FM Approvals®

Member of the FM Global Group

Not to be distributed outside of FM Approvals except by Customer
Customer must distribute this Report in its entirety.

TEST REPORT

Project No:	3058840
Class:	Class Series 2000, Class 2017, Automatic Sprinklers, Non-Storage, Pendent
Product Name:	Model 2013 KT, 2014 SHKT and 2015 SHKT with a Nominal Discharge Coefficient of 5.6 gal/min/(psi)$^{1/2}$ [80.7 L/min/bar$^{1/2}$] in Chrome Finish, with a Nominal Temperature Rating of 155°F (68°C) (F5 Job Bulbs)
Product Type:	Automatic Sprinklers
Name of Manufacturer :	Unknown
Address of Manufacturer :	Unknown
Customer ID:	Work performed on behalf of the International Fire Sprinkler Association (IFSA)
Customer website:	www.firesprinkler.global

Prepared by:

Claude Bosio

Technical Team Manager
Fire Protection

Reviewed by:

David B. Fuller

Assistant Vice President, Manager-
Fire Protection

Richard P. Ferron

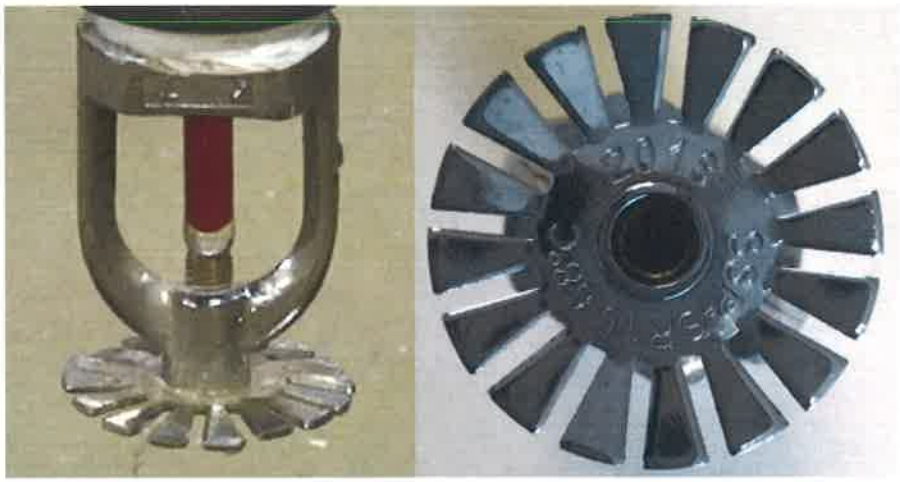
Operations Vice President, Manager,
Testing and Certification

10 May 2016
Date of Report

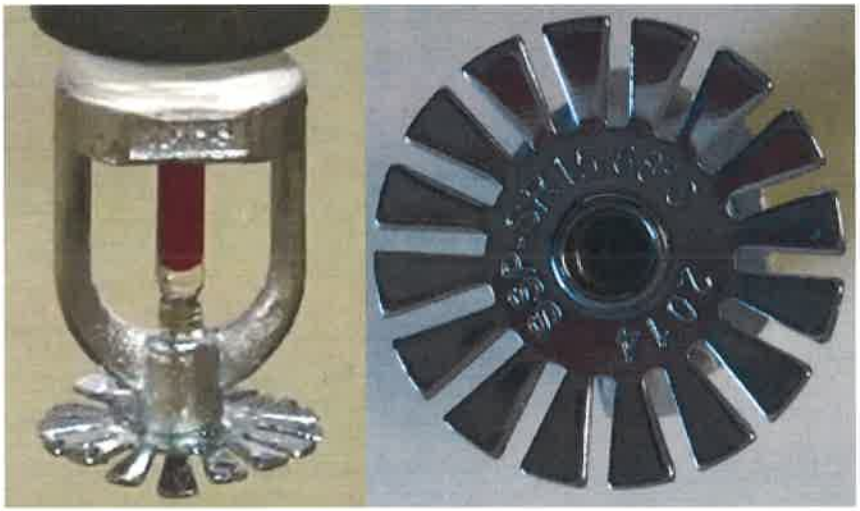
FM Approvals
1151 Boston Providence Turnpike
P.O. Box 9102
Norwood, MA 02062

1 INTRODUCTION

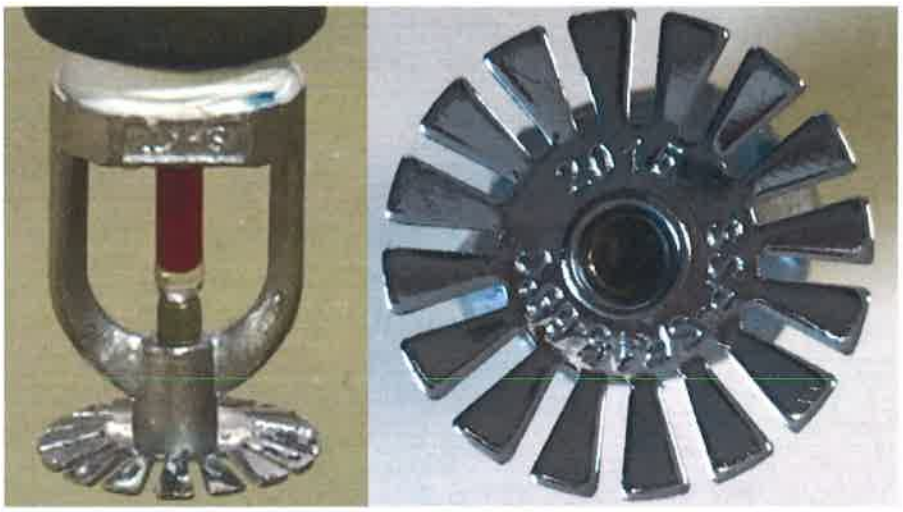
1.1 The International Fire Sprinkler Association (IFSA) requested an examination (not for FM Approval) of 136 automatic sprinklers reportedly removed from a facility in Brazil. These were Model KT (2013) and Model SHKT (2014 and 2015) sprinklers. These automatic sprinklers had a nominal discharge coefficient of 5.6 gal/min/(psi)$^{1/2}$ [80.7 L/min/bar$^{1/2}$], in a chrome finish, and utilized 5 mm Job F5 bulbs with a nominal temperature rating of 155°F (68°C). The tests discussed in this Report were conducted in accordance with the standard listed in Section 1.3.



2013 KT Automatic Sprinkler



2014 SHKT Automatic Sprinkler



2015 SHKT Automatic Sprinkler

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

1.3 **Standard**

FM Approvals Standard

Title	Number	Issue Date
Automatic Control Mode Sprinklers for Fire Protection	Class Series 2000	March 2006

1.4 **Listing**

These sprinklers were not subjected to the complete test program as outlined in the standard listed in Section 1.3 and did not meet the requirements as specified in the standard listed in Section 1.3. Therefore, these sprinklers are not FM Approved and are not listed in the Approval Guide, an on-line resource of FM Approvals.

2 DESCRIPTION

2.1 These Model KT (2013) and Model SHKT (2014 and 2015) automatic sprinklers utilized a 155°F (68°C) nominal rated 5 mm Job F5 bulb heat responsive element which operates within a predetermined temperature range, allowing water to flow at a specified rate and in a particular distribution pattern for a given supplied water pressure. The sprinklers were presumed to be designed for use in automatic sprinkler fire protection systems and were presumed to be rated for 175 psi (12.1 bar) maximum system pressure. The sprinklers utilized an o-ring seal.

3 EXAMINATIONS AND TESTS

3.1 One hundred and thirty six samples (total) of the Model KT (2013) and Model SHKT (2014 and 2015) automatic sprinklers were submitted for examination and testing. The samples were supplied by the International Fire Sprinkler Association (IFSA) and were reportedly removed from a building in Brazil. All data from this program remains on file at FM Approvals along with other documents and correspondence applicable to this program.

3.2 All testing and analysis considered appropriate (for the sample size provided) was conducted in compliance with the standard defined in Section 1.3.

The test program is summarized below:

NUMBER OF SPRINKLERS	TEST	ADDITIONAL TESTING ON THE SAME SPRINKLERS	SPRINKLER MODEL AND MARKINGS
10	Hang-Up (7 psi) [0.5 bar]	Strength of Deflector	"K T" "SSP-SR 15-68°C 2013"
10	Hang-up (25 psi) [1.7 bar]	Distribution	"K T" "SSP-SR 15-68°C 2013"
10	Hang-Up (50 psi) [3.4 bar]	K-Factor	"K T" "SSP-SR 15-68°C 2013"
10	Hang-Up (75 psi) [5.2 bar]		"K T" "SSP-SR 15-68°C 2013"
10	Hang-Up (100 psi) [6.9 bar]		"K T" "SSP-SR 15-68°C 2013"
10	Hang-Up (125 psi) [8.6 bar]		"K T" "SSP-SR 15-68°C 2013"
10	Hang-Up (150 psi) [10.3 bar]	Materials Analysis	"K T" "SSP-SR 15-68°C 2013"
10	Hang-Up (175 psi) [12.1 bar]	High Temperature Exposure	"K T" "SSP-SR 15-68°C 2013"
11	Assembly Load	Frame Strength	"K T" "SSP-SR 15-68°C 2013"
8	Salt Spray		"K T" "SSP-SR 15-68°C 2013"
5	Rough Use and Abuse		"K T" "SSP-SR 15-68°C 2013"
5	Minimum Operating Pressure		"K T" "SSP-SR 15-68°C 2013"
5	Water Hammer		"SHKT" "SSP-SR 15-68°C 2014"
5	Hang-Up (7 psi) [0.5 bar]	Strength of Deflector	"SHKT" "SSP-SR 15-68°C 2014"
5	Hang-Up (75 psi) [5.2 bar]	Distribution	"SHKT" "SSP-SR 15-68°C 2014"
5	Hang-Up (175 psi) [12.1 bar]	K-Factor	"SHKT" "SSP-SR 15-68°C 2014"
2	Rough Use and Abuse	High Temperature Exposure	"SHKT" "SSP-SR 15-68°C 2014"
5	Hang-Up (175 psi) [12.1 bar]	Materials Analysis	"SHKT" "SSP-SR 15-68°C 2015"
136	**TOTAL**		

3.3 Detailed analysis of the examination and testing can be found as an attachment, Appendix A, at the end of this report.

4 MARKING

4.1 The following information appears on the sprinklers identified in Section 2 of this Report:

- For the 2013 sprinklers:
  - The letters "K T" (separated by spaces) on both sides of the wrench boss
  - On the deflector:
    - "2013"
    - "SSP"
    - "SR"
    - "15"
    - "68°C"
  - There are no testing organization marks on the sprinkler

- For the 2014 and 2015 sprinklers:
  - The letters "SHKT" on both sides of the wrench boss
  - On the deflector:
    - "2014" or "2015"
    - "SSP"
    - "SR"
    - "15"
    - "68°C"
  - There are no testing organization marks on the sprinkler

5 DOCUMENTATION FILE

All pertinent Report documents are outlined in the Appendix A.

6 CONCLUSION

The automatic sprinklers described in Section 2 do not meet the requirements of the FM Approvals' standard referenced in Section 1.3.

PROJECT DATA RECORD: 3058840

ATTACHMENT: Appendix A - Detailed Analysis

APPENDIX A - DETAILED ANALYSIS

Following is a detailed description of the examinations and tests that were performed on the automatic sprinklers described in Section 2 and in accordance with the FM Approvals' standard referenced in Section 1.3.

1 Assembly Load And Frame Strength

The assembly load, including the load due to the maximum allowable inlet water pressure, was measured on eleven samples ("2013 KT"). While restraining the threaded portion of the sprinkler from movement, the heat responsive element of the sample was removed and the negative axial deflection of the frame, due to release of the assembly load, was recorded. A force necessary to return the deflection of the frame back to the original zero position was applied and the value of the force was recorded as the assembly load. The frames were then stressed to twice the respective assembly load and the permanent elongation was measured.

The average assembly load was determined to be 137 lbf (609 N) with a calculated upper tolerance limit (UTL_{frame}) of 500 lbf (2224 N). For all samples, the permanent elongation was less than the maximum allowed.

Due to the limited number of samples provided, the bulb crush test was not conducted. Assuming a bulb strength Lower Tolerance Limit (LTL_{bulb}) of 850 lbf (3781 N), [which could be considered typical of a Job F5 bulb], the assembly load does not meet the requirement that:

$$2UTL_{frame} < LTL_{bulb}$$

$$2 \times 500 \text{ lbf} = 1000 \text{ lbf} > 850 \text{ lbf} \qquad [2 \times 2224 \text{ N} = 4448 \text{ N} > 3781 \text{ N}]$$

The results were deemed not to meet the requirements of the standard listed in Section 1.3.

2 Water Hammer

Five samples ("2014 SHKT") were installed on a water-filled test manifold and subjected to changes in water pressure from approximately 50 to 500 psi (3.4 to 34.5 bar) with a cycle period of 1 to 10 seconds. Periodic inspection of the samples during this period revealed no evidence of leakage. Following 100,000 cycles, the samples were subjected to a 500 psi (34.5 bar) hydrostatic test for one minute. No leakage was observed. The samples were then visually examined and showed no evidence of physical damage.

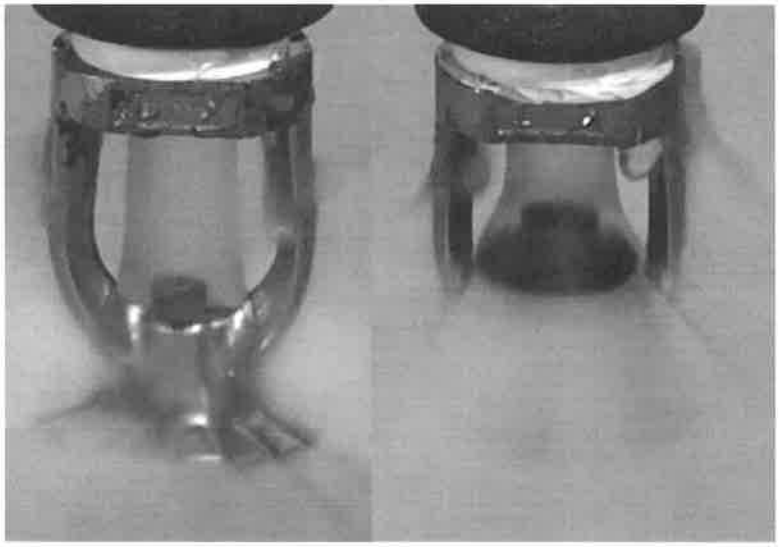
Subsequently, the samples were individually installed on a water supply line and hydrostatically pressurized to 3 psi (0.2 bar). The samples were each activated using a suitable heat source and observed. All samples functioned properly and promptly with all operating components clearing the waterway within 5 seconds of release of the heat responsive element.

The results were deemed to meet the requirements of the standard listed in Section 1.3.

3 Hang-up of Operating Parts (Lodgment)

Eighty samples ("2013 KT") total were installed in their intended orientation on a water supply line. Five samples at each water pressure of 7, 25, 50, 75, 100, 125, 150 and 175 psi (0.5, 1.7, 3.4, 5.2, 6.9, 8.6, 10.3 and 12.1 bar) were tested utilizing a double feed piping arrangement. Five samples at each water pressure of 7, 25, 50, 75, 100, 125, 150 and 175 psi (0.5, 1.7, 3.4, 5.2, 6.9, 8.6, 10.3 and 12.1 bar) were tested utilizing a single feed piping arrangement. The samples were each activated using a suitable heat source and observed. The results are shown in Table 1. The cumulative lodgment rate for the forty samples tested in the double feed piping configuration was 47.5% (19/40). The cumulative lodgment rate for the forty samples tested in the single feed piping configuration was 37.5% (15/40). The cumulative lodgment rate for all eighty samples tested was 42.5% (34/80). In order to fulfill the requirements of the standard listed in Section 1.3, the cumulative lodgment rate cannot exceed 1%. It should be noted that the cumulative lodgment rate at 150 psi [10.3 bar] was 80% (8/10) with 100% of the samples tested on the double pipe configuration at 150 psi [10.3 bar] resulting in a lodgment. Similarly, the cumulative lodgment rate at 175 psi [12.1 bar] was 80% (8/10) with 100% of the samples tested on the single pipe configuration at 175 psi [12.1 bar] resulting in a lodgment.

The results were deemed not to meet the requirements of the standard listed in Section 1.3.



No Lodgment Lodgment

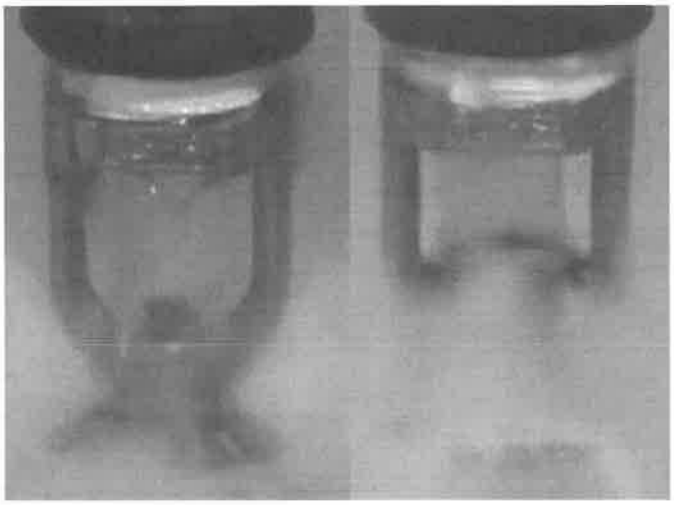
2013 KT Automatic Sprinkler at 7 psi

Table 1
Hang-up of Operating Parts (Lodgment) for the "2013 KT" Sprinklers

Model	Pressure (psi)	Feed Direction	Number of Samples Tested	Number of Failures	Failure Rate (%)
KT	7	double	5	1	20
KT	25	double	5	1	20
KT	50	double	5	2	40
KT	75	double	5	2	40
KT	100	double	5	3	60
KT	125	double	5	2	40
KT	150	double	5	5	100
KT	175	double	5	3	60
KT	7	single	5	1	20
KT	25	single	5	0	0
KT	50	single	5	0	0
KT	75	single	5	1	20
KT	100	single	5	4	80
KT	125	single	5	1	20
KT	150	single	5	3	60
KT	175	single	5	5	100

Fifteen samples total ("2014 SHKT") were installed in their intended orientation on a water supply line. Five samples at each water pressure of 7, 75 and 175 psi (0.5, 5.2 and 12.1 bar) were tested utilizing a double feed piping arrangement. The samples were each activated using a suitable heat source and observed. The results are shown in Table 2. The cumulative lodgment rate for the samples was 46.7% (7/15). In order to fulfill the requirements of the standard listed in Section 1.3, the cumulative lodgment rate cannot exceed 1%. It should be noted that the lodgment rate at 175 psi [12.1 bar] was 100% (5/5).

The results were deemed not to meet the requirements of the standard listed in Section 1.3.



No Lodgment Lodgment

2014 SHKT Automatic Sprinkler at 75 psi

Table 2
Hang-up of Operating Parts (Lodgment) for the "2014 SHKT" Sprinklers

Model	Pressure (psi)	Feed Direction	Number of Samples Tested	Number of Failures	Failure Rate (%)
SHKT	7	double	5	0	0
SHKT	75	double	5	2	40
SHKT	175	double	5	5	100

Five samples total ("2015 SHKT") were installed in their intended orientation on a water supply line. Five samples at a water pressure of 175 psi (12.1 bar) were tested utilizing a double feed piping arrangement. The samples were each activated using a suitable heat source and observed. The results are shown in Table 3. The lodgment rate for the samples was 80.0% (4/5). In order to fulfill the requirements of the standard listed in Section 1.3, the cumulative lodgment rate cannot exceed 1%.

The results were deemed not to meet the requirements of the standard listed in Section 1.3.

Table 3
Hang-up of Operating Parts (Lodgment) for the "2015 SHKT" Sprinklers

Model	Pressure (psi)	Feed Direction	Number of Samples Tested	Number of Failures	Failure Rate (%)
SHKT	175	double	5	4	80

4 Strength of Deflector (Flow Endurance)

Three samples ("2013 KT") were individually installed on a water-filled test manifold and pressurized to 225 psi (15.5 bar). The samples were each operated using a suitable heat source and allowed to flow water at approximately 225 psi (15.5 bar) for a period of 15 minutes. The samples were then visually examined and showed no evidence of physical damage.

The results were deemed to meet the requirements of the standard listed in Section 1.3.

Three samples ("2014 KT") were individually installed on a water-filled test manifold and pressurized to 225 psi (15.5 bar). The samples were each operated using a suitable heat source and allowed to flow water at approximately 225 psi (15.5 bar) for a period of 15 minutes. The samples were then visually examined and showed no evidence of physical damage.

The results were deemed to meet the requirements of the standard listed in Section 1.3.

5 Discharge Coefficient (K-Factor)

Four samples ("2013 KT") were individually tested over the range of pressures from 25 to 175 psi (1.7 to 12.1 bar) to determine K-factor. The average K-factor of all the samples was determined to be 5.4 gal/min/(psi)$^{1/2}$ [77.8 L/min/bar$^{1/2}$], within the acceptable limits. All individual test points were within the required limits of 5.3 to 5.8 gal/min/(psi)$^{1/2}$ [76.4 to 83.6 L/min/bar$^{1/2}$].

The results were deemed to meet the requirements of the standard listed in Section 1.3.

Four samples ("2014 KT") were individually tested over the range of pressures from 25 to 175 psi (1.7 to 12.1 bar) to determine K-factor. The average K-factor of all the samples was determined to be 5.6 gal/min/(psi)$^{1/2}$ [80.7 L/min/bar$^{1/2}$], within the acceptable limits. All individual test points were within the required limits of 5.3 to 5.8 gal/min/(psi)$^{1/2}$ [76.4 to 83.6 L/min/bar$^{1/2}$].

The results were deemed to meet the requirements of the standard listed in Section 1.3.

6 Corrosion - Salt Spray

Eight samples ("2013 KT") were exposed to the standard salt spray test as specified by ASTM B117 using a 20 percent salt solution for a period of 10 days. Following the exposure period and a drying period of 2 days, a visual inspection was conducted. The inspection indicated no severe deterioration or impending component failure.

Each sprinkler was then subjected to a 175 psi (12.1 bar) hydrostatic test for one minute. No leakage was detected.

Half of the samples were then operated in a controlled rate-of-temperature-rise liquid bath. All samples operated within the required temperature limits of 149.6 to 160.4°F (65.3 to 71.3°C).

The remaining samples were tested in accordance with the procedures for determining Response Time Index (RTI). Given the number of samples supplied, testing for conductivity and operating temperature was not conducted. For the purposes of this analysis, a C-factor of 0.8 $(ft/s)^{1/2}$ [0.44 $(m/s)^{1/2}$] and a nominal bath temperature of 155°F (68°C) was utilized. All values for RTI were determined to be below the minimum allowable RTI limit for a standard response automatic sprinkler (145 $(ft\text{-}s)^{1/2}$ [80 $(m\text{-}s)^{1/2}$]. (See Table 4) The Job F5 is reported to be an intermediate response bulb. The standard listed in Section 1.3 does not permit the use of intermediate response thermal elements.

The results were deemed not to meet the requirements of the standard listed in Section 1.3.

Table 4
Post Salt Fog Corrosion RTI for the "2013 KT" Sprinklers

Model	RTI $((ft\text{-}s)^{1/2})$	RTI $((m\text{-}s)^{1/2})$	Pass / Fail
KT	118.22	65.31	Fail
KT	120.18	66.40	Fail
KT	130.08	71.87	Fail
KT	128.03	70.73	Fail

7 Rough Use and Abuse

Two samples ("2013 KT") were individually subjected to a drop impact test. A weight equal to that of the sprinkler was dropped from a height of 3.3 ft (1.0 m) onto the deflector end of each sample. Following the impact test, a visual inspection was conducted. No significant fracture, deformation, or other deficiency was detected.

Three additional samples ("2013 KT") were individually subjected to a tumbling test for three minutes. Each sample was placed in a vinyl lined right hexagonal prism shaped drum designed to provide a tumbling action along with five oak wood blocks [1.5 in. (38 mm) cube] and tumbled at 60 revolutions per minute. Following the tumbling test, a visual inspection was conducted. All samples showed significant deformation to the tines of the deflector. Post-test examination also revealed that one deflector easily spun after the test.

All five samples were then subjected to a 500 psi (34.5 bar) hydrostatic test for one minute. No leakage was detected.

Following the hydrostatic test, the samples were tested in accordance with the procedures for determining Response Time Index (RTI). Given the number of samples supplied, testing for conductivity and operating temperature was not conducted. For the purposes of this analysis, a C-factor of 0.8 $(ft/s)^{1/2}$ [0.44 $(m/s)^{1/2}$] and a nominal bath temperature of 155°F (68°C) was utilized. Four of the five values for RTI were determined to be below the minimum allowable RTI limit for a standard response automatic sprinkler (145 $(ft\text{-}s)^{1/2}$ [80 $(m\text{-}s)^{1/2}$]. (See Tables 5 and 6) The Job F5 is reported to be an intermediate response bulb. The standard listed in Section 1.3 does not permit the use of intermediate response thermal elements.

The results were deemed not to meet the requirements of the standard listed in Section 1.3.

Table 5
Post Drop Test RTI for the "2013 KT" Sprinklers

Model	RTI $((ft\text{-}s)^{1/2})$	RTI $((m\text{-}s)^{1/2})$	Visual Damage	Pass / Fail
KT	126.63	69.96	None	Fail
KT	135.90	75.08	None	Fail

Table 6
Post Tumble Test RTI for the "2013 KT" Sprinklers

Model	RTI $((ft\text{-}s)^{1/2})$	RTI $((m\text{-}s)^{1/2})$	Visual Damage	Pass / Fail
KT	124.78	68.94	Bent Tines	Fail
KT	154.98	85.62	Bent Tines / Deflector Spins	Fail
KT	119.87	66.23	Bent Tines	Fail

One sample ("2014 SHKT") was individually subjected to a drop impact test. A weight equal to that of the sprinkler was dropped from a height of 3.3 ft (1.0 m) onto the deflector end of the sample. Following the impact test, a visual inspection was conducted. No significant fracture, deformation, or other deficiency was detected.

One additional sample ("2014 SHKT") was individually subjected to a tumbling test for three minutes. The sample was placed in a vinyl lined right hexagonal prism shaped drum designed to provide a tumbling action along with five oak wood blocks [1.5 in. (38 mm) cube] and tumbled at 60 revolutions per minute. Following the tumbling test, a visual inspection was conducted. The sample showed significant deformation to the tines of the deflector.

Both samples were then subjected to a 500 psi (34.5 bar) hydrostatic test for one minute. No leakage was detected.

Following the hydrostatic test, the samples were tested in accordance with the procedures for determining Response Time Index (RTI). Given the number of samples supplied, testing for conductivity and operating temperature was not conducted. For the purposes of this analysis, a C-factor of 0.8 $(ft/s)^{1/2}$ [0.44 $(m/s)^{1/2}$] and a nominal bath temperature of 155°F (68°C) was utilized. The drop sample yielded an RTI (126.38 $ft\text{-}s)^{1/2}$ [69.82 $(m\text{-}s)^{1/2}$]) which is below the minimum allowable RTI limit for a standard response automatic sprinkler (145 $(ft\text{-}s)^{1/2}$ [80 $(m\text{-}s)^{1/2}$]. A timing error during the testing of the tumble sample resulted in the inability to calculate the RTI for that sample. The Job F5 is reported to be an intermediate response bulb. The standard listed in Section 1.3 does not permit the use of intermediate response thermal elements.

The results were deemed not to meet the requirements of the standard listed in Section 1.3.

8 High Temperature Exposure (800°C) [1470°F]

One operated sample ("2013 KT") was subjected to an ambient temperature of 1470°F (800°C) for 15 minutes then plunged into 60°F (16°C) water for 1 minute. No damage was observed.

The results were deemed to meet the requirements of the standard listed in Section 1.3.

One operated sample ("2014 KT") was subjected to an ambient temperature of 1470°F (800°C) for 15 minutes then plunged into 60°F (16°C) water for 1 minute. No damage was observed.

The results were deemed to meet the requirements of the standard listed in Section 1.3.

9 Minimum Operating Pressure

Five samples ("2013 KT") were individually installed on a 1 in. nominal (25 mm nominal) size water supply line and hydrostatically pressurized to 3 psi (0.2 bar). The samples were each activated using a suitable heat source and observed. All samples functioned properly and promptly with all operating components clearing the waterway within 5 seconds of release of the heat responsive element.

The results were deemed to meet the requirements of the standard listed in Section 1.3.

10 Distribution - Standard Coverage Pendent

The distribution from four and six sprinklers ("2013 KT") mounted on a pipe manifold located above a suspended ceiling was measured over a centrally located 16 ft^2 (1.5 m^2) area 7.5 ft (2.3 m) below the deflectors. The results obtained are listed in Table 7. Note that the standard listed in Section 1.3 allows no more than one individual collection pan below the minimum individual collection pan value for each distribution test.

The results were not deemed to meet the requirements of the standard listed in Section 1.3.

Table 7
Multiple Sprinkler Distribution ("2013 KT")

16 Pan Location Centered Under	Waterflow Per Sprinkler gal/min (L/min)	Average Collected gal/min/ft^2 (mm/min)		Minimum Required Average Collection gal/min/ft^2 (mm/min)	Number of Water Distribution Pans Below the Minimum Pan Collection	Results
4	12.8 (48.5)	0.147	(5.99)	0.128 (5.21)	3	Fail
4	16.6 (62.8)	0.173	(7.05)	0.166 (6.76)	0	Pass
4	24.0 (90.8)	0.253	(10.31)	0.240 (9.77)	0	Pass
2	16.6 (62.8)	0.181	(7.37)	0.166 (6.76)	3	Fail

The distribution from four and six sprinklers ("2014 SHKT") mounted on a pipe manifold located above a suspended ceiling was measured over a centrally located 16 ft^2 (1.5 m^2) area 7.5 ft (2.3 m) below the deflectors. The results obtained are listed in Table 8. Note that the standard listed in Section 1.3 allows no more than one individual collection pan below the minimum individual collection pan value for each distribution test.

The results were deemed to meet the requirements of the standard listed in Section 1.3.

Table 8
Multiple Sprinkler Distribution ("2014 SHKT")

16 Pan Location Centered Under	Waterflow Per Sprinkler gal/min (L/min)	Average Collected gal/min/ft^2 (mm/min)		Minimum Required Average Collection gal/min/ft^2 (mm/min)	Number of Collection Pans Below the Minimum Pan Collection	Results
4	12.8 (48.5)	0.214	(8.72)	0.128 (5.21)	0	Pass
4	16.6 (62.8)	0.235	(9.58)	0.166 (6.76)	0	Pass
4	24.0 (90.8)	0.291	(11.86)	0.240 (9.77)	0	Pass
2	16.6 (62.8)	0.202	(8.23)	0.166 (6.76)	1	Pass

The distribution from four and six sprinklers ("2013 KT") mounted on a pipe manifold located above a suspended ceiling was measured over a centrally located 16 ft^2 (1.5 m^2) area 7.5 ft (2.3 m) below the deflectors. Three of these sprinklers were configured with lodged parts to simulate the results seen in the hang-up testing. Three sprinklers were chosen to represent a lodgment rate similar to that of the cumulative lodgment rate. The results obtained are listed in Table 9. Note that the standard listed in Section 1.3 allows no more than one individual collection pan below the minimum individual collection pan value for each distribution test.

This test is not typically conducted as part of the testing to the standard listed in Section 1.3 however, given the high lodgment rate determined in the hang-up test, it was deemed prudent to determine the effect of the high lodgment rate on the water distribution.

The results were deemed not to meet the requirements of the standard listed in Section 1.3.

Table 9
Multiple Sprinkler Distribution ("2013 KT" with 50% Simulated Hang-up)

16 Pan Location Centered Under	Waterflow Per Sprinkler gal/min (L/min)	Average Collected gal/min/ft^2 (mm/min)		Minimum Required Average Collection gal/min/ft^2 (mm/min)	Number of Collection Pans Below the Minimum Pan Collection	Results
4	12.8 (48.5)	0.074	(3.02)	0.128 (5.21)	12	Fail
4	16.6 (62.8)	0.097	(3.95)	0.166 (6.76)	11	Fail
4	24.0 (90.8)	0.157	(6.40)	0.240 (9.77)	10	Fail
2	16.6 (62.8)	0.144	(5.87)	0.166 (6.76)	9	Fail

2013 KT Automatic Sprinkler 6 Sprinkler Distribution with Simulated Lodgment

11 Material Analysis

Materials analysis was performed on several parts of the submitted sprinklers. The standard listed in Section 1.3 states that automatic sprinkler parts exposed to water must utilize materials having resistance to corrosion equal to, or exceeding that of, bronze alloy having a minimum copper content of 80 percent.

"2013 KT" Automatic Sprinklers

Load Screw – Match to C857 Yellow Brass in XRF library

This part is not exposed to water until the sprinkler operates.

Pipcap – No Match in XRF library

Fe: 0.745 (%w)
Ni: 0.474 (%w)
Cu: 53.60 (%w)
Zn: 39.10 (%w)
Sn: 0.885 (%w)
Pb: 5.09 (%w)

Based on these results the pipcap appears to be nickel coated

This part is exposed to water but does not meet the minimum material requirement stated above. However, the nickel coating may protect the part from corrosion to some extent.

Frame – Match to C857 Yellow Brass in XRF library

Mn: 0.038 (%w)
Fe: 0.670 (%w)
Ni: 0.366 (%w)
Cu: 57.53 (%w)
Zn: 37.14 (%w)
Sn: 0.714 (%w)
Sb: 0.035 (%w)
Pb: 3.37 (%w)

Based on these results the frame appears to be nickel coated

This part is exposed to water but does not meet the minimum material requirement stated above. However, the nickel coating may protect the part from corrosion to some extent.

Deflector – Match to C280 Muntz Metal in XRF library

Cr: 0.038 (%w) [This element may be leftover from the plating]
Fe: 0.078 (%w)
Ni: 0.273 (%w)
Cu: 61.13 (%w)
Zn: 38.35 (%w)
Sn: 0.080 (%w)
Pb: 0.034 (%w)

Based on these results the deflector appears to be nickel coated

This part is not exposed to water until the sprinkler operates.

"2014 SHKT" Sprinklers

Load Screw – Match to Nitronic 32 Stainless Steel in XRF library

Sl: 0.169 (%w)
P: 0.032 (%w)
Cr: 13.45 (%w)
Mn: 12.81 (%w)
Fe: 69.07 (%w)
Ni: 1.08 (%w)
Cu: 3.23 (%w) [This element may be leftover from the plating]

This part is not exposed to water until the sprinkler operates.

"2015 SHKT" Sprinklers

Pipcap – No Match in XRF library

Fe: 0.689 (%w)
Ni: 0.451 (%w)
Cu: 53.51 (%w)
Zn: 38.96 (%w)
Sn: 0.900 (%w)
Pb: 5.06 (%w)

Based on these results the pipcap appears to be nickel coated

This part is exposed to water but does not meet the minimum material requirement stated above. However, the nickel coating may protect the part from corrosion to some extent.

Frame – Match to C857 Yellow Brass or C864 Manganese Bronze in XRF library

Mn: 0.061 (%w)
Fe: 0.401 (%w)
Ni: 0.417 (%w)
Cu: 57.48 (%w)
Zn: 37.41 (%w)
Sn: 1.00 (%w)
Pb: 3.13 (%w)

Based on these results the frame appears to be nickel coated

This part is exposed to water but does not meet the minimum material requirement stated above. However, the nickel coating may protect the part from corrosion to some extent.

Deflector – Match to C280 Muntz Metal in XRF library

Fe: 0.083 (%w)
Ni: 0.328 (%w)
Cu: 61.06 (%w)
Zn: 38.29 (%w)
Sn: 0.107 (%w)
Pb: 0.071 (%w)

Based on these results the deflector appears to be nickel coated

This part is not exposed to water until the sprinkler operates.