## Contents

Factors Influencing Wearing of Armor	Pa	_
Soft Armor and Hard Armor		
Summary of NIJ Standard 0101.03         7           FINDINGS         13           Benefits of Wearing Armor         13           Factors Influencing Wearing of Armor         14           Goals obtesting and Certiffication         16           Test Procedures         21           Assuring Quality         27           UNRESOLVED ISSUES         27           OPTIONS FOR THE DEPARTMENT OF JUSTICE         29           Specify Acceptable Risks         30           Revise NIJ Standard 0101.03         32           Assure Quality         36           Sponsor Research         38           OTHER POLICY OPTIONS         39           Expand FTC Activities; Involve OSHA         39           LEGISLATIVE OPTIONS         40           Fund NIJ-Sponsored Research         40           BIBLIOGRAPHY         41           Boxes         2           Box         Page           A. How Soft Armor Works         2           B. Kevlar and Twaron and Twaron and Ammunition Used in Assaults on Police         8           E. Types of Guns         9           F. ABCs of Ammunition, Bullets, and Cartridges         10           G. Stringency, Validity, and Reproducibility.         17 <th></th> <th></th>		
FINDINGS       13         Benefits of Wearing Armor       13         Factors Influencing Wearing of Armor       14         Goals obtesting and Certitification       16         Test Procedures       21         Assuring Quality       27         UNRESOLVED ISSUES       27         OPTIONS FOR THE DEPARTMENT OF JUSTICE       29         Specify Acceptable Risks       30         Revise NIJ Standard 0101.03       32         Assure Quality       36         Sponsor Research       38         OTHER POLICY OPTIONS       39         Expand FTC Activities; Involve OSHA       39         LEGISLATIVE OPTIONS       40         Fund NIJ-Sponsored Research       40         BIBLIOGRAPHY       41         Boxes       Page         B. Kevlar* and Twaron*       2         C. Spectra* and Spectra Shield**       4         D. Trends in Weapons and Ammunition Used in Assaults on Police       8         E. Types of Guns       9         F. ABCs of Ammunition, Bullets, and Cartridges       10         G. Stringency, Validity, and Reproducibility.       17         H. Statistical Confidence       18         Figure       Page	Soft Armor and Hard Armor	7
Benefits of Wearing Armor   13   Factors Influencing Wearing of Armor   14   Goals obtesting and Certitfication   16   16   16   16   17   17   17   17	Summary of NIJ Standard 0101.03	7
Benefits of Wearing Armor   13   Factors Influencing Wearing of Armor   14   Goals obtesting and Certitfication   16   16   16   16   17   17   17   17	FINDINGS	13
Goals obtesting and Certitification   1.6     Test Procedures		
Goals obtesting and Certitification   1.6     Test Procedures		
Test Procedures       21         Assuring Quality       27         UNRESOLVED ISSUES       27         OPTIONS FOR THE DEPARTMENT OF JUSTICE       29         Specify Acceptable Risks       30         Revise NIJ Standard 0101.03       32         Assure Quality       36         Sponsor Research       38         OTHER POLICY OPTIONS       39         Expand FTC Activities; Involve OSHA       39         LEGISLATIVE OPTIONS       40         Fund NIJ-Sponsored Research       40         BIBLIOGRAPHY       41         Boxes       Page         A. How Soft Armor Works       2e         B. Kevlar <sup>8</sup> and Twaron <sup>8</sup> 2         C. Spectra <sup>8</sup> and Spectra Shield <sup>™</sup> 4         D. Trends in Weapons and Ammunition Used in Assaults on Police       8         E. Types of Guns       9         F. ABCs of Ammunition, Bullets, and Cartridges       10         G. Stringency, Validity, and Reproducibility.       17         H. Statistical Confidence       18         Figure         Figure         Figure       1         1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitte	Goals obtesting and Certiffication	16
Assuring Quality UNRESOLVED ISSUES  OPTIONS FOR THE DEPARTMENT OF JUSTICE Specify Acceptable Risks 30 Revise NIJ Standard 0101.03 32 Assure Quality 36 Sponsor Research 38 OTHER POLICY OPTIONS 39 Expand FTC Activities; Involve OSHA 39 LEGISLATIVE OPTIONS 40 Fund NIJ-Sponsored Research 40 BIBLIOGRAPHY 41   **Boxes**  **Boxes**  **Box**  **Boxes**  **Box**  **Box		
UNRESOLVED ISSUES  OPTIONS FOR THE DEPARTMENT OF JUSTICE  Specify Acceptable Risks  Revise NIJ Standard 0101.03  Assure Quality  Sponsor Research  OTHER POLICY OPTIONS  Expand FTC Activities; Involve OSHA  LEGISLATIVE OPTIONS  Fund NIJ-Sponsored Research  BIBLIOGRAPHY  BIBLIOGRAPHY  Boxes  Box  Box  Boxes  Box  Boxes  Box  Boxes  Box  Boxes  Box  Boxes  Box  Fagge  A. How Soft Armor Works  Spectra and Spectra Shield™  D. Trends in Weapons and Ammunition Used in Assaults on Police  E. Types of Guns  G. Stringency, Validity, and Reproducibility.  H. Statistical Confidence  Figure  Figure  Figure  Figure  Figure  Page  1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer  13  2. Instrumented Ballistic Test Range for Testing Armor as Specified in NIJ Standard 0101.03  14  3. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.03  14		
OPTIONS FOR THE DEPARTMENT OF JUSTICE         29           Specify Acceptable Risks         30           Revise NIJ Standard 0101.03         32           Assure Quality         36           Sponsor Research         38           OTHER POLICY OPTIONS         39           Expand FTC Activities; Involve OSHA         39           LEGISLATIVE OPTIONS         40           Fund NIJ-Sponsored Research         40           BIBLIOGRAPHY         41           Boxes           Box         Page           A. How Soft Armor Works         2           B. Kevlar <sup>®</sup> and Twaron <sup>®</sup> 3           C. Spectra <sup>®</sup> and Spectra Shield <sup>™</sup> 4           D. Trends in Weapons and Ammunition Used in Assaults on Police         8           E. Types of Guns         9           F. ABCs of Ammunition, Bullets, and Cartridges         10           G. Stringency, Validity, and Reproducibility         17           H. Statistical Confidence         18           Figure           Figures         Page           1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer         13           2. Instrumented Ballistic Test Range for Testing Armor		
Specify Acceptable Risks 30 Revise NIJ Standard 0101.03 32 Assure Quality 36 Sponsor Research 38 OTHER POLICY OPTIONS 39 Expand FTC Activities; Involve OSHA 39 LEGISLATIVE OPTIONS 40 Fund NIJ-Sponsored Research 40 BIBLIOGRAPHY 41  Boxes Box Page A. How Soft Armor Works 22 B. Kevlar <sup>®</sup> and Twaron <sup>®</sup> 22 B. Kevlar <sup>®</sup> and Twaron <sup>®</sup> 37 C. Spectra <sup>®</sup> and Spectra Shield 40 D. Trends in Weapons and Ammunition Used in Assaults on Police 88 E. Types of Guns 99 F. ABCs of Ammunition, Bullets, and Cartridges 10 G. Stringency, Validity, and Reproducibility 17 H. Statistical Confidence 18  Figure Figure Page 1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer 13 2. Instrumented Ballistic Test Range for Testing Armor as Specified in NIJ Standard 0101.03 14 3. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.03 14		
Revise NIJ Standard 0101.03  Assure Quality  Sponsor Research  OTHER POLICY OPTIONS  Expand FTC Activities; Involve OSHA  39  EXPAND FTC ACTIVITIONS  FUND NIJ-Sponsored Research  BIBLIOGRAPHY  BOXES  Box  Boxes  Box  Boxes  Box  A. How Soft Armor Works  Spectra* and Twaron*  C. Spectra* and Spectra Shield™  D. Trends in Weapons and Ammunition Used in Assaults on Police  E. Types of Guns  F. ABCs of Ammunition, Bullets, and Cartridges  G. Stringency, Validity, and Reproducibility.  H. Statistical Confidence  Figure  Figure  Figure  Figure  Figure  Figure  Figure  Figure  Page  1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer  2. Instrumented Ballistic Test Range for Testing Armor as Specified in NIJ Standard 0101.03  3. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.03  14  3. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.03  14		
Assure Quality Sponsor Research 38 OTHER POLICY OPTIONS 39 Expand FTC Activities; Involve OSHA 39 LEGISLATIVE OPTIONS 40 Fund NIJ-Sponsored Research 40 BIBLIOGRAPHY 41   **Boxes**  **Box**  **Boxes**  **Box**  **Box**  **Box**  **Box**  **Box**  **Box**  **A How Soft Armor Works 2  **B. Kevlar* and Twaron* 3  **C. Spectra* and Spectra Shield™ 4  **D. Trends in Weapons and Ammunition Used in Assaults on Police 4  **E. Types of Guns 5  **E. Types of Guns 5  **F. ABCs of Ammunition, Bullets, and Cartridges 4  **G. Stringency, Validity, and Reproducibility 4  **G. Stringency, Validity, and Reproducibility 4  **I. Statistical Confidence  **Figure**	Revise NIJ Standard 0101.03	32
Sponsor Research       38         OTHER POLICY OPTIONS       39         Expand FTC Activities; Involve OSHA       39         LEGISLATIVE OPTIONS       40         Fund NIJ-Sponsored Research       40         BIBLIOGRAPHY       41         Boxes         Box       Page         A. How Soft Armor Works       2         B. Kevlar³ and Twaror³       3         C. Spectra³ and Spectra Shield™       4         D. Trends in Weapons and Ammunition Used in Assaults on Police       8         E. Types of Guns       9         F. ABCs of Ammunition, Bullets, and Cartridges       10         G. Stringency, Validity, and Reproducibility       17         H. Statistical Confidence       18         Figures         1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of S		
OTHER POLICY OPTIONS         39           Expand FTC Activities; Involve OSHA         39           LEGISLATIVE OPTIONS         40           Fund NIJ-Sponsored Research         40           BIBLIOGRAPHY         41           Boxes           Box         Page           A. How Soft Armor Works         2           B. Kevlar <sup>®</sup> and Twaron <sup>®</sup> 3           C. Spectra <sup>®</sup> and Spectra Shield <sup>™</sup> 4           D. Trends in Weapons and Ammunition Used in Assaults on Police         8           E. Types of Guns         9           F. ABCs of Ammunition, Bullets, and Cartridges         10           G. Stringency, Validity, and Reproducibility         17           H. Statistical Confidence         18           Figure           Figures         Page           1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer         13           2. Instrumented Ballistic Test Range for Testing Armor as Specified in NIJ Standard 0101.03         14           3. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.03         14		
Expand FTC Activities; Involve OSHA		
LEGISLATIVE OPTIONS		
Fund NIJ-Sponsored Research		
BIBLIOGRAPHY		
Box Box Page A. How Soft Armor Works 2 B. Kevlar <sup>®</sup> and Twaron <sup>®</sup> 3 C. Spectra <sup>®</sup> and Spectra Shield <sup>™</sup> 4 D. Trends in Weapons and Ammunition Used in Assaults on Police 8 E. Types of Guns 9 F. ABCs of Ammunition, Bullets, and Cartridges 10 G. Stringency, Validity, and Reproducibility 17 H. Statistical Confidence 18  Figure Page 1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer 13 2. Instrumented Ballistic Test Range for Testing Armor as Specified in NIJ Standard 0101.03 14 3. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.03 14		
BoxPageA. How Soft Armor Works2B. Kevlar® and Twaron®3C. Spectra® and Spectra Shield™4D. Trends in Weapons and Ammunition Used in Assaults on Police8E. Types of Guns9F. ABCs of Ammunition, Bullets, and Cartridges10G. Stringency, Validity, and Reproducibility17H. Statistical Confidence18FigureI. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer132. Instrumented Ballistic Test Range for Testing Armor as Specified in NIJ Standard 0101.03143. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.0314		
A. How Soft Armor Works	Boxes	
B. Kevlar <sup>®</sup> and Twaron <sup>®</sup>		
F. ABCs of Ammunition, Bullets, and Cartridges	A. How Soft Armor Works	2
F. ABCs of Ammunition, Bullets, and Cartridges	B. Kevlar <sup>R</sup> and Twaron <sup>R</sup>	3
F. ABCs of Ammunition, Bullets, and Cartridges	C. Spectra <sup>R</sup> and Spectra Shield <sup>™</sup>	4
F. ABCs of Ammunition, Bullets, and Cartridges	D. Trends in Weapons and Ammunition Used in Assaults on Police	8
G. Stringency, Validity, and Reproducibility	E. Types of Guns	9
G. Stringency, Validity, and Reproducibility	F. ABCs of Ammunition, Bullets, and Cartridges	10
Figures  Figure  1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer		
Figures  Figure Page  1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer		
Figure  1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer		
Figure  1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer	E:	
1. Certification That a Model of Armor Complies With the NIJ Standard is Based on Inspection and Testing of Samples Submitted by the Manufacturer		
Inspection and Testing of Samples Submitted by the Manufacturer		ige
Instrumented Ballistic Test Range for Testing Armor as Specified in     NIJ Standard 0101.03	Increasion and Testing of Complex Submitted by the Manufacturer	12
NIJ Standard 0101.03	Inspection and Testing of Samples Submitted by the Manufacturer	13
3. Sequence of Aim Points on Each Panel, as Specified in NIJ Standard 0101.03 14		1.4
	NIJ Standard U101.03	14
A How Estal Dullet Wounds in the Tomas Would Damage if the Ween Date January 1 14	4. How Fatal Rullet Wounds in the Torso Would Decrease if the Wear Rate Increased	

## Contents—Continued

	Page
5. Wear Rate Versus Temperature-Humidity Index (THI)	15
6. Wear Rate Versus Month	15
7. Wear Rate Versus Areal Density of Armor	
8. "Reenactment" of a Ballistic Test That Armor Shot in an Assault Could Have	
Been Subjected To	22
9. Discrimination of the NIJ Test for Protection From the Impact of Stopped Bullets	
10. Shots Per Panel in Actual Assaults	
11. Effect of Wetness on Ballistic Resistance of Kevlar <sup>R</sup> Armor	29
12. Estimates of V <sub>50</sub> and V <sub>10</sub> Obtained by Logistic Regression	35
13. Notional Control Chart for Sequential Lot-Acceptance Testing	
Tables	
Table	Page
1. Types of Ballistic Resistance Defined by NIJ Standard 0101.03 in Terms of	o o
Bullets and Velocities Specified for Testing	11
2. Tyes of Ballistic Resistance Defined by NIJ Standard 0101.03 in Terms of	
Guns and Ammunition Against Which Protection is Expected	12
3. Choices for Safety Goals	32