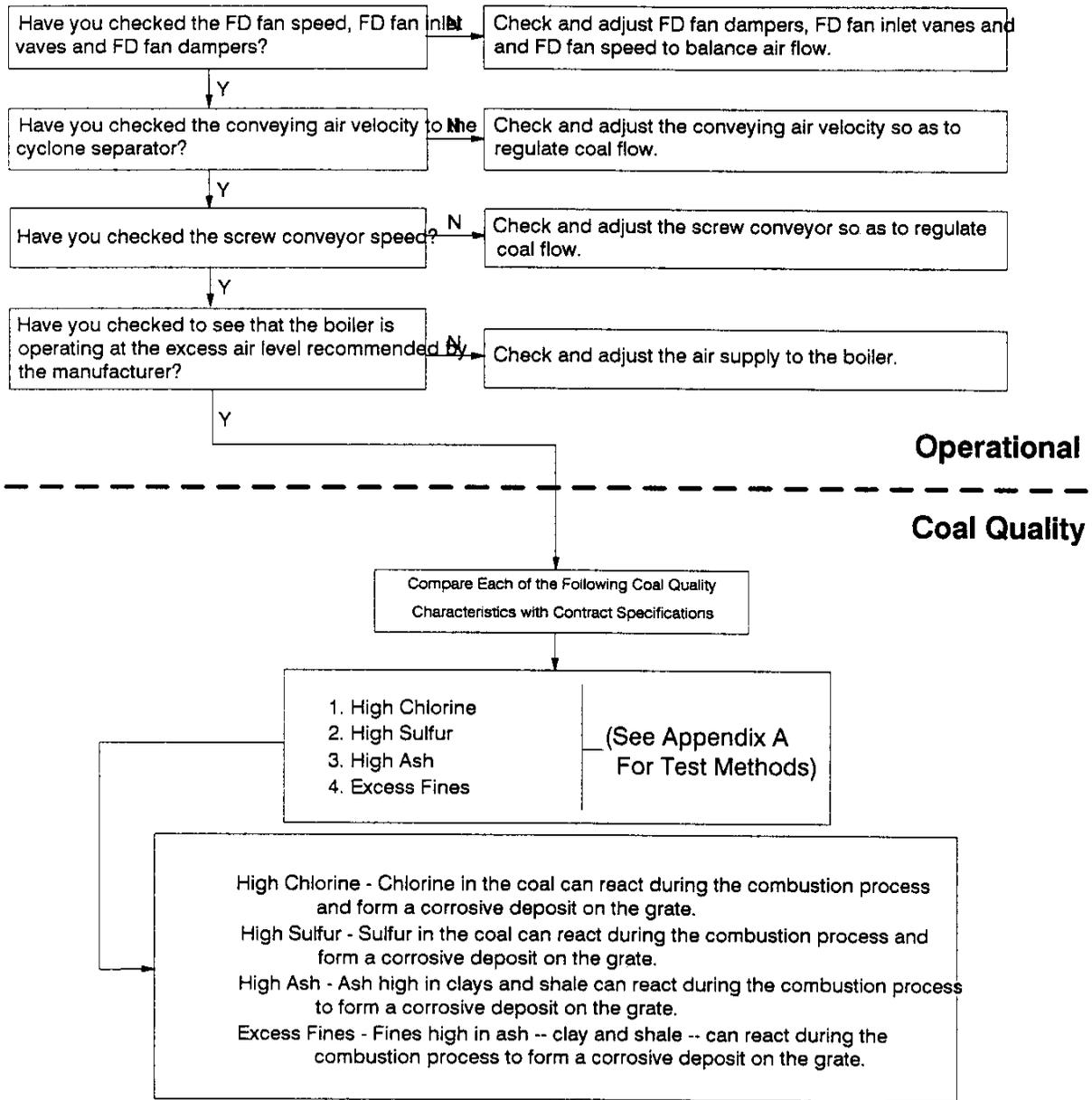
See next page for Coal Quality Section.

FIGURE 4-19 (continued): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

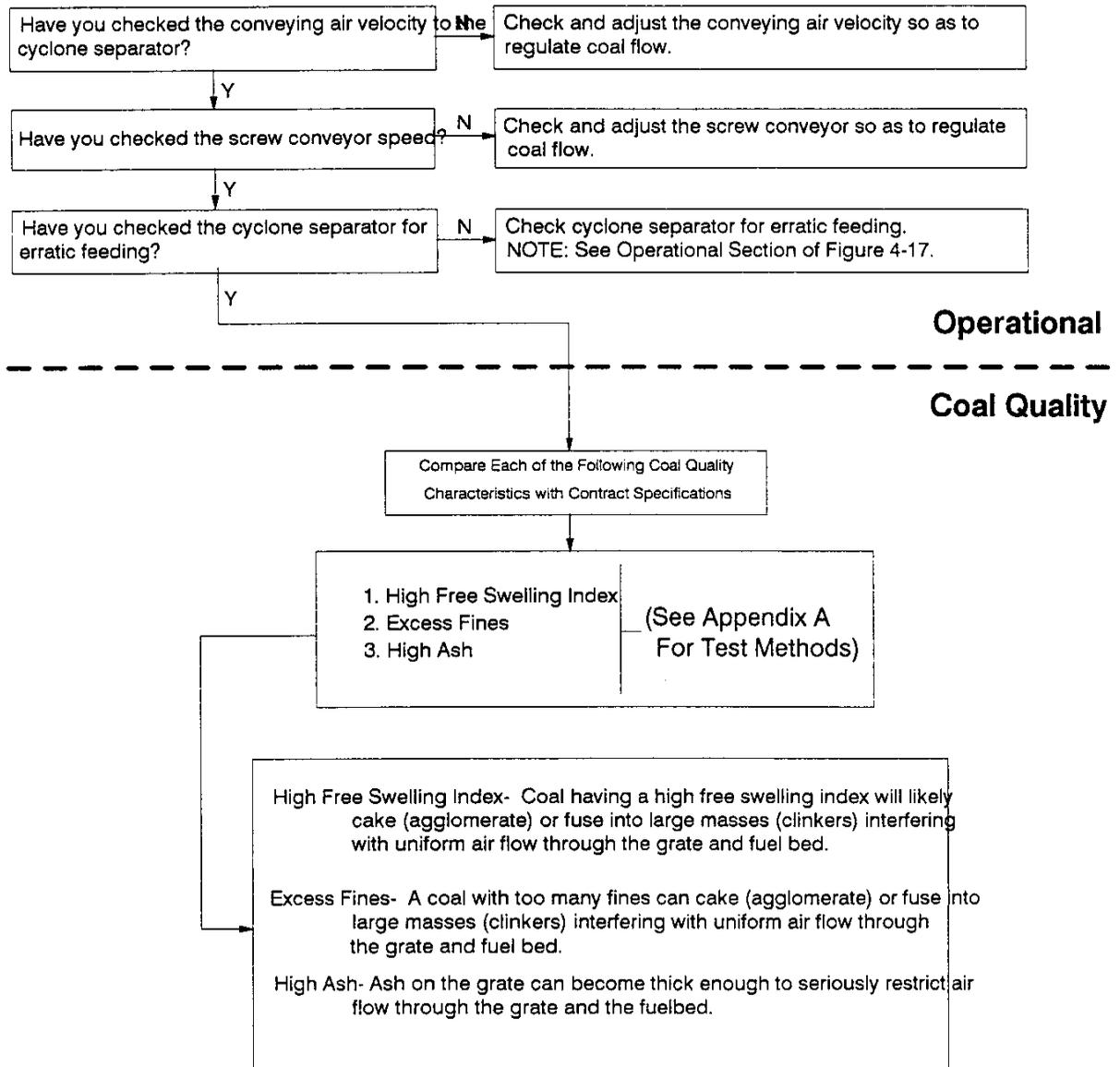
For Reduced Boiler Efficiency



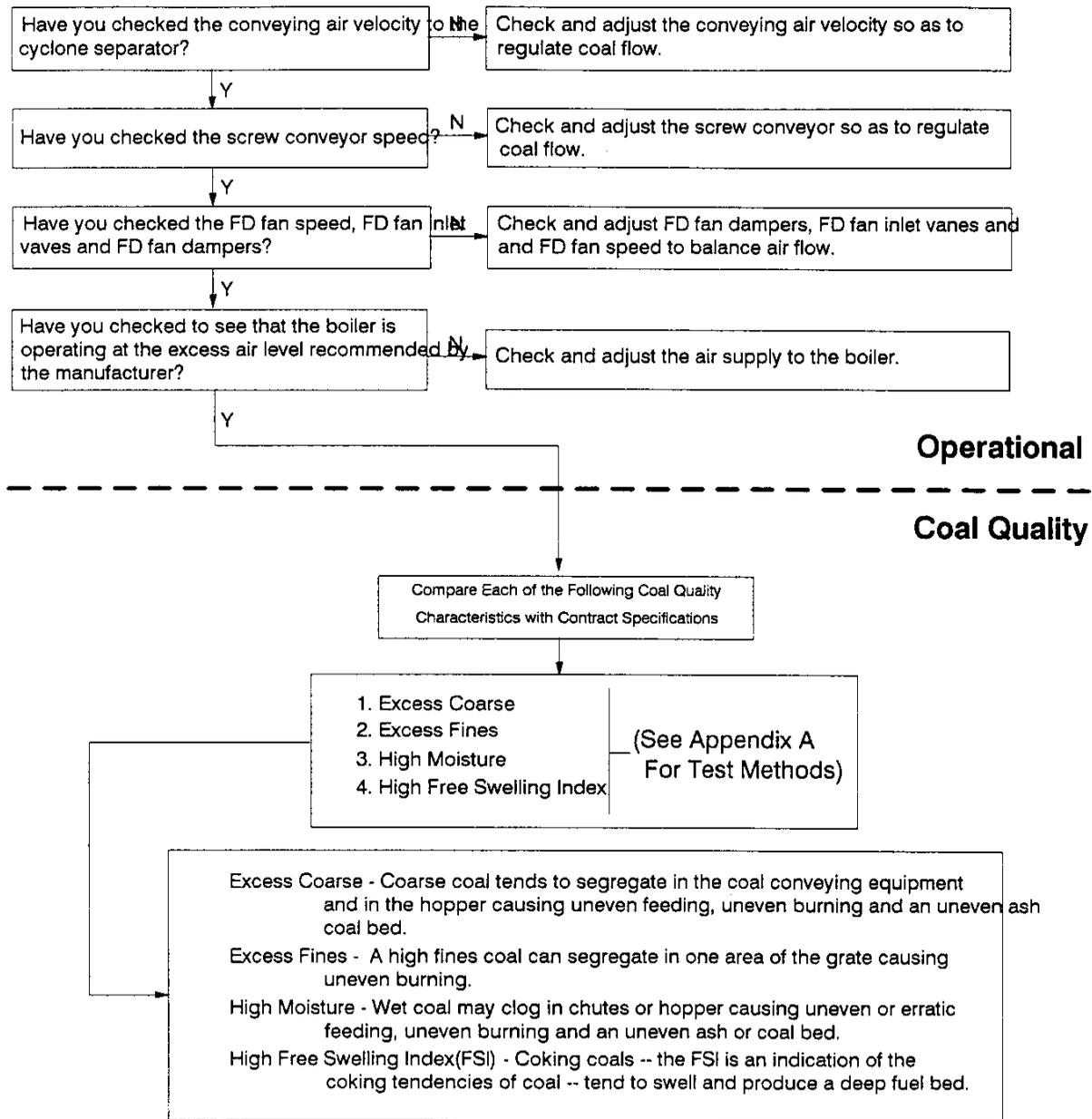
**FIGURE 4-20: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion On The Boiler Components
(Static Grate)**



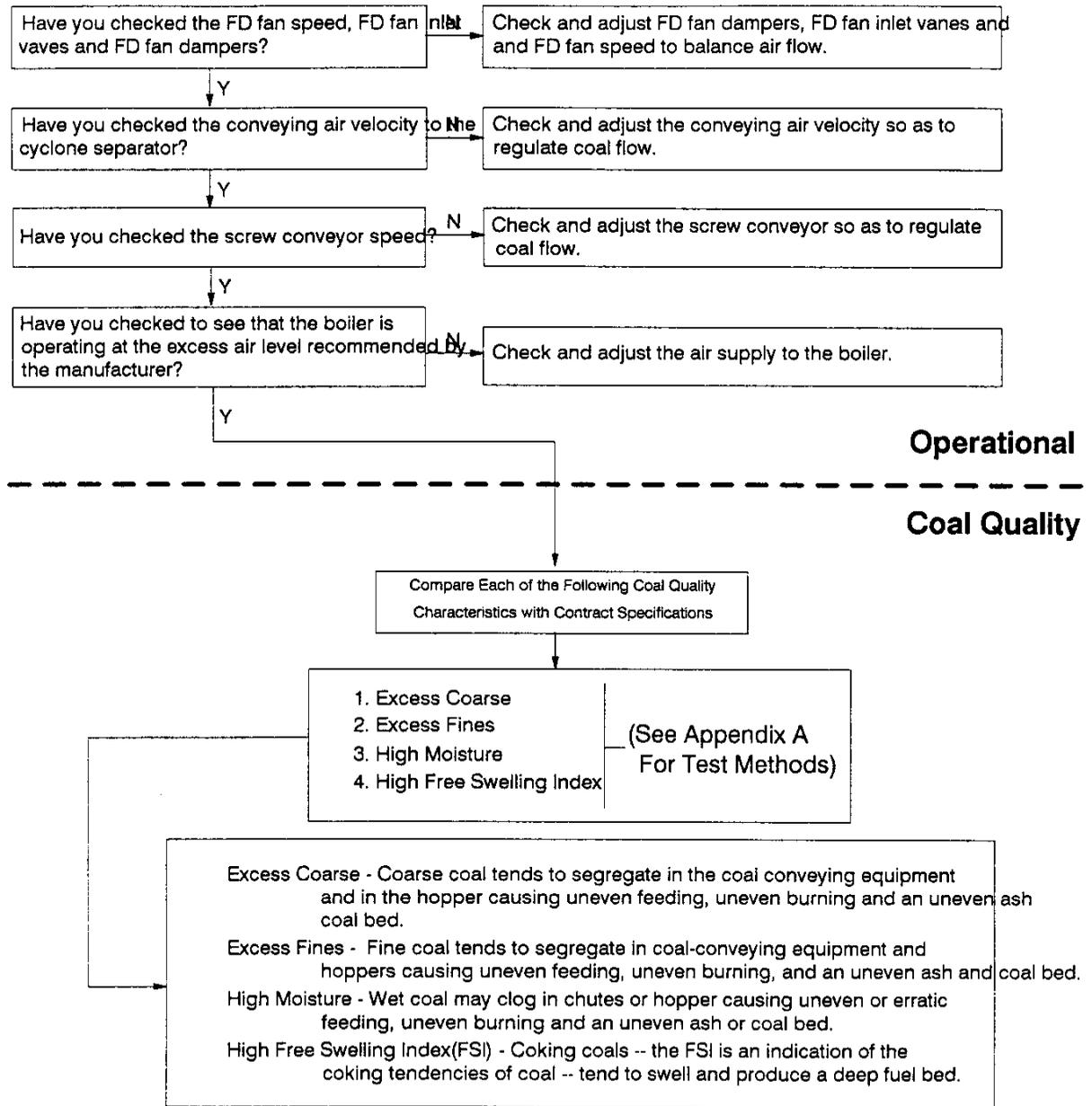
**FIGURE 4-21: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pressure Drop Across The Grate**



**FIGURE 4-22: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Ash Bed On The Grate**



**FIGURE 4-23: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Coal Bed On The Grate**



**FIGURE 4-24: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Coal Burning On The Grate**

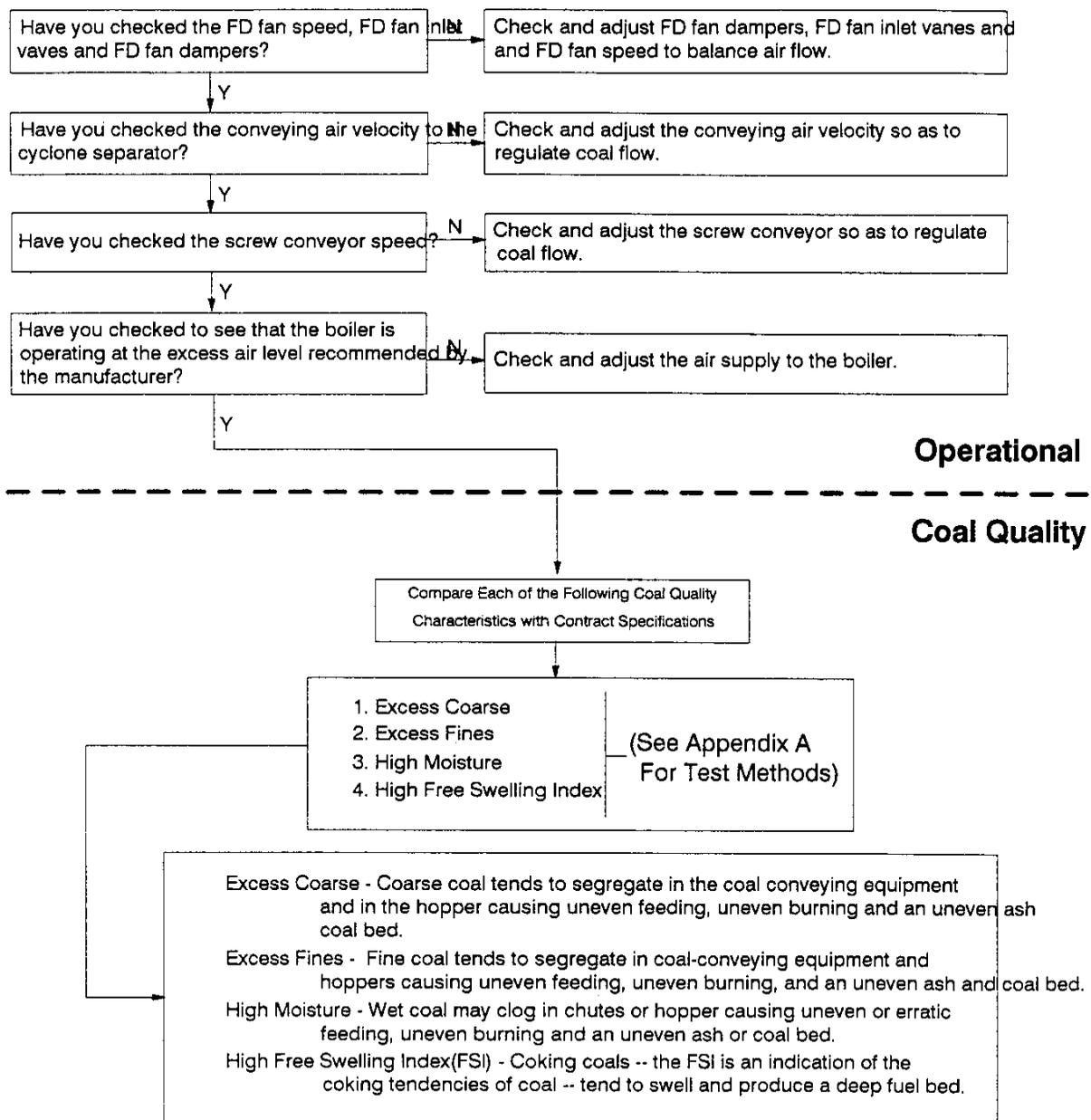
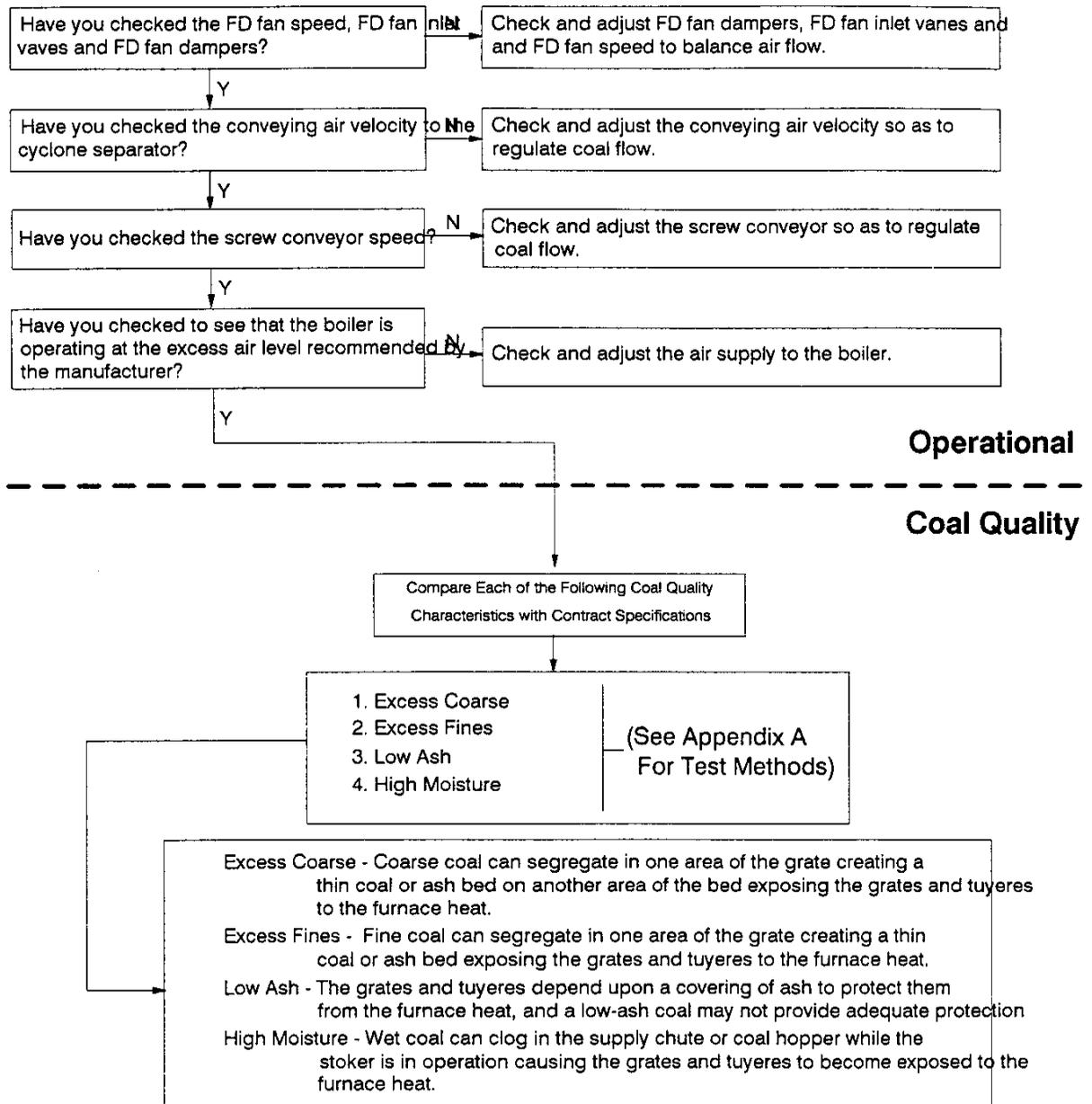
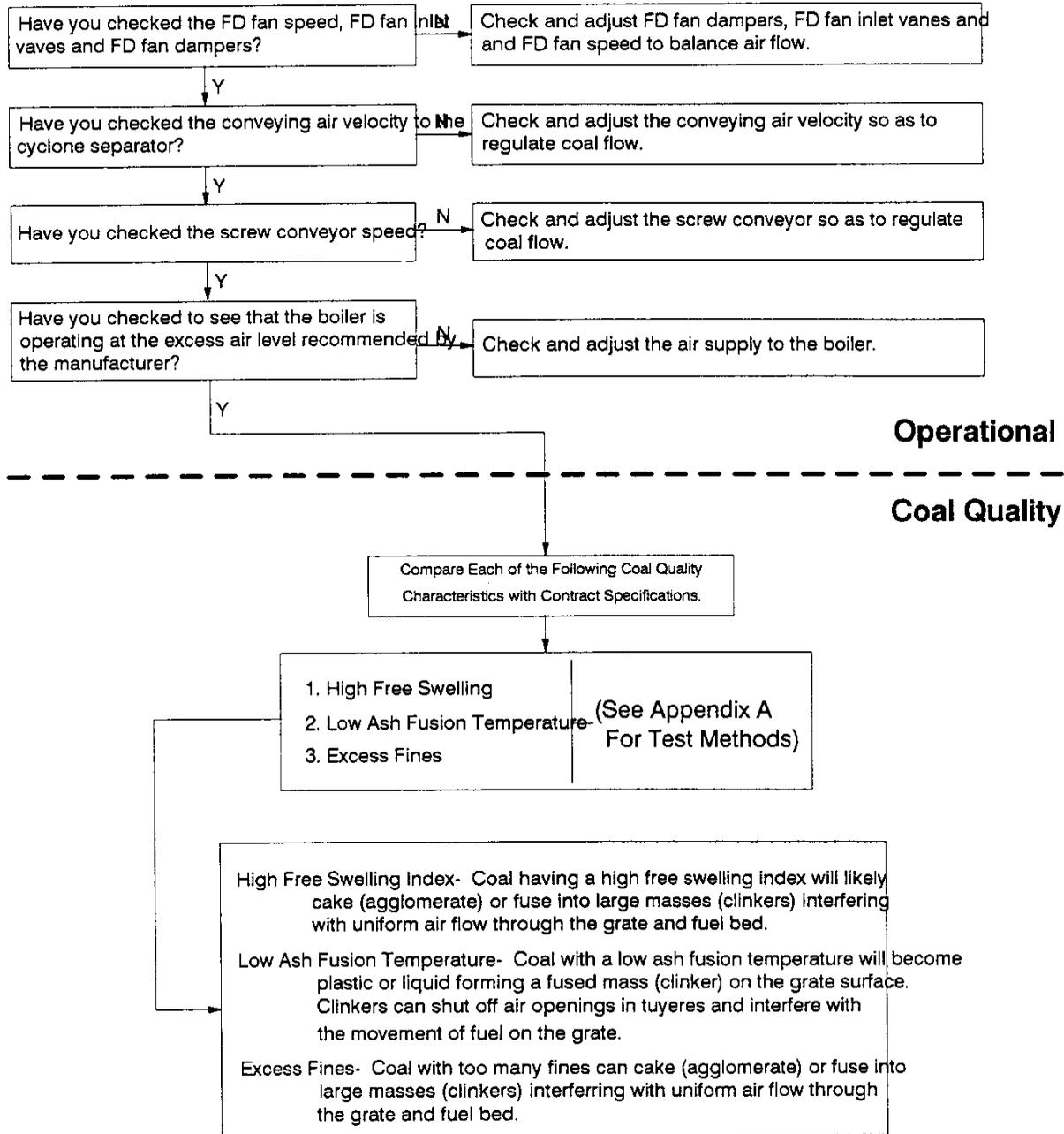


FIG4-24n/1

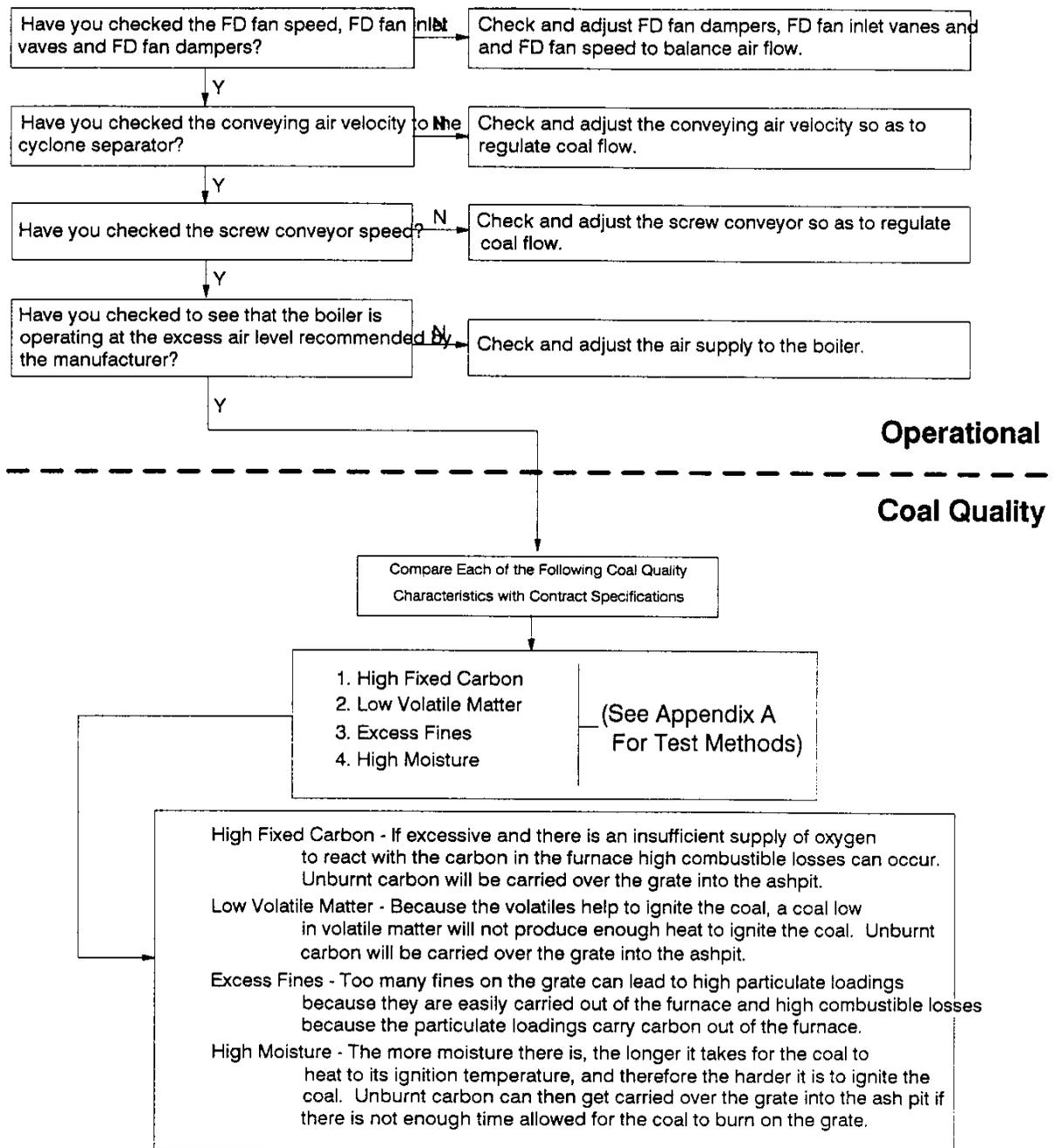
**FIGURE 4-25: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Warped, Burnt and Cracked Grates**



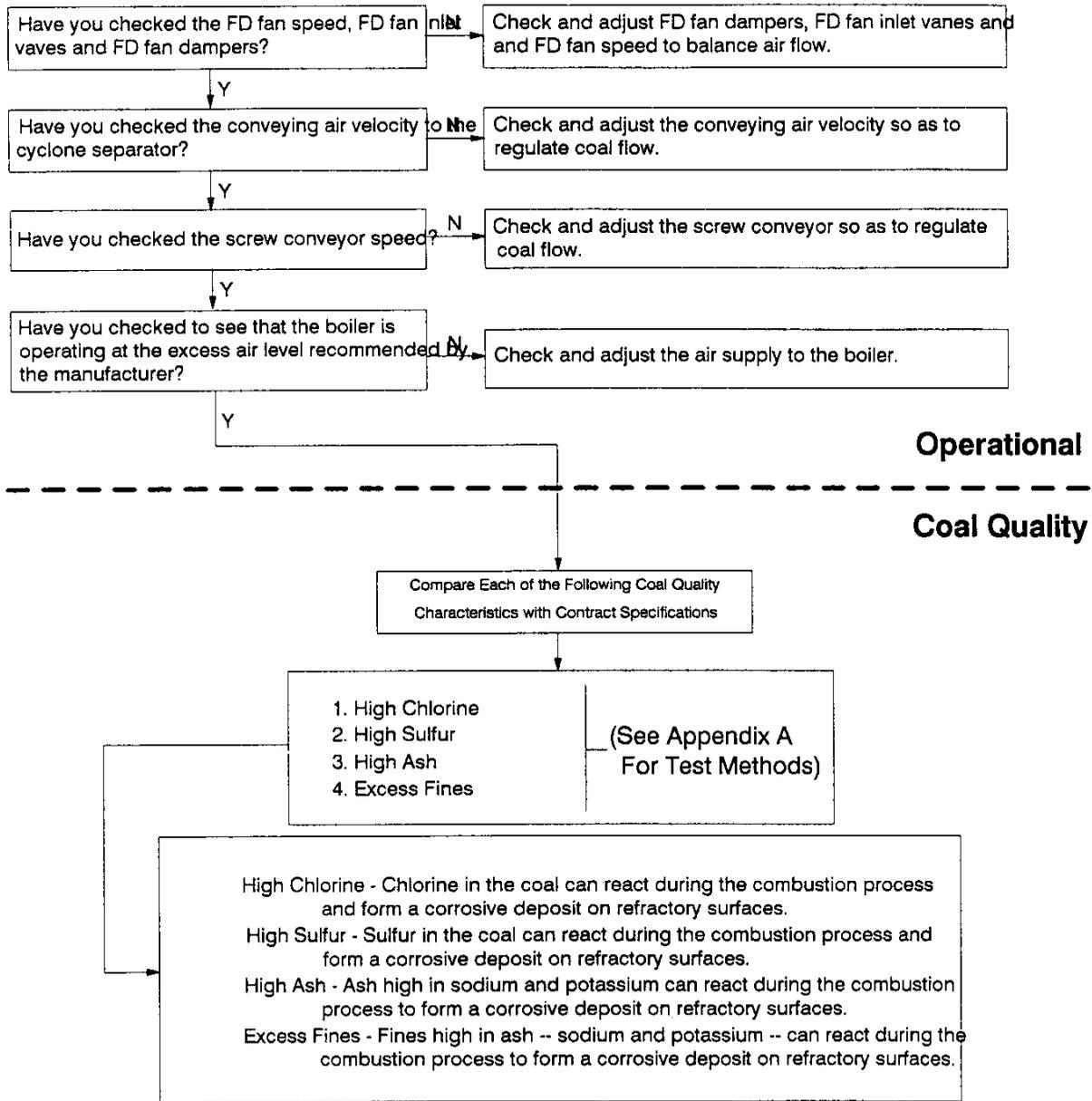
**FIGURE 4-26: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Clinkers On The Grate**



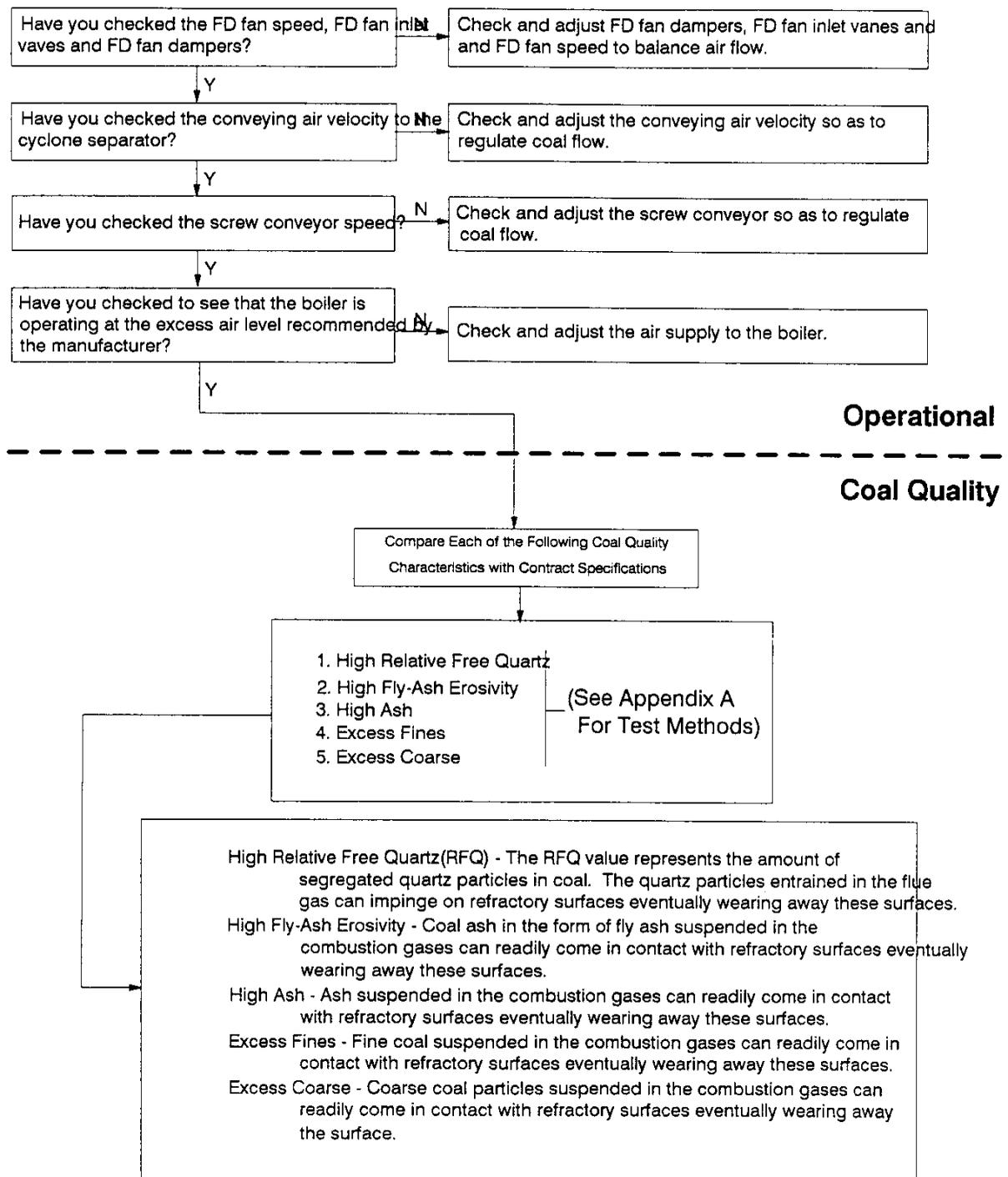
**FIGURE 4-27: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout On The Grate**



**FIGURE 4-28: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Refractory Surfaces**



**FIGURE 4-29: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Refractory Surfaces**



**FIGURE 4-30: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging/Spalling Of Refractory Surfaces**

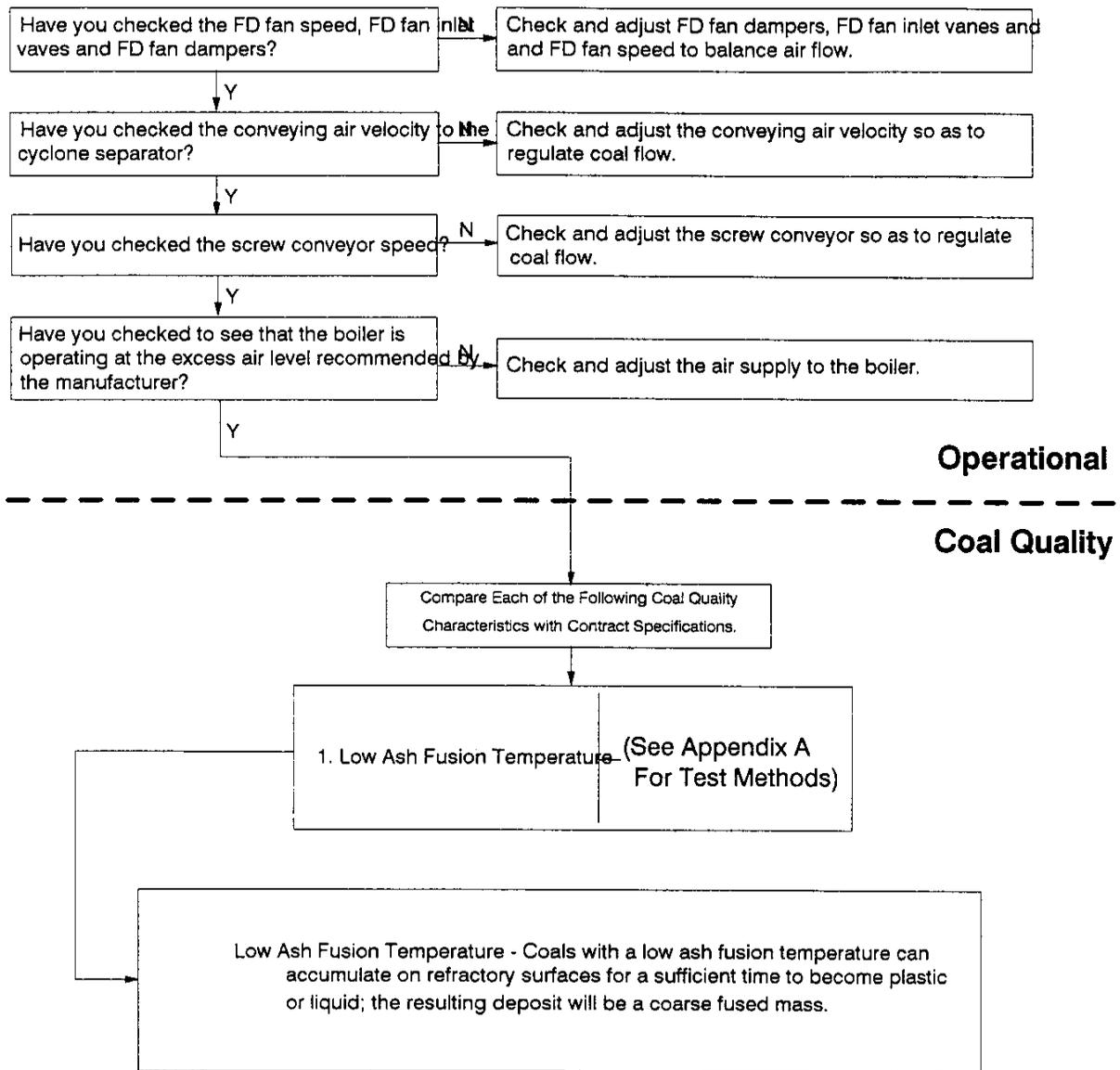
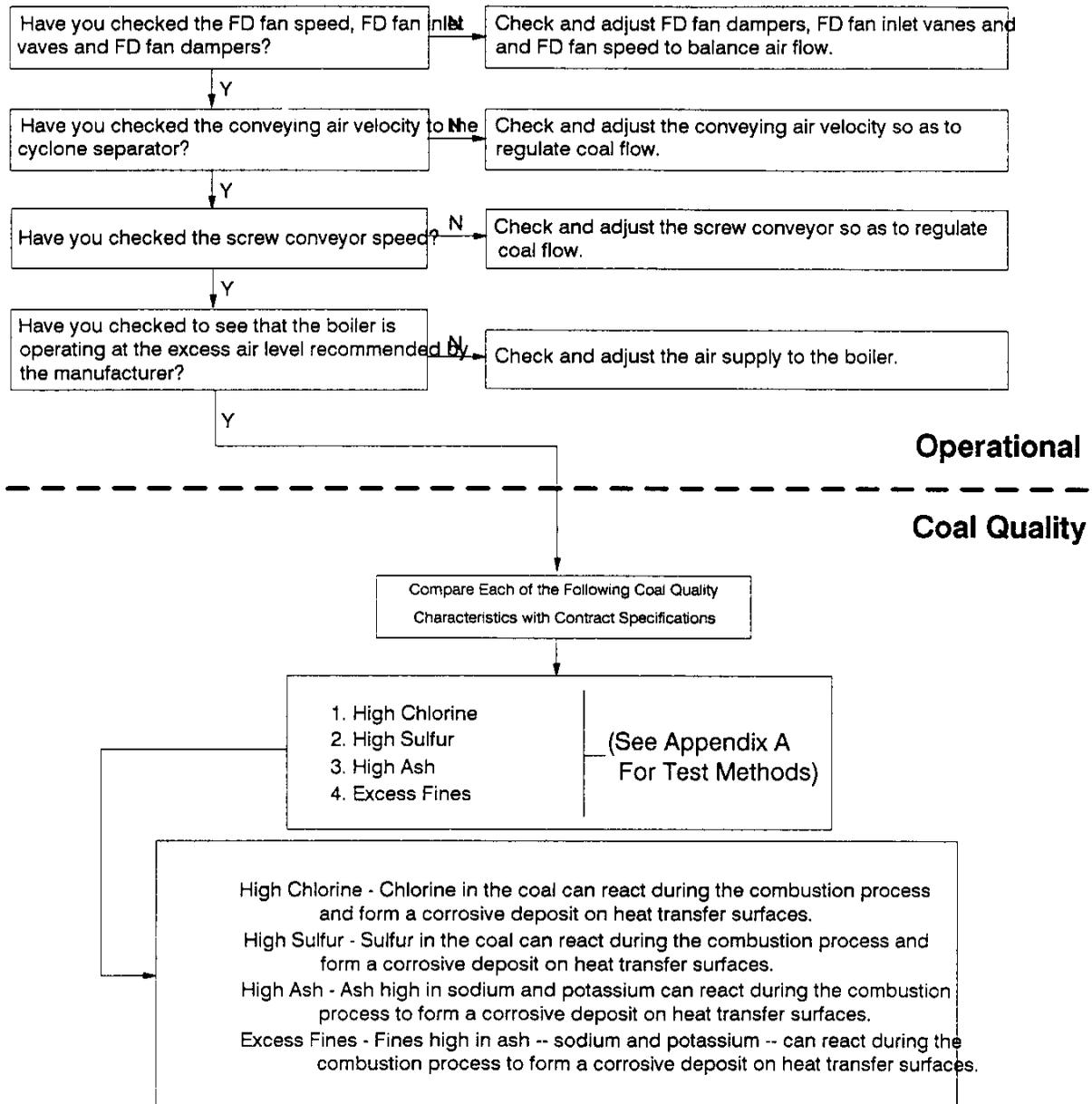


FIG4-30v1

**FIGURE 4-31: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Heat Transfer Surfaces
(Boiler Tubes And Water Walls)**



**FIGURE 4-32: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Heat Transfer Surfaces
(Boiler Tubes And Water Walls)**

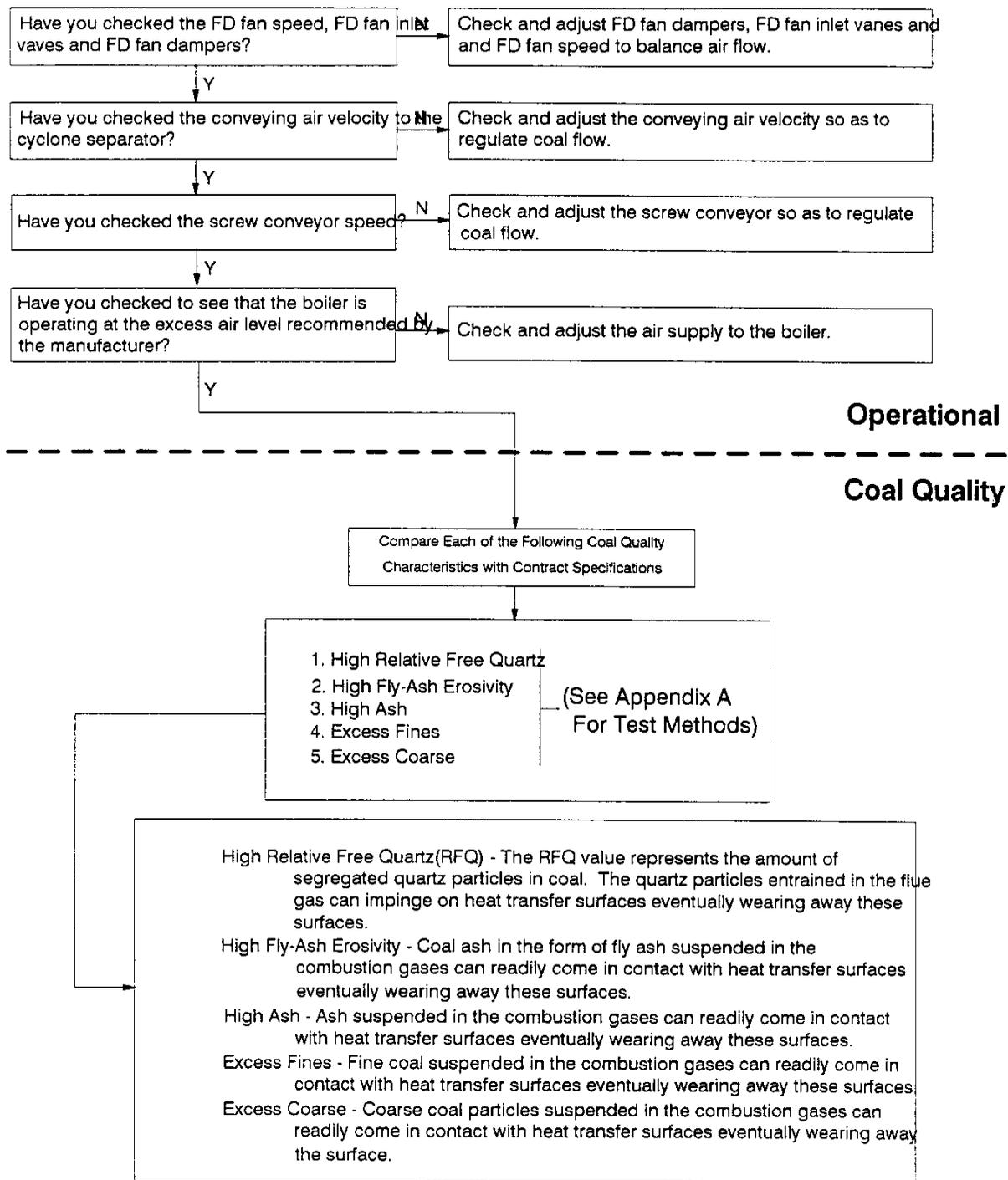


FIGURE 4-33: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging/Spalling Of The Heat Transfer Surfaces
(Boiler Tubes And Water Walls)

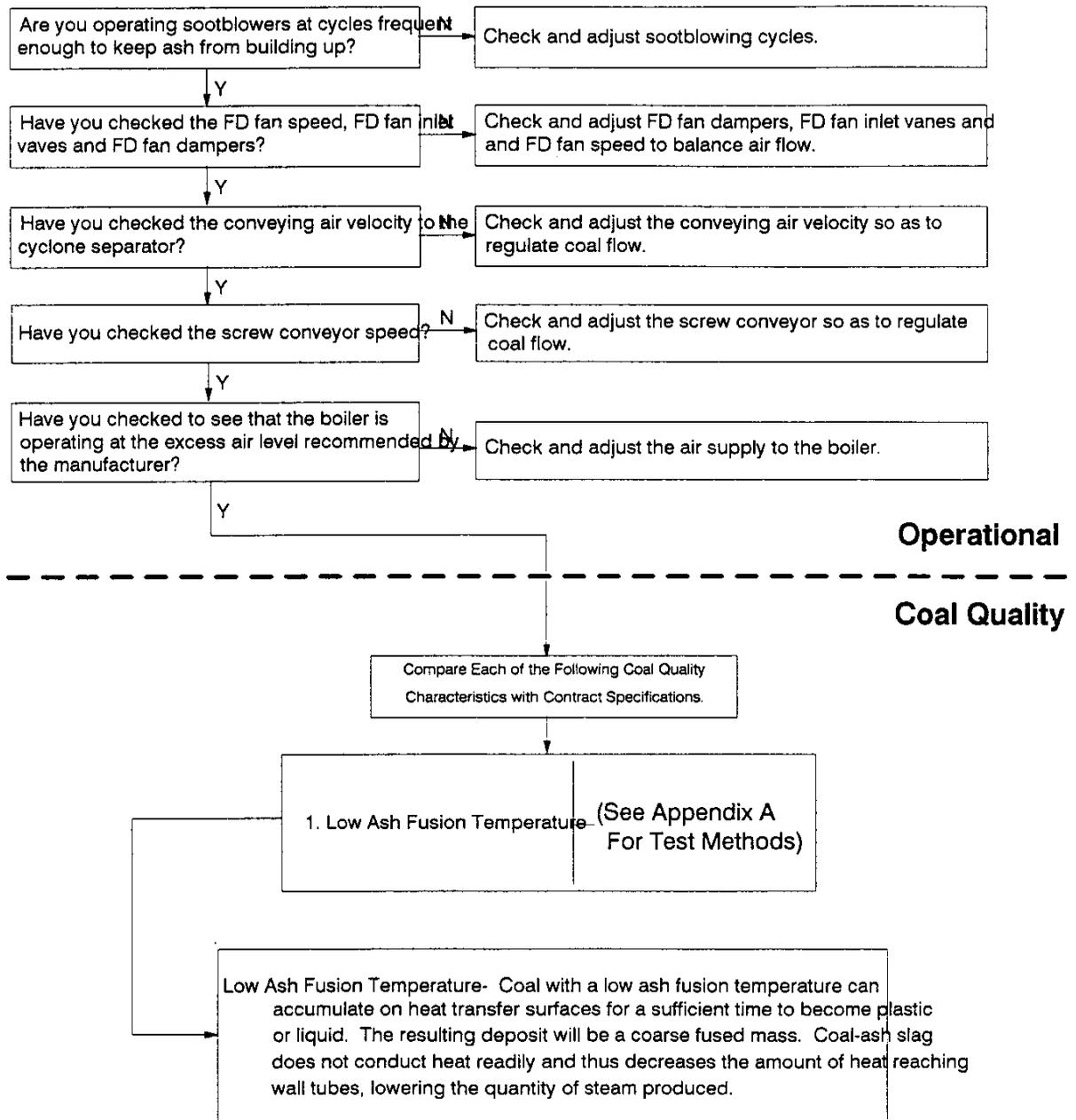


FIGURE 4-34: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of The Heat Transfer Surfaces
(Boiler Tubes And Water Walls)

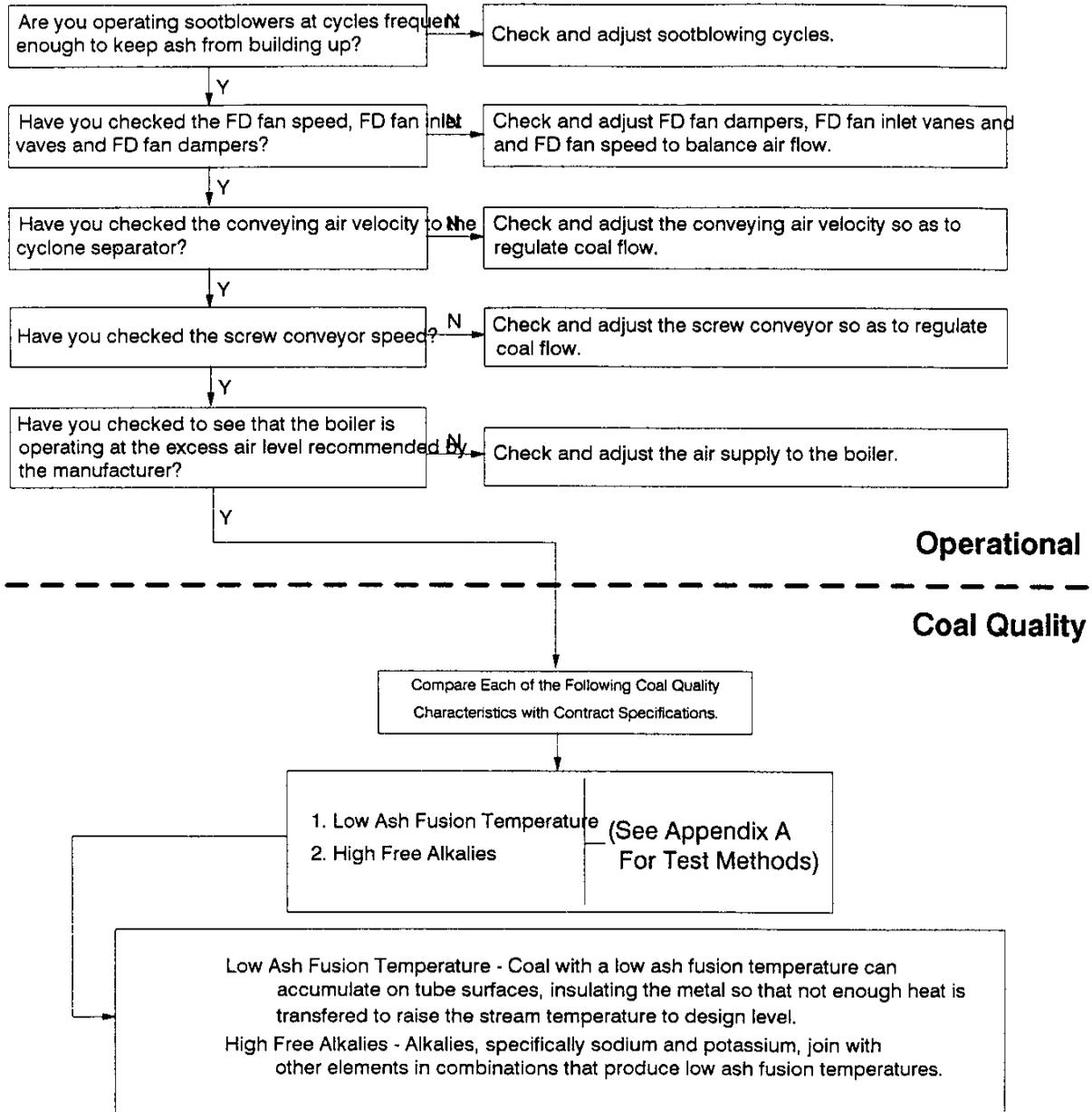
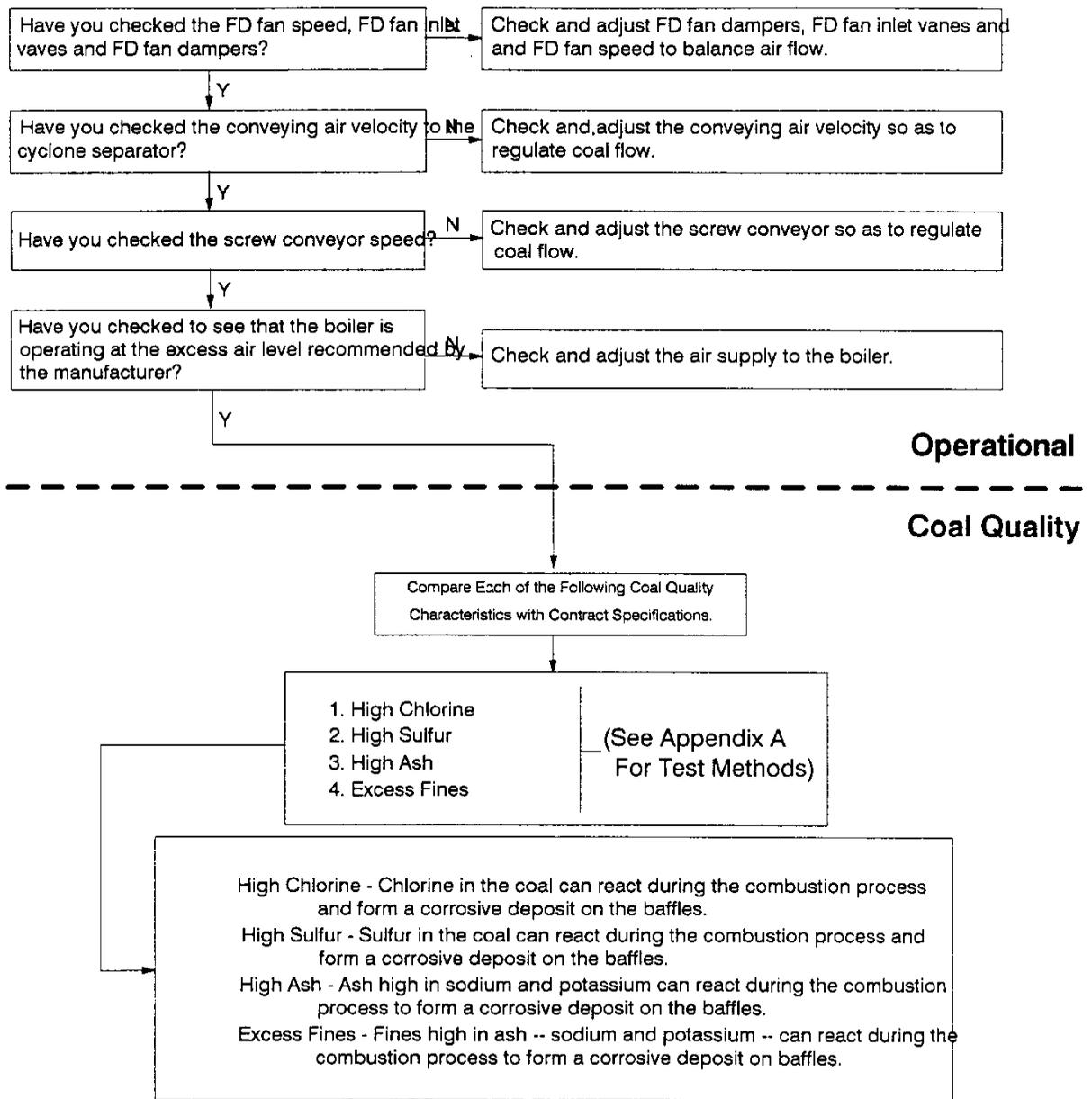


FIG4-34r/1

FIGURE 4-35: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM For Corrosion Of The Baffles



**FIGURE 4-36: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Baffles**

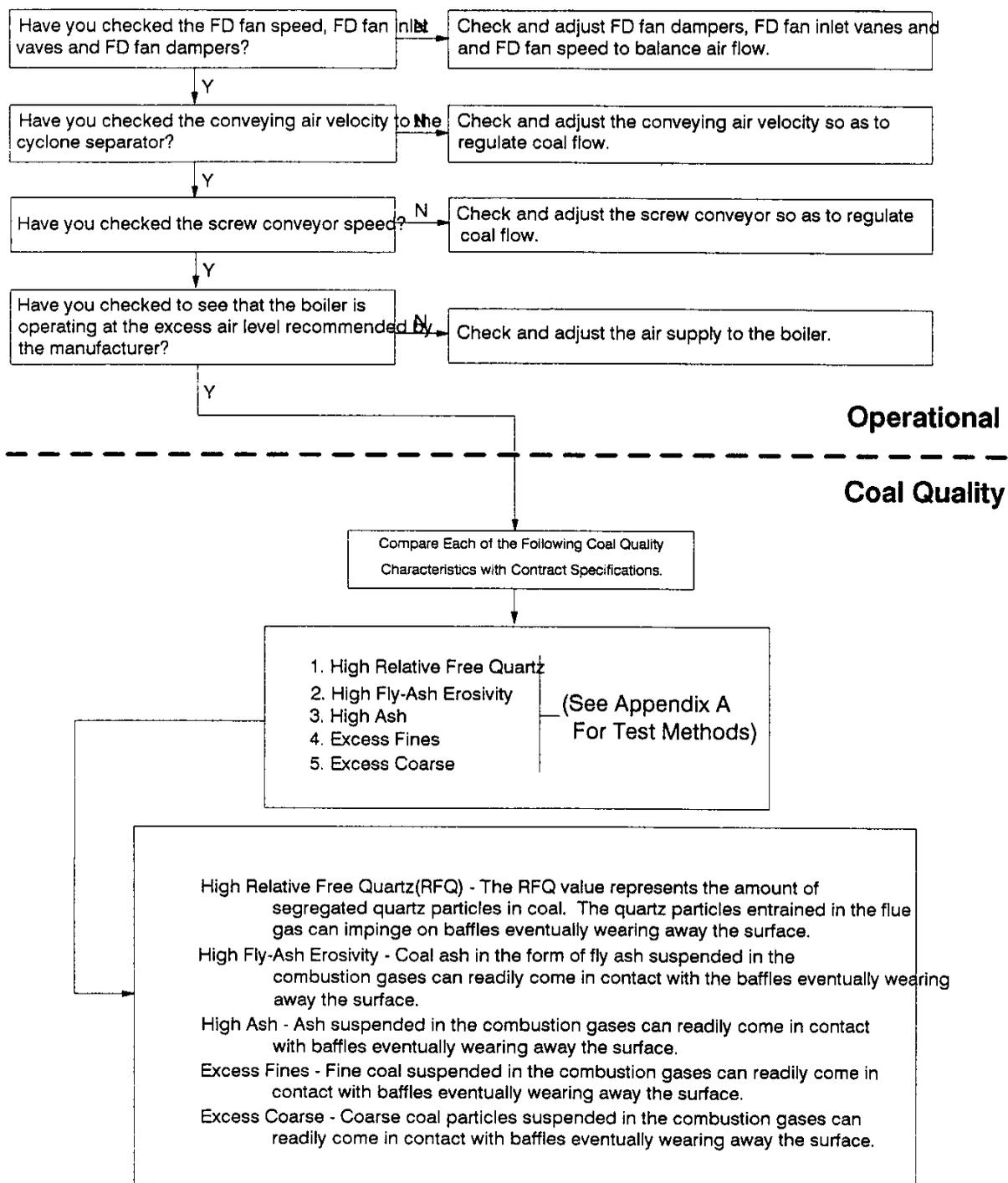
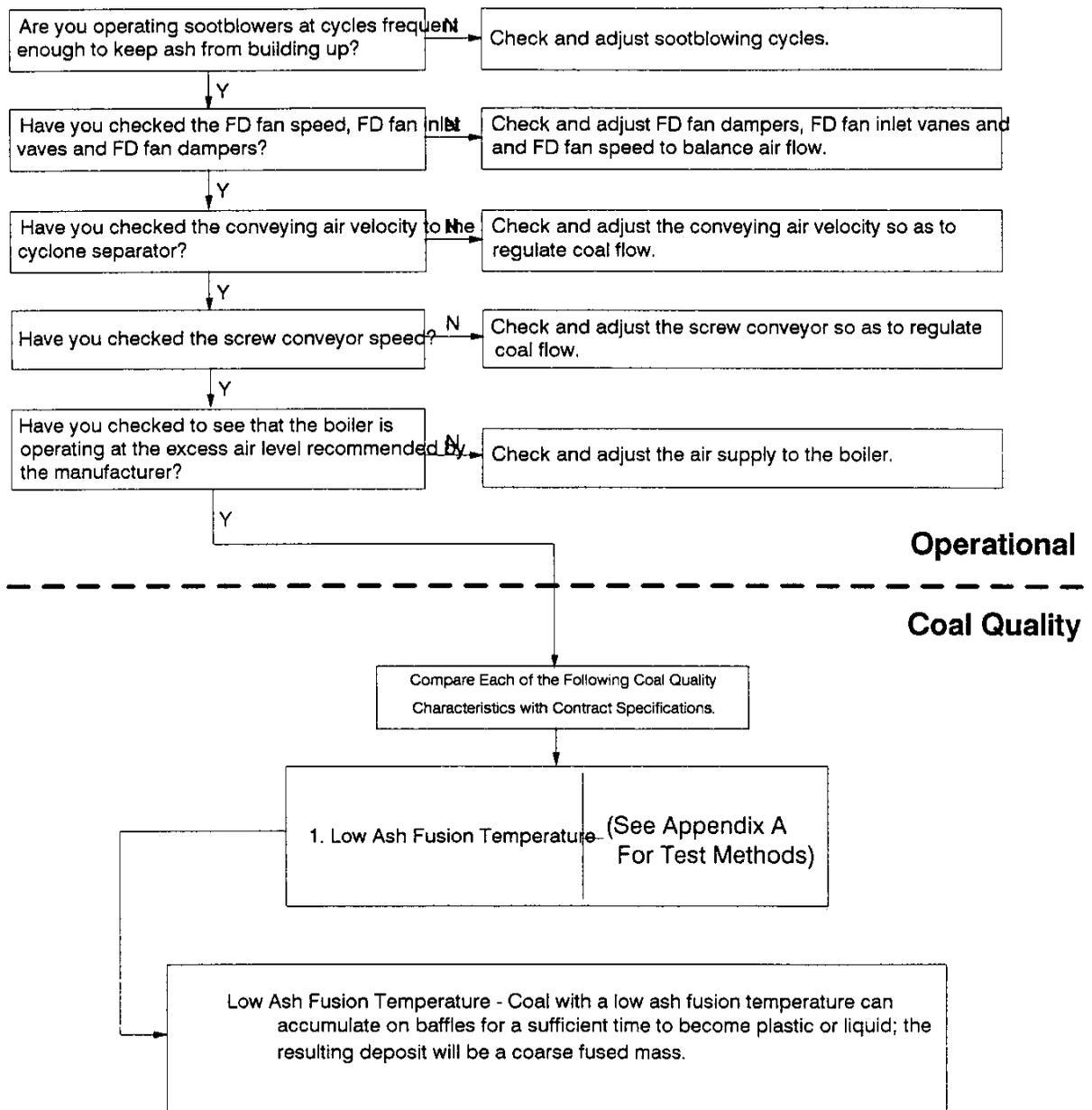
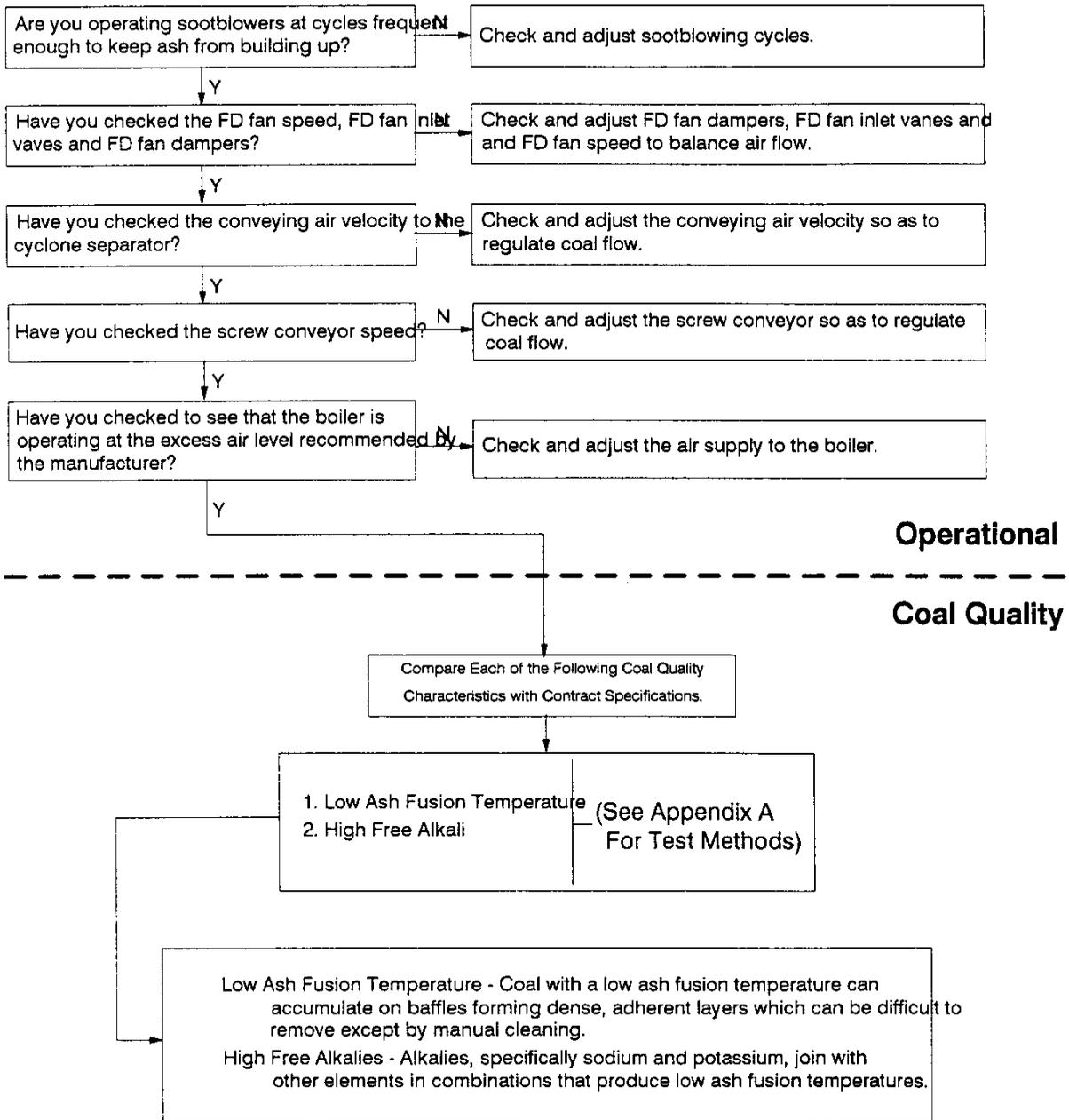


FIG4-36/v1

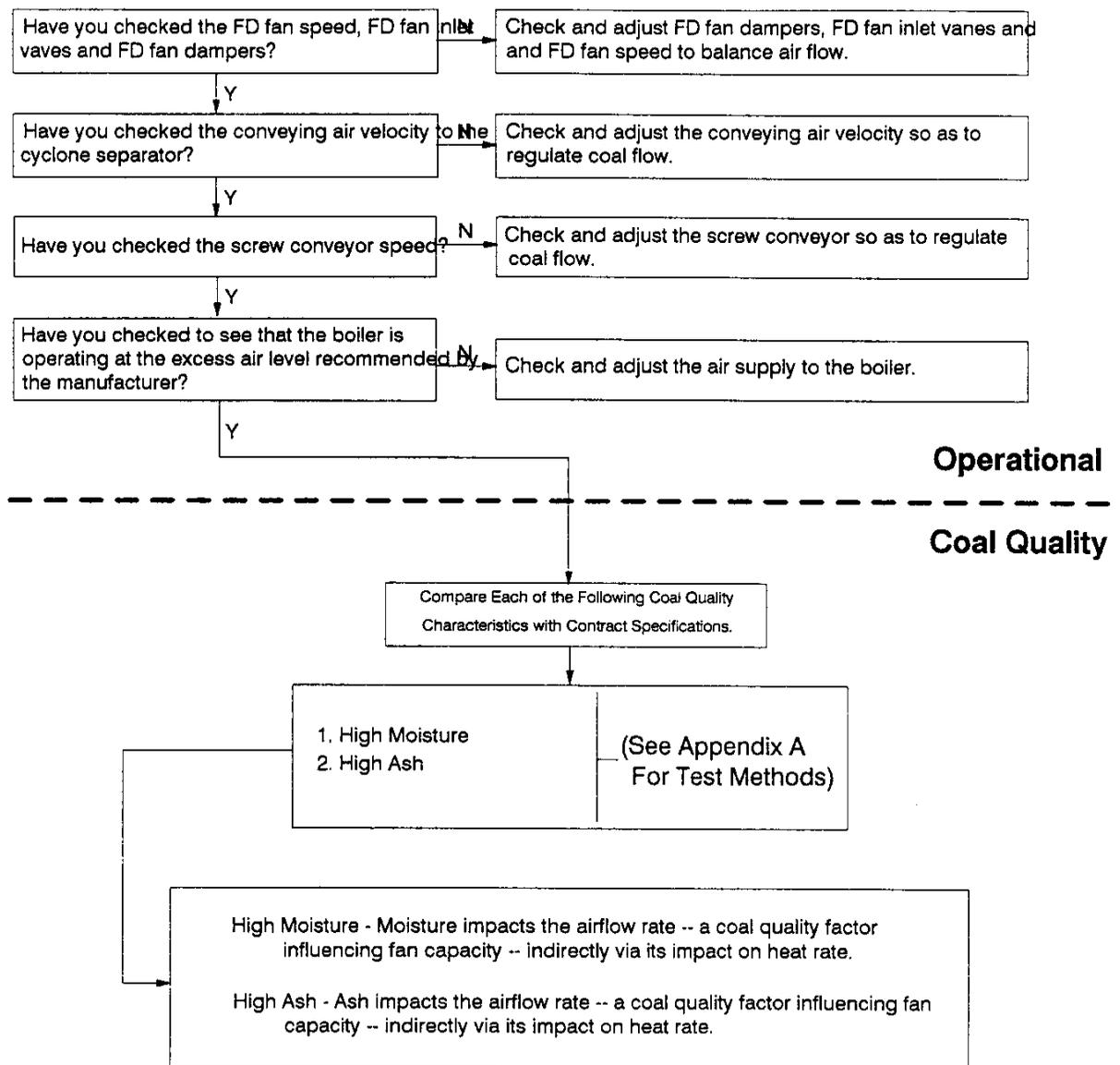
**FIGURE 4-37: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging Of The Heat Transfer Surfaces
(Baffles)**



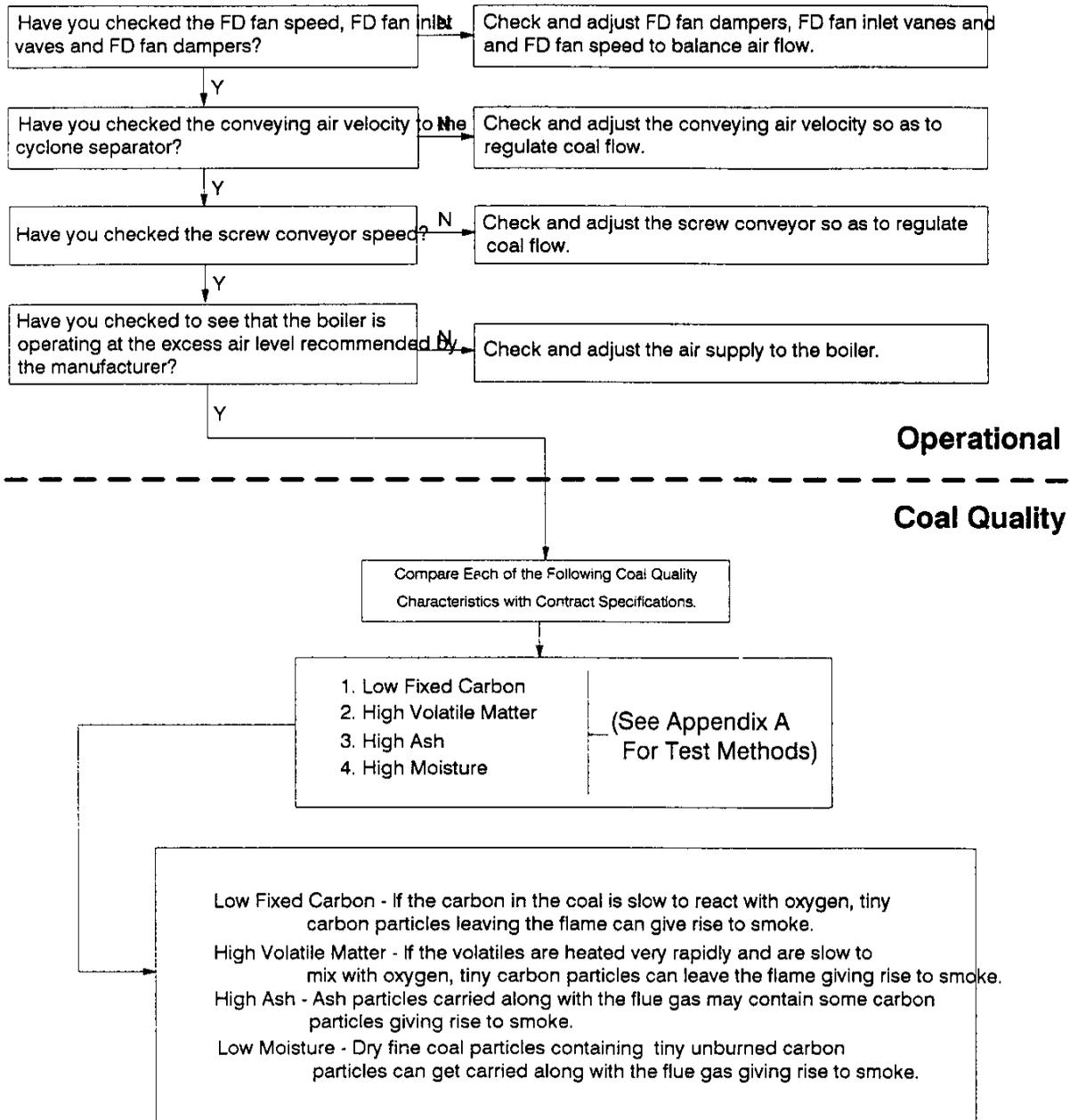
**FIGURE 4-38: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of The Heat Transfer Surfaces
(Baffles)**



**FIGURE 4-39: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Forced Draft Fan)**



**FIGURE 4-40: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Forced Draft Fan**



**FIGURE 4-41: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Induced Draft Fan)**

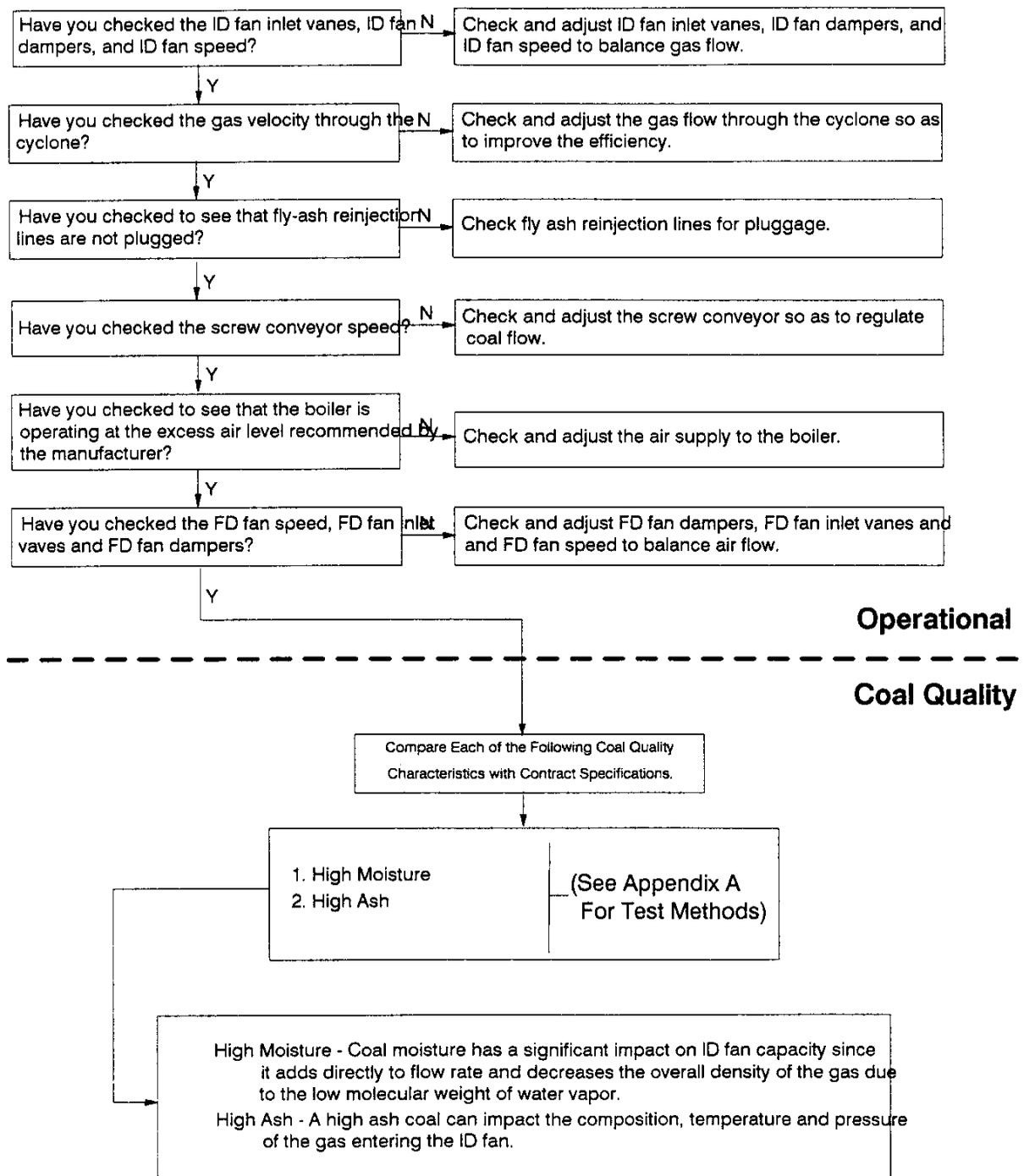


FIG4-41n2

**FIGURE 4-42: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Induced Draft Fan**

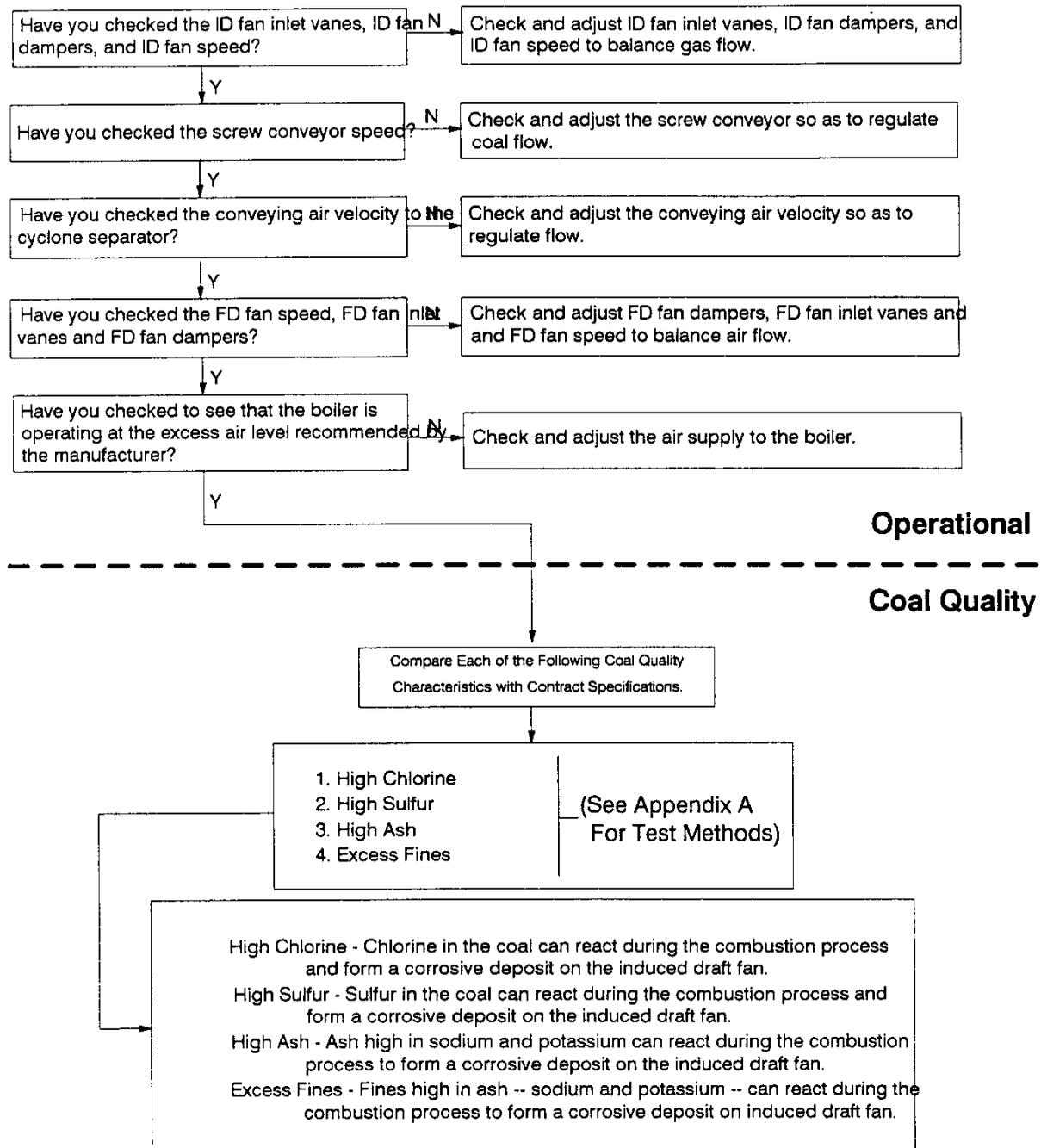
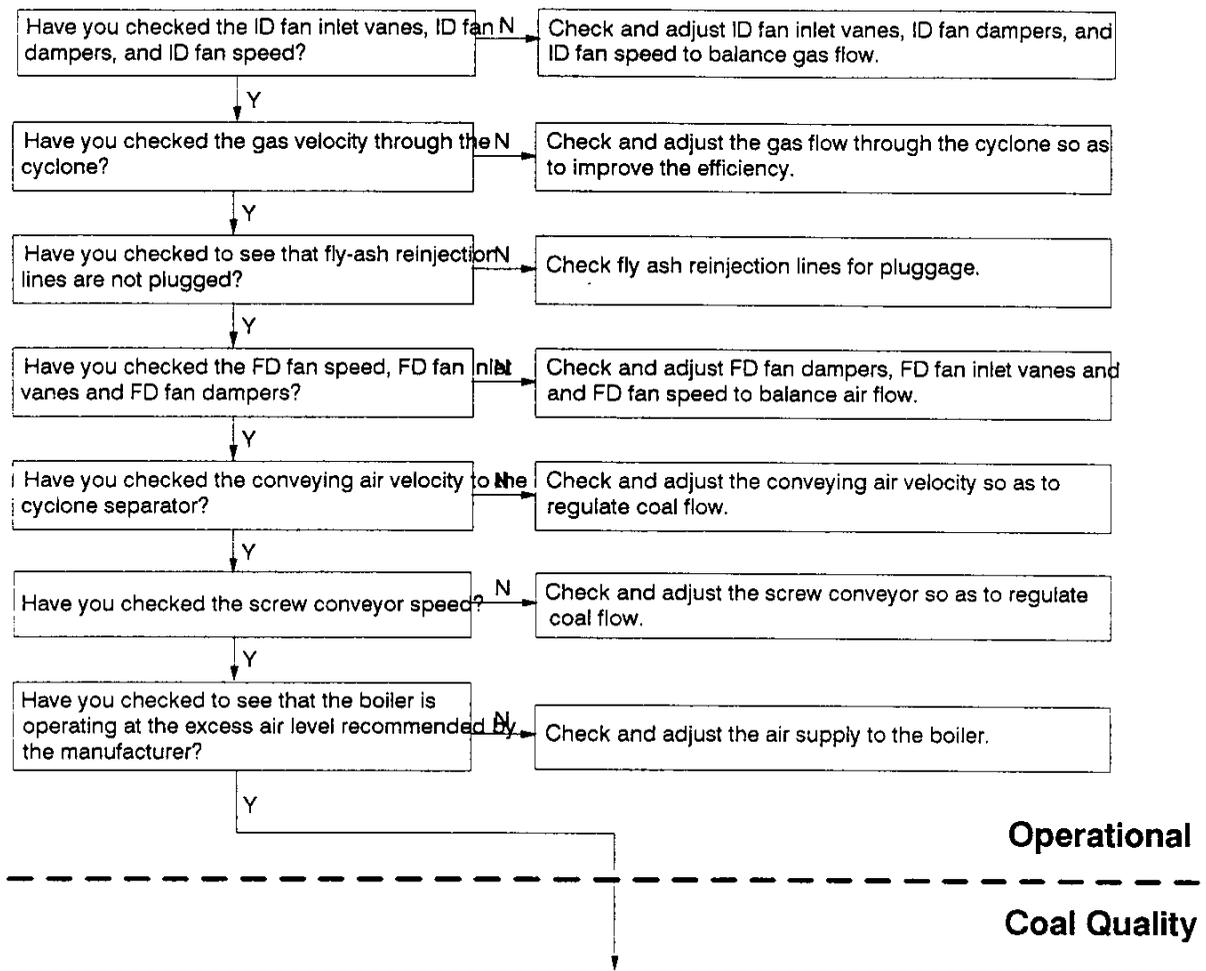


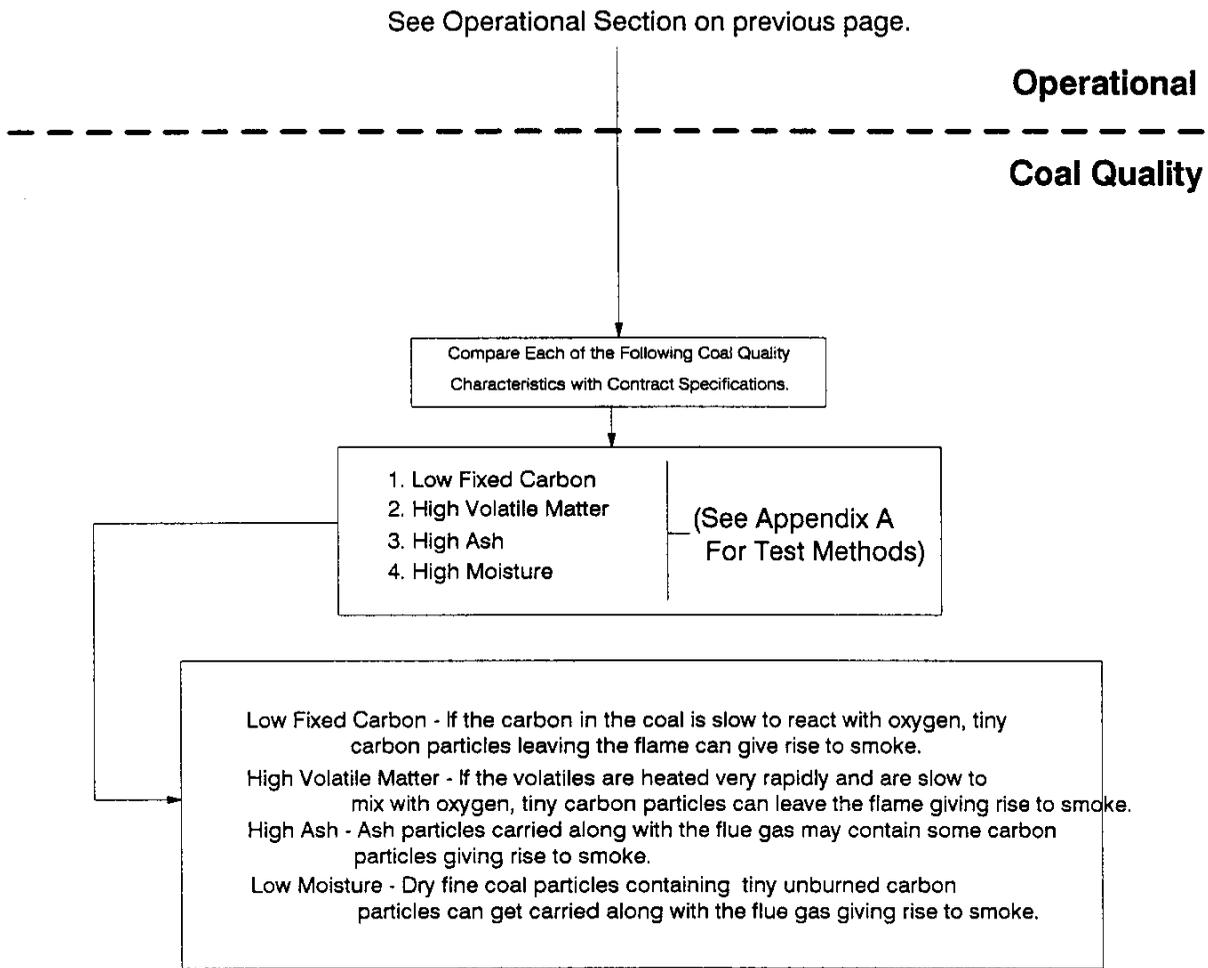
FIG4-42rv2

**FIGURE 4-43: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Induced Draft Fan**

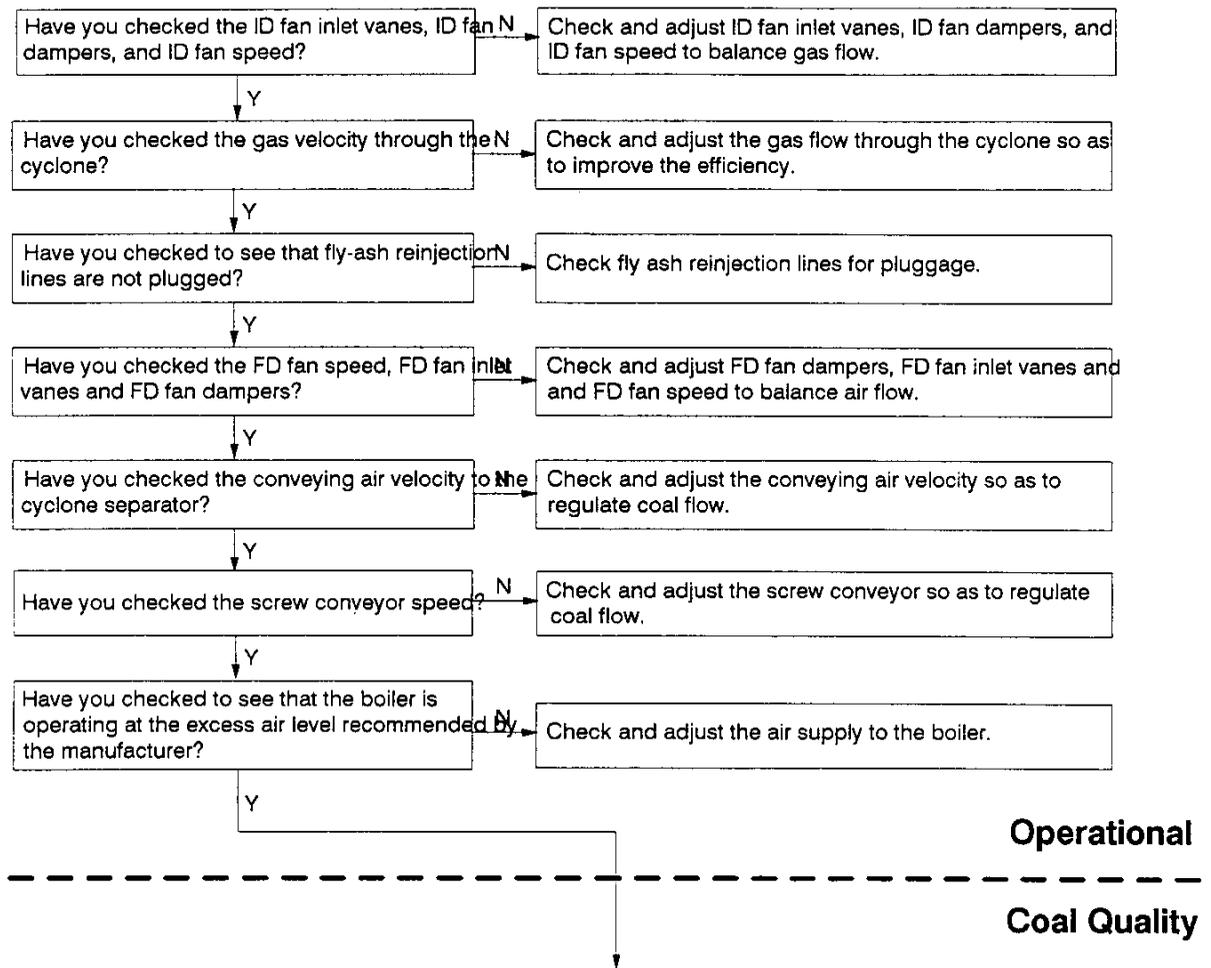


See next page for Coal Quality Section.

**FIGURE 4-43 (continued): TOP FEED STATIC GRATE STOKER
TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Induced Draft Fan**

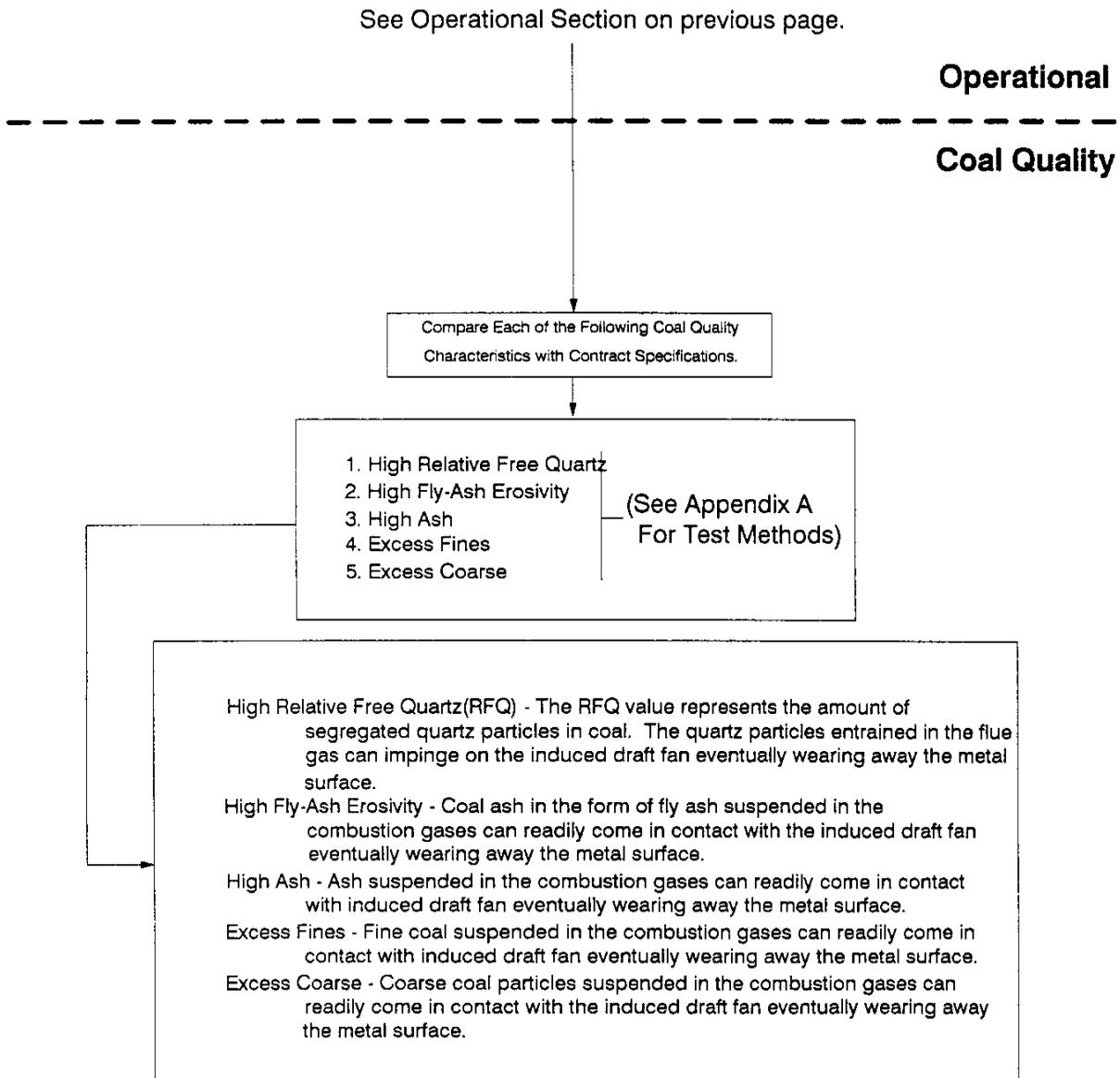


**FIGURE 4-44: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Induced Draft Fan**



See next page for Coal Quality Section.

**FIGURE 4-44 (continued): TOP FEED STATIC GRATE STOKER
TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Induced Draft Fan**



**FIGURE 4-45: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Particulate Removal System
(Cyclone)**

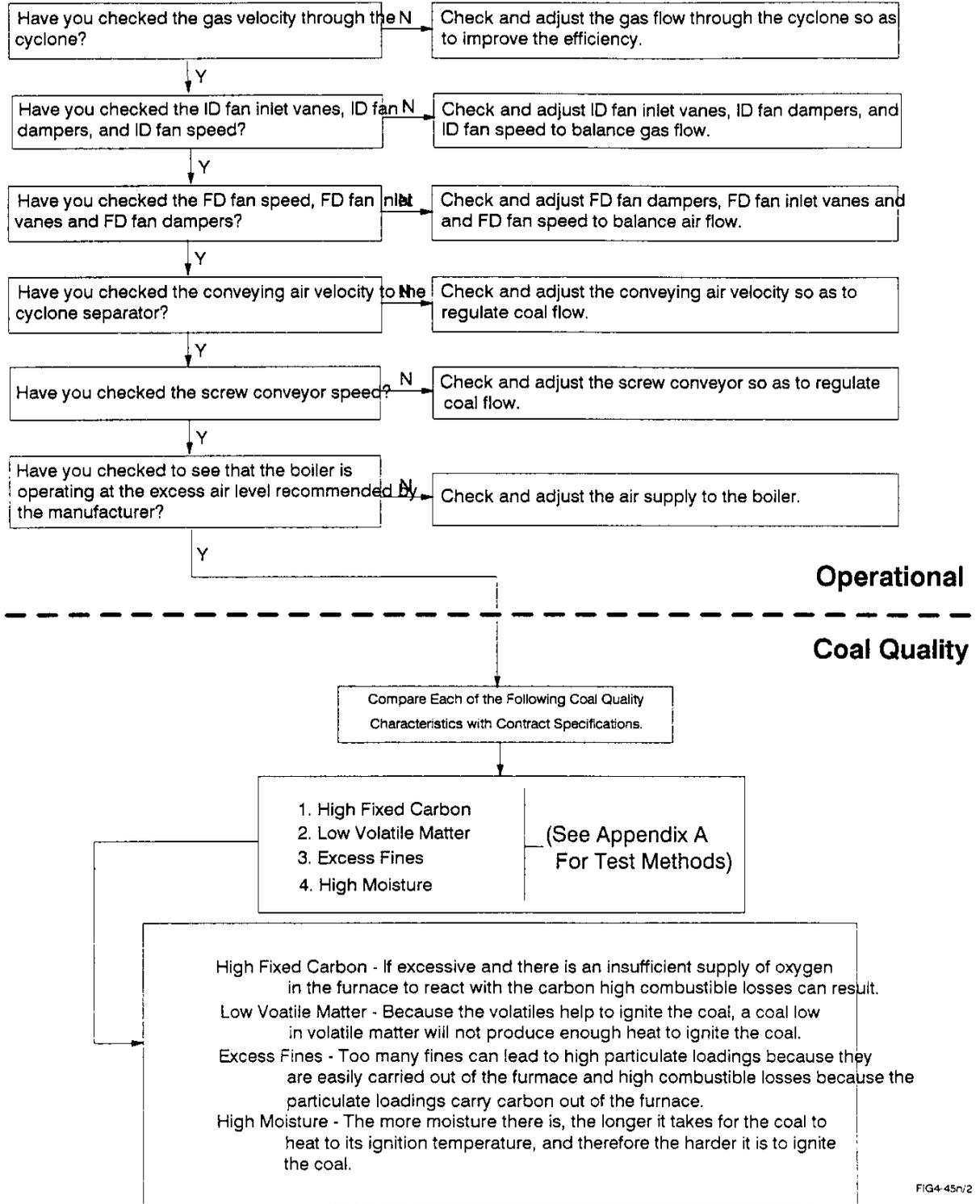
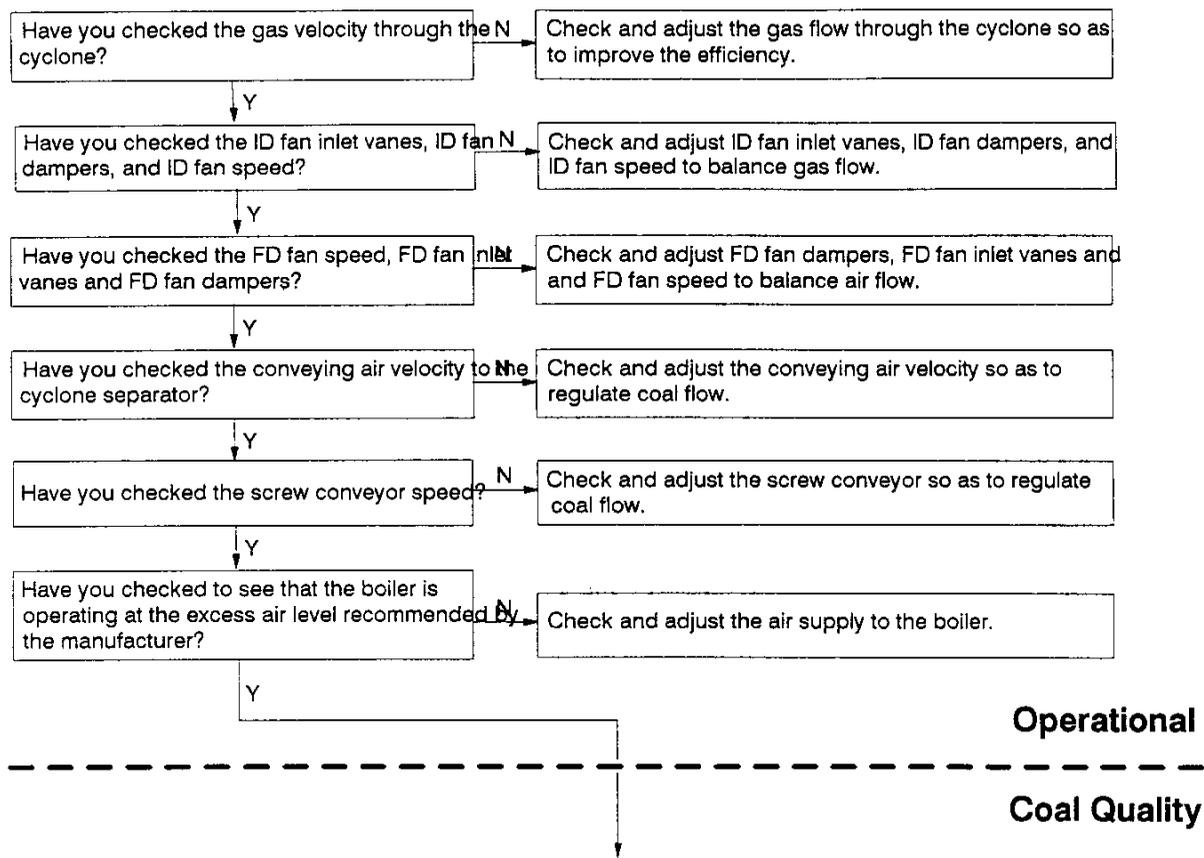


FIG4-45v2

**FIGURE 4-46: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Particulate Removal System
(Cyclone)**



See next page for Coal Quality Section.

**FIGURE 4-46 (continued): TOP FEED STATIC GRATE STOKER
TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Particulate Removal System
(Cyclone)**

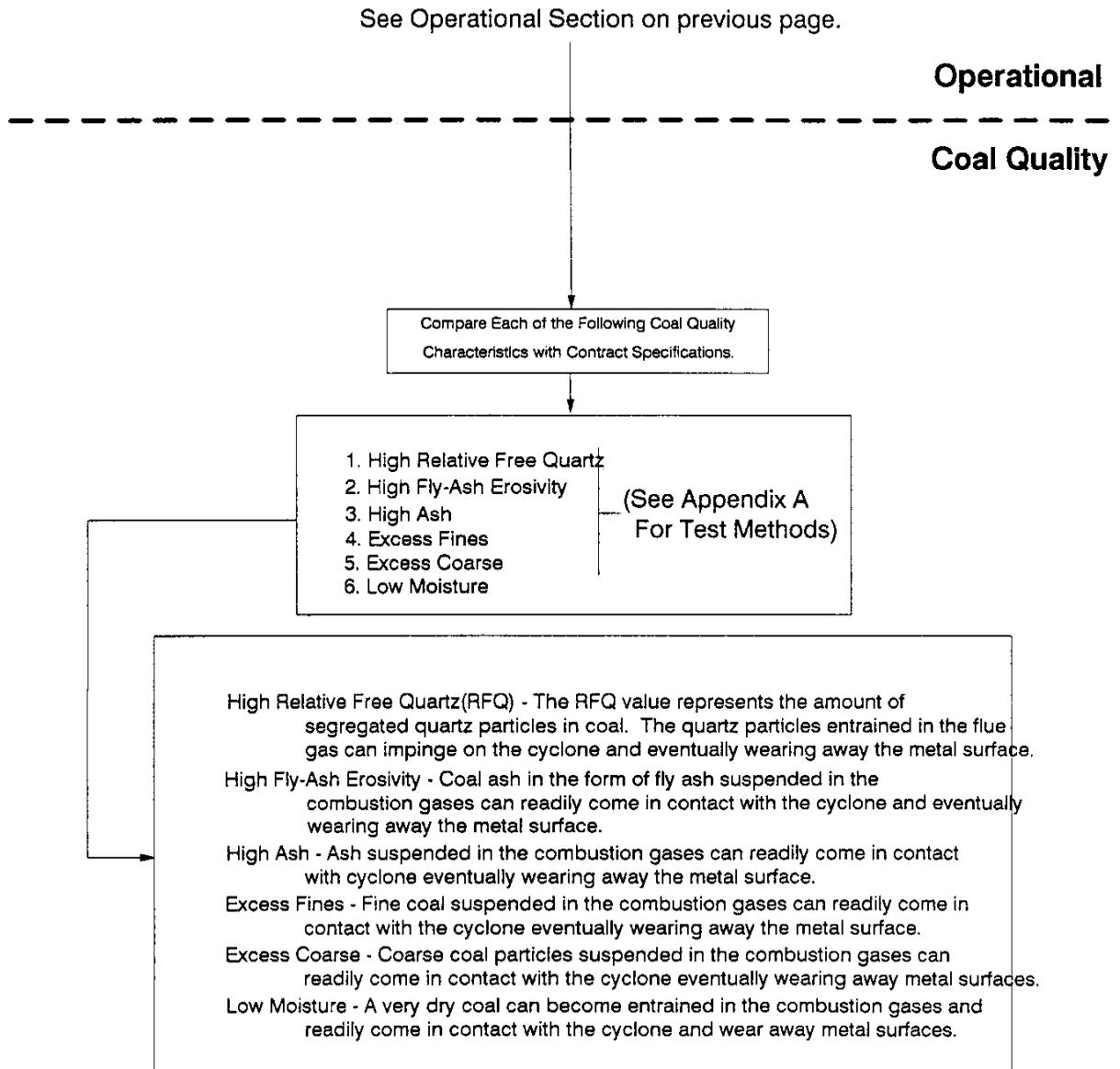


FIGURE 4-47: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM For Excess Particulate Emissions From The Particulate Removal System

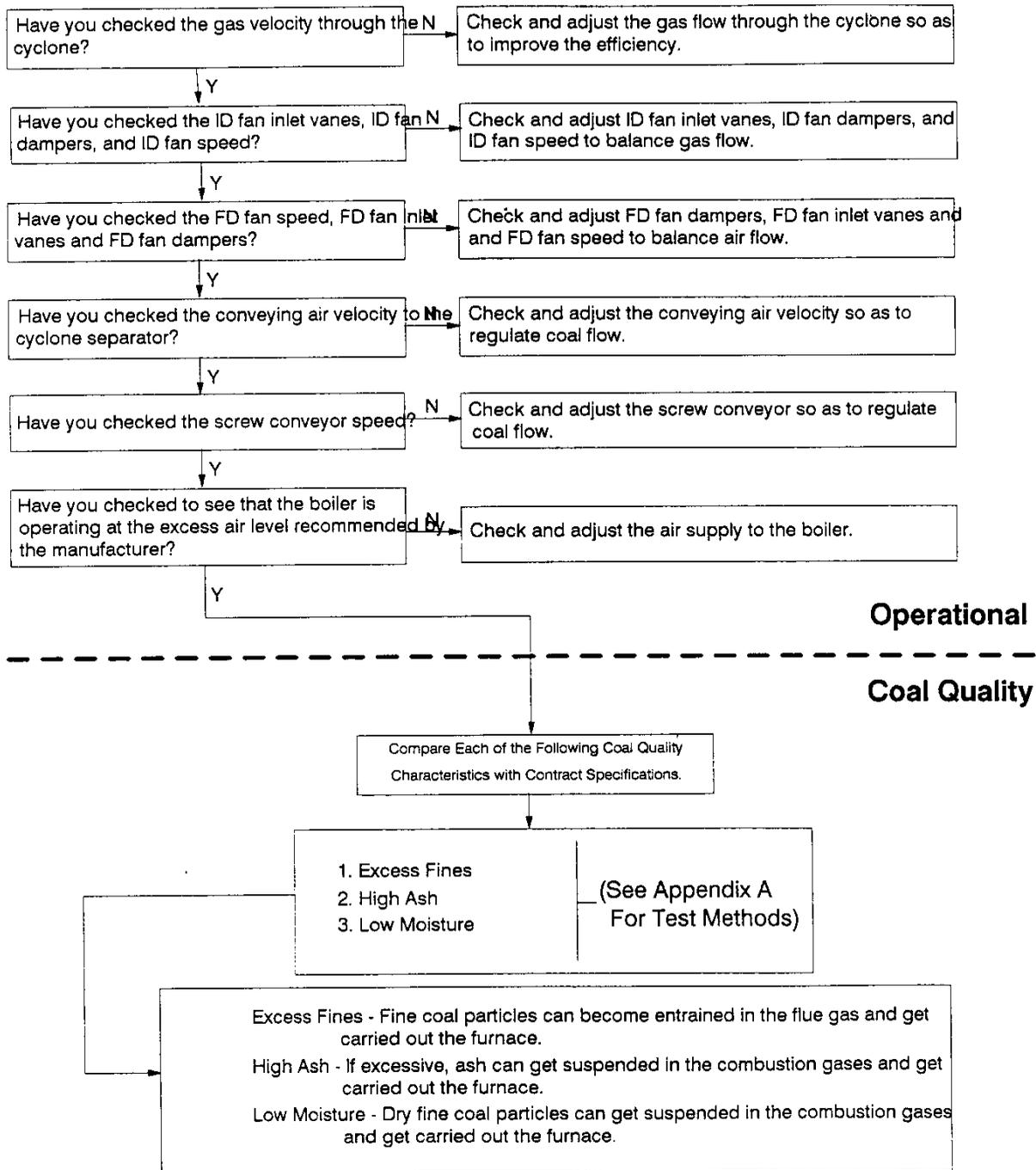


FIG4-47v2

FIGURE 4-48: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM For Carbon Burnout In The Fly-Ash Recycle

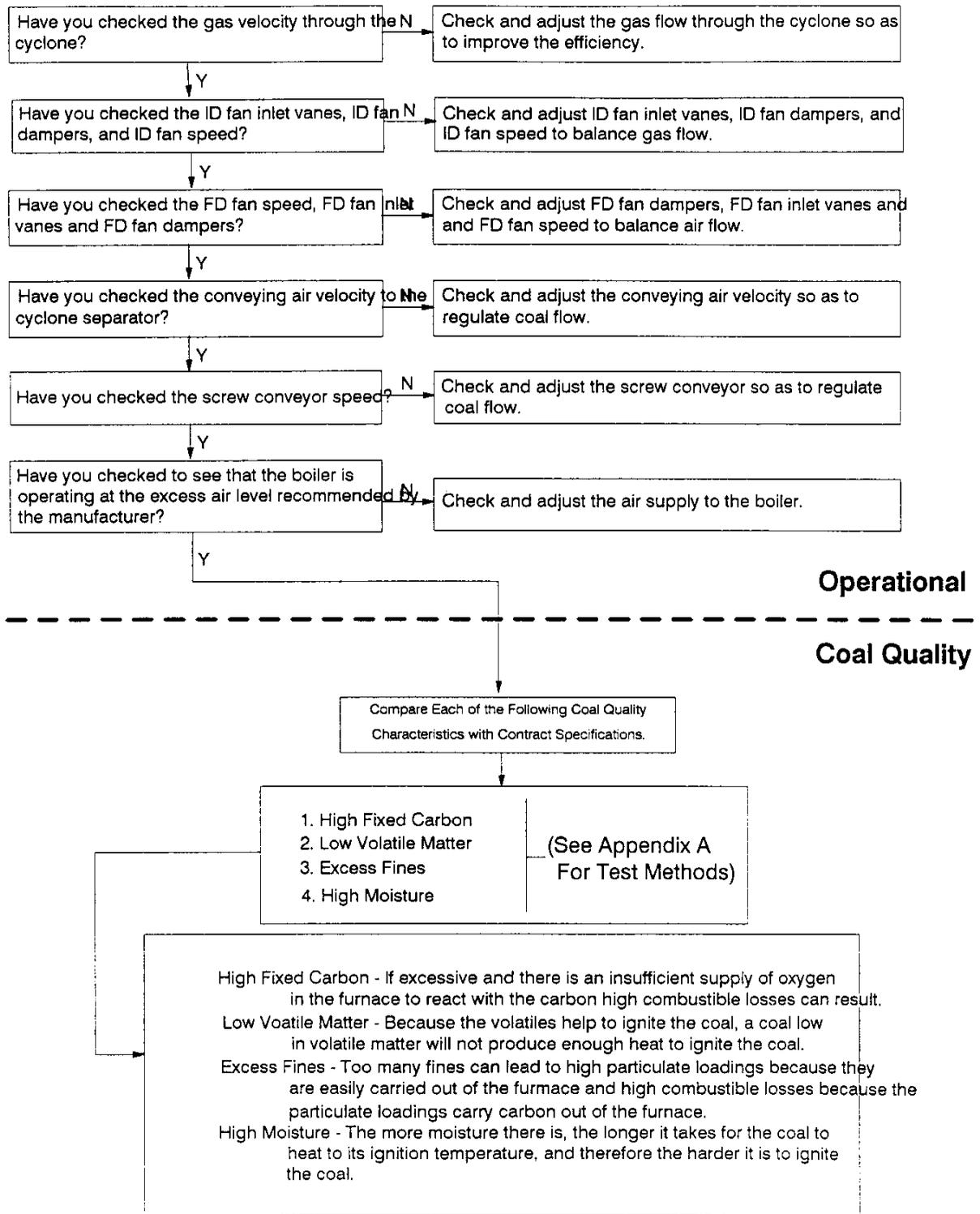
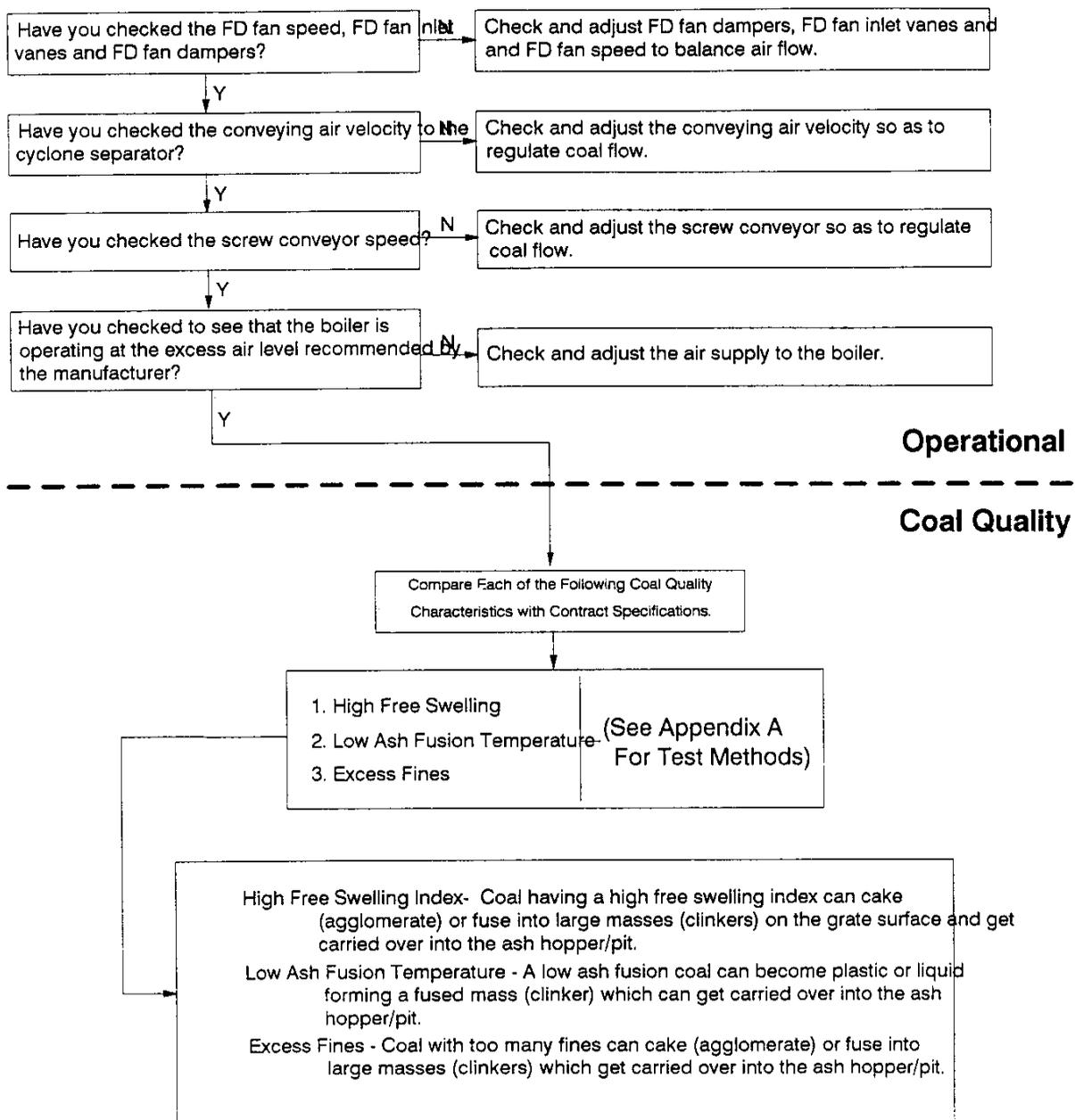
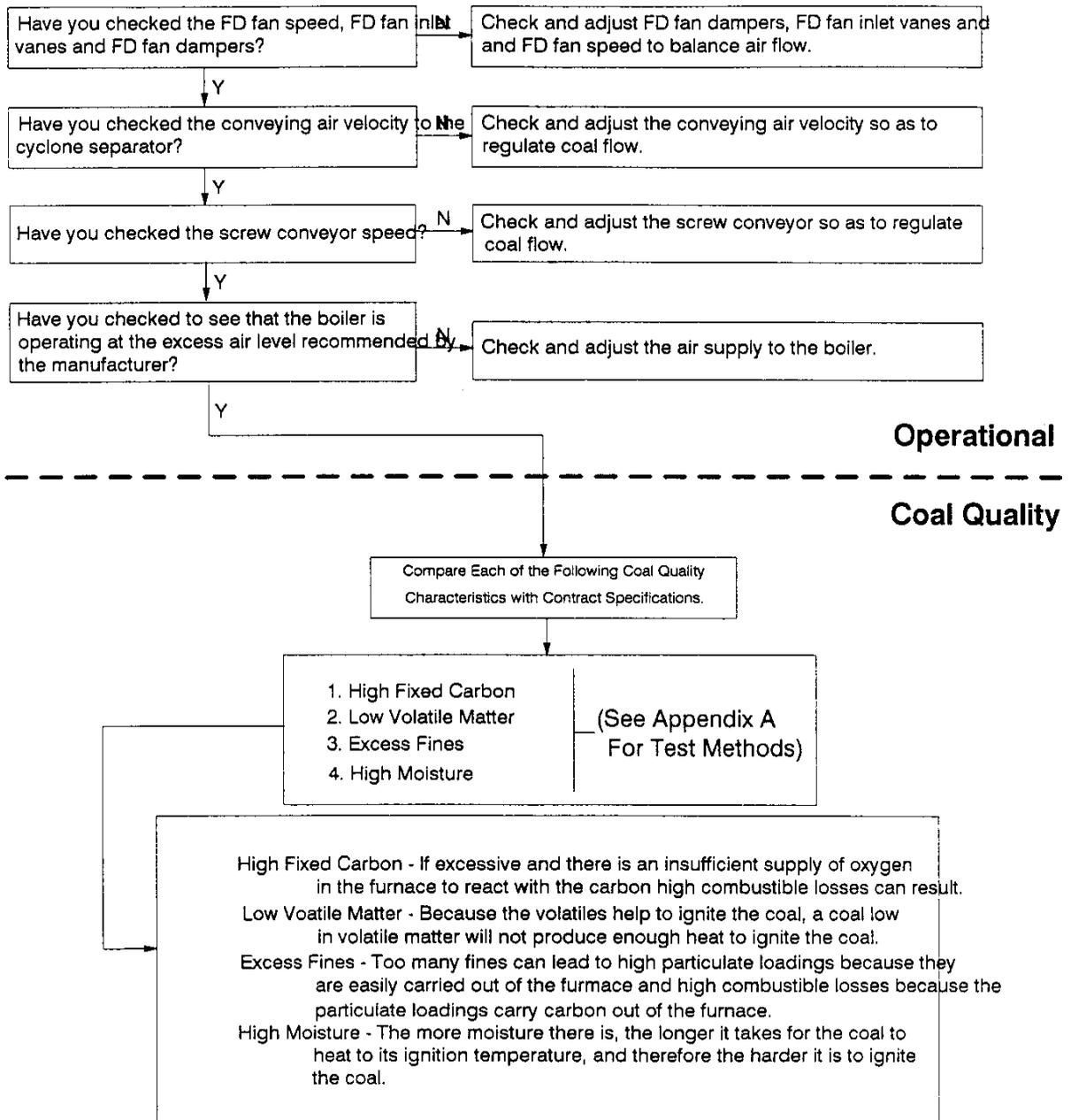


FIG4-48r/2

**FIGURE 4-49: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Clinkers In The Ash Dollie**



**FIGURE 4-50: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Ash Dollie**



**FIGURE 4-51: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of Stack/Chimney**

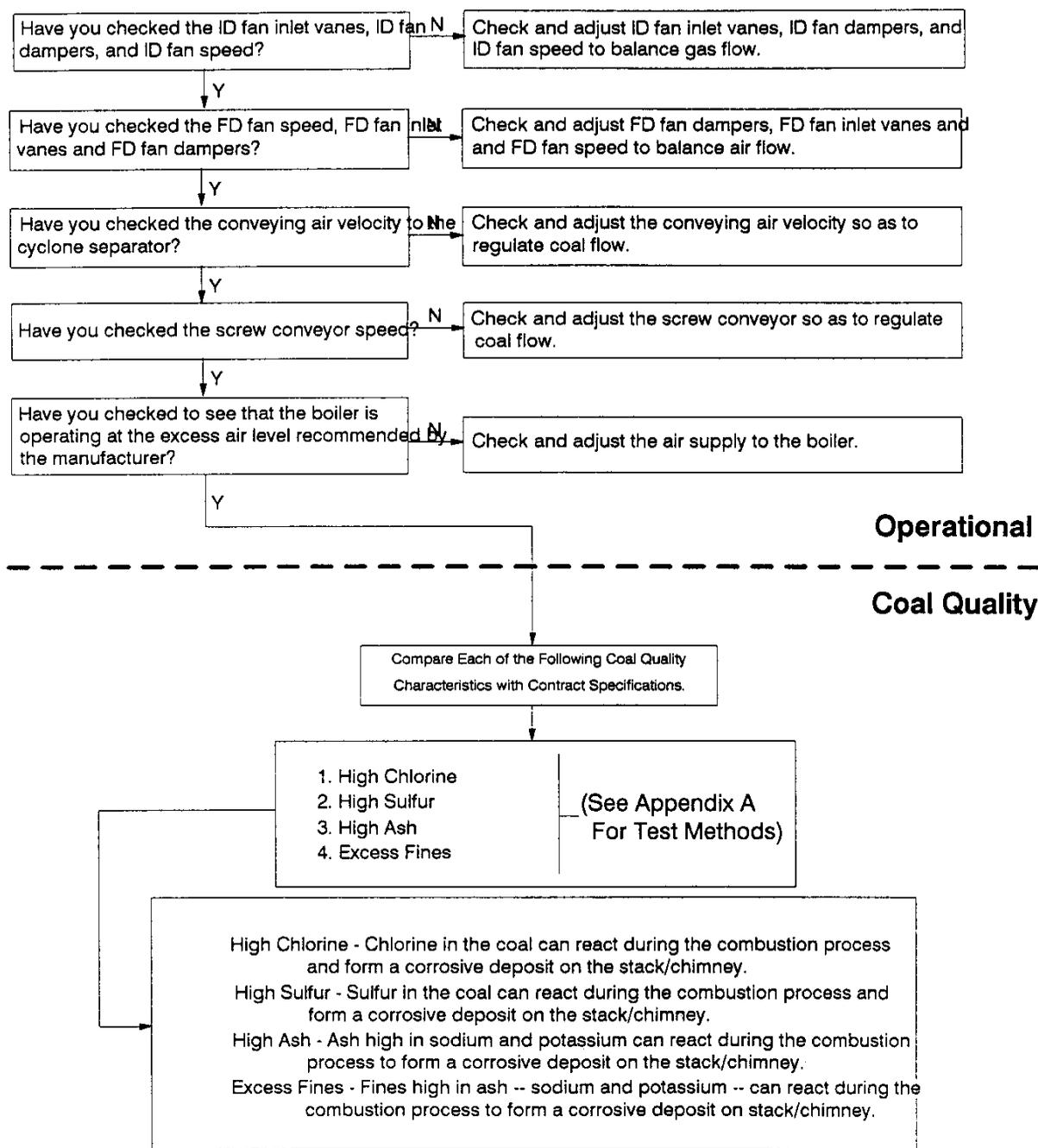


FIG4-51n/2

**FIGURE 4-52: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Stack/Chimney**

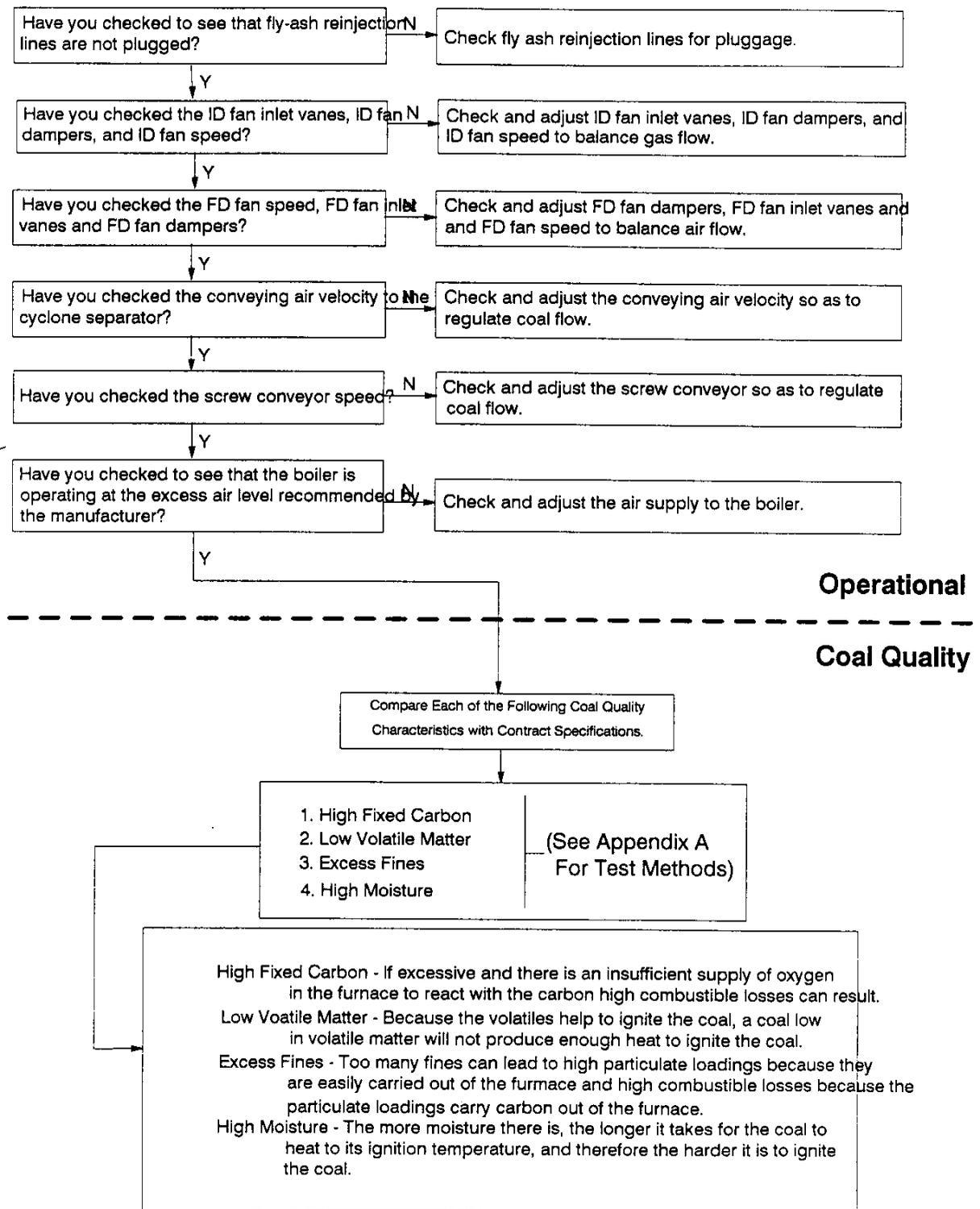
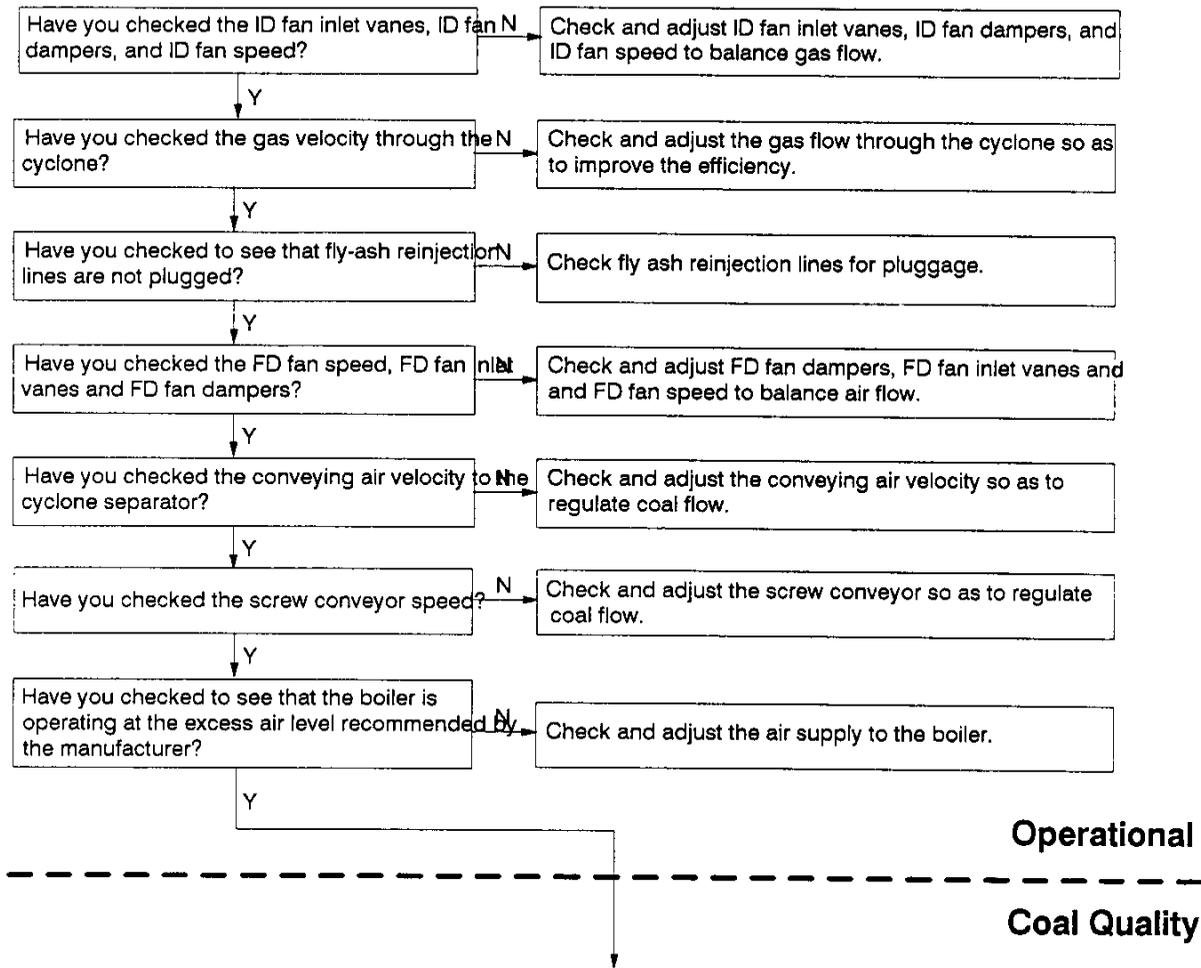


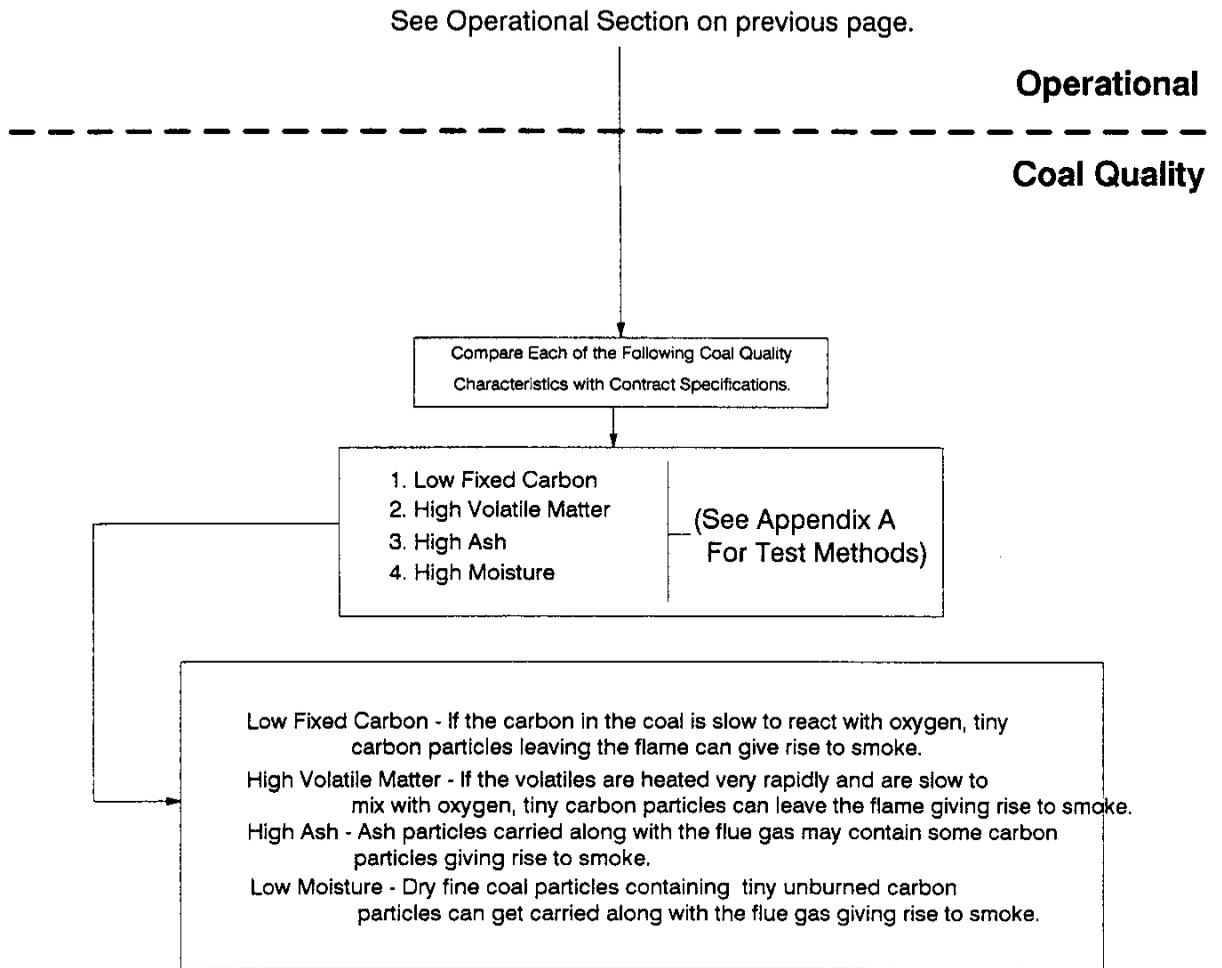
FIG4-52n/2

**FIGURE 4-53: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Stack/Chimney**

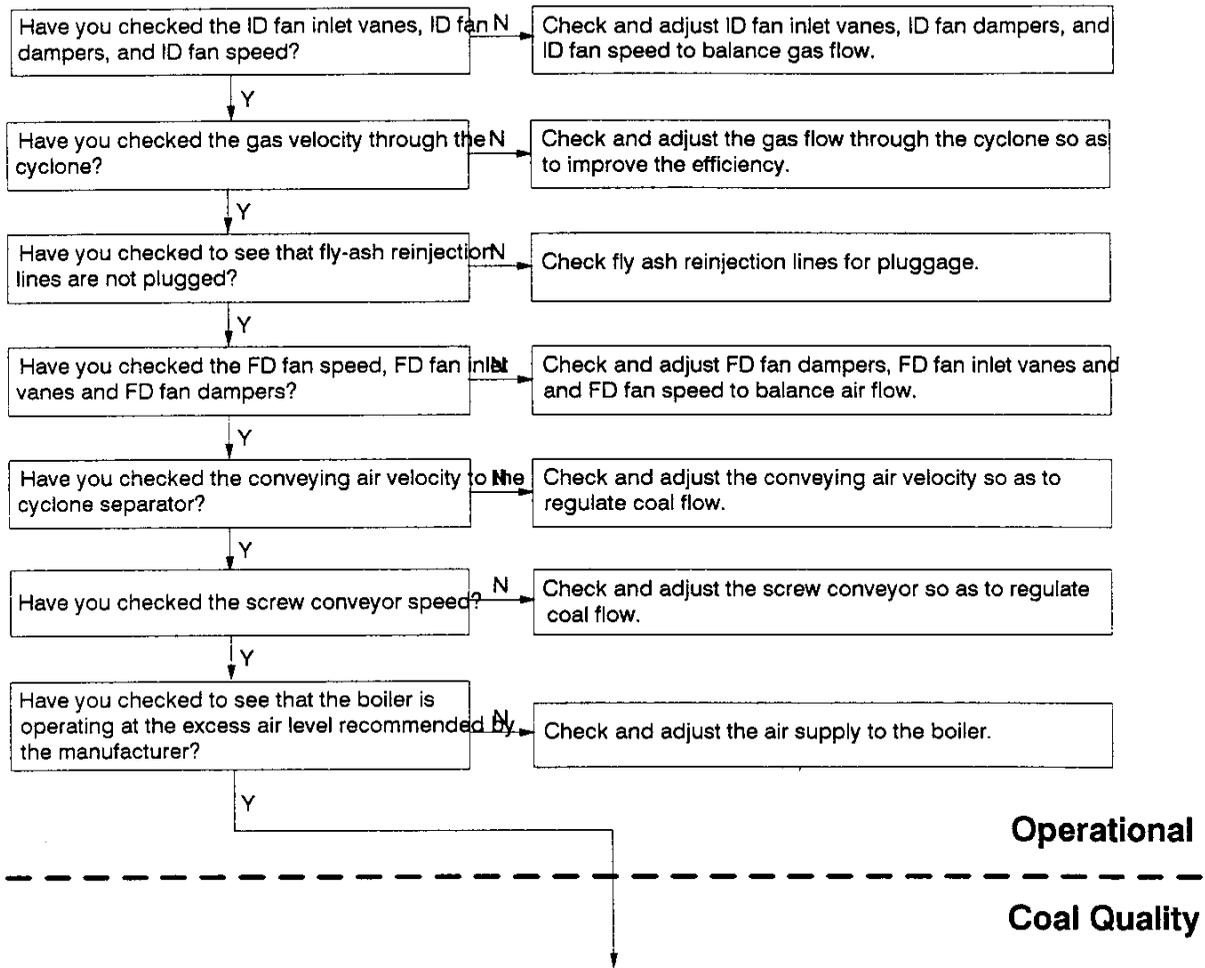


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**FIGURE 4-53 (continued): TOP FEED STATIC GRATE STOKER
TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Stack/Chimney**

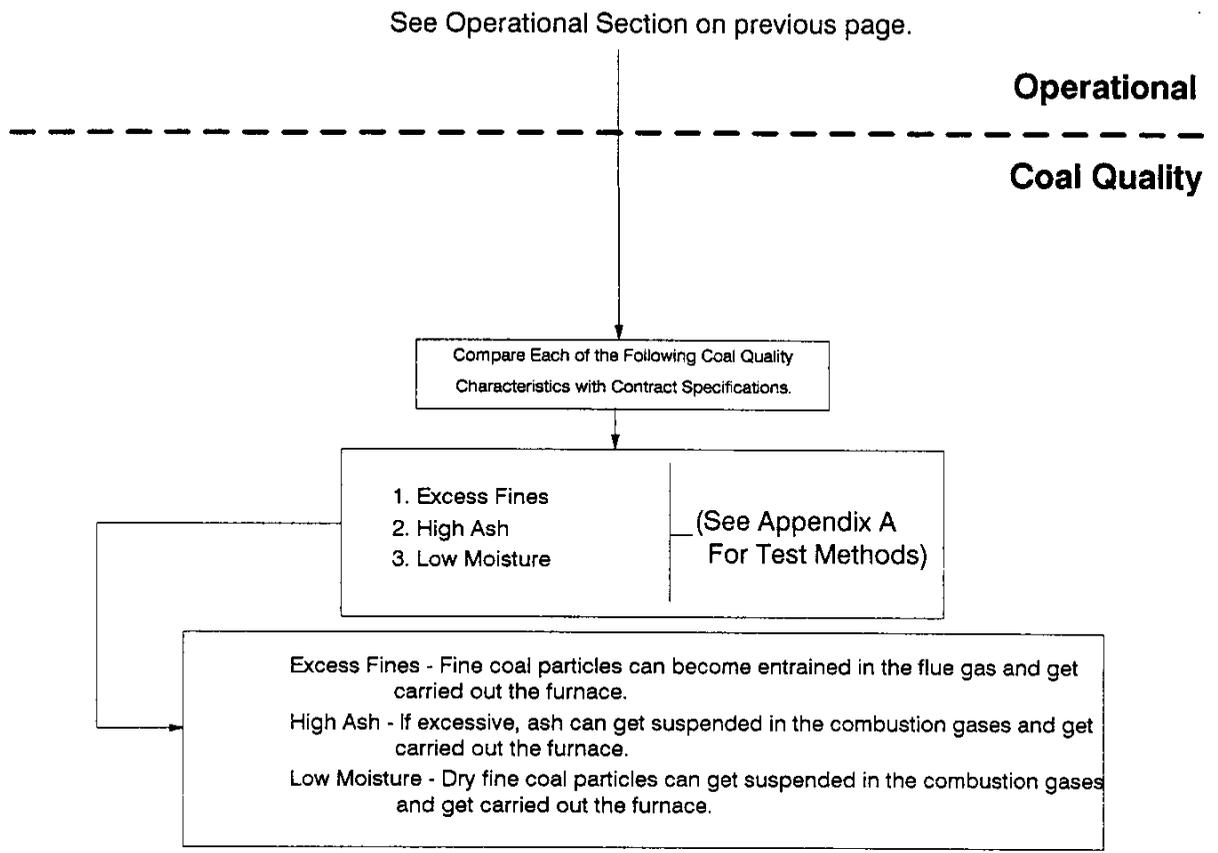


**FIGURE 4-54: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Stack/Chimney**



See next page for Coal Quality Section.

**FIGURE 4-54 (CONT'D): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Diagnosing Excess Particulate Emissions From The Stack/Chimney**



**FIGURE 4-55: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For SO2 Emissions From The Stack/Chimney**

