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APPROVAL REPORT

MODELS YB25, YB28, YB28 A TYPE AND YB28 B TYPE FLEXIBLE SPRINKLER HOSE WITH FITTINGS FOR COMMERCIAL SUSPENDED CEILINGS AND MODELS YB25-I, YB25-II AND YB25-III FLEXIBLE SPRINKLER HOSE WITH FITTINGS FOR CLEAN ROOM CEILINGS.

Prepared For:

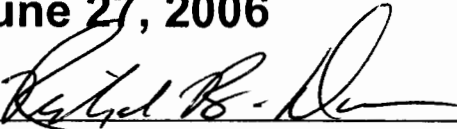
**Yong Won E.N.C., Ltd.
116-1 Seogu-Ri, Kwangjeuk-Myun, Yangju-Gun
Keungki-Do, Korea**

Project Identifier: 3024303

Class: 1637

Date of Approval: June 27, 2006

Authorized by:


Richard B. Dunne, Group Manager-Hydraulics

**MODELS YB25, YB28, YB28 A TYPE AND YB28 B TYPE
FLEXIBLE SPRINKLER HOSE WITH FITTINGS
FOR COMMERCIAL SUSPENDED CEILINGS
AND
MODELS YB25-I, YB25-II AND YB25-III
FLEXIBLE SPRINKLER HOSE WITH FITTINGS
FOR CLEAN ROOM CEILINGS
from
YONG WON E.N.C., LTD.
116-1 SEOGU-RI, KWANGJEUK-MYUN, YANGJU-GUN
KEUNGKI-DO, KOREA**

I INTRODUCTION

- 1.1 Yong Won E.N.C., Ltd., requested an examination for possible FM Approval of their 1 in. nominal diameter flexible sprinkler hose with threaded fittings for connection of water supply piping to fire sprinklers as follows:

Models	Type of Application
YB28 A Type, YB28 B Type, YB25 and YB28	Commercial ceiling
YB25-I, YB25-II and YB25-III	Clean Rooms

- 1.2 This Report may be freely reproduced only in its entirety and without modification.

- 1.3 **Standard:**

Title	Class Number	Date
Approval Standard for Flexible Sprinkler Hose with Threaded Fittings	1637	April 2003

- 1.4 **Listings:** The product will appear in the Approval Guide as follows:

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Flexible Sprinkler Hose with Fittings for Commercial Suspended Ceilings

Flexible sprinkler hose with threaded end fittings are for use in commercial suspended ceilings. The flexible hoses are to be installed according to the manufacturer's directives. Unless indicated, the hoses have a rated working pressure of 175 psi (1205 kPa).

Yong Won E.N.C. Ltd, 116-1 Seogu-Ri, Kwangjeuk-Myun, Yangju-Gun Keungki-Do, Korea

Model	NPT in.	Hose Assembly length ft (m)	Equivalent Length of 1 in. Schedule 40 Pipe, ft (m)
YB28 A Type	1/2	3.5 (1.07)	5.5 (1.6)
YB28 A Type	1/2	8.4 (2.57)	15.2 (4.6)
YB28 A Type	3/4	3.5 (1.07)	5.7 (1.7)
YB28 A Type	3/4	8.4 (2.57)	17.0 (5.2)

Model: YB28 A Type. 1 in. nominal dia. flexible metal sprinkler hose for providing a connection to automatic sprinklers in commercial ceilings. Available in a range from 3.5 to 8.4 ft (1075 mm to 2575 mm). This model is a one piece style as the reducer and nipple are welded to the flexible hose. Approval is limited for use in a wood tile ceiling. The tile size is 11.5 x 11.5 x 1 in. (292 x 292 x 25 mm) with a ceiling bracket system manufactured by Yong Won E.N.C., Ltd.

Model	NPT in.	Hose Assembly length ft (m)	Equivalent Length of 1 in. Schedule 40 Pipe, ft (m)
YB28 B Type	1/2	3.5 (1.07)	5.5 (1.6)
YB28 B Type	1/2	8.4 (2.57)	15.2 (4.6)
YB28 B Type	3/4	3.5 (1.07)	5.7 (1.7)
YB28 B Type	3/4	8.4 (2.57)	17.0 (5.2)

Model: YB28 B Type. 1 in. nominal dia. flexible metal sprinkler hose for providing a connection to automatic sprinklers in commercial ceilings. Available in a range from 3.5 to 8.4 ft (1075 mm to 2575 mm). This model is a one piece style as the reducer and nipple are welded to the flexible hose. Approval is limited for use in a S.G.P Ceiling (metal panel). The tile size is 11.75 x 11.75 x 1-5/8 in. (300 x 300 x 41.3 mm), with a ceiling bracket system manufactured by Yong Won E.N.C., Ltd.

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Model	NPT in.	Hose Assembly length ft (m)	Equivalent Length of 1 in. Schedule 40 Pipe, ft (m)
YB25	1/2	2.2 (0.7)	18.6 (5.7)
YB25	1/2	8.2 (2.5)	91.5 (27.8)
YB28	1/2	2.2 (0.7)	5.5 (1.6)
YB28	1/2	8.2 (2.5)	15.2 (4.6)

Model YB25 and YB28. 1 in. nominal dia. flexible metal sprinkler hose for providing a connection to automatic sprinklers in commercial ceilings. Available in a range from 2.2 to 8.2 ft (700 mm to 2500 mm). Approval is limited for use in commercial suspended ceilings with a ceiling bracket system manufactured by Yong Won E.N.C., Ltd. This model is a three piece style as the reducer and nipple is threaded to the flexible hose.

Flexible Sprinkler Hose with Fittings for Clean Room Ceilings

Flexible sprinkler hose with threaded end fittings are for use in cleanroom ceilings. The flexible hoses are to be installed according to the manufacturer's directives. Unless indicated, the hoses have a rated working pressure of 175 psi (1205 kPa).

Model	NPT in.	Hose Assembly length ft (m)	Equivalent Length of 1 in. Schedule 40 Pipe, ft (m)
YB25-I	1/2	3.5 (1.07)	9.3 (2.8)
YB25-I	1/2	8.4 (2.57)	18.4 (5.6)

Model YB25-I. 1 in. nominal dia. flexible metal sprinkler hose for providing a connection to automatic sprinklers in cleanroom ceilings. Available in a range from 3.5 to 8.4 ft (1075 mm to 2575 mm). Approval is limited for use in cleanroom ceilings manufactured by Shin Sung Engineering Co. Ltd. The Model YB25-I is a one piece style. The reducer and nipple are welded to the flexible hose.

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Model	NPT in.	Hose Assembly length ft (m)	Equivalent Length of 1 in. Schedule 40 Pipe, ft (m)
YB25-II	1/2	3.5 (1.07)	9.3 (2.8)
YB25-II	1/2	8.4 (2.57)	18.4 (5.6)

Model YB25-II. 1 in. nominal dia. flexible metal sprinkler hose for providing a connection to automatic sprinklers in cleanroom ceilings. Available in a range from 3.5 to 8.4 ft (1075 mm to 2575 mm). Approval is limited for use in cleanroom ceilings manufactured by Shin Sung Engineering Co. Ltd. The Model YB25-II is a three piece style. The reducer and nipple are connected to the flexible hose using as a nut.

Model	NPT in.	Hose Assembly length ft (m)	Equivalent Length of 1 in. Schedule 40 Pipe, ft (m)
YB25-III	1/2	3.5 (1.07)	9.3 (2.8)
YB25-III	1/2	8.4 (2.57)	18.4 (5.6)

Model YB25-III. 1 in. nominal dia. flexible metal sprinkler hose for providing a connection to automatic sprinklers in cleanroom ceilings. Available in a range from 3.5 to 8.4 ft (1075 mm to 2575 mm). Approval is limited for use in cleanroom ceilings manufactured by Shin Sung Engineering Co. Ltd. The Model YB25-III is a two piece style. The reducer is welded to the flexible hose and nipple is connected to the flexible hose using a nut.

II DESCRIPTION

- 2.1 The 1 in. nominal diameter flexible sprinkler hose with fittings provides a connection to automatic sprinklers in commercial suspended ceilings and clean rooms.
- 2.2 The Yong Won E.N.C., Ltd. Flexible sprinkler hose has a rated working pressure of 175 psi (1205 kPa).
- 2.3 The flexible hose used in this system has a minimum bend radius of 8 in. (203 mm) measured to the center of the flexible hose.
- 2.4 The following is a description for each model:

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Models	Description
YB28 A Type YB28 B Type	One piece style. The reducing nipple and the inlet nipple is welded to the hose assembly.
YB25 YB28	Three piece style. The reducer and nipple are connected to the hose by threaded nuts.
YB25-I	The Model YB25-I is a one piece style. The reducer and nipple are welded to the flexible hose.
YB25-II	The Model YB25-II is a three piece style. The reducer and nipple are connected to the flexible hose using as a nut.
YB25-III	The Model YB25-III is a two piece style. The reducer is welded to the flexible hose and nipple is connected to the flexible hose using a nut.

2.5 The flexible hoses discussed in this Report are an extension to their currently Approved line of flexible sprinkler hoses, the details of which are described in the following Approval Reports:

Project Identifier	Report Date	Model and Description
3005888	December 21, 1999	YB28-I: Flexible sprinkler hose with fittings for clean rooms
3006998	October 23, 2000	YB28-II and YB28-III: Flexible sprinkler hose with fittings for clean rooms. YB28: Flexible sprinkler hose with fittings for commercial suspended ceilings.
3010351	June 17, 2002	YB28-D-B and YB28-D-F: Flexible sprinkler hose with fittings for ducts.
3019062	March 23, 2005	YB28-1A: Flexible sprinkler hose with fittings for clean rooms. YB28-D-BP: Flexible sprinkler hose with fittings for Ducts.

III EXAMINATION AND TESTS

3.1 Samples, as detailed below, were submitted for examination and testing. The samples were considered to be representative of the product line and were examined, tested, and compared to the manufacturer's drawings. All data remains on file at FM Approvals along with other documents and correspondence applicable to this program.

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3.2 Fatigue Test, Models: YB25 and YB28

Fatigue tests were conducted on 8.2 ft (2.5 m) long flexible hoses with a 1/2 in. NPT outlets. Two hoses were arranged in a U shape with one end fixed in place and the other end attached to an air actuated piston in the vertical orientation. The ends of the hose were arranged at a horizontal distance of 16 in. (406 mm) apart, which represents twice the minimum bend radius. A piston was set to travel 4 in. (102 mm) above and 4 in. (102 mm) below the horizontal for a total travel of 8 in. (203 mm). The hose samples were filled with water and pressurized to a pressure of 175 psi (1205 kPa) and cycled up and down a total of 50,000 times where a cycle consists of starting at the bottom, raising 8 in. (203 mm) and lowering 8 in. (203 mm). After completing the 50,000 cycles, the samples were pressurized with water to 700 psi (4825 kPa) for five minutes. There was no failure or permanent damage as a result of these tests. These results are satisfactory.

3.3 Vibration Tests, Models: YB28A Type and YB28B Type

3.3.1 The Commical Model YB28A Type flexible sprinkler hose is for use in a commercial ceiling assembly. This model consists of the hose with a threaded outlet nipple and a circular threaded plate to be screwed on the nipple. On the plate is a series of four holes for self tapping screws for attachment of the plate to the ceiling assembly. This assembly was individually secured to a vibration table with the hose in the vertical position. The hose was bent in a 90° angle at the minimum bend radius and the inlet end of the hose was fastened to a stationary fixture. The assembly was hydraulically pressurized to 90 psi (620 kPa) while subjected to a series of vibrations shown in Table 3.3. At the completion of the vibration series, the flexible hose was hydrostatically pressurized to 700 psi (4825 kPa) for five minutes. There was no failure or visible damage as a result of this test. These results are deemed satisfactory.

3.3.2 The Commical Model B-Type flexible sprinkler hose is for use in a ceiling assembly. This model consists of the hose with a threaded outlet nipple, and two screw type supporting plates for placement on both sides of the ceiling assembly. This assembly was individually secured to a vibration table with the hose in the vertical position. The hose was bent in a 90° angle at the minimum bend radius and the inlet end of the hose was fastened to a stationary fixture. The assembly was hydraulically pressurized to 90 psi (620 kPa) while subjected to a series of vibrations shown in Table 3.3. At the completion of the vibration series, the flexible hose was hydrostatically pressurized to 700 psi (4825 kPa) for five minutes. There was no failure or visible damage as a result of this test. These results are deemed satisfactory.

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TABLE 3.3			
Total Table Stroke		Frequency	Time
(in.)	(mm)	(Hz)	(hours)
0.020	0.51	28	5
0.040	1.04	28	5
0.150	3.81	28	5
0.040	1.04	18 to 37 (variable)	5
0.070	1.78	18 to 37 (variable)	5

3.4 Pressure Cycling

The models listed in Table 3.4, considered representative of all sprinkler hose discussed in this Report, were subjected to 20,000 cycles of pressure varying from 0 psi to 175 psi (0 to 1205 kPa). During this test the samples were bent in a 90° angle at their minimum bend radius of 8 in. (203 mm). After completing 20,000 cycles, the models were hydrostatically pressurized to 700 psi (4820 kPa) for a period of five minutes. There was no failure or visible damage to the samples as a result of this test. These results are deemed satisfactory.

Table 3.4			
Test	Model	Orifice Size	Hose Lengths
1.	YB25	1/2 in.	3.5 ft (1.1 m) and 8.2 ft (2.5 m)
2.	YB28	1/2 in.	3.5 ft (1.1 m) and 8.2 ft (2.5 m)

3.5 Vacuum Test

The models listed in Table 3.5, considered representative of sprinkler hose discussed in this Report, were subjected to a vacuum of 25 in. (635 mm Hg) for a period of five minutes. Following the tests, each model was hydrostatically pressurized to 700 psi (4830 kPa) and maintained for a period of five minutes. There was no visible damage or leakage observed. These results were deemed satisfactory.

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Table 3.5			
Test	Model	Orifice Size	Hose Lengths
1.	YB25	1/2 in.	3.5 ft (1.1 m) and 8.2 ft (2.5 m)
2.	YB28	1/2 in.	3.5 ft (1.1 m) and 8.2 ft (2.5 m)

3.6 Friction Loss Test

In order to determine the friction loss of the flexible hose, flow measurements were taken at 10 psi (69 kPa) increments from 15 to 175 psi (103 to 1205 kPa). Measurements were conducted using a standard orifice sprinkler butt and a large orifice sprinkler butt, with nominal discharge coefficients (K-factor) of 5.6 and 8.0 gal/min/(psi)^{1/2} respectively. Tests were conducted with the sprinkler head alone and with the sprinkler mounted to each flexible hose being evaluated. The models listed below were tested with the sprinkler attached to the hose, and the hose extended straight or with the hose bent at its minimum bend radius (with multiple bends) to achieve the maximum friction loss. The average discharge coefficient values were then used to calculate the theoretical length of nominal 1 in. diameter schedule 40 sprinkler pipe. The results are listed in Table 3.6.

Table 3.6				
Model	Hose length	NPT	Test Position	Equivalent length of 1 in. schedule 40 pipe
YB25	2.2 ft (0.7 m)	1/2 in.	Straight	12.9 ft (3.9 m)
YB25	2.2 ft (0.7 m)	1/2 in.	With one bend	18.6 ft (5.7 m)
YB25	8.1 ft (2.5 m)	1/2 in.	Straight	47.3 ft (14.4 m)
YB25	8.1 ft (2.5 m)	1/2 in.	With six bends	91.5 ft (27.8 m)

3.7 Due to the nature of the design and similarity to the currently Approved models manufactured by Yong Won E.N.C., Ltd., no other tests were deemed necessary.

IV MARKING

The following information is stamped on the collar: Manufacturer's name, model designation, year of manufacture, hose length, rated working pressure, and the FM Approval Mark. A paper sticker, signifying final plant acceptance, is also put on the hose after the final successful factory testing.

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V REMARKS

The hose must be installed in accordance with the manufacturer's installation instructions.

VI FACILITIES AND PROCEDURES AUDIT

- 6.1 The flexible sprinkler hose models described in this Report are manufactured at the following location. This site has been audited, and is included in the FM Approvals Facilities and Procedures Audit program.

Yong Won E.N.C., Ltd.
116-1 Seogu-Ri, Kwangjeuk-Myun, Yangju-Gun
Keungki-Do, Korea

- 6.2 This manufacturing site is subject to follow-up audit inspections. 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.

VII MANUFACTURER'S RESPONSIBILITIES

Documentation considered critical to this Approval is on file at FM Approval and listed in the Documentation Section of this Report. 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 as notice of proposed changes.

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VIII DOCUMENTATION

The following drawings describe the Models and are filed under Project ID: 3024303:

Drawing No.	Date Rev.	Description	Model
YW-DA-017	10 Oct 2004 Rev. 0	Fast Flex	YB28A
YW-DA-017-1	28 January 04 Rev. 0	Commical A-Type	A-Type
YW-DA-017-1A	30 March 04 Rev. 1	Fast Flex	YB28 III – A, B (1075 – 2575)
YW-DA-017-2	28 January 04 Rev. 0	Commical B-Type	B-Type
YW-DA-001-1A	04 May 2004	Flexible Tube Assembly	YB25
YW-DA-004A	06 May 2004	Flexible Tube Assembly	YB28
YW-DA-016	16 Aug 2005	Sprinkler Flex (R.B. Sprinkler Joint)	YB25-I, YB25-II, YB25-III

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IX CONCLUSION

The Models described in Section 1.4 meet FM Approval requirements. Since a duly signed Master Agreement is on file for this manufacturer, Approval is effective the date of this Report.

TESTS AND EXAMINATION BY: P. J. Conroy and J. W. Normington

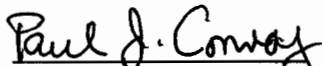
EXAMINATION BY: P. J. Conroy

PROJECT DATA RECORD: P.I. 3024303

ORIGINAL TEST DATA RECORD: P.I. 3005888

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