

# Series 69TV Furnace Monitor System

## Closed Circuit Television System



*Figure 1 - CCTV System Components*

### **APPLICATION**

Combustion Tec's Closed Circuit Television (CCTV) Furnace Monitor System is one of the most advanced instrumentation systems for observing flame characteristics and batch distribution inside glass melting furnaces. The system includes a time-lapse video cassette recorder for process optimization.

The 90E field-of-view CCTV Furnace Monitor System allows observation of 75 percent or more of the furnace interior from a single location (whereas direct observation from peepholes is limited to straight on views.) The use of a high resolution CCD camera, superior optics, and a highly efficient cooling system provides a reliable, sharp, clear image of internal furnace operation. The CCD camera signal can be used in conjunction with image processing equipment for automatic furnace control.

The Pneumatic Retraction System provides for the automatic withdrawal of the CCTV water jacket/lens assembly from its operational position in the furnace wall. Automatic retraction

is initiated by a failure in feed water, air pressure, or electrical power. A manual retraction feature of the system is provided to facilitate preventive maintenance, cleaning, equipment repair, and/or replacement as appropriate.

The exact camera placement and viewing angle are determined by furnace site and accessibility. For example, in sideport furnaces, the optimum viewing is from the furnace centerline high on the front or back wall as close to the crown as possible. On an endport furnace, high on the bridgewall (front wall) with a downward angle provides an excellent view of the flame and batch patterns. On direct-fired furnaces, end wall views facing the approaching batch give the best coverage. Additionally, the CCTV Furnace Monitor System can monitor bubbler operations for glass current improvement.



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## **BENEFITS**

The Combustion Tec CCTV Furnace Monitor System, using time-lapse video recording, is an excellent tool to increase furnace productivity and product quality. The system allows you to analyze the furnace operation and if necessary, correct any problems or deviations, such as erratic flame patterns, poor batch melt, and inefficient bubbler operation. Burner flame characteristics can be viewed over time, so flame length, shape, and angle can be adjusted for optimal operation.

## **FEATURES**

Combustion Tec's furnace monitor system uses a solid state, high resolution, CCD camera. The camera uses a cobalt filter to absorb sodium wavelength emissions. This filter reduces the effects of the visual intensity in the furnace interior and improves flame and batch pattern definition.

The camera system requires protection against high temperature furnace conditions which is provided by air and water circulation under controlled pressure through the lens tube, water jacket and camera enclosure. Air and water service are connected to the water-jacketed lens assembly from the pipe train, using flexible hose with quick-disconnect end fittings.

Sealing air provides an isolation barrier for the lens tube and water jacket openings, to prevent entry of corrosive vapors. The water jacket, which surrounds the lens tube, gives added temperature regulation and provides physical support for the lens tube in the furnace wall opening.

The carrier plate assembly provides support for a camera enclosure, lens tube and water jacket, when installed into a 3-inch (76mm) opening in the furnace wall. The refractory block is normally made of AZS or Zircon. Air and water service with quick-disconnecting couplers are provided.

The lens tube, attached to the camera enclosure, contains cooling air passages for the objective lens. Air flow around the lens body provides cooling and minimizes dust accumulation by directional vanes, thus reducing cleaning needs. Sealing air flowing across the lens face is sufficient to overcome furnace pressures, and also blocks entry of corrosive vapors. Special lens lengths, filters, and fields-of-view are available on request.

The camera enclosure has a special exterior surface to repel radiant heat. The body of the enclosure is made of stainless steel and can be water cooled, if required, to protect the camera from the effects of the radiant heat from the furnace. The internal temperature of the enclosure is monitored by a thermometer and controlled by a cooler.

The water jacket is constructed of stainless steel, which provides excellent service life at high temperatures as well as resistance to oxidation. The water jacket uses a double-pass circulation design to ensure effective, continuous cooling of the camera's objective lens.

The pipe train and drain assembly provided with the CCTV system regulate water jacket assemblies. The pipe train is equipped with pressure switches. The drain assembly is equipped with a temperature switch to signal potential malfunctions, thus preventing system overheating and damage.

Air filters keep oil mist and debris from entering the system. A water strainer (included in the water line) will remove particulates from the cooling water but not mineral content. (We recommend that you use treated water, because the mineral content is removed.)

Water and air pressure switches on the pipe train and the water and temperature switch on the water drain can be used to monitor the water and air services to the camera system to warn against possible malfunction in the case of water or air loss. These switches are connected to the alarm



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panel and retraction system for automatic retraction of the camera system in case of service failure.

The mounting bracket allows attachment to the furnace structure. The bracket has horizontal, lateral, vertical, and rotational adjustments, as it supports the carrier plate assembly.

The alarm panel reduces reaction time to system failures. Failure alarm lights are located on the central panel. This panel also serves as a system control and may be located in the furnace control room or at the system pipe train.

The video cassette recorder is a time-lapse unit. Unlike a conventional recorder, accumulation of continuous data over a multiple day span is compressed into a short duration display. A typical 24-hour period can be displayed in as little as 6 minutes of tape time; permitting fast, accurate displays of furnace conditions for evaluation.

The time-lapse VCR records up to 20 days of operation on a 2-hour tape and shows time and date on the TV screen. The time-lapse playback shows the batch patterns in fast motion so batch patterns can be quickly and accurately determined.

The Retraction Carriage Assembly contains a 25-inch rodless cylinder assembly which allows for 25 inches of retraction. The water jacket of the CCTV system attaches to the assembly which has a pivot point so the camera system can be rotated for maintenance.

The adjustable frame allows for minor adjustments in position after it has been permanently mounted, so the CCTV system can retract freely without binding.

The Control Panel assembly provides both a visual and audible indication of a "failure" of a service supply. The Control Panel monitors: water pressure, purge air pressure, and cooling air

pressure. The system will also retract in case of electrical failure. There is an indicator light for system silence and reset.

The system-ready indicator light indicates that the supply services are in operating range. The silence indicator light shows that the audible annunciator has been turned off at the panel by the activation of the "silence" button. The reset light lights up only when the reset button is pushed. The reset button resets the system after the problem has been solved. The off/on switch turns power on to control panel.

The MAN/AUTO select switch normally remains in the "AUTO" position during system operation. In this position, any failure will initiate automatic carriage retraction. This results in movement of the camera and lens assembly from its position in the furnace wall to one of relative safety for the equipment.

Placing the MAN/AUTO select switch in the MAN position will initiate immediate retraction. This feature allows access to system components for cleaning, maintenance, repair, or replacement as appropriate.

The recommended mounting position of the control panel is adjacent to the Pipe-Train assembly, within sight of the retraction carriage position or in the control room. Mounting the control panel in this manner will make it easier to maintain and repair the system components.

The Air Reservoir tank is assembled to Combustion Tec's specifications. With a charged tank, 80-120 PSIG/(552/827kPa), the system will reliably provide a minimum of two full retractions, when the air supply is interrupted. In the event of an electrical power failure, loss of plant air or plant water, the control solenoid will automatically initiate retraction and cause the control panel alarm circuit to activate through the interconnecting wiring.



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## CAMERA LOCATION

The CCTV camera location and angle depend upon viewing needs and furnace restrictions. Batch pattern movements or flame shapes within the furnace should be considered for primary emphasis. The ambient temperature at the camera site should also be considered to reduce the possibility of heat damage.

**SIDE PORT FURNACES** - For flame pattern observation on a side port furnace, the optimum view would be obtained at the crown centerline near the refiner end, since batch vapors at the charging end require increased lens maintenance. Ideally, the camera would be mounted at the centerline of the bridgewall near the crown, pointed at a slight downward angle to give a multiple flame and batch meltout view. Bubbler operation can also be monitored.

However, if the side port furnace is large and batch patterns are to be emphasized, the batch patterns can be monitored with a camera mounted on the charging wall near the crown centerline and aimed downward. (A camera located near the refiner end could illustrate batch patterns too small to be distinctive.)

**END PORT FURNACES** - End port furnaces batch patterns are best viewed when the camera is located on the centerline of the bridge wall near the crown. A downward angle will provide a complete view of flame and batch patterns.

**DIRECT FIRED FURNACES** - On direct fired furnaces, a view from the end wall facing the on-coming batch may be best. Placement near the exhaust flue or recuperator may make camera placement and service difficult because of inaccessibility and high temperature.

## INSTALLATION

The CCTV water jacket requires a 3-inch (76mm) diameter hole through the furnace wall. The water jacket is inserted into this hole until the

water jacket is inserted approximately ½ inch (13 mm) back from the furnace wall hot face. The water jacket is attached to the mounting bracket. The water jacket then supports the lens tube and carrier plate assemblies.

Clearance is of great concern where maintenance is involved. There must be sufficient space available to retract the carrier assembly and, if needed, the water jacket. A distance of 6 feet (1829mm) will be adequate for removal. Air and water cooling lines should also be long enough to allow for retraction of this equipment without disassembly.

## CCTV CAMERA BLOCK

The CCTV water jacket can be installed in existing furnace blocks or in a modified block, typically AZS or Zircon refractory block. Of course, a 3-inch (76mm) diameter hole can be drilled through furnace refractories to permit installation on an operating furnace.

Lens tube and water jacket ends must be recessed in the block to protect from furnace heat. When an angled view is used, it is important to prevent the refractory block from interfering with the camera view. An angled hot face on the refractory block can be used to ensure a full unobscured view, as well as providing protection to the CCTV system.

(The installation block is not included.)

## INSTALLATION

Combustion Tec provides system drawings and schematics covering Site Preparation, Facility Service Requirements, and Operation/Maintenance Procedures.

The installation time of a complete CCTV Furnace Monitor System with the Pneumatic Retraction System is approximately 25 to 30 man-hours.

## SERVICE REQUIREMENTS

The CCTV system operates on 120 volt, 50/60 hertz service. A 220 volt, 50 hertz version is



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available. Both the purge air and sealing air must be of instrument grade purity to prevent contamination of internal passages of the system. Cooling air is less critical and may be of lower purity.

The purging air and sealing air require flow rates of 15 SCFM, (25.5 Nm<sup>3</sup>/hr) at 20 psig (1.4 bar) minimum. The cooling air must be at least 15 SCFM (25.5 Nm<sup>3</sup>/hr) at 80 psig (5.5 bar). The water flow rate should be between 4 to 6 gal. (15 to 22.5 ltr.) per minute.

### SAFETY DISCLAIMER

*ATTENTION: Certain components of the CCTV Furnace Monitor System can be dangerous to personnel and property if incorrectly installed or operated. Combustion Tec, Inc. urges customer compliance with Insurance Underwriters recommendations, National Safety Standards, and National Electrical codes, and to exercise proper care and maintenance of the system controls and installed safety devices.*

SERVICE	SUPPLY	FLOW RATE SCFM/(Nm <sup>3</sup> /Hr)	NOMINAL PRESSURE PSIG/Bar	MINIMAL PRESSURE PSIG/Bar
Purge air	Instrument Grade Air	15/25.5	20/1.4	15/1.0
Sealing Air	Instrument Grade Air	15/25.5	20/1.4	15/1.0
Cooling Air	Plant Compressed Air	15/25.5	90/6.2	80/5.5
Cooling Water	Plant Recirculating Water (1)	5 GPM (19 LPM)	50/3.4	35/2.4*

\* Maintain 3 GPM (11.4 LPM)

SERVICE	VOLTAGE	NOMINAL POWER
CCTV Camera	120 VAC, 50/60 Cycle (2)	15 Watts
CCTV Monitor	120 VAC, 50/60 Cycle (2)	30 Watts
CCTV VCR	120 VAC, 50/60 Cycle (2)	40 Watts

(1) Most plants have the capability to switch from plant water to city water to ensure continuous water supply: Continuous water supply is critical to the life of the water jacket and lens tube.

(2) Optional 220 VAC, 50 Cycle models available.



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