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APPROVAL REPORT

AUTOMATIC WATER CONTROL VALVES

MODEL ZSFG/FM FOR DELUGE SPRINKLER SYSTEMS SIZES 4 and 6 inch (100 and 150 mm) NPS

Prepared for:

**Shanghai Jindun Fire Fighting Security Services Co. Ltd.
65# Henquiao Road, Fanron Industrial Area
Zhoupu Pudong, Shanghai 201318
Peoples Republic of China**

Project Identifier: 3029837

Class: 1011, 1020

Date of Approval: December 9, 2008

Authorized by:

A handwritten signature in black ink, appearing to read "Richard B. Dunne".

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**AUTOMATIC WATER CONTROL VALVES
MODEL ZSFG/FM**

FOR

**DELUGE SPRINKLER SYSTEMS
SIZES 4 AND 6 INCH (100 and 150 mm) NPS**

from

**Shanghai Jindun Fire Fighting Security Services Co. Ltd.
65# Henquiao Road, Fanron Industrial Area
Zhoupu Pudong, Shanghai 201318
Peoples Republic of China**

I INTRODUCTION

- 1.1 Shanghai Jindun Fire Fighting Security Services Co. Ltd. requested an examination for possible FM Approval of their Model ZSFG/FM automatic water control valves in sizes 4 and 6 (100 and 150 mm) NPS. The rated working pressure of the Model ZSFG/FM valves and the deluge sprinkler systems is 232 psi (1600 kPa). The Model ZSFG/FM valves can be trimmed in a variety of configurations which result in the following sprinkler systems:

System	Release
Deluge	Wet pilot
Deluge	Dry pilot
Deluge	Electric

- 1.2 This report may be reproduced only in its entirety and without modification.
- 1.3 These devices and systems were examined in accordance with the requirements of the FM Approval Standards listed below:

Title	Class Number	Date
Deluge Systems and Preaction Systems	1011/1012	November 1973
Automatic Water Control Valves	1020	April 2007

1.4 **Listings:**

1.4.1 Automatic Water Control Valves

The automatic water control valves discussed in this Report will appear in the FM Approval Guide, an online resource of FM Approvals, in the Fire Protection Section under the heading "Automatic Sprinkler Systems – Valves – System Valves – Automatic Water Control Valves" as shown below:

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Manufacturer	Water Valve Designation & Size	Deluge System Only		Deluge or Preaction System				
		Wet Pilot Sprinkler Line	Dry Pilot Sprinkler Line & Actuator	Pneumatic Rate-of-Rise	Hydraulic Rate-of-Rise	Solenoid Release Groups	Electric Control Panel Groups	Detectors
Shanghai Jindun Fire Fighting Security Services Co. Ltd 65# Henquiao Road, Fanron Industrial Area, Zhoupu Pudung, Shanghai, PRC 201318	Model ZSFG/FM 4 and 6 inch NPS 232 psi (1600 kPa) RWP	X (ZSFQD15)	X			X [E]	X [1] X [2]	

1.4.2 Deluge Sprinkler Systems

The deluge sprinkler systems discussed in this Report will appear in the FM Approval Guide, an online resource of FM Approvals, in the Fire Protection Section under the heading “Automatic Sprinkler Systems – Sprinkler Systems – Deluge Sprinkler Systems” as shown below:

Wet Pilot Deluge System. Consists of Model ZSFG/FM automatic water control valves in sizes 4 and 6 inch (100 and 150 mm) NPS. Flanged end connections. Vertical installations only. The rated working pressure of the Wet Pilot Deluge System is 232 psi (1600 kPa). Major trim components include:

- System Main Drain Valve, 2 inch NPS
- Alarm test trim
- Water supply pressure gauge
- Push rod chamber pressure gauge
- Emergency pull station (ball valve)

Dry Pilot Deluge System. Consists of Model ZSFG/FM automatic water control valves in sizes 4 and 6 inch (100 and 150 mm) NPS. Flanged end connections. Vertical installations only. The rated working pressure of the Dry Pilot Deluge System is 232 psi (1600 kPa). Major trim components include:

- System Main Drain Valve, 2 inch NPS
- Alarm test trim
- Water supply pressure gauge
- Push rod chamber supply connections
- Emergency pull station (ball valve)
- Model ZSFQD15 pneumatic valve (dry pilot actuator)

Electric Actuation Deluge System. Consists of Model ZSFG/FM automatic water control valves in sizes 4 and 6 inch (100 and 150 mm) NPS. Flanged end connections. Vertical installations only. The rated working pressure of the Electric Actuated Deluge System is 232 psi (1600 kPa). Major trim components include:

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- Solenoid valve: Skinner Model No. 73212BN4TN00N0C111C2.
- System Main Drain Valve, 2 inch NPS
- Alarm test trim
- Water supply pressure gauge
- Push rod chamber supply connections
- Emergency pull station (ball valve)
- Any compatible FM Approved Fire Alarm/Releasing Control Panel and associated batteries

II DESCRIPTION

2.1 Model ZSFG/FM Deluge Valve

In the closed position, the system water supply pressure acts on the underside of the valve clapper and behind the piston in the releasing chamber. The clapper is held latched closed by the force of the piston push rod acting on the lever latch, thereby holding the clapper assembly onto the seat. Each trim configuration listed in Section 1.1 and described below result in tripping the Model ZSFG/FM valve in the same manner: the water supply pressure holding the piston is vented to drain, the piston retracts, and the ZSFG/FM valve trips. Therefore, whether the release mechanisms are hydraulic, pneumatic, electric, or a combination, valve trip is ultimately accomplished by venting the releasing chamber. It should be noted that the restriction in the water supply line to the releasing chamber inlet is much smaller than the releasing chamber outlet which insures the piston remains retracted.

Once the clapper has opened, a torsion spring rotates the lever into the flow stream and latches and prevents the clapper from reseating. After trip, water flows to the sprinkler piping, alarm outlet, and alarm devices.

2.3 Deluge Sprinkler Systems

The deluge sprinkler systems discussed in this report consists of 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM automatic water control valves that include a mechanical latch which prevents the valve from resetting after the initial trip. Model ZSFG/FM automatic water control valves have an external reset feature whereas a lever is manually rotated to reseat the clapper. Deluge systems are Approved for hydraulic (wet pilot line), pneumatic (dry pilot line), or electric (solenoid valve) releasing methods. Each of these methods is discussed in detail below. The 4 and 6 inch (100 and 150 mm) Model ZSFG/FM valves have flanged end connections. In the event that water builds up inside the Model ZSFG/FM deluge valve due to condensate from the air supply system or water from a valve trip, a drain valve is provided to drain the valve body and riser. The 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM valve based deluge systems include a 2 inch (50 mm) NPS main drain, the alarm test, the water supply pressure gage, and the push rod releasing chamber supply connections.

2.3.1 Wet Pilot Trim

The wet pilot trim is connected to the push rod releasing chamber outlet. It includes a wet pilot line, which extends up to the open deluge sprinkler grid and contains closed sprinklers or other fixed temperature releases. When a closed wet pilot line sprinkler is activated and opened by a fire, or a

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fixed temperature release activates, the pilot line pressure is released which vents the releasing chamber allowing the ZSFG/FM valve to open, sending water to the sprinklers and sounding alarms. Any FM Approved fixed temperature release can be used in the wet pilot line. An emergency station/manual pull box can also be used for releasing. The rated working pressure of the wet pilot deluge system is 232 psi (1600 kPa).

2.3.2 Dry Pilot Trim

The dry pilot trim is connected to the push rod releasing chamber outlet. It includes a Model ZSFQD15 pneumatic actuator and trim piping that extends up to the open deluge sprinkler grid and contains closed sprinklers or other fixed temperature releases. When a closed sprinkler is activated and opened by a fire, or a fixed temperature release activates, the pilot line pneumatic pressure is released which opens the Model ZSFQD15 pneumatic actuator which vents the releasing chamber allowing the ZSFG/FM valve to open, sending water to the sprinklers and sounding alarms. The Model ZSFQD15 pneumatic actuator is used in the dry pilot line and is designed for systems with water supply pressures from 20 psi (140 kPa) to 232 psi (1600 kPa), and corresponding dry pilot line pneumatic pressures, nominally 20 to 67 psi (138 to 462 kPa). Any FM Approved fixed temperature release can be used in the dry pilot line. An emergency station/manual pull box can be used for manual releasing. The rated working pressure of the dry pilot deluge system is 232 psi (1600 kPa).

2.3.3 Electric Actuation Trim

The electric actuation trim is connected to the push rod releasing chamber outlet. Only when there is an electrical signal to the releasing control panel from a fire detector, such as when a fixed temperature heat detector is activated, does the solenoid valve open which vents the releasing chamber allowing the ZSFG/FM automatic water control valve to open sending water to the sprinklers. An emergency station/manual pull box can be used for manual releasing. The rated working pressure of the electric actuation deluge system is 232 psi (1600 kPa). Only FM Approved fixed temperature heat devices shall be used in the release system. The Fire Alarm/Releasing Control Panel, selected to be compatible with aforementioned Skinner Model No. 73212BN4TN00N0C111C2 solenoid valve, has an appropriately sized battery to provide 90 hours of backup emergency power.

III EXAMINATION and TESTS

3.1 Model ZSFG/FM Deluge Sprinkler System Operational Tests

3.1.1 Model ZSFG/FM Wet Pilot Line

Operational tests were conducted on a 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM deluge valve in the vertical orientation only. These were conducted at various water supply pressures through the range of 20 psi (140 kPa) to 232 psi (1600 kPa) by slowly reducing the water supply pressure in the push rod chamber by slowly opening the emergency pull station ball valve. This permitted the water pressure in the releasing chamber to be reduced to the trip point of the valve and this water pressure at trip was recorded. Satisfactory results are shown in Appendix I.

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3.1.2 Model ZSFG/FM Dry Pilot Line

Operational tests were conducted on size 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM deluge valve in the vertical orientation only, at various water supply pressures and system air pressures recommended by the manufacturer. The system air pressure above the Model ZSFQD15 pneumatic actuator was slowly reduced by opening a valve in the pilot line until the pneumatic actuator opened. This permitted the water pressure in the releasing chamber to be reduced to the trip point of the valve. In all cases the system air pressure in the dry pilot line at ZSFG/FM valve trip was within the pressure range requirement of 5.0 to 30.0 psi (35 to 205 kPa) over the water supply pressure range of 20 to 232 psi (140 to 1600 kPa). These results are considered satisfactory.

3.1.3 Model ZSFG/FM Electric Actuation

Operational tests were conducted on sample 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM deluge valve in the vertical orientation only at various water supply pressures. At each pressure, through the range of 20 psi (140 kPa) to 232 psi (1600 kPa), in 20 psi (140 kPa) increments, the solenoid valve was energized open. This permitted the water pressure in the releasing chamber to be reduced to the trip point of the valve. The valve tripped satisfactorily at all pressures. These results are considered satisfactory.

3.2 Body Hydrostatic

Sample 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM deluge valve were subjected to a shell hydrostatic pressure of 928 psi (6400 bar) for 5 minutes. This pressure represents 4 times the rated working pressure, 232 psi (16 bar), of the valves. The valves were tested with the clapper removed from the valve. There was no apparent damage to either body, trim or trim components as a result of this test. These results are considered satisfactory.

3.3 Clapper Strength

Sample 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM automatic water control valves were subjected to a differential pressure across their clapper, tending to open the valve, of 464 psi (32 bar) for 5 minutes. This pressure represents 2 times the rated working pressure of 232 psi (16 bar) of the Model ZSFG/FM valve. The pressure was applied to the valves' inlets and releasing chambers while the discharge was open to atmosphere. At the conclusion of testing, examination revealed that there was no damage or distortion to the either clapper or the valve seat. These results are considered satisfactory.

3.4 Seat Leakage

After the above clapper strength testing, the 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM automatic water control valves were subjected to several hydrostatic pressures applied across the clapper, with the valve outlet open to atmosphere. The pressures applied as described in Section 3.3 were 30 psi (205 kPa), 100 psi (690 kPa), 175 psi (1205 kPa), and 232 psi (1600 kPa), the rated working pressure. Each pressure was applied for 5 minutes, and the clapper/seat interface observed from the valve outlet. There was no leakage through either seat during this testing. These results are considered satisfactory.

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3.5 Diaphragm Strength

The diaphragm of a Model ZSFQD15 pneumatic actuator was subjected to a differential pressure across the diaphragm of 464 psi (32 bar) for 5 minutes. This pressure represents 2 times the rated working pressure of 232 psi (16 bar) of the Model ZSFG/FM valve. At the conclusion of testing, examination revealed that there was no visible damage, distortion or tearing of the diaphragm. These results are considered satisfactory.

3.6 Ammonia Exposure of Rubber Diaphragm on Model ZSFQD15 Pneumatic Actuator

A sample diaphragm used in the Model ZSFQD15 pneumatic actuator was subjected to an atmosphere of 35 percent ammonia, 5 percent water vapor and 60 percent air at a temperature of $93 \pm 4^{\circ}\text{F}$ ($34 \pm 2^{\circ}\text{C}$) for a period of 10 days. At the conclusion of this conditioning the tested diaphragm sample was rinsed with potable water and was air dried. The diaphragm was then compared to a new diaphragm for spring rate and resiliency. The conditioned diaphragm compared favorably. These results are considered satisfactory.

3.7 Friction Loss

Sample 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM automatic water control valves were tested in a horizontal flow line to determine their pressure drop vs. flow characteristics. The measured net head loss across the valves was measured at a flow rate of 17.5 ft/sec [2760 gal/min (10 445 l/min)]. For the 4 inch (100 mm) valve the measured friction loss was 2.0 psi (14 kPa) at a flow rate of 675 gal/min (2555 l/min). For the 6 inch (150 mm) valve the measured friction loss was 2.8 psi (19 kPa) at a flow rate of 1530 gal/min (5790 l/min). These results are within the FM Approval requirement of 5.0 psi (35 kPa). These results are considered satisfactory.

3.8 Bonding Adequacy

Sample 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM automatic water control valves were subjected to a flow rate producing a velocity of 30 ft/sec (9 m/sec) in Schedule 40 steel pipe of the same nominal diameter as the valve under test for 90 minutes. For the 4 inch (100 mm) valve the flow rate was 1190 gal/min (4505 l/min). For the 6 inch (150 mm) valve the flow rate was 2700 gal/min (10 220 l/min). Following this test, each valve was examined for any indication of separation of the rubber facing from the clapper, or loosening of the retaining hardware. Neither of these conditions were observed as a result of these tests. These results are considered satisfactory.

3.9 Clearances

Sample 4 and 6 inch (100 and 200 mm) NPS Model ZSFG/FM automatic water control valves were examined for clearances. The radial clearance between the valve clapper outside diameter and the iron valve body interior was gauged with a $\frac{3}{4}$ inch diameter ball. The clearance provided exceeded the $\frac{3}{4}$ inch minimum clearance requirement. The clearance between the valve body interior and clapper hubs was gauged with a $\frac{1}{2}$ inch diameter ball. The clearance provided exceeded the $\frac{1}{2}$ inch minimum clearance requirement. It was determined by inspection that more than 1/16 inch play existed between the clapper arms and hinge pin spacer washer. These results are considered satisfactory.

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- 3.10 No other testing was deemed necessary due to similarities between the rubber sealing compounds used in the Model ZSFG/FM valves to those used in the Model ZSFZ waterflow alarm valves, discussed in the Approval Report for Project ID 3025154, dated October 20, 2006.

IV MARKINGS

- 4.1 Cast in raised characters on the body of the 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM valve is the following pertinent information:
- A directional flow arrow
- 4.2 A nameplate is affixed to the cover of all the Model ZSFG/FM valves discussed in this report which lists the following pertinent information:
- The “Shanghai Jindun” logo
 - The Model No. – ZSFG/FM
 - The valve size in millimeters
 - The rated working pressure in bars (16 bar)
 - The serial number of the device
 - The year of manufacture
 - The FM Approval Mark

V REMARKS

- 5.1 All devices in this Report must be located in an indoor environment, above 40°F, which is not subject to weather, freezing temperatures, or physical damage.
- 5.2 These sprinkler system valves should be installed in accordance with FM Global Loss Prevention Data Sheets.
- 5.3 Installations shall comply with the latest edition of the manufacturer’s operation and installation instructions.
- 5.4 System calculations regarding required system air capacity should be performed if only one air pressure maintenance device is contemplated for several sprinkler systems.

VI FACILITIES AND PROCEDURES AUDIT

The devices discussed in this Report are FM Approved when manufactured in the following facilities:

Shanghai Jindun Fire Fighting Security Services Co. Ltd.
65# Henquiao Road, Fanron Industrial Area
Zhoupu Pudong, Shanghai 201318
Peoples Republic of China

The facilities and quality control procedures in place have been found to be satisfactory to manufacture product identical to that examined and tested as described in this report.

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VII MANUFACTURERS RESPONSIBILITIES

No changes of any nature shall be implemented unless notice of the proposed change has been given and written authorization obtained from FM Approvals. The Approved Product Revision Report, Form 797, shall be forwarded to FM Approvals by Shanghai Jindun Fire Fighting Security Services Co. Ltd. as notice of proposed changes.

VIII DOCUMENTATION

The following drawings describe the Model ZSFG/FM Valve in sizes 4 and 6 inch (100 and 150 mm) NPS and are filed under P.I. 3029837:

Drawing Number	Description	Revision
ZSFG10-01-6/FM	AXIS OF FASTENER	1
ZSFG10-01-4/FM	AXIS OF VALVE FLAP	1
ZSFG15-01-7/FM	VALVE BODY	1
SYL10-01-7	BED RING	1
ZSFG10-01-3/FM	CAPUT OF PIN-LIFT	1
ZSFG10-01-4/FM	AXIS OF VALVE FLAP	1
SYL15-01-5	BED OF MEMBRANE	1
ZSFG10-01-6/FM	AXIS OF FASTENER	1
ZSFQD15-2	VALVE COVER	1
ZSFQD15-1	VALVE BODY	1
ZSFQD15-6	SPRING	1
ZSFQD15-00	PNEUMATIC VALVE	1
ZSFQD15-3	PRESSURE PLATE	1
ZSFQD15-5	LAMELLA (DIAPHRAGM)	1
ZSFQD15-4	AXIS	1
SYL15-01-13	VALVE FLAP	1
ZSFG15-01-2/FM	VALVE COVER	1
ZSFG15-01-24	SPRING	1
ZSFG15-01-23	RESET AXIS	1
ZSFG15-01-14	SEAL RING	1
ZSFG15-01-8	MEMBRANE	1
SYL15-01-4/FM	END CAP	1
ZSFG15-01-20/FM	GASKET SEAL	1
ZSFG15-01/FM	DELUGE VALVE	1
ZSFG15-01-5/FM	NAMEPLATE	1
ZSFG15-01-11/FM	CAPUT OF PIN-LIFT	1
SYL15-01-16	BED RING	1
ZSFG15-01-12	FASTENER	1
SYL15-01-5	BED OF MEMBRANE	1
ZSFG15-01-25/FM	AXIS OF VALVE FLAP	1
ZSFG10-01-5/FM	VALVE COVER	1
ZSFG10-01-1/FM	VALVE BODY	1
SYL10-01-4	VALVE FLAP	1

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SYL15-01-24	SPRING	1
SYL10-01-5	SEAL RING	1
SYL15-01-23	RESET AXIS	1
ZSFG10-01-2/FM	PIN-LIFT	1
SYL15-01-8	MEMBRANE	1
SYL10-01-8	GASKET SEAL	1
SYL10-01-3	FASTENER	1
ZSFG10-01/FM	DELUGE VALVE	1
SYL15-01-4	END CAP	1

IX CONCLUSION

The 4 and 6 inch (100 and 150 mm) NPS Model ZSFG/FM valves installed in the sprinkler systems listed in Section 1.1 of this Report meet FM Approval requirements. Since a duly signed Master Agreement is on file for Shanghai Jindun Fire Fighting Security Services Co. Ltd., FM Approval is effective the date of this Report.

EXAMINATION BY:

Stanley M. Ziobro

INTERNAL TESTING BY:

**John W. Normington
Stanley M. Ziobro**

ATTACHMENTS:

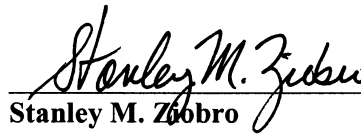
Appendix: Wet Pilot Height Limitation

REPORT BY:

REPORT REVIEWED BY:



**Pamela J. Munslow
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**Stanley M. Ziobro
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OPERATIONAL TESTS

**Shanghai Jindun Fire Fighting Security Services Co. Ltd.
Model ZSFG/FM-Wet Pilot Deluge System Pilot Height Limitations**

4 inch (100 mm) NPT

Water Supply Pressure psi (kPa)	Chamber Pressure at Valve Trip psi (kPa)	Maximum Wet Pilot Height ft (m)
20 (140)	4 (28)	6.2 (2.1)
40 (280)	7 (48)	10.8 (3.7)
60 (410)	11 (76)	17.0 (5.8)
80 (560)	15 (103)	23.1 (7.9)
100 (690)	19 (131)	29.3 (10.0)
120 (830)	22 (152)	34.0 (11.6)
140 (970)	23 (159)	35.4 (12.1)
160 (1105)	25 (172)	38.5 (13.1)
175 (1205)	29 (200)	44.7 (15.2)
200 (1400)	35 (241)	53.9 (18.4)
232 (1600)	49 (338)	75.5 (25.7)

6 inch (150 mm) NPT

Water Supply Pressure psi (kPa)	Chamber Pressure at Valve Trip psi (kPa)	Maximum Wet Pilot Height ft (m)
20 (140)	3.5 (24)	5.4 (1.6)
40 (280)	10 (69)	15.4 (5.2)
60 (410)	16 (110)	24.6 (8.4)
80 (560)	24 (165)	37.0 (12.6)
100 (690)	28 (193)	43.1 (14.7)
120 (830)	35 (241)	53.9 (18.4)
140 (970)	40 (276)	61.6 (21.0)
160 (1105)	46 (317)	70.8 (24.1)
175 (1205)	51 (352)	78.5 (26.8)
200 (1400)	55 (380)	84.7 (28.9)
232 (1600)	67 (462)	103.2 (35.2)