File: F-100145

Worker Injured in Explosion

Date of Incident: 1999 11 15
Type of Incident: Fatal

SUMMARY

On 99 11 15 at approximately 10:25, during manufacturing, a worker was calibrating the furnace of a heating, ventilating and air conditioning (HVAC) unit at Airtex Industries Management Ltd, Calgary, Alberta. When the worker started the unit, the furnace section exploded and he was fatally injured.

The primary cause of the incident was the build up of an explosive mixture in the combustion chamber of the furnace when incorrect wiring kept the main gas valve open prior to start up of the unit. The explosive mixture was ignited and exploded when the unit was started. The exact source of ignition could not be determined. The secondary cause was a missed test procedure to ensure electrical wiring was correctly installed for proper function of the main gas valve.

Workplace Health and Safety responded to the site and initiated an investigation on 99 11 15. A stop work order was issued requiring the employer to conduct an incident investigation and implement corrective measures to prevent a reoccurrence of the incident. A stop use tag was also placed on the main electrical breaker for the test bay until all electrical components were inspected and repaired.

The employer completed an incident investigation and prepared a report. Test procedures were updated to ensure wiring and function of main gas valves was correct on HVAC units. Training was provided to the workers regarding the new test procedures and electrical wiring in control panels.

The employer complied with the provisions of the stop work order and stop use tag by 99 11 23.

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Section 1.0 FILE NUMBER

1.1 F-100145

Section 2.0 DATE AND TIME OF INCIDENT

2.1 99 11 15, 10:25

Section 3.0 DATE AND TIME OF INVESTIGATION

3.1 99 11 15, 11:00

Section 4.0 NAME OF INVESTIGATOR(S) (INTERNAL)

4.1 Chuck Samphire, Workplace Health and Safety Officer

4.2 Perry Scott, Workplace Health and Safety Officer

Section 5.0 INCIDENT REPORTED BY

5.1 Emergency Medical Services

Section 6.0 DATE AND TIME INCIDENT WAS REPORTED

6.1 99 11 15, 10:35

Section 7.0 NAME AND ADDRESS OF PRINCIPAL STAKEHOLDER(S)

7.1 **Owner(s)**

7.1.1 Airtex Industries Management Ltd.
1401 Hastings Crescent SE
Calgary, Alberta T2G 4C8

7.2 **Employer**

7.2.1 Airtex Industries Management Ltd.
1401 Hastings Crescent SE
Calgary, Alberta T2G 4C8

Section 8.0 DESCRIPTION OF PRINCIPAL OWNER(S) OR EMPLOYER(S)

8.1 Airtex Industries Management Ltd. (Airtex Manufacturing Partnership/ Engineered Air) is a manufacturer of heating, ventilating and air conditioning equipment (HVAC). This Calgary-based company, formed in 1966, supplies HVAC equipment for the Canadian and American markets. Production facilities are located in Alberta, Ontario and the United States.

Section 9.0 LOCATION OF INCIDENT

9.1 Highfield Plant
1360 Highfield Crescent SE
Calgary, Alberta T2G 5M3

Section 10.0 EQUIPMENT AND MATERIAL INVOLVED

10.1 The HVAC unit involved in the incident, Model FWD-1203-DG-650, consisted of heating and cooling sections. The unit had a heating capacity of 1904 kilowatts and a cooling capacity of 422 kilowatts. (Refer Attachment A, Diagram 1 and Attachment B, Photograph 1)

10.2 Natural gas was supplied to the unit through a flexible gas line equipped with a manual shut-off valve. The unit had a regulator, a main gas valve and a flow control valve in place to control the flow of gas to the combustion chamber of the furnace.

10.3 The main gas valve was a Honeywell, Model V4055A-1007. The main gas valve was designed to remain open when power was supplied. The regulator was a Maxitrol gas regulator designed to reduce the gas pressure in the line. The flow control valve was a Neptronic gas valve and operator designed to control the flow of gas to the combustion chamber of the furnace. (Refer Attachment A, Diagram 2 and Attachment B, Photograph 2)

10.4 The unit had an electrical control panel. Power to the control panel was supplied through a high limit switch. During production of the control panel, the wiring was incorrectly installed putting the relay contact ahead of the transformer. This did not allow power to the transformer. During testing, an additional wire was installed to provide power to the transformer. This additional wire also supplied continuous power to the main gas valve (Refer Attachment A, Diagram 3 and Attachment B, Photographs 3 and 4)

Section 11.0 NAMES OF OTHER INVESTIGATORS (EXTERNAL)

11.1 City of Calgary Joint Forces Arson Unit

11.2 Airtex Management Industries Ltd.

11.3 The City of Calgary Planning and Building Department #8108

11.4 Honeywell Limited

Section 12.0 NARRATIVE DESCRIPTION OF INCIDENT

12.1 On 99 11 15, the final testing on the HVAC unit (Model FWD-1203-DG-650) commenced at approximately 8:00 in the test bay. Electrical power was supplied to the unit.

12.2 Worker 2 attempted to test blower fans and found there was no power. He connected the transformer to the power source with an additional wire. Power from the transformer activated controls that allowed the blower fans to operate. Tests on the blower fans were completed.

12.3 At approximately 9:45, Worker 1 began testing the furnace of the unit. A pilot safety check was completed. Gas was supplied to the unit. The unit was put into operation and heat output was tested. Test indicated that there was not enough heat output.

12.4 Worker 1 shut off the gas supply to the HVAC unit. He adjusted the gas regulator to increase the supply of gas to the furnace.

12.5 Worker 1 turned on the gas supply to the unit. He walked over to the control panel and activated the start-up sequence of the unit.

12.6 Worker 1 walked to the front of the furnace to observe the start-up operation and the explosion occurred. The force of the explosion blew him against the wall of the test bay.

12.7 Workers 2 and 3, who were testing the cooling side of the unit, heard the explosion. Worker 2 deactivated power to the test bay. EMS was called to the scene.

12.8 Other workers in the area attended the injured worker until EMS arrived.

12.9 Worker 1 was transported to the Foothills Hospital. He was pronounced dead at the hospital.

Section 13.0 CONCLUSIONS

13.1 The primary cause of the incident was the build-up of an explosive mixture in the combustion chamber of the furnace when incorrect wiring kept the main gas valve open prior to start-up of the unit. The explosive mixture was ignited and exploded when the unit was started. The exact source of ignition could not be determined.

13.2 The secondary cause was a missed test procedure to ensure electrical wiring was correctly installed for proper function of the main gas valve. The standard procedure of the company indicated that a safety test should have been performed to ensure electrical wiring was correctly installed for proper function of the main gas valve. There was no evidence to indicate the worker performed this test.

13.3 The correct wiring installation would have allowed the unit to operate in proper sequence. This would have prevented the build-up of an explosive mixture in the combustion chamber of the furnace and prevented the incident.

Section 14.0 FOLLOW-UP/ACTION TAKEN

14.1 Industry

14.1.1 The employer voluntarily stopped work after the incident. The employer completed an incident investigation and prepared a report. Test procedures were updated to ensure wiring and function of the main gas valves were correct on HVAC units. Training was provided to the workers regarding the new test procedures and electrical wiring in control panels. The employer complied with provisions of the stop work order and stop use tag.

14.2 **Alberta Human Resources & Employment**

14.2.1 Workplace Health and Safety responded to the site and initiated an investigation on 99 11 15. A stop work order was issued requiring the employer to conduct an incident investigation and implement corrective measures to prevent a reoccurrence of the incident. A stop use tag was also placed on the main electrical breaker for the test bay until all electrical components were inspected and repaired.

14.2.2 Workplace Health and Safety released the stop work order and stop use tag on 99 11 23 after the employer complied with the provisions of the stop work order and stop use tag.

14.3 **Additional Measures**

14.3.1 The revised test procedures have been implemented in other Airtex Industries Management Ltd. plants throughout North America.

Section 15.0 INJURY SEVERITY

15.1 Worker died as a result of blast injury.

Section 16.0 SIGNATURES

[original signed]

Section 17.0 ATTACHMENTS

Attachment A	Diagrams
Attachment B	Photographs

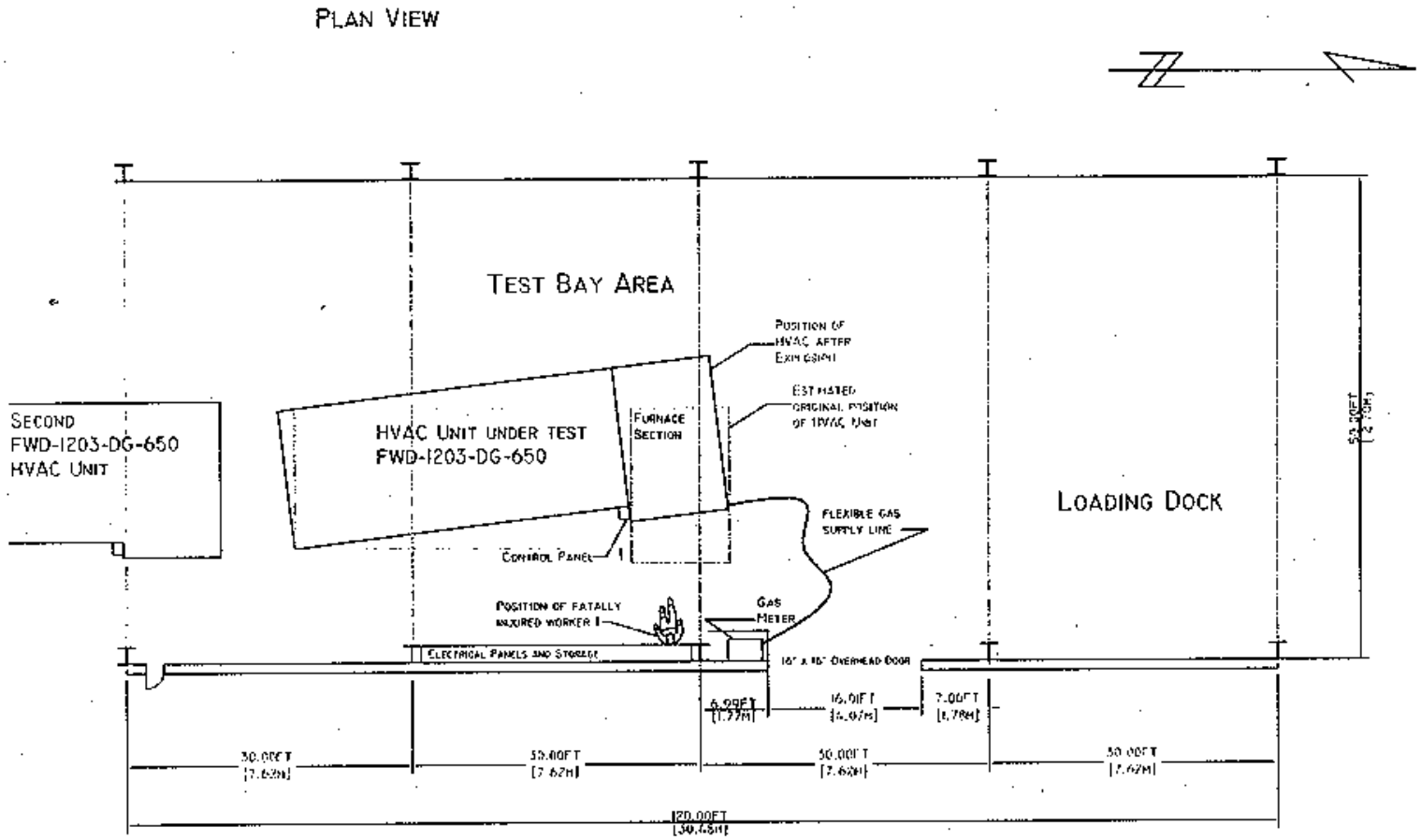

Diagram 1: General Arrangement of Accident Site — Not to Scale

Airtex Industries Management Ltd.

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Attachment A
Diagram 2 of 3

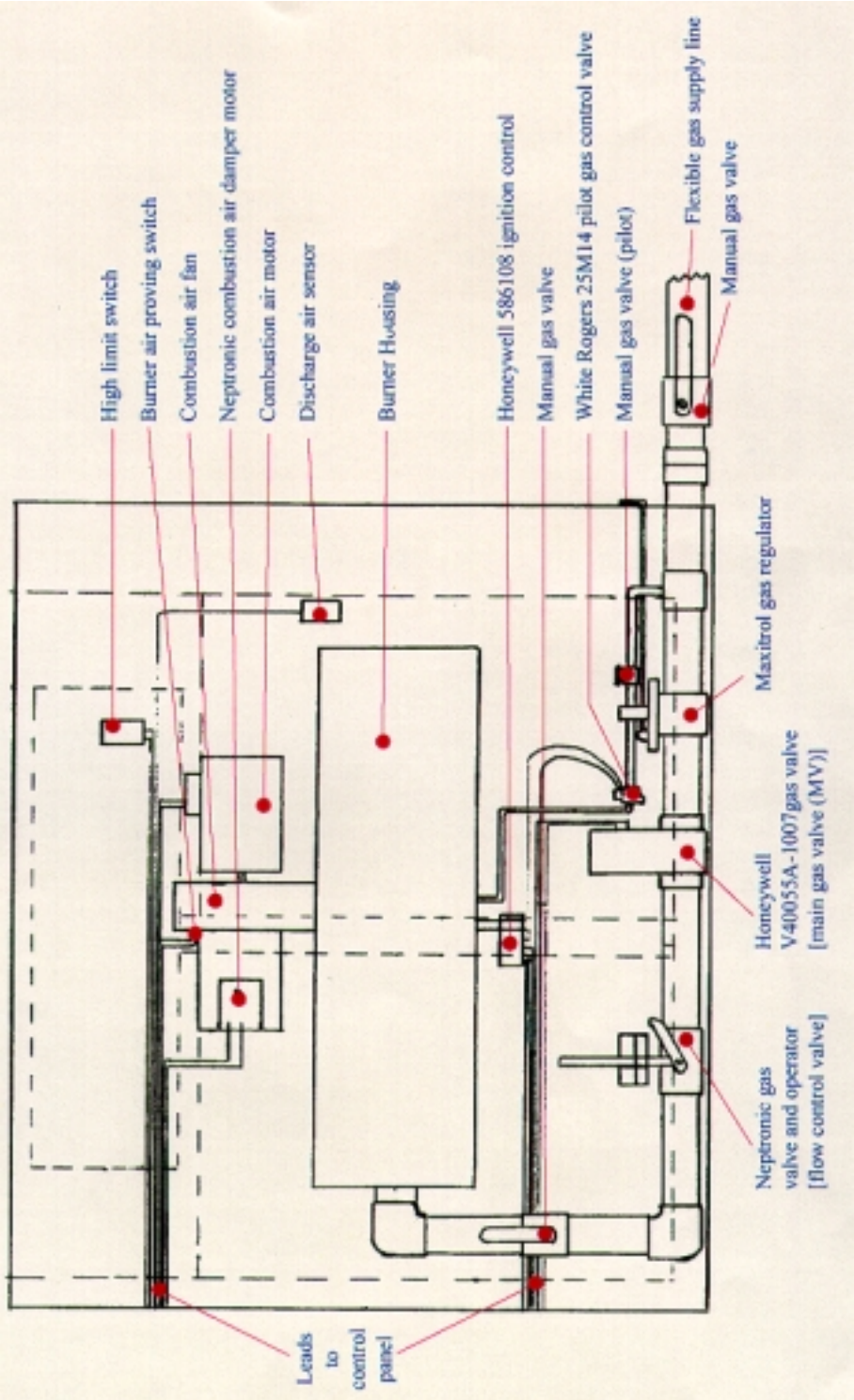
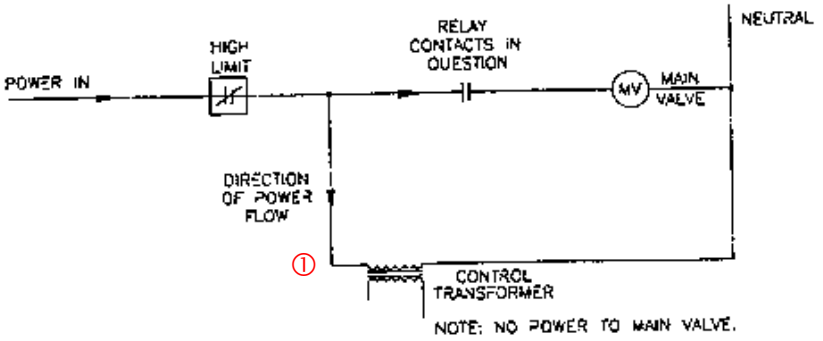
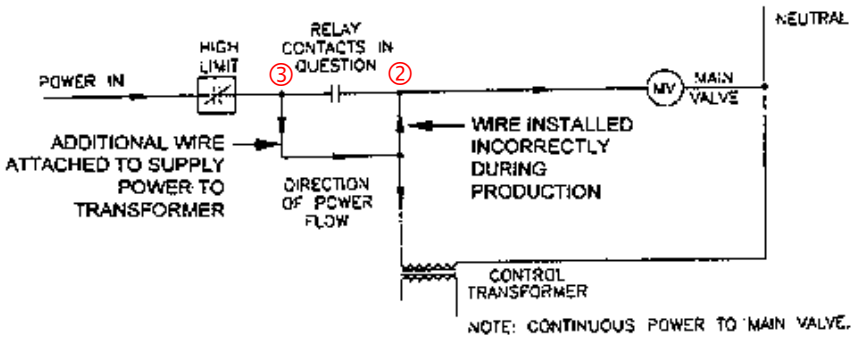


Diagram 2: Front view of burner unit showing approximate position of controls and gas line (not to scale).



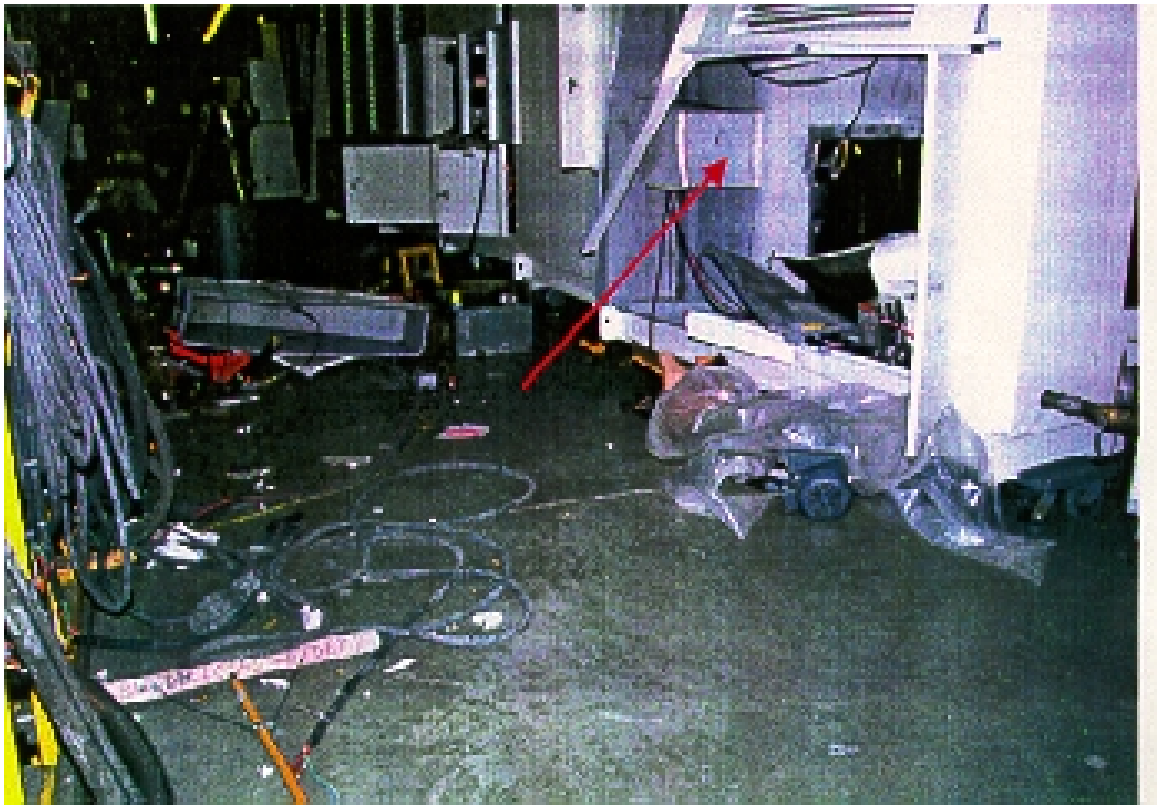
PROPER DESIGN OF WIRING



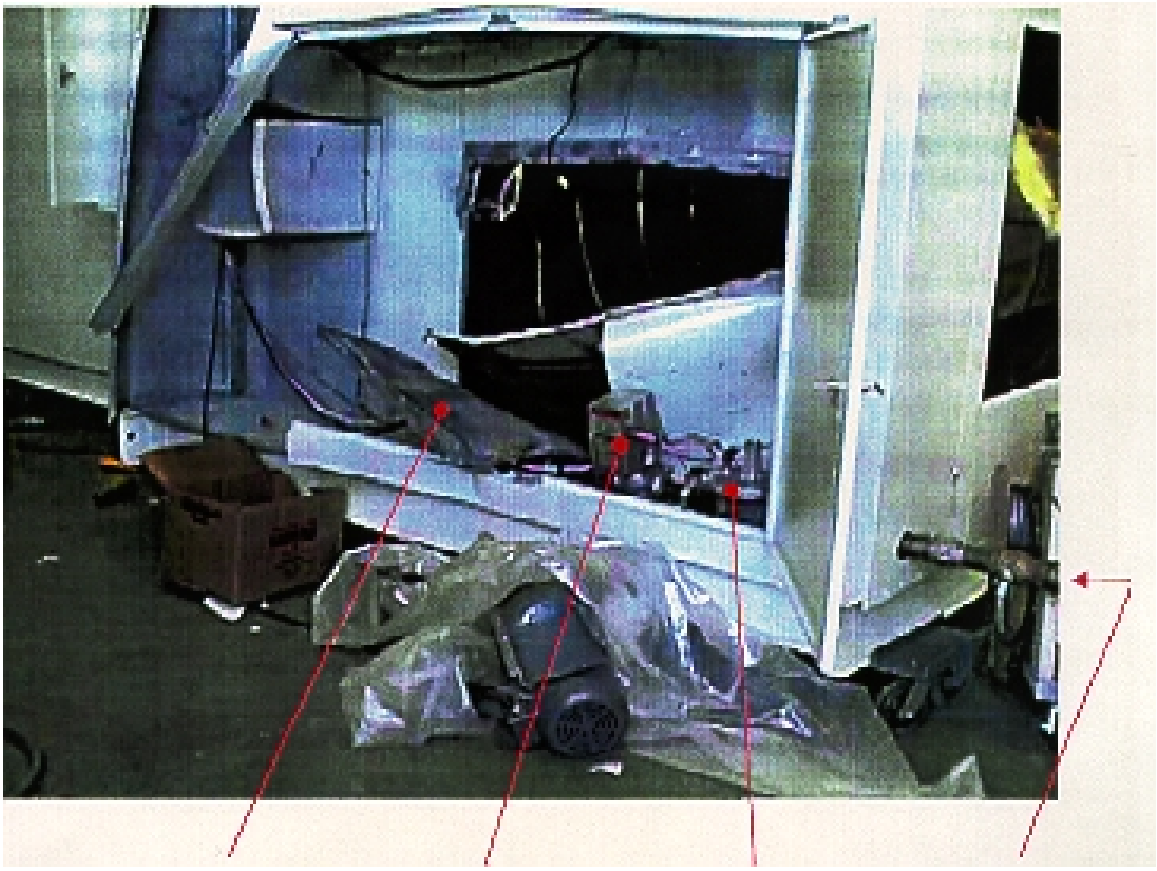
AS FOUND

Diagram 3: Shows wiring diagram supplied by Airtex Industries Management Ltd. indicating proper wiring (top) and incorrect wiring on unit at time of incident (bottom). Note extra wire bypassing relay contacts in bottom diagram.

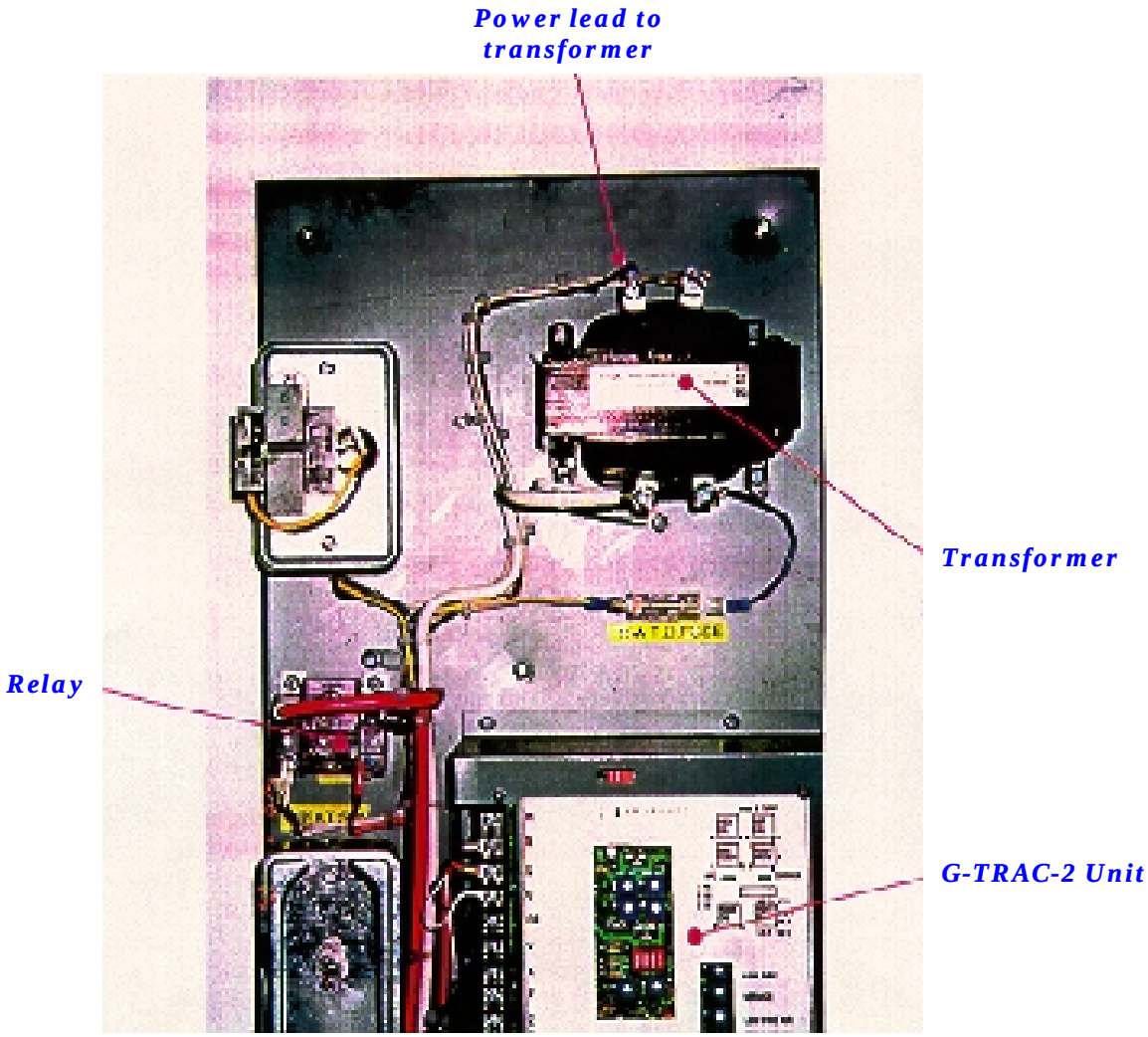
1. Shows proper design of wiring.
2. Shows relay installed before transformer which did not allow power to the transformer.
3. Shows additional wire attached to supply power to the transformer.



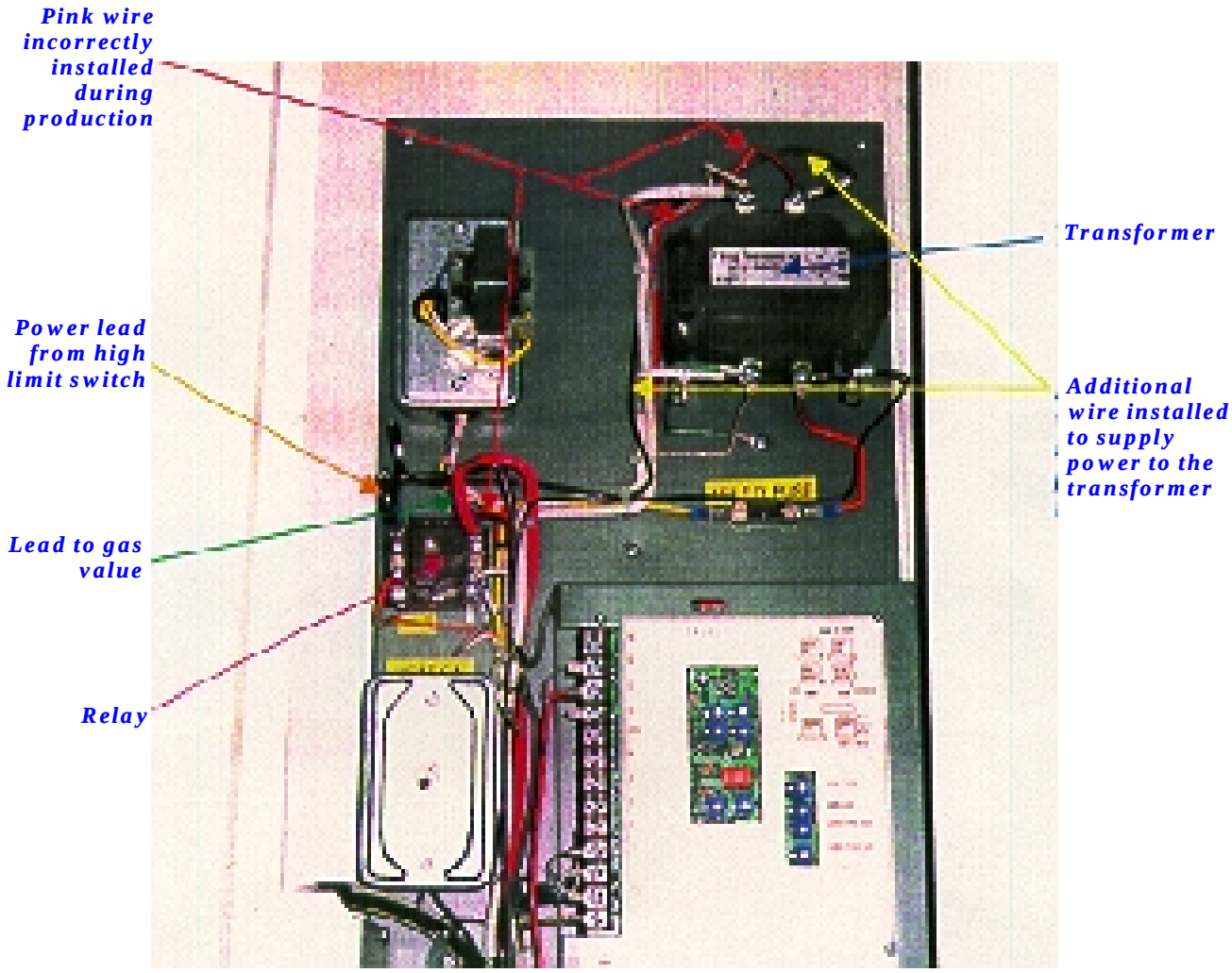
Photograph 1: View of the HVAC unit (model FWD-1203-DG-650) involved in the incident viewed from the North side. Furnace is the lower section in the foreground. Arrow shows damage to front of furnace resulting from explosion.



Photograph 2: Shows front of the furnace following the explosion viewed from the Northeast.



Photograph 3: Shows properly wired relay. Thin black power lead to transformer travels from top right side of relay to transformer. Main power (thick black) lead to relay also attaches to top right side of relay but is obscured by pink power lead to gas valve. Larger pink power lead to main valve is the only lead attached to opposite (upper left) side of relay.



Photograph 4: Improper wiring showing by-pass of relay. Thin pink wire, incorrectly installed during production, is attached to large pink power lead to gas valve at relay and to transformer. Thin black wire, attached during testing to provide power to the transformer, connects to the same transformer terminal as the thin pink wire and by-passes relay.