

IN THE MATTER OF

TEXTRON, INC.

CONSENT ORDER, ETC., IN REGARD TO ALLEGED VIOLATION OF
SEC. 7 OF THE CLAYTON ACT AND SEC. 5 OF
THE FEDERAL TRADE COMMISSION ACT*Docket 9226. Complaint, Feb. 28, 1989--Decision, May 6, 1994*

This consent order requires, among other things, the respondent to license to a Commission-approved entity the right to manufacture and sell Monobolt rivets, divest to the licensee certain Monobolt manufacturing assets, and provide technical assistance to the licensee for five years.

Appearances

For the Commission: *Howard Morse* and *Allee A. Ramadhan*.

For the respondent: *Dhikhaii M. Maneckii*, in-house counsel, Providence, R.I. *Patricia Bailey*, *Squire, Sanders & Dempsey*, Washington, D.C. *Patricia Hennessey*, *Beigel & Sandler*, New York, N.Y.

COMPLAINT

The Federal Trade Commission, having reason to believe that respondent Textron Inc., ("Textron"), a corporation subject to the jurisdiction of the Commission, has entered into agreements with Avdel PLC ("Avdel") and Banner Industries, Inc. that violate Section 5 of the Federal Trade Commission Act, as amended, 15 U.S.C. 45, that pursuant to these agreements, Textron has acquired stock in "Avdel" and has commenced a cash tender offer to acquire all outstanding shares of Avdel, which acquisition, cash tender offer, and merger would, if consummated, violate Section 7 of the Clayton Act, as amended, 15 U.S.C. 18, and Section 5 of the Federal Trade Commission Act, as amended, 15 U.S.C. 45, and it appearing to the Commission that a proceeding by it in respect thereof would be in the public interest, hereby issues its complaint pursuant to Section 11 of the Clayton Act, 15 U.S.C. 21, and Section 5(b) of the Federal Trade Commission Act, 15 U.S.C. 45(b), stating its charges as follows:

I. THE PARTIES

A. *Textron, Inc.*

1. Respondent Textron is a corporation organized and existing under the laws of the State of Delaware, with its principal place of business located at 40 Westminster Street, Providence, Rhode Island.

2. Textron designs, manufactures and sells aerospace fasteners, including aerospace blind rivets, aerospace blind bolts, nutplate rivets, and lock bolts, and non-aerospace fasteners, including non-aerospace structural blind rivets. It is one of the two leading manufacturers of aerospace blind rivets and of non-aerospace structural blind rivets in the Free World. Textron also has operations in aerospace, commercial products and financial services. For the year ending January 2, 1988, Textron had net revenues of approximately \$7.2 billion and total assets of \$7.8 billion.

B. *Avdel PLC*

3. Avdel PLC is a corporation organized and existing under the laws of Great Britain, with its principal place of business located at Welwyn Garden City, Herts, England.

4. Avdel operates in the United States through its subsidiary Avdel Corporation, which has its principal offices located at 15 Lackawana Avenue, Parsippany, New Jersey. In 1987, Avdel Corporation's sales in the United States were around \$22 million.

5. Avdel designs, manufactures and sells fasteners for aerospace and non-aerospace use. Avdel is one of the two largest manufacturers of non-aerospace structural blind rivets in the Free World and the third largest manufacturer of aerospace blind rivets. For the year ended December 31, 1987, Avdel had net sales of approximately 76.3 million pounds and total assets of approximately 53.2 million pounds.

II. JURISDICTION

6. At all times relevant herein, respondent Textron has been, and is now, engaged in commerce as "commerce" is defined in Section 1 of the Clayton Act, as amended, 15 U.S.C. 12, and is a corporation whose business is in or affecting commerce as "commerce" is defined

in Section 4 of the Federal Trade Commission Act, as amended, 15 U.S.C. 44.

7. At all times relevant herein, Avdel has been, and is now, engaged in commerce as "commerce" is defined in Section 1 of the Clayton Act, as amended, 15 U.S.C. 12, and is a corporation whose business is in or affecting commerce as "commerce" is defined in Section 4 of the Federal Trade Commission Act, 15 U.S.C. 44.

III. THE PROPOSED ACQUISITION

8. On January 16, 1989, Textron agreed to acquire 46.6% of the shares of Avdel from Banner Industries, Inc. for 60 million pounds.

9. Textron and Avdel entered into an agreement pursuant to which Textron commenced to acquire by a cash tender offer and other means all outstanding voting securities of Avdel. Textron currently owns or has accepted for payment in excess of 95 percent of the stock of Avdel.

IV. TRADE AND COMMERCE

10. A relevant line of commerce within which to analyze the effects of this acquisition is the design, manufacture and sale of aerospace blind rivets, and any narrower market contained therein.

11. A relevant section of the country or geographic area within which to analyze the effects of this acquisition with respect to the design, manufacture and sale of aerospace blind rivets is the entire Free World, the United States, and any narrower market contained therein.

12. A relevant line of commerce within which to analyze the effects of this acquisition is the design, manufacture and sale of non-aerospace structural blind rivets, and any narrower market contained therein.

13. A relevant section of the country or geographic area within which to analyze the effects of this acquisition with respect to the design, manufacture and sale of non-aerospace structural blind rivets is the entire Free World, the United States, and any narrower market contained therein.

V. MARKET STRUCTURE

14. The proposed acquisition would substantially increase concentration in the Free World and United States aerospace blind rivet markets and the Free World and United States non-aerospace structural blind rivet markets, and would make those markets highly concentrated, whether measured by the Herfindahl-Hirschmann Indices or two-firm and four-firm concentration ratios.

VI. ENTRY CONDITIONS

15. Entry into the Free World and United States aerospace blind rivet markets and the Free World and United States non-aerospace structural blind rivet markets is difficult.

VII. ACTUAL COMPETITION

16. Textron and Avdel are actual, direct and substantial competitors in the design, manufacture and sale of aerospace blind rivets in the Free World and the United States.

17. Textron and Avdel are actual, direct and substantial competitors in the design, manufacture and sale of non-aerospace structural blind rivets in the Free World and the United States.

VIII. EFFECTS OF THE ACQUISITION

18. The effects of the proposed acquisition of Avdel by Textron may be substantially to lessen competition in the relevant markets in violation of Section 7 of the Clayton Act, as amended, 15 U.S.C. 18, and Section 5 of the Federal Trade Commission Act, as amended, 15 U.S.C. 45, in the following ways, among others:

(a) It will eliminate substantial direct competition between Textron and Avdel in the relevant markets;

(b) It will substantially increase concentration in the relevant markets, thereby increasing the likelihood of successful anticompetitive interdependent conduct, nonrivalrous behavior, and actual or tacit collusion among firms in the relevant markets; and

(c) It will eliminate Avdel as a substantial independent competitive force in the relevant markets.

All of the above increase the likelihood that firms in the relevant markets will increase prices and restrict output, both in the near future and in the long term.

IX. VIOLATIONS CHARGED

19. The acquisition of Avdel stock by Textron, from Banner Industries, Inc. and otherwise, violated Section 7 of the Clayton Act, as amended, 15 U.S.C. 18. The agreement between Textron and Avdel, and the agreement between Textron and Banner Industries, Inc., whereby Textron agreed to acquire stock of Avdel, violated Section 5 of the Federal Trade Commission Act, as amended, 15 U.S.C. 45.

INITIAL DECISION

BY JAMES P. TIMONY, ADMINISTRATIVE LAW JUDGE
OCTOBER 4, 1991

I. BACKGROUND

A. Textron

1. Respondent Textron Inc. ("Textron") is a publicly-held corporation organized under the laws of the state of Delaware, with its principal place of business in Providence, Rhode Island. Textron has more than thirty divisions and subsidiaries in three areas: aerospace and defense, commercial products, and consumer financial services. (Dolan, Tr. 6225-27; CX-1826-A to CX-1826-Z-44.)

2. Textron's total revenues in 1989 were \$7.4 billion. (CX-897-D.)

3. Beverly Dolan ("Dolan") is the Chief Executive Officer and Chairman of the Board of Directors of Textron. (Dolan, Tr. 6223.)

4. The Cherry division of Textron ("Cherry"), in Santa Ana, California, manufactures and sells fasteners and installation tooling for aerospace and commercial (truck cabs, trailers and buses) use. Cherry is the only division of Textron that manufactures any products in the lines of commerce alleged in the complaint. (Wahlberg, Tr. 6342.)

5. Textron's divisions that manufacture fasteners, including Cherry, are smaller than its aerospace divisions. The fasteners

divisions report to the group vice president for commercial products, who is not the vice-president for the aerospace and defense divisions. (Dolan, Tr. 6227-29.)

B. Avdel

6. Avdel PLC ("Avdel") is a corporation organized under the laws of the United Kingdom, with its principal place of business in Welwyn Garden City, England. (CX-253-A to CX-253-J.)

7. John Marley is a member of the Board of Directors and Chief Executive of Avdel. (Marley, Tr. 3351.)

8. Avdel manufactures and sells fasteners and installation tooling for commercial and industrial use, and fasteners for aerospace use. (CX-253-A to CX-253-J.)

9. Avdel's total revenues world-wide in 1990, in U.S. dollars, were \$162.9 million. (CX-1311.)

10. Avdel has subsidiary or related companies engaged in the sale and marketing of its products in Canada, Australia, Japan, Germany, Italy, France, Mexico and South Africa. (Marley, Tr. 3353-54; RX-457.)

C. The Transaction

11. In the latter part of 1988, Banner Industries launched a hostile take-over bid for Avdel by a tender-offer. (Marley, Tr. 3422; CX-290-A to CX-290-S.)

12. The Avdel Board of Directors recommended to the company's shareholders that they reject Banner's offer. (Marley, Tr. 3427; CX-258-A to CX-258-S.)

13. By December of 1988, Banner acquired 38% of Avdel's equity. John Marley contacted Quinton Achuff, the group vice president for Textron's fastener divisions, to solicit Textron as a "white knight" to acquire Avdel. (Marley, Tr. 3428-29.)

14. Textron explored the acquisition of Avdel because its fastener divisions and automotive components divisions had been unsuccessful in penetrating markets in Europe and Japan, in which Avdel sold. (Dolan, Tr. 6231-33.)

15. Textron sent William Ledbetter, Mark Woolley and Donald Eckerson, then President of Cherry, to visit Avdel in December of

1988 to gather information to decide whether to bid for Avdel. (Marley, Tr. 3429-30; Eckerson, Tr. 5457-59; Dolan, Tr. 6231, 6258-59.)

16. In 1986, Mr. Eckerson recommended the acquisition of Avdel as a means for Cherry to expand its commercial fastener sales outside of the United States (Eckerson, Tr. 5499-5500; RX-304-A to RX-304-N.)

17. In December 1988, Textron senior management perceived the primary strategic benefits of acquiring Avdel to be (1) giving Textron a worldwide network of trained sales engineers to sell the different fasteners of the various Textron fastener divisions, (2) providing a presence in Europe before "Europe 1992," and (3) gaining an entree into Japan for all of Textron's fastener and automotive divisions. (CX-387, Tr. 5464; CX-388-A.)

18. On December 14, 1988, the Board of Directors of Textron considered acquiring Avdel and authorized management to proceed with the transaction. (CX-496-Z-87 to CX-496-Z-89.)

19. By notice dated December 23, 1988, the Avdel Board recommended to its shareholders that they accept Textron's offer for their shares. (CX-496-Z-68 to CX-496-Z-69.)

20. On January 10, 1989, the Textron Board of Directors authorized an increase in the offer to acquire the remaining shares of Avdel since Banner would not relinquish its shares at the lower price. (Dolan, Tr. 6244; CX-451-M to CX-451-N.)

21. Textron paid \$250 million to acquire all of the shares of Avdel plc. (Dolan, Tr. 6248.)

22. Antitrust authorities in the U.K. reviewed Textron's acquisition of Avdel and determined that it raised no competitive concerns. (Dolan, Tr. 6243.)

D. This Proceeding

23. On February 22, 1989, the Federal Trade Commission obtained a Temporary Restraining Order to block the completion of Textron's acquisition of Avdel stock.

24. The complaint was filed on February 28, 1989, naming Textron as respondent. The complaint alleges that Textron's acquisition of Avdel violates Section 7 of the Clayton Act by substantially lessening competition in two lines of commerce: one involving aerospace "structural" blind rivets and the other involving

commercial (industrial) “structural” blind rivets. (Complaint paragraphs 10-13.)

25. On March 9, 1989, the U.S. District Court for the District of Columbia entered an order, consented to by the parties, requiring that Avdel voting stock be held in trust and that Avdel be maintained under separate management pending the outcome of this proceeding.

II. AEROSPACE BLIND RIVETS

A. *The Industry*

1. Manufacturers of aerospace blind rivets

26. Cherry manufactures aerospace blind rivets, including the CherryLOCK, Bulbed CherryLOCK, CherryMAX, CherryMAX A, and the CherryLOCK A (or A Code) at its plant in Santa Ana, California. It also manufactures other aerospace fasteners, including blind bolts and self-plugging and pull-through rivets. (RX-278-A to RX-278-D; RX-279-A to RX-279-C; RX-280-A to RX-280-C; RX-283-A to RX-283-B.)

27. Avdel manufactures aerospace blind rivets, including the MBC, Chobert and the Avdel Rivet. The MBC is manufactured at Avdel’s facility in the U.K. (CX-270-A to CX-270-L; CX-214-A to CX-214-D; Palmiteer, Tr. 505.)

28. Allfast Fastening Systems, Inc. (“Allfast”), manufactures aerospace blind rivets at its plant in City of Industry, California. Its aerospace blind rivets include rivets identified as NAS 1398 and NAS 1399 rivets (Allfast 1398 and Allfast 1399), rivets identified as NAS 1738 and NAS 1739 rivets (Allfast 1738/39), and the AllMax. It also manufactures the aerospace blind rivets previously manufactured by Olympic, whose assets relating to aerospace rivets Allfast acquired in April 1989. (CX-24-B to CX-Z-9; RX-78-A to RX-78-C; RX-80-A to RX-80-C; F. 33.)

29. John Hassall Co. (“Hassall”), manufactures aerospace blind rivets, by a license from Cherry for the CherryMAX, at its plant in Westbury, New York. (RX-456-A to RX-456-Z-18; Hachadoorian, Tr. 6986-87.)

30. Hi-Shear Corporation, not currently a manufacturer of aerospace blind rivets, has its plant in Torrence, California. It

manufactures non-blind aerospace fasteners including Hi-Locks, Hi-Lights, and others. (Ragan, Tr. 1773, 1906.)

31. Huck Manufacturing Co. (“Huck”) manufactures aerospace and commercial fasteners, including aerospace blind rivets. Its aerospace blind rivet manufacturing facilities are in Tucson, Arizona. (Faulkner, Tr. 138.) Its aerospace blind rivets include the MLS, Unimatic, and the Huck Clinch. (CX-89-A to CX-89-D; CX-90-A to CX-90-C; CX-91-A to CX-91-C; CX-52-A to CX-52-P.)

32. Monogram manufactures aerospace blind bolts and other aerospace fasteners. Monogram manufactured aerospace blind rivets from 1978 until 1983. It manufactured an A Code rivet and holds patents on other blind rivets. (Pratt, Tr. 9203-04; Faulkner, Tr. 146; CX-317-Z-2.)

33. Olympic Fastening Systems, Inc. (“Olympic”), was a manufacturer of aerospace blind rivets and installation tooling until it sold its aerospace assets to Allfast in March 1989. Before it exited the industry, Olympic manufactured several aerospace blind rivets, including the OlympicLok and Bulb-Lok. (CX-24-Z-34 to CX-24-Z-47; Willey, Tr. 1171.)

34. Voi-Shan/Screw Corp. (“Voi-Shan”), a division of VSI Corp., a wholly owned subsidiary of Fairchild Industries, is the world’s largest aerospace fastener manufacturer and is in Culver City, California. It was a manufacturer of aerospace structural blind rivets until late 1988. Voi-Shan manufactured blind rivets, including the CherryLOCK, Bulbed CherryLOCK, and CherryMAX, all by a license from Cherry, as well as an A Code rivet it developed itself. (CX-210-A to CX-210-Z-10; CX-116-A to CX-116-E.)

35. Fukui Byora is a commercial fastener manufacturer in Japan. It is affiliated with Hassall through a trading company and, by agreement with Hassall, can only sell to the U.S. through Hassall. It will soon begin production of CherryMAX for sale in Japan and for sale by Hassall in the United States. (Hachadoorian, Tr. 7069-79, 7171-77.)

2. Purchasers of aerospace blind rivets in the U.S. market

36. Beech Company, Wichita, Kansas, manufactures general aviation (small, light-weight, propeller-engined) airplanes. (RX-252; Skrobecki, Tr. 7992.)

37. Bell Helicopter, a subsidiary of Textron, is in Ft. Worth, Texas. It manufactures commercial and military helicopters. (Cabe, Tr. 5040-41.)

38. The Boeing Company (Boeing) manufactures airplanes (commercial and military), helicopters, and space vehicles, with over 150,000 employees. (Jarosz, Tr. 7626.) Last year Boeing had revenues of \$27.5 billion and is the world's largest producer of commercial airplanes. (Overstreet, Tr. 11029; RX-369-A.) Boeing has plants in Renton, Washington, Everett, Washington, Wichita, Kansas and Philadelphia, Pennsylvania. (Boeing Helicopter.) (RX-26-A; Beals, Tr. 7889-90.)

39. A division, Boeing Commercial Airplane Group (BCAG), makes all commercial airplanes made by Boeing. (Jarosz, Tr. 7425.)

40. Defense Industrial Supply Center ("DISC"), Philadelphia, Pennsylvania, is a part of the Defense Logistics Agency, Department of Defense. It purchases spare parts and consumable items for the military services, the Coast Guard and NASA. (Cosfol, Tr. 2049-51.)

41. Douglas Aircraft Corporation, Long Beach, California, is part of McDonnell Douglas Corporation. It manufactures commercial jet aircraft, including the narrow-bodied DC-9, and the wide-bodied DC-10 and DC-11. It designs and manufactures a military transport known as the C-17, which is the Air Force's next generation of military transport. (RX-140-A to RX-140-I; RX-142-A to RX-142-Z-257; RX-146-A to RX-146-Z-31.)

42. General Dynamics, Fort Worth, Texas, manufactures military aircraft. Its primary product is the F-16 (Flying Falcon) fighter aircraft. (Benson, Tr. 11163-64.)

43. Grumman Corporation, Long Island, New York, manufactures the F-14 airplane, a naval, carrier-based, fighter plane, and other military planes. (Beal, Tr. 812.)

44. Lockheed Corporation, Southern California, has plants all over the United States and manufactures commercial and military airplanes. The commercial airplanes it manufactures include the wide-bodied L-1011. A division, the Lockheed Advanced Development Company, makes advanced military and intelligence airplanes including the U-2, SR-71, and the F-117 (the Stealth Fighter-Bomber). (Hatton, Tr. 8667.)

45. McDonnell Douglas Helicopter ("MDHC"), Mesa, Arizona, a subsidiary of McDonnell Douglas Corporation, manufactures military and commercial helicopters including the AH-64A (Apache)

attack helicopter and the MD-500. (Santee, Tr. 1599-600; Van Horn, Tr. 1479-80; Findley, Tr. 942.)

46. McDonnell Douglas ("McAir"), St. Louis, Missouri, manufactures military and commercial airplanes. McAir produces the front end of the F-18 Naval Fighter-Bomber, for which it is the prime contractor; the F-15 (Fighting Eagle) Air Force fighter bomber; the T-45, which is a naval jet trainer; the AV-8B (Harrier), a vertical takeoff and landing fighter bomber for the Marines and for which McAir is the prime contractor. (Smith, Tr. 4336, 4348.)

47. Mooney Aircraft, Kerrville, Texas, manufactures small, general aviation planes. Its primary product is a four-seater, single engine plane. In 1989 it manufactured 150 planes, which is down from its peak several years earlier. (Rogers, Tr. 766, 797.)

48. Northrop Corporation, Southern California, manufactures commercial and military airplanes. (Page, Tr. 8776.) It currently manufactures the aft fuselage of the F-18 fighter aircraft, a naval, carrier-based, fighter bomber designed by McDonnell Douglas Corporation. (Page, Tr. 8781.) It also subcontracts for the Boeing Corporation on some of its commercial airplanes, including the 747. It also produces the B-2 bomber.

B. *The Product*

1. General characteristics

49. A blind rivet is a fastener that joins two or more sheets of material with access to only one side of the joint. A blind rivet is composed of components, including a sleeve and a stem. The back part of the stem, the plug, has a larger diameter than the inside diameter of the sleeve. The sleeve fits around the stem above the plug. The rivet is installed by inserting it into a hole through the sheets to be joined and pulling the stem, forcing the plug up into the rivet. This deforms the blind-side of the rivet sleeve to form a head on the back of the material being joined. A point on the rivet stem known as the "break notch" is manufactured to be less able to bear stress than the remainder of the stem. When the force exerted on the stem exceeds what the break notch can bear, the stem breaks off and installation is complete. (Wahlberg, Tr. 6347-48; RX-279-D, RX-279-E, RX-279-P.)

50. If the stem is left in the rivet after installation, it may be locked in place either mechanically -- by deforming metal on the sleeve, the stem or both -- or by the force of friction between the stem and sleeve. Rivets that retain their stem only by friction do not retain the stem as well as those that are mechanically locked. (Wahlberg, Tr. 6348-49; 6358; RX-390-A; RX-389-A.)

51. Aerospace blind rivets that require greater strength are referred to as structural. Structural is also used to refer to aerospace blind rivets that are mechanically locked. (Luhm, Tr. 1124-26; Wahlberg, Tr. 6345.)

52. Aerospace blind rivets are sold to manufacturers of airplanes, missiles, and helicopters ("aerospace OEMs") and to repair these products. Aerospace blind rivets require tighter tolerances than commercial blind rivets, and are made in monel, inconel, grades of aluminum, and specialty steels. (Luhm, Tr. 998-99.)

53. Aerospace blind rivets are not used in primary structure that is heavily loaded. (Skrobecki, Tr. 7996-97.) They are used for slots, flaps, wings, and doors. (Wahlberg, Tr. 6342; RX-388-A.)

54. Aerospace blind rivets come in several materials. (Hammer, Tr. 1715.) The ability to make a rivet in one material does not indicate a firm's ability to make the rivet in other materials. (Zurko, Tr. 6139.) Changing the stem material can affect the shear strength and tensile strength of a blind rivet. (RX-279-H.)

a. *Installation and tooling*

55. Blind rivets are installed with pneumatic tools that hold the rivet in a pre-drilled hole and pull on the stem to form the blind-side head. The tool has a nose piece, the pulling-head, that fits over the stem of the rivet and grips it during the installation process. Some rivets require different sized nose pieces for every diameter of rivet. (Wahlberg, Tr. 6418; RX-279-Z-7 to RX-279-Z-13 (CherryLOCK tooling).)

56. Tooling is double (shifting) or single (non-shifting) action depending on the design of the rivet. (Wahlberg, Tr. 6352-54.) Rivets requiring double-action tooling cannot be installed with single-action tooling. (Wahlberg., Tr. 6395-96.)

57. Single-action tooling is lighter and easier to maintain than double-action tooling and is preferred by blind rivet customers. (Wahlberg, Tr. 6394-95.)

b. Rivet sizes

58. Aerospace blind rivets are measured in diameter and grip. Diameter is the outer diameter of the rivet sleeve (Wahlberg, Tr. 6439-41), and is measured in 32nds of an inch. A “four diameter” rivet is a rivet with a sleeve diameter of 4/32nds of an inch. (RX-279-T.) The most common aerospace diameters are four, five, six, and eight. Grip measures the combined thickness of all the sheets being fastened. In aerospace rivets, grip is measured in 16ths of an inch. A “two grip” rivet means a rivet that is suitable for fastening material that is 2/16ths of an inch thick. (RX-279-G.) A “4-2” is a rivet that is 4/32 of an inch in diameter with a grip of 2/16 of an inch. (RX-280-G.)

59. Some aerospace rivets are sold in oversize, 1/64 of an inch larger in diameter than the standard measurement in 32nds of an inch. (RX-279-F.) Rivets that are not oversize are referred to as nominal. (Wahlberg, Tr. 6426-27.)

60. Rivets come in head styles, including a flush or countersunk head, and a protruding or universal head. (Wahlberg, Tr. 6362-63; RX-279-F, RX-280-G.)

c. Bulbs and wiredraws

61. There are two types of structural aerospace blind rivets based on their configuration after installation and the method of forming the blind-side head on installation: wiredraws and bulbs. (Hammer, Tr. 1677; Faulkner, Tr. 351 (some customers like bulb feature, others value sheet take-up); Findley, Tr. 948-49, 974-75; Luhm, Tr. 1009-12, 1106-07 (MDD-St. Louis prefers wiredraws); Palmiteer, Tr. 727 (MBC not as good in thin sheets as Cherry bulbs); Willey, Tr. 1302; Santee, Tr. 1632-34; Jarosz, Tr. 7426-28 (design manual says to use bulbs if blind side sheet less than D/4); Petraska, Tr. 7814 (wiredraws have good hole-fill, but bulbs better in thin sheet).)

62. During the installation of a wiredraw rivet, the plug of the stem is pulled up into the sleeve, forcing the sheets together; the rivet sleeve, reinforced by the back-side sheet, acts like a die through which the plug of the stem is extruded. (Wahlberg, Tr. 6360; RX-279-P; RX-392-A.) Because the inside diameter of the wiredraw rivet's sleeve is initially smaller than the die formed by the sleeve pressing against the backside sheet, the extruding stem of the rivet

gradually forces the rivet sleeve outward, filling the hole as the extrusion takes place. (Wahlberg, Tr. 6354-58, 6416-17; Jarosz, Tr. 7428-29; RX-392-A; RX-279-P.)

63. Bulb rivets do not wiredraw or rely on pressure against the backside sheet (Wahlberg, Tr. 6374); rather the plug or back, end of the stem collapses the rivet sleeve and compresses it outward, creating a large bulge or bulb on the backside. (Wahlberg, Tr. 6371-73; Pratt, Tr. 8901; RX-279-E.) Because of the way the large blind side head is formed, bulb rivets do not distort the back sheet if it is thin, as do wiredraw rivets. (F. 317.) Bulb fasteners tend to exhibit less hole-fill, especially in longer grips (Wahlberg, Tr. 6374, 6382-83; RX-379-B), and less sheet-takeup than wiredraw fasteners. (Wahlberg, Tr. 6656-57.)

d. *Other fasteners*

64. Aerospace blind rivets are among thousands of fasteners used to hold together an airplane. Other fasteners used in the aircraft include solid rivets, shear pins, taper locks and blind bolts. (Jarosz, Tr. 7426-27; Chenarides, Tr. 8069-71; RX-146-J; Parker, Tr. 6862.)

65. Nutplates can also be used in blind applications. They consist of a plate with a large threaded hole in the center and small holes at either end. The plate is then attached to what will become the blind side sheet by rivets through the two small holes. Nut plates are used to be able to remove and replace the fastener. (Hatton, Tr. 8671-75; Parker, Tr. 6870, 6956.)

66. Aerospace blind bolts, like blind rivets, join sheets of material that can be installed with access to only one side of the joint. They differ from blind rivets in that they tend to be heavier, of larger diameter, stronger, more expensive than blind rivets, and are used in applications that are subject to tensile stress (stress along the length of the fastener), rather than shear stress (stress across the width of the fastener). (Faulkner, Tr. 63-66.)

2. *Aerospace specifications*

67. Aerospace blind rivets differ according to (1) materials, dimensions, head styles, and sizes; (2) performance characteristics, such as shear strength, fatigue resistance, and spindle retention; (3)

different materials and sheet thicknesses; and (4) tooling for their installation. (F. 83-106; RX-347-A; RX-408-A.)

68. Aerospace blind rivets are specified for use by callouts on the design drawing. A callout identifies the blind rivet by vendor's part number, buyer's part number or an aerospace specification. (Wahlberg, Tr. 6361-62, 6369-70.)

69. There are several kinds of specifications to which blind rivets are sold: manufacturer (vendor) specifications, National Aerospace Standards (NAS) specifications, military specifications, and customer specifications. (Beal, Tr. 867; RX-127-Z-239 to RX-127-Z-246; RX-280-C.)

70. Aerospace blind rivet specifications are composed of: (a) a procurement specification of the tests a fastener must pass (RX-376-A to RX-376-O (NAS 1400); RX-378-A to RX-378-M (NAS 1740)) and (b) standards pages that describe the physical attributes of the fastener, its dimensions, head style and materials. (Wahlberg, Tr. 6364-69; RX-377-A to RX-377-D (NAS 1398/1399); RX-379-A to RX-379-D (NAS 1738/1739).)

71. Procurement specifications for blind rivets identify two types of testing: (a) "quality assurance," "lot," or "inspection" tests that every batch of rivets shipped under that specification must pass (Pratt, Tr. 8907), and (b) "qualification" tests that the fastener must pass to meet that specification. (Cabe, Tr. 5144-45; Wahlberg, Tr. 6364-69, 6433-35 (Mil-R-7885); Hachadoorian, Tr. 7122-23; Pratt, Tr. 8901-07; RX-376-F (NAS 1400); RX-378E-F (NAS 1740); RX-402-A (Mil-R-7885).)

a. *Manufacturer (vendor) specs*

72. Some blind rivet manufacturers have their own specifications for the products they sell. Each manufacturer has part numbers to identify fasteners by rivet, sleeve and stem material, head style, and size. (Wahlberg, Tr. 6360-62.) Cherry shipped over 2,000 aerospace part numbers in the first three months of 1991. (Andrews, Tr. 9754-55.)

b. *NAS specs*

73. NAS specifications are written by the National Aerospace Standards Committee (NAS), standardizing hardware purchased by

aerospace original equipment manufacturers (“OEMs”). (Faulkner, Tr. 105; Page, Tr. 8812, 8816.) The NASC is a committee of the Aerospace Industries Association (AIA), a trade association of OEMs (Chenarides, Tr. 8100; Wahlberg, Tr. 6363-64) (McDonnell Douglas, Boeing, Northrop, Rockwell International, and Grumman). Voting members represent OEMs that are members of the AIA. Government agencies are represented. The manufacturers who supply OEMs can attend as non-voting members. NASCs hold public meetings and also closed meetings where only the government representatives and the AIA members can attend. Fastener manufacturers cannot attend closed meetings. The agenda is set and meetings run by the Steering Committee. (Page, Tr. 8806-09.)

74. Fastener manufacturers demonstrate that a product meets an NAS specification by passing tests in the procurement specification and preparing a qualification report of these tests. (Wahlberg, Tr. 6368.) OEMs that purchase blind rivets are invited, but not required, to witness these tests and to sign these qualification reports. (Page, Tr. 8873.)

75. Qualification to a specification must be accomplished for each combination of materials in which the fastener manufacturer offers the rivet. (Wahlberg, Tr. 6368-69; Chenarides, Tr. 8144-45.)

76. A specification is issued by NASC. A member of the NASC requests it. A draft of the specification is circulated to the members. (Page, Tr. 8818; Ford, Tr. 1467.)

c. Military specs

77. The military has specifications for blind rivets. The only military specification for aerospace blind rivets is Mil-R-7885 by Naval Air Systems Command (NavAir). (CX-390-A to CX-390-Z-152; Zurko, Tr. 6044-47; Keimes, Tr. 5850-51.)

78. Mil-R-7885 has slash sheets that specify material, head-style, and whether the rivet is oversize or nominal. (Zurko, Tr. 6191-92.)

79. A Qualified Products List (QPL), identifies companies and products qualified by specification. The military conducts or reviews qualification tests for the QPL. (Zurko Tr. 6062; Keimes, Tr. 5850, 5888; CX-390-A to CX-390-Z-152.)

d. *Air frame manufacturer specs*

80. Major aerospace OEMs (Boeing and McDonnell Douglas at St. Louis (McAir)), procure some blind rivets by their own specifications, which may not match the vendor, NAS, or military specification for the same rivet. (Faulkner, Tr. 105-07; Willey, Tr. 1335; Luhm, Tr. 1081, 1099-1100; Jarosz, Tr. 7435; RX-127-Z-239 to RX-127-Z-246.)

e. *Military Handbook 5*

81. Military Handbook 5 ("Mil-Hdbk-5") is a volume of tables published by the Mil-Hdbk-5 Committee of the Air Force. It lists data for products the industry uses, including blind rivets. These tables list lap joint shear tests. The values in these tables are known as joint allowables. (Faulkner, Tr. 108; Ford, Tr. 1399-1401.)

82. The Fastener Task Group ("FTG") is the subcommittee of the Mil-Hdbk-5 Committee responsible for the chapter on fasteners and is made up of representatives from OEMs. A rivet can have values added to Mil-Hdbk-5 by a request from a sponsor. The data is from joint allowable tests on different sizes of fasteners.

3. Specific products

a. *MLS*

83. In the early 1960's Huck began manufacturing and selling an aerospace blind rivet, the MLS. The MLS uses double-action tooling and requires a different nose piece for every diameter. (CX-89-A to CX-89-D.) It is a bulb-type fastener (Beal, Tr. 867, 876; Faulkner, Tr. 82-83) that some customers use for both thin and thick sheet applications. (Benson, Tr. 11135-37.)

84. Many years after the MLS was introduced and sold in the marketplace, the NASC issued the NAS 1900 procurement specification and standards pages NAS 1919 (protruding head) and NAS 1921 (flush-head) to cover the MLS. (RX-381-A to RX-381-J.) NAS 1900 states that it describes "blind rivets with a mechanically-locked-spindle and bulbed blind side." NAS 1900, paragraph 1.1. (RX-381-A.)

b. *CherryLOCK (1398/1399 rivets)*

85. Cherry sold its first structural aerospace blind rivet, the CherryLOCK, about 1961. (Wahlberg, Tr. 6351-52; RX-347-A; RX-391-A.) The CherryLOCK is a wiredraw fastener that requires double-action tooling and a different nose piece for every diameter, and is available only in nominal sizes. (CX-93-A to CX-93-E.) The wiredraw CherryLOCK had good clamp-up and hole-fill, a flush break and a wide grip range. (Benson, Tr. 11139; RX-347-A.)

86. Shortly after the CherryLOCK appeared on the market, the NASC issued procurement specification NAS 1400 (RX-376-A to RX-376-O (April 1961)) and NAS standards pages 1398 and 1399, covering mechanically locked, wire-drawing fasteners in nominal sizes. (RX-377-A to RX-377-D (April 1961); RX-279-P.)

c. *Bulbed CherryLOCK (1738/1739 rivets)*

87. Cherry found that it needed a fastener that performed better in thin sheets than the wiredrawing CherryLOCK. The wiredraw rivet's pressure on the backside sheet during installation can dimple or fold that sheet if it is too thin. (Wahlberg, Tr. 6374; Jarosz, Tr. 7429; Benson, Tr. 11144; RX-347-A; RX-394-A.) The Bulbed CherryLOCK, a bulb fastener that requires double-action tooling and a different nose piece for every diameter, was sold in 1964 for thin sheets. It is only in oversize diameters. (CX-94-A to CX-94-E.)

88. The Bulbed CherryLOCK sold under Cherry part number or OEM specifications until 1968, at which time NASC issued NAS 1740 (RX-378-A to RX-378-M (March 1968)) and standards pages 1738 and 1739, describing bulb-type, mechanically locked blind rivets such as the Bulbed CherryLOCK. (RX-379-A to RX-379-D (March 1968); RX-279-D.)

d. *OlympicLok (A Code rivets)*

89. Olympic began in 1969 to manufacture and sell the OlympicLok, a wiredraw rivet that resembled the CherryLOCK and met the requirements of NAS 1400, but could be installed with single-action tooling. The OlympicLok is only in nominal sizes. (CX-94-A to CX-94-C; Wahlberg, Tr. 6390-93; RX-397-A.)

90. Because the CherryLOCK qualified to NAS 1400, but could not be installed with single-action tooling, the NASC added an "A" to the specification for OlympicLok-type rivets. (Luhm, Tr. 1021-22; Wahlberg, Tr. 6390-93.) NAS 1400 rivets installed with single-action tools are known as "A Code" rivets. (Wahlberg, Tr. 6390.) A Code blind rivets identical to the OlympicLok were later sold by Monogram, Voi-Shan and Cherry. (RX-127-Z-218 to RX-127-Z-219.)

91. Most aerospace OEMs that use NAS 1400 rivets use either the CherryLOCK or the A Code, but not both depending on the type of tooling the air frame company owned. (Wahlberg, Tr. 6396-97; Jarosz, Tr. 7433-34.)

e. *Bulb-Lok*

92. In 1974, Olympic began manufacturing and selling a rivet known as the Bulb-Lok, under the same NAS specification as the Bulbed CherryLOCK. (Wahlberg, Tr. 6397-98; RX-398-A.)

93. Using single-action tooling, the Bulb-Lok has a cavity stem different than the Bulbed CherryLOCK. (Wahlberg, Tr. 6398-99; RX-398-A.) The Bulb-Lok uses wiredrawing action to form its blind-side head, and has a blind-side head after installation that is smaller than that of the Bulbed CherryLock. (Wahlberg, Tr. 6398-6400; RX-399-A.) The Bulb-Lok met the performance requirements of NAS 1740 but because it differed from the Bulbed CherryLOCK, the NASC generated two new standards pages, NAS 1768 and 1769, to cover the Bulb-Lok. (Wahlberg, Tr. 6397-98.)

f. *Unimatic*

94. In the 1970's, Huck introduced the Unimatic, a version of its MLS that uses single-action tooling. The Unimatic is identical in performance to the MLS and is sold pursuant to NAS 1919 and 1921, except that an S is added to the specification. (CX-90-A to CX-90-C.)

g. *CherryMAX*

95. Cherry first marketed the CherryMAX rivet about 1975. (RX-400-A; CX-593-C to CX-593-D.) The installed CherryMAX

looks like the Bulbed CherryLOCK. The CherryMAX has an improved locking mechanism and can be installed with single-action tooling with one nose piece for any diameter of rivet. (Wahlberg, Tr. 6414-15, 6418; RX-347-A.) The CherryMAX had a new component, called the driving anvil, that falls away after the installation process is completed. (Wahlberg, Tr. 6402-04, 6418.) The CherryMAX's new locking mechanism increased the rivet's stem retention. (Wahlberg, Tr. 6420-21.) With the CherryMAX, Cherry introduced a new single-action tool that was lighter and easier to operate. (Wahlberg, Tr. 6422-23.)

96. Cherry sold the CherryMAX under its own specification or customer specifications for several years. The military issued the Mil-R-7885 specification to cover some versions of the CherryMAX in 1980. (Wahlberg, Tr. 6429.) In 1987 the NASC issued procurement specifications NAS 1686 and NAS 1687 and standards pages NAS 9301 through 9312 that covered different versions of the CherryMAX. (RX-382-A to RX-382-Z-18; RX-383-A to RX-383-X.) Now the CherryMAX is sold under Cherry part number, customer specifications, Mil-R-7885 and the NAS standards pages. (RX-208-C.)

h. *MBC*

97. In the late 1970's Avdel developed a fastener for aerospace applications based on its commercial blind rivet, the Monobolt. Avdel called this rivet the MBC, which stands for Monobolt concept. (Palmiteer, Tr. 551-52; Marley, Tr. 3480.)

98. The MBC uses single-action tooling. Like the Olympic Bulb-Lok, MBC is a wiredraw rivet that has a hollow cavity, but the MBC's cavity is larger than that of the Bulb-Lok. Unlike the Bulb-Lok and other aerospace blind rivets, the MBC is a two-piece rivet because its mechanical lock is the Monobolt lock integral to the stem. (CX-228-A to CX-228-F; Luhm, Tr. 1132-33.)

99. The MBC uses the Monobolt lock. At the factory, part of the stem is skived away forming a lip which is then folded back unto itself. During installation, the lip moves along the sleeve as the stem is pulled until it comes in contact with a special nose piece that unfolds the lip into a groove in the sleeve. (CX-228-C to CX-228-D; Marley, Tr. 3382; Peavy, Tr. 1948.)

100. Originally, the MBC required a different nose piece for every diameter and a special nose piece configuration to form the

lock. Proper formation of the lock depends on a high level of maintenance of the nose piece. (F. 183; Smith, Tr. 4416; Peavy, Tr. 1971.)

101. Avdel considered qualifying the MBC under NAS 1400, but tests showed that the MBC could not qualify to that specification. (Palmiter, Tr. 736; Marley, Tr. 3466; Overstreet, Tr. 10272-75.) Avdel proceeded to sell in the United States under its part number. Avdel eventually got a new NAS procurement specification for the MBC, NAS 1722, and associated standards pages, NAS 1719, 1720, and 1721 in 1987. (RX-358-A to RX-358-P; RX-357-A to RX-357-D; RX-356-A to RX-356-D; Chenarides, Tr. 8102-05.)

i. *CherryMAX A*

102. In 1984, Cherry began selling a new wiredrawing blind rivet with the CherryMAX lock, using an anvil and a single nosepiece for all diameters, which it called the CherryMAX A. (RX-347-A; Wahlberg, Tr. 6457-59.) This fastener was for customers who required wiredraw-type rivets but did not want the CherryLOCK because of its double-action tooling or the CherryMAX because it was a bulb rivet. (Wahlberg, Tr. 6460-61.) The CherryMAX A meets the requirements of NAS 1400 and is sold to standards pages NAS 1398 and 1399, with an A to identify its use of single-action tooling. (Wahlberg, Tr. 6461-62.) As with all NAS 1400 rivets, it is available in nominal sizes only. (F. 85, 89.)

j. *Huck Clinch*

103. In 1985, Huck introduced another aerospace blind rivet, the Huck Clinch. (CX-91-A to CX-91-E; RX-351-A.) The Huck Clinch has an internal lock formed by the stem scraping away material from the sleeve as the rivet is installed. After installation, the lock is not visible. (Keimes, Tr. 5846-47; Cabe, Tr. 5081.)

104. The internal lock of the Clinch was different than the locking mechanism originally specified by Mil-R-7885 as promulgated in 1980. The Navy added the Huck Clinch to the QPL for Mil-R-7885 in 1986, and later revised Mil-R-7885 to delete reference to a visible, separate locking element. (Smith, Tr. 4433; Zurko, Tr. 6172-74; Keimes, Tr. 5850.)

k. *AllMax*

105. In 1986, Allfast began selling a rivet called the AllMax that infringed Cherry's patent for the CherryMAX. It was placed on the QPL for some slash sheets of Mil-R-7885 and sold to the Government under Government immunity from infringement suits. It differed from the CherryMAX in that it lacked a stop ring at the back of the stem and the plug section had knurls rather than steps. This version of the AllMax was also known as the AllMax I and is no longer marketed. (Luhm, Tr. 1112; Willey, Tr. 1293-94; CX-520-H to CX-520-I.)

106. About 1988 Allfast began selling the version of the AllMax currently sold that does not infringe on the CherryMAX patents. (Luhm, Tr. 1026.) This is known as the AllMax II. This version has a stop ring and a stepped plug section and was also placed on the QPL for some slash sheets of Mil-R-7885. (Luhm, Tr. 1113-14; CX-19-A to CX-19-F; Chenarides, Tr. 8126.)

4. Manufacturing processes

107. Components are assembled into blind rivets. All components begin as wire, which is cut off and formed. Operations include heading (forming by striking the wire one or more times into one or more dies) (Hachadoorian, Tr. 7093-95); thread rolling (forming by rolling the wire between dies) (Hachadoorian, Tr. 7106-07); chucking (forming by cutting the wire to a particular shape) (Hachadoorian, Tr. 7128); and wrapping (the process of flattening and shaping the wire) (Hachadoorian, Tr. 7134-36). Each component may undergo heat treatment (used to soften or harden the metal), cleaning, plating, and/or lubrication as part of the manufacturing process. (Hachadoorian, Tr. 7099-102; Andrews, Tr. 9738-9747.) Components are made to drawings that specify allowable values for dimensions known as "tolerances." (Hachadoorian, Tr. 7096.)

a. *Batch method*

108. Once the components are formed, it is necessary to join them to form a blind rivet. Traditionally rivets have been manufactured by a batch process in which the components such as the stem, sleeve and lock ring are made in different parts of the factory and

then joined to form a completed rivet. (Andrews, Tr. 9747-48; Hachadoorian, Tr. 7138-41.)

109. The components, even if all made within the allowable manufacturing tolerances, sometimes do not fit. It is then necessary to use different lots of components or lubricants or to use heat or chemicals on the components to get a combination of parts that will form a functioning rivet. This process of fitting together the components to form a working blind rivet is called "matching" and is part of the batch manufacturing process. (Andrews, Tr. 9748-49, 9751-59; Hachadoorian, Tr. 7142; RX-411-A to RX-411-B.)

110. In the manufacturing process at Cherry, rivets that cannot be matched in final assembly go to a part of the plant called "matching" where specialists try to make them work. (Andrews, Tr. 9757-61; Hachadoorian, Tr. 7142-46; Pratt, Tr. 9149-50; RX-411-A to RX-411-B.)

111. If components are outside of tolerances, they sometimes can be reworked to be inside the tolerances. (Hachadoorian, Tr. 7141-42.) After assembly, with whatever matching was necessary, the rivets go through quality control. (Andrews, Tr. 9751; Hachadoorian, Tr. 7120-21.) If components do not work they are scrapped. A manufacturer's scrap rate is the percentage of components that are not made into finished rivets. (Andrews, Tr. 10020; Eckerson, Tr. 5426.)

112. The amount of matching a manufacturer must engage in will affect the expense of making aerospace blind rivets. (F. 115.) At Cherry for certain rivets matching is part of the thread-roll operation. (Pratt, Tr. 8944-46; Andrews, Tr. 9799-9803, RX-455.) Certain materials and rivet designs require more matching than do others. (Andrews, Tr. 9760-61 (70% of monel CherryMAX vs. 15-20% of the other material combinations), 9798-9801 (A-Code); Pratt, Tr. 5429.)

113. The batch manufacturing process can take from 5 to 40 weeks to produce a batch of rivets. (Andrews, Tr. 9752.) The average length of time for CherryMAX today is about 10-12 weeks. (Andrews, Tr. 9752-53.)

b. *Cell method*

114. Huck, Hassall, and Cherry have begun using a Japanese technique of production known as the cell method. The cell method

groups all the operations to manufacture a single rivet in one location in the factory with a single team of people operating all the machines in what is known as a cell. (Andrews, Tr. 9761-64; Hachadoorian, Tr. 7125-26; Faulkner, Tr. 331-32; RX453.) This allows faster feedback, rather than discovering at the end of the process that sleeves and stems will not work together. (Andrews, Tr. 9774-75; Hachadoorian, Tr. 7126-27.) This method also reduces the level of in-process inventory. (Andrews, Tr. 9764-65.)

115. The cell is better able to use modern statistical process control (SPC) to reduce variation in lots of components. (Hachadoorian, Tr. 7014-15, 7191-92.) The use of the cell method in CherryMAX production has reduced the time from start to finish down to 11-12 days, cut scrap to zero, and eliminated matching. (Andrews, Tr. 9766, 9771-74; RX-451-A to RX-451-B; RX-452-A to RX-452-B.)

C. Competitive History of Aerospace Blind Rivets

1. Mechanically locked aerospace blind rivets

116. The first aerospace blind rivets, in the late 1930's, were hollow and friction lock rivets. The hollow rivets were known as pull-thrus. (Wahlberg, Tr. 6343-45; RX-389-A.) The friction lock rivets were known as self-pluggers, because the stem that formed the blind side "plugged" the sleeve. (Wahlberg, Tr. 6346-49; RX-390-A.) The self-pluggers required a secondary operation after installation to remove by grinding, shaving, or clipping, the stem that protruded above the installed rivet head. (Wahlberg, Tr. 6348; RX-389-A; RX-390-A.)

117. By the early 1960's, Huck and Cherry sold mechanically locked fasteners that broke flush and did not require an operation after installation. Cherry had a wire draw fastener, the CherryLOCK, and a bulb fastener, the Bulbed CherryLOCK, and Huck had the MLS. (F. 83, 85, 87.) Soon after Cherry introduced the CherryLOCK and the Bulbed CherryLOCK, it licensed Voi-Shan to make both rivets. (Buster, Tr. 2648; CX-491-Z-39 to CX-491-Z-49 (CherryLOCK 1964 license).) Voi-Shan sold about 25% of all structural aerospace blind rivets purchased in the U.S. Voi-Shan frequently underbid Cherry. (Buster, Tr. 2750-51; Hammer, Tr. 1738; Ragan, Tr. 1833-35, 1869-70.)

2. Entry of Olympic

118. Olympic began manufacturing aerospace blind rivets in the late 1960's. (CX-95-A to CX-95-C; Wahlberg, Tr. 6389; RX-397-A; F. 89.) Olympic first developed its OlympicLok blind rivet because McAir, a user of NAS 1400 rivets and Olympic tools, wanted better tools than the double-action tools. (Smith, Tr. 4423, 4425.) The OlympicLok qualified to NAS 1400 and gained sales because of its superior, single-action tool. (Wahlberg, Tr. 6391-95.)

119. Olympic later introduced its Bulb-Lok to better compete with bulb rivets like the Bulbed CherryLOCK. (Wahlberg, Tr. 6400-01; RX-398-A; F. 92-93.) Some OEM's did not view the Bulb-Lok as interchangeable with other bulb rivets, even though it qualified to NAS 1740. (Jarosz, Tr. 7443; Wahlberg, Tr. 6398-6401; Chenarides, Tr. 8051-53.) Many customers rejected the Olympic Bulb-Lok because it was a wiredraw and not a bulb. (Peavy, Tr. 1979-81, 1986; Wahlberg, Tr. 6411-12; Jarosz, Tr. 7442-43; Overstreet, Tr. 10276; RX-105-A to RX-105-G; RX-350.) The Olympic Bulb-Lok's sales declined to \$427,500 by 1990. (Luhm, Tr. 1134-36; RX-460-C.)

3. Development of the CherryMAX

120. The CherryMAX was a replacement for the Bulbed CherryLOCK. It was offered in the oversize diameters rivets under NAS 1740, and not in the nominal diameters under NAS 1400. (Wahlberg, Tr. 6426-27.) Later a nominal version of the CherryMAX was sold. (RX-280-H (CherryMAX brochure).)

121. The CherryMAX initially sold in 1976 under Cherry part numbers and OEM specifications because it had no military or NAS specification. Northrop, a subcontractor to McDonnell Douglas on the F-18, procured the CherryMAX for the F-18 under a McAir spec., (Smith, Tr. 4440; Page, Tr. 8788.) Boeing also developed its own spec for the CherryMAX in 1977. (Jarosz, Tr. 7435; RX-127-Z-239 to RX-127-Z-246.) The CherryMAX succeeded in the marketplace because it was perceived as equivalent to the Bulbed CherryLOCK and much easier to install. (Wahlberg, Tr. 6425-26.)

122. The lack of an NAS or military specification did not deter those customers who wanted the CherryMAX from purchasing it. (Wahlberg, Tr. 6427-28; Chenarides, Tr. 8063-64.) Cherry was selling ten million CherryMAX rivets a year to the government

before the rivet had its military specification. (Keimes, Tr. 5834.) Some aerospace OEMs that adopted the CherryMAX to replace the Bulbed CherryLOCK continued to design their aircraft on the basis of the performance characteristics of NAS 1740. (Cabe, Tr. 5148, 5316; Jarosz, Tr. 7733.)

123. In 1976 Cherry licensed Voi-Shan to manufacture and sell the CherryMAX in the United States. (Buster, Tr. 2703-04; CX-440-Z-5 to CX-440-Z-6; CX-440-O to CX-440-R.)

4. Development of Mil-R-7885

124. In the mid 1970's, NavAir requested the Naval Air Development Center to study all blind rivets to develop a new specification of aerospace blind rivets for repair. The study included the CherryMAX, MLS, Unimatic, OlympicLok, Bulb-Lok, CherryLOCK, and Bulbed CherryLOCK. (Zurko, Tr. 6046-52; RX-135-A; RX-136-A; RX-137-A to RX-137-Y.)

125. NavAir's examination of blind rivets in the mid 1970's found that no fastener served all purposes, but that the CherryMAX, because of its simplified tooling and installation, had more desirable features than any other blind rivet. (RX-137-W to RX-137-Y.) NavAir drafted a new blind rivet specification intended to describe the desirable attributes of the CherryMAX. (Zurko, Tr. 6053-54; RX-351-A.)

126. The Navy circulated its draft of the new specification, in the form of a revision of an old specification, Mil-R-7885, for comment by the other military services, aerospace OEMs, and fastener manufacturers. This was done via the Fastener Engineering and Optimization of Performance (FEOPS) Committee, a committee established by the Navy with members from government agencies and OEMs. (RX-259-B to RX-259-D.) Over four hundred comments were received and resolved by the FEOPS committee before the specification was officially issued on August 20, 1980 as Mil-R-7885, Revision C. (RX-259-B to RX-259-D; Wahlberg, Tr. 6429, 6432-33.) Mil-R-7885 was written to cover more than one producer's rivets. (Ford, Tr. 1468-69.) Mil-R-7885 did not require any features that were covered by Cherry patents. (Wahlberg, Tr. 6443-44.)

5. Entry of additional A Code manufacturers

127. In the late 1970's and early 1980's Voi-Shan and Monogram designed and began selling their own versions of the A Code rivet. (F. 90.)

6. Entry of Allfast

128. Allfast first sold aerospace blind rivets about 1979 with a copy of the original CherryLOCK, whose patent had expired. (Luhm, Tr. 1020.) Allfast identified these rivets by their standards pages numbers as NAS 1398 and NAS 1399 rivets and by Allfast part number. (RX-78-W to RX-78-Y.)

129. About 1980, Allfast began making and selling a rivet that was a copy of the Bulbed CherryLOCK, whose patent had one more year to run. Allfast identified these rivets by their standards page numbers as NAS 1738 and NAS 1739 rivets, and by Allfast part number. (Luhm, Tr. 1022-23; RX-78-S to RX-78-V.)

130. Allfast designed a copy of the CherryLOCK and Bulbed CherryLOCK and produced blind rivets in a short time by hiring experienced employees from Cherry and other fastener companies. (Willey, Tr. 1208-09.)

7. Entry of the MBC to the U.S.

131. Avdel began in the aerospace blind rivet business in the 1950's and 1960's by selling two aerospace rivets, the Avdel Rivet (a friction locked, self-plugging rivet) and the Chobert, neither of which are structural blind rivets and both of which had been developed by other companies. (Lambe, Tr. 4103-04.)

132. About 1981, Avdel asked Cherry to make and sell the MBC in the United States pursuant to Cherry's original Monobolt license (Ragan, Tr. 1850-51; Buster, Tr. 2682-83; Marley, Tr. 3385). This license gave Cherry the right to manufacture and sell the MBC in the U.S. because the MBC is based on the same patents as the Monobolt. (Marley, Tr. 3380.) Cherry decided not to make and sell the MBC under its Monobolt license. (Buster, Tr. 2757-59; Marley, Tr. 3386; CX-491-Z-91 to CX-491-Z-92.)

133. In 1982, Avdel introduced the MBC to the U.S. market, manufacturing it in England. (Palmiter, Tr. 552; F. 27.)

134. In 1987, Martin Marietta (Denver)'s representative to the NASC, Darryl Miller, requested a new NAS specification for the MBC, released as NAS 1722, to have a fastener with a space compatible lubricant for use on missiles and rockets. (Page, Tr. 8810.) The lubricant specified in NAS 1722 was dichronite. Avdel later found that the MBC would not perform to specification with that lubricant. (Palmiter, Tr. 679-81.)

135. Avdel modified the design of the MBC it markets in the U.S. to include what it calls a "lock creator," which is a driving anvil. (Palmiter, Tr. 677-79; Peavy, Tr. 1949-50.) NAS 1722 was modified to reflect the change. (RX-384-A to RX-384-N.) The effect was to permit Cherry's tooling to install Avdel's MBC. (Palmiter, Tr. 666.)

136. Boeing Helicopter sponsored a revision to Mil-Hdbk-5 to provide for Avdel's request to manufacture the MBC in hard metric sizes. (CX-1208-A to CX-1208-B.) There is no evidence that Avdel, to date, has made the MBC in any metric sizes. (Grawe, Tr. 4777.)

137. Avdel was to receive Mil-Hdbk-5 tables in mid-1991, after the addition of the lock creator to the design. (Ford, Tr. 1434.)

8. Qualification of CherryMAX to Mil-R-7885

138. Cherry's CherryMAX was listed on the QPL for slash sheets 6 and 7 under Mil-R-7885, on August 6, 1982. (Wahlberg, Tr. 6429-30; CX-498-F.) Cherry's CherryMAX was listed on the QPL for slash sheets 2 and 3 under Mil-R-7885, March 13, 1984. (Wahlberg, Tr. 6430-31; CX-498-F.) Voi-Shan's version of the aluminum sleeve and alloy steel stem CherryMAX was listed on the QPL for slash sheets 2, 3, 6 and 7 under Mil-R-7885 as of June 18, 1984. (Wahlberg, Tr. 6445; CX-498-D.)

139. Most blind rivet purchasers did not change their callouts to Mil-R-7885 as soon as Cherry was listed on the QPL for that specification; most continued to buy the CherryMAX under Cherry part number. (Wahlberg, Tr. 6445-46.)

9. Introduction of Cherry A Code rivets

140. Cherry did not offer its new CherryMAX A, which is a wiredraw rivet with the tooling and lock features of the CherryMAX, as a Mil-R-7885-type rivet or as an alternative to the standard, bulb CherryMAX. (Wahlberg, Tr. 6460-62; F. 111-12.)

141. In 1986-87, Cherry developed its version of the Olympic-Lok or A Code, also sold under NAS standards pages 1398A and 1399A (Wahlberg, Tr. 6470), because Cherry's customers wanted a wiredraw-type blind rivet, installed with single-action tools, but without the driving anvil of the CherryMAX A. (Wahlberg, Tr. 6463-67.) Cherry called this rivet the CherryLOCK A or A Code. (Wahlberg, Tr. 6466.) Cherry found the CherryLOCK A or A Code rivets difficult to manufacture consistently. (Andrews, Tr. 9798-9801.)

10. Huck Clinch and NAS 1686 and 1687

142. Despite opposition because the fastener lacked a visible locking ring (Petraska, Tr. 7822), the Huck Clinch was listed on the QPL for slash sheets 6 and 7 of Mil-R-7885 as of October 7, 1985. (CX-498-D.) In April 1988, despite opposition from Cherry, several OEMs, and the Air Force, Mil-R-7885 revision D was released, deleting references to a separate visible locking ring from Mil-R-7885. (RX-351-B; Wahlberg, Tr. 6490.) The Clinch was not regarded by many aerospace customers as interchangeable with the other fasteners qualified under Mil-R-7885 because of its unique, non-visible locking mechanism. (Petraska, Tr. 7820-22, 7844; Faulkner, Tr. 99-100; RX-122-A; Luhm, Tr. 1075-76.)

143. NASC in 1986 began two new NAS procurement specifications, NAS 1686 and 1687, requiring a visual locking mechanism. (Chenarides, Tr. 8118-21; Wahlberg, Tr. 6491; Cabe, Tr. 5084-86.) An ad hoc committee under Nick Chenarides of Douglas proposed a specification, with representatives of Huck, Olympic, Allfast, and Cherry invited to participate. (Chenarides, Tr. 8121-22.) Huck threatened suit. (Chenarides, Tr. 8128-31; RX-112-A to RX-112-G.)

144. NAS 1686 and 1687 were issued by the NASC in June 1987 (Wahlberg, Tr. 6491), requiring a visible locking ring. (Chenarides, Tr. 8133-37.) Cherry qualified its monel sleeve/stainless steel stem CherryMAX to NAS 1687 in 1987. (Wahlberg, Tr. 6497.) Only a

few OEMs have used NAS 1686 and 1687 or the standards pages in their call-outs. (Cabe, Tr. 5157-58; Wahlberg, Tr. 6497-98; Chenarides, Tr. 8319.)

11. Introduction of AllMax

145. The AllMax I was listed on the QPL for Mil-R-7885 in one diameter of slash sheets 6 and 7 as of September 12, 1986. (CX-18-Z-37.) The AllMax II was listed on the QPL for Mil-R-7885 in all diameters of slash sheets 2, 3, 4, 5, 6, 7, and 8 as of January 9, 1989. (CX-594-J to CX-594-K; RX-98-A.)

12. Exit of Voi-Shan and Olympic

146. In September 1988, Voi-Shan left the aerospace blind rivet business after more than twenty years as a successful manufacturer. (CX-593-I.) Voi-Shan left because of declining profits due to Allfast's aggressive price-cutting and "horrible price erosion." (RX-32-H; Grawe, Tr. 4851; Willey, Tr. 1170; CX-1717.)

147. At the time Voi-Shan announced its exit, Allfast had not yet introduced to the market its non-infringing version of the AllMax. (CX-520-I.)

148. In April 1989, Olympic sold its aerospace assets to Allfast. (CX-24-A.) Allfast then moved the equipment and machinery it had purchased to its plant in City of Industry, California. (Willey, Tr. 1174.) Some major aerospace OEMs, such as Boeing, required Allfast to qualify the former Olympic products Allfast proposed to sell because it moved the equipment. (Jarosz, Tr. 7453-54; Beals, Tr. 7884-85.) This left Cherry as the only qualified supplier of A Code type rivets procured under NAS 1398 and 1399. (Andrews, Tr. 9827.)

13. Cherry's April 15, 1989 disclosure

149. From late 1987 until early 1989, Cherry attempted to qualify its aluminum sleeve (5056)/stainless steel stem (15-7 ph) version of the CherryMAX to the newly issued NAS 1686. This materials combination was not covered by Mil-R-7885. (Wahlberg, Tr. 6498-99.)

150. Testing in preparation for Cherry's qualification to NAS 1686 indicated that aluminum sleeve (5056)/stainless steel (15-7 ph) stem version of the CherryMAX, a version not covered by Mil-R-7885, did not consistently meet the qualification requirements of NAS 1686 for sheet take-up and shank expansion. (Wahlberg, Tr. 6498-6499; Pratt, Tr. 8909.)

151. At a Cherry staff meeting in early April of 1989, John Pratt, then Cherry's head of R&D, revealed difficulties in producing an aluminum sleeve/stainless steel stem version of the CherryMAX to meet the sheet take-up and shank expansion requirements of NAS 1686 and 1687. (Pratt, Tr. 8915-17; Andrews, Tr. 9804; Wahlberg, Tr. 6501-02.) The question was whether every rivet, in every size and head style, had to meet every qualification test in the specification, or whether only the size and style of rivets identified in the specification for testing needed the characteristics. (Andrews, Tr. 9808-10.)

152. On April 15, 1989, Cherry wrote to its customers that as Cherry now interpreted the spirit or intent of NAS 1686 and 1687, Mil-R-7885 and the Cherry company specification for the CherryMAX, the CherryMAX did not consistently meet the sheet take-up and shank expansion qualification requirements of these specifications. (Andrews, Tr. 9805-07; RX-308-A to RX-308-H.)

153. Allfast's Ralph Luhm described Mil-R-7885 as "ambiguous." (Luhm, Tr. 1068.) Some OEMs told Cherry that its new reading of the specifications was incorrect. (Page, Tr. 8818-21; CX-794-A to CX-794-B; Benson, Tr. 11278-79.) Many of Cherry's customers did not regard sheet take-up and shank expansion as important attributes of the CherryMAX rivet. (Chenarides, Tr. 8150-52; Jarosz, Tr. 7456-59; RX-423-A to RX-423-E; Beals, Tr. 7890-91; Benson, Tr. 11307-08.) Most of Cherry's customers continued to purchase the CherryMAX after Cherry's April 15 letter. (Wahlberg, Tr. 6506; Andrews, Tr. 9814-15; CX-817-A to CX-817-C.)

154. After Mooney Aircraft received a letter from their CherryMAX distributor about Cherry's April 15 disclosure, the next rivet manufacturer to contact Mooney was Avdel, and Mooney identified the MBC for use on its aircraft. (Rogers, Tr. 770-71, 801.)

155. In the summer of 1989, Cherry requested that the Navy waive or modify the sheet take-up and shank expansion requirements of Mil-R-7885. (Andrews, Tr. 9817-18.)

156. NavAir found that the AllMax rivet by Allfast also was deficient in sheet take-up and shank expansion. (Zurko, Tr. 6187.)

157. The Navy reduced tests for sheet take-up and shank expansion, but required a test known as the Boomer Banger. (CX-859-A to CX-859-B.) In 1990, DISC resumed making some CherryMAX purchases by waiving the sheet take-up and shank expansion requirements. (Andrews, Tr. 9951-52.)

158. In further testing of CherryMAX rivets following the April 15 disclosure letter, Cherry determined that its current production rivets could not always meet the joint allowables published for the CherryMAX in Mil-Hdbk-5. (Pratt, Tr. 5738-39.) Cherry notified the Mil-Hdbk-5 Committee, and, in May of 1990, the joint allowables previously published in Mil-Hdbk-5 for the CherryMAX were removed. (Ford, Tr. 1423-24; Pratt, Tr. 5745-46.)

159. Following Cherry's April 15 disclosure letter, the NASC began a project to consider modifications of NAS 1686 and 1687. (Chenarides, Tr. 8153-55.) The likely result of the NASC's project will be the NASC's decision to eliminate the sheet take-up and shank expansion requirements from NAS 1686 and 1687. (Chenarides, Tr. 8167, 8174-75.) Allfast initially opposed this change, but then later changed their position. (Chenarides, Tr. 8173-74.)

160. The April 1989 disclosure and the Mil-Hdbk-5 problem cost Cherry credibility with some of its customers. (Chenarides, Tr. 8160-62; Overstreet, Tr. 11017-18.)

14. The licensing of John Hassall Co.

161. Started over 100 years ago, John Hassall Co. manufactures fasteners for commercial and aerospace use; its techniques include reheading, a form of heading that is precise and economical. (Hachadoorian, Tr. 6992-95, 7001-04.) Hassall also designs machinery for fasteners production. (Hachadoorian, Tr. 7262-64.) Hassall's aerospace customers regard it as one of their best suppliers of fasteners. (Schwarz, Tr. 7378-81; RX-413; RX-414; RX-415; RX-416; RX-417-A to RX-417-B.)

162. Among the aerospace products Hassall manufactures are fasteners for aircraft jet engine manufacturers (none of them blind) that require both high tolerances and the ability to form exotic materials such as monel, inconel, and specialty steels. (Hachadoorian, Tr. 7003-05, 7031-32.)

163. In 1989, Textron decided to license Hassall to make and sell the CherryMAX to meet concerns about diminished competition in the sale of aerospace blind rivets. (Dolan, Tr. 6285-87.) Hassall surveyed the market and found that the CherryMAX was in demand. (CX-557-A to CX-557-D.) Demand for the MBC in the U.S. was very small. (Hachadoorian, Tr. 7242-43, 8623-26, 8650-53.)

164. In June 1990, a license for the CherryMAX was granted by Cherry to Hassall. (Hachadoorian, Tr. 7159.) The license was not final unless Hassall manufactured 20 part numbers of the aluminum sleeve (5056)/alloy steel stem (8740) version of the CherryMAX and passed the tests in the CherryMAX specification by October 15, 1990. (RX-456-A to RX-456-Z-18; Hachadoorian, Tr. 7160-64.)

165. Hassall used cell manufacturing rather than the batch technique primarily employed by Cherry. (Hachadoorian, Tr. 7155-56.) Hassall's personnel went to Cherry's Santa Ana factory and trained on a cell to produce the aluminum sleeve/alloy steel stem version of the CherryMAX. (Hachadoorian, Tr. 7164-68.) Hassall purchased most of the necessary tooling and machinery from Cherry and set up its own cell to manufacture the CherryMAX. (Hachadoorian, Tr. 7168-69.) Hassall qualified the requisite 20 sizes before the October 15 deadline, less than 100 days after the license was signed. (Hachadoorian, Tr. 7169-70.)

166. Hassall is considering production of other aerospace blind rivets, such as the Huck MLS and the A Code rivets, for which no license is necessary. (Hachadoorian, Tr. 7240-42, 8626-27.)

167. Hassall's CherryMAX license permits Hassall's Japanese affiliate Fukui Byora, a fastener manufacturer for the Japanese commercial market, to manufacture the CherryMAX for sale in Japan and export to Hassall for sale in the U.S. (Hachadoorian, Tr. 7171; RX-456-A to RX-456-Z-18; F. 35.) Fukui Byora also designs and manufactures fastener manufacturing machinery. (Hachadoorian, Tr. 7074-77.)

168. Hassall changed the CherryMax production process using Fukui Byora machinery. (Hachadoorian, Tr. 7181, 7187-92.) Hassall intends to differentiate its CherryMAX through improved quality and advanced manufacturing techniques. (Hachadoorian, Tr. 8654-56.) Hassall's prices for CherryMAX are lower than Cherry's list prices. (Hachadoorian, Tr. 8601.)

D. Recent Sales and Trends

169. Total U.S. sales in 1989 of structural aerospace blind rivets were \$49,815,095. Estimated 1990 sales for these products were \$63,700,000. (RX-460-D.)

170. In 1988, Voi-Shan's total U.S. sales of aerospace blind rivets were \$4,600,000; by 1989, Voi-Shan's sales dropped to \$300,000. (RX-460-D.)

171. In 1989 and 1990, Cherry's U.S. sales of aerospace blind rivets were (RX-460-B to RX-460-D):

	<u>1989</u>	<u>1990</u>
CherryMAX	\$22,394,932	\$30,149,564
CherryMAX A	1,070,970	1,339,226
Bulbed CherryLOCK	2,757,801	3,476,259
CherryLOCK	4,071,912	5,874,365

172. The exit of Olympic and Voi-Shan, Allfast's having to requalify, and more orders from Boeing and other aerospace OEMs increased Cherry's sales of aerospace blind rivets late in 1989 and early in 1990. (Andrews, Tr. 9792-9795.) This influx of orders at Cherry increased Cherry's past due orders. (Andrews, Tr. 9790-91, 9797-98.) Production of A Code rivets ordered by Boeing fell behind. (Andrews, Tr. 9827; Farley, Tr. 3033.)

173. Since 1989, Cherry increased its aerospace blind rivet output. Its past dues were reduced and its current production exceeds its shipments. (Beals, Tr. 7894; Andrews, Tr. 9795-9798.)

174. For 1989 and 1990, Allfast's U.S. sales were (RX-460-B to RX-460-D):

	<u>1989</u>	<u>1990</u>
AllMax	\$2,378,000	\$4,195,500
Allfast 1398, 1399 and A Code	3,727,000	4,908,000
Allfast 1738 and 1739	1,927,000	2,245,500
Bulb-Lok	265,000	427,500

175. Allfast's acquisition of Olympic's aerospace business expanded Allfast's line and capacity and customers. (Luhm, Tr. 1037-38, 1146; Smith, Tr. 4468.) Allfast recently qualified its AllMax blind rivet at several major OEMs, including Bell Helicopter

and Northrop. (Cabe, Tr. 5299-5300; Page, Tr. 8792; 92-A-B.) Allfast should be qualified on its A Code blind rivet at Boeing by mid 1991. (Jarosz, Tr. 7454.) Allfast should be qualified on the AllMax at Boeing by early 1992. (Jarosz, Tr. 7454-55; Farley, Tr. 3026-27.) Allfast should gain approval for the AllMax at Douglas, Long Beach when NAS 1686 and 1687 are revised, at which point, Nick Chenarides of Douglas expects "a massive industry conversion from Cherry to AllMax." (Chenarides, Tr. 8126-27.) Allfast expects blind rivet sales of \$4-5 million in 1991. (Willey, Tr. 1298.)

176. In 1989 and 1990, Huck's U.S. sales were (RX-460-B to RX-460-D; Andrews, Tr. 9820):

	<u>1989</u>	<u>1990</u>
Clinch	\$17,000	900,000
MLS/Unimatic	10,561,000	10,594,500

177. Because it moved to a new plant in Tuscon, Huck stopped marketing the Clinch from 1986 until mid-1989. (Faulkner, Tr. 100-02.) In 1990, Huck sales of the Clinch to DISC were \$900,000. (Andrews, Tr. 9820.) Through August, the 1990 Clinch sales were estimated to be only \$99,000. (RX-460-D.)

178. Hassall has CherryMAX orders of \$800,000, and has shipped \$100,000 worth. (Hachadoorian, Tr. 7213.) Hassall projects that it will ship \$2,000,000 of CherryMAX in 1991. (Hachadoorian, Tr. 7214-15.) Boeing's on-site, quality audit of Hassall went very well and Hassall was approved. (Beals, Tr. 7886-87; Hachadoorian, Tr. 7225.)

E. History and Prospects of MBC in U.S.

1. The past

179. MBC sales in the U.S. have been "essentially flat" from 1988 to 1990, despite receiving an NAS specification in 1987. (Palmiter, Tr. 734-35.)

