



The same,
only
different:
fitting the
job to
women's
needs

International conference
Women's health and work

March 4-6 2015 Brussels

www.etui.org



etui.

Presented by:
Dorothy Wigmore
Winnipeg, Canada

Women are not small men.
(Small men are not women)

- quickly pair up with someone next to you
- compare these features:
 - hand width and length
 - waist position
 - feet size (length and breadth)
 - arm length
- report back:
 - what's the same/different?
 - what does this mean for the work you do?

Talking about ergonomics ... for protective equipment (PPE), clothing (PPC) and work tools

- emphasis on women in construction and “non-traditional” work, usually
- what’s the history?
- where are we at?
- what is to be done?



The 1941 mantra in the U.S.



Safety clothing is designed for its attractiveness as well as its utility. It has become fashionable to dress and act so that accidents cannot happen. The main rules are:

The well-dressed woman in industry is a safe worker.

Clothing suitable to the job helps to avoid accidents.

Consider your feet first.

Wear your goggles; you can't replace an eye.

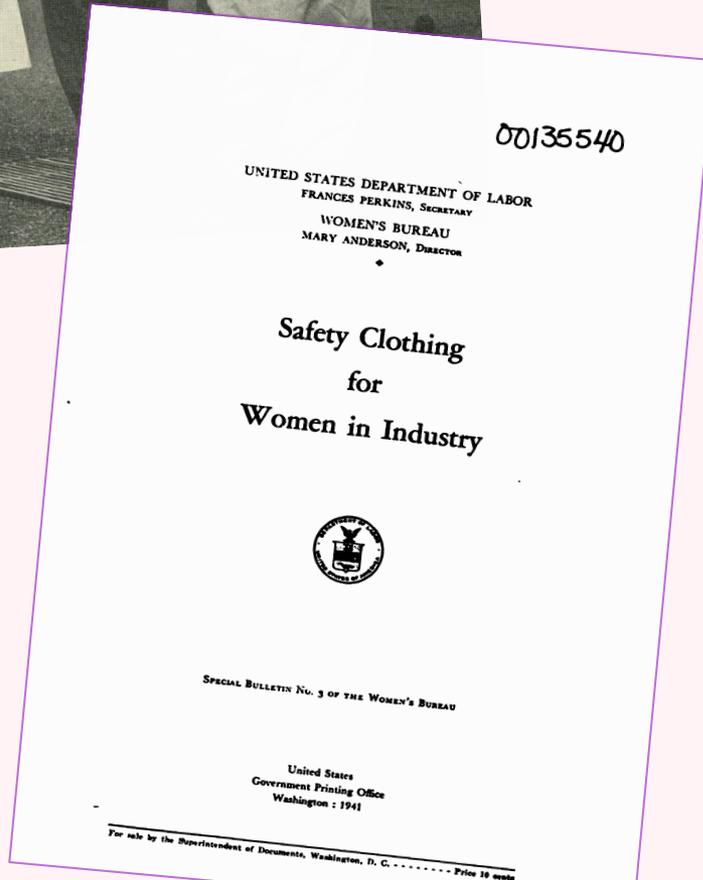
Wear a cap around moving machinery.

Work dress must suit the job to be safe.

Hand coverings can prevent skin infection and other injury.

Jewelry has no place in the factory.

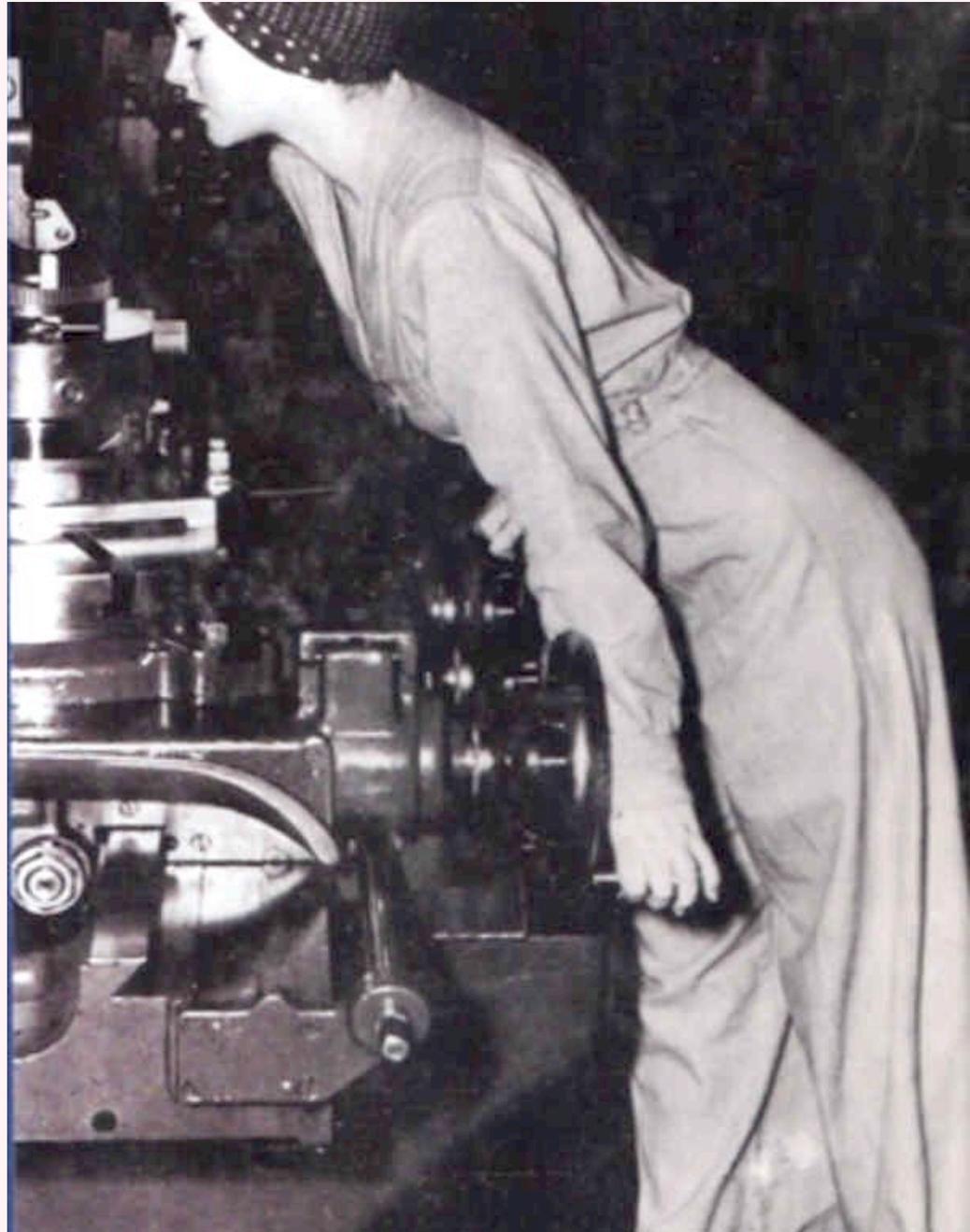
Jobs with special dangers require special kinds of work clothing.



"Rosie the Riveter" had OHS issues

"Shortly after Miller took the photo, Doyle left her job at the factory. She had been shocked to learn that another worker at the factory had badly injured her hands working at the machines and feared her skills as a cellist might be in danger."

And what about the work she's doing?





Big issues for women who use PPE/PPC on the job

- comfort
- fit
- proper sizes
- availability
- who chooses

Interest/attention ebbs and flows

- in early 1980s, there were questions in the US health and safety magazines about women's PPE, especially for coal miners and, later, construction workers and women in other "non-traditional work"

Do Blue Collars Protect Working Women?

By Charlotte R. Punski

During 1980, women represented 30 per cent of the industrial workforce, twice the 1971 level. As women make inroads into traditionally "male" areas of employment, they share the potential risks associated with these jobs.

To date, women in blue-collar jobs are not afforded the same protection as their male counterparts. This article will address the unique needs in non-traditional areas

mining. The number of women working as mechanics, electricians, and sheet and metal workers has at least doubled since 1979.

Injury and Illness To date, the frequency and distribution of work-related injuries for women in non-traditional

workplace hazards such as chemical exposures, dangerous tools and equipment, and potentially harmful procedures.³ Women's participation in apprenticeship programs provides them with the skills necessary to handle potentially dangerous equipment such as chain saws or welding

Women are not "scaled down" versions of men, yet they share the same potential job risks.

There is data from the 1970s and 80s about men's and women's sizes and shapes -- anthropometry

Table 4 External bodily dimensions (in cm) of men and women. Means (\bar{x}) and 90% confidence intervals (Ci) for persons aged 20-65 years from the Federal Republic of Germany. No. of men 15700; no. of women 17700. Measurements of the unclothed body; add 2.5 cm to men's heights and 4 cm to women's, to allow for height when wearing shoes. After Kroemer [184].

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ANTHROPOMETRY
BETWEEN FACES
MEN AND WOMEN

EDWARD SCHAFER
BARRY T. BATES, F
BIO-DYNAMICS C

JUNE 1988

FINAL REPORT

DDC FILE COPY

Approved for public release;
distribution unlimited.

HARRY
HUMAN
AIR F
WRIT

AD-A046692

AD
TECHNICAL REPORT
NATICK/TR-77/028

ANTHROPOMETRY OF WOMEN
OF THE U.S. ARMY-1977
Report No. 3 - Bivariate Frequency Tables

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NATICK
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July 1977

UNITED STATES ARMY
RESEARCH and DEVELOPMENT COMMAND
NATICK, MASSACHUSETTS 01760

Clothing, Equipment & Materials Engineering Lab



Factors affecting PPE use, selection, especially for women (1988)

1. Users often don't buy their own PPE/PPC, so they're like children who are provided for (and should just be grateful)
2. Information available/used about workplace demographics
3. Bias against blue collar work -- work clothing issues not serious -- worse for women
4. Importance of occupational health and safety (OHS) issues/hazards to employers, unions, others
5. Sexist attitudes among manufacturers, suppliers, buyers, employers, committees
6. Size and shape -- ethnic and sex differences
7. Design problems, including sizing, comfort and selection
8. What's available, or thought to be



What are some differences?

Feet:

- usually smaller in length, breadth and circumference
- specialty footwear is not designed for women

Hands:

- usually smaller in length, breadth and circumference
- no uniform and size specifications for gloves
- 98 percent of men have hands wider than average woman's

Eyes:

- standards deal with splash and impact,, not fit
- standard six-inch-wide goggles may not provide adequate protection for women's faces



THE SAME,
BUT DIFFERENT

Personal Protective Equipment Issues for Women

by DOROTHY W. MORE

Personal protective equipment and clothing has never been the perfect solution to health and safety problems in the workplace. From a preventive health point of view, controls at the worker's level — PPE being one of them — are the last resort to reduce or eliminate exposure to hazards. Still, proper PPE is essential to workplace health and safety.

only the "average" male face, glove fingers are too long for most women, and coveralls are too long in the arms or legs and not wide enough across the hips. Sizing, fit and comfort problems have consequences: accidents have been caused by oversized glove fingers and sleeves becoming caught in machinery; exposure to hazardous substances has occurred when wearing ill-fitting respirators or large gloves.

glasses must fit snugly and comfortably against the face. When they do not, they may cause headaches or dizziness, can slip too easily off the face or fog up, and consequently are less likely to be used. It is therefore essential that a full range of eye, bridge and temple sizes be available and that a properly trained individual assist in fitting them.

... and...

... other differences?

Faces:

- women's faces are smaller in length, breadth and circumference than men's
- five-inch-wide "mini-goggle" may be better for narrower faces but not give adequate seal for nose, temples,, cheeks

Ears:

- Royster (1982) found distribution of ear canal sizes is related to "sex and racial characteristics" so that more than 18 percent of white women and 40 percent of black women have ear canal diameters requiring extra small sizes of hearing protectors
- foam plugs may be harder to insert in smaller ears

... and...

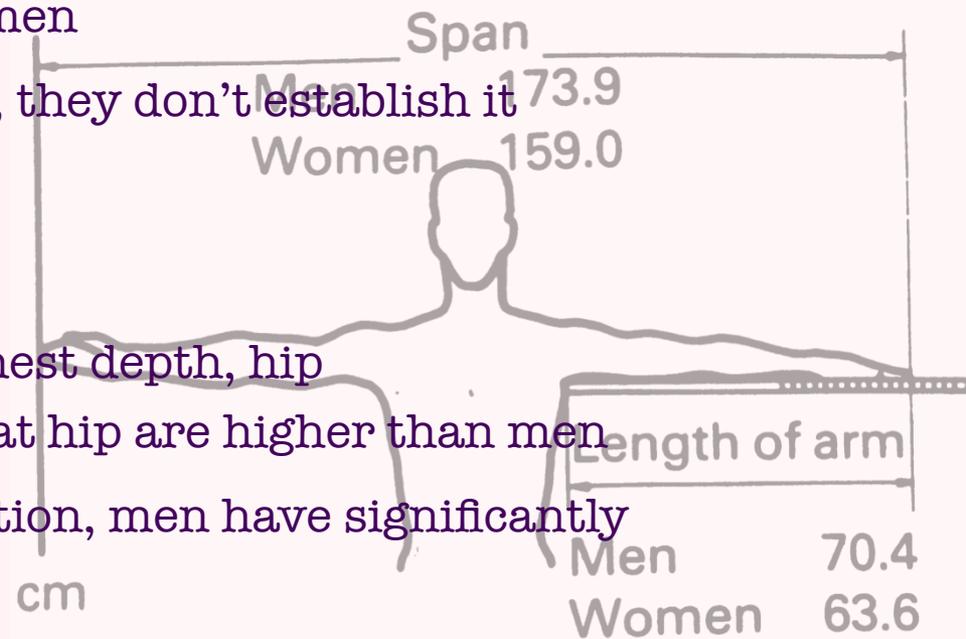
... other differences?

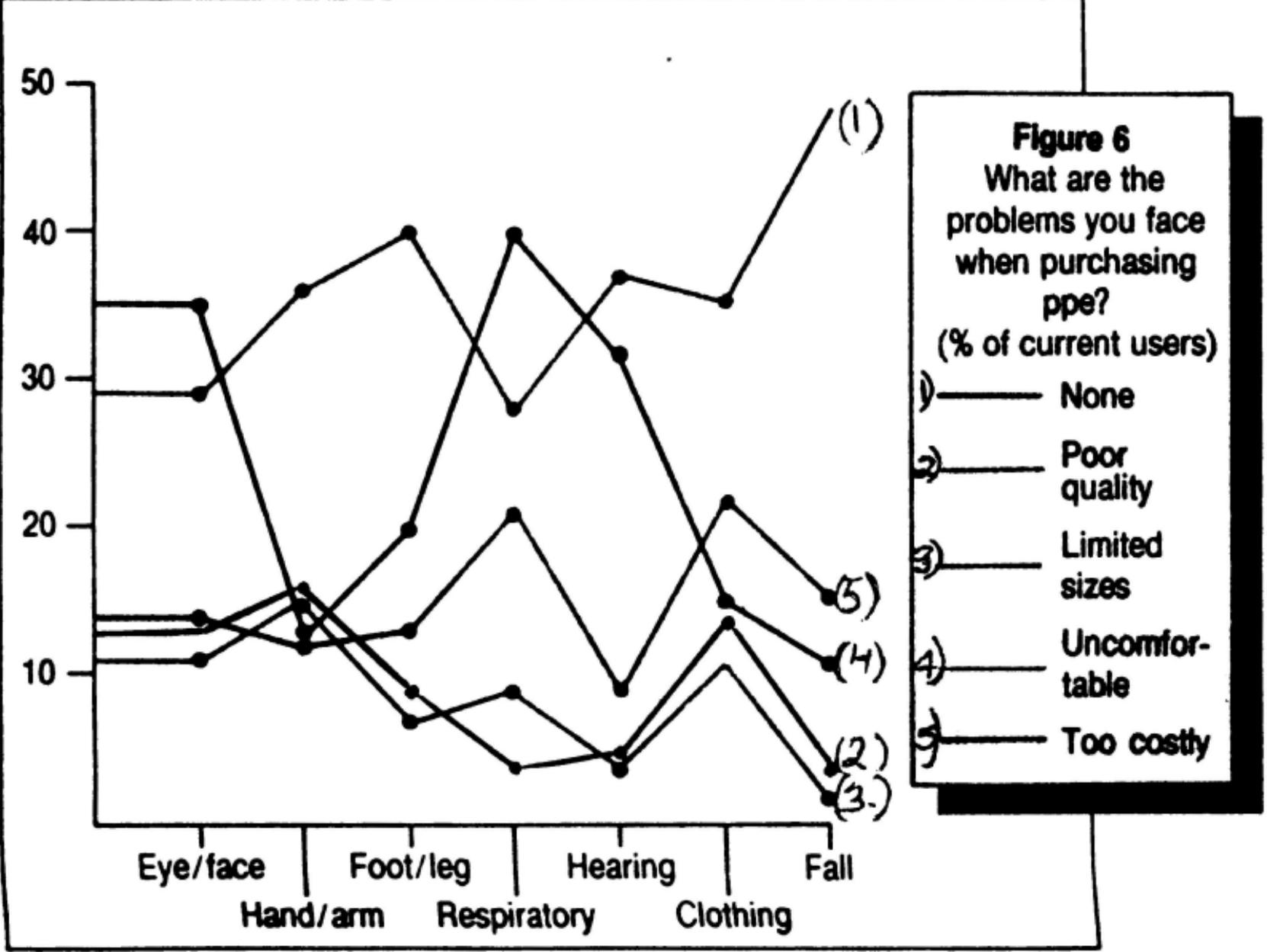
Respirators:

- none made specifically for women or non-WASPS, with specs based on white, often military, men
- adjustable straps adjust the FIT, they don't establish it
- no uniform size specifications

Clothing:

- body dimensions for women's chest depth, hip circumference, back curvature at hip are higher than men
- at every height-weight combination, men have significantly larger shoulders than women
- specialty items less likely to fit women, non-"average" men
- lines start in different sizes
- how do women go to the washroom with coveralls/overalls on?





From: *The same, only different: Some personal protective equipment issues for women*, by Dorothy Wigmore. Presented at the Conference on Protective Equipment (COPE), Toronto, 1988.

There's nowhere to
keep my 'everybody
out' whistle!



Labour Research Department

HOSPITAL
KITCHEN

DANGER -
USE
MINCER
WITH
CARE



SKIRTS - A HAZARDOUS
SITUATION



Electronic Library of Construction
Occupational Safety & Health

Women in the Construction Workplace: Providing Equitable Safety and Health Protection

Organization(s): Occupational Safety and Health
Administration (OSHA)

Women in the first NIOSH study were particularly outspoken about this concern. One of the participants said:

When I went through the welding apprenticeship, ...they issued us welding boots, size 9-1/2, I had to wear two pairs of socks to wear them. They gave me a welding leather jacket that was a foot longer than my hand. I had to roll it up. And they said that they couldn't order anything smaller. They gave me gloves so humongous, I couldn't even pick anything up.

(1999)



Source: The University of Maryland at College Park

Becky Lorenz—who runs her own shop, Aerospace Welding Services in Silver Spring Md.—is among America's few female welders and machinists.

American manufacturing and welding to women: We want you!

<http://www.cnbc.com/id/101385929> (2014)

It's still a problem in manufacturing too



(S)ince her arms were short she had to sit close to the machine. She adjusted her straps accordingly but now cannot reach the e-stop. So imagine a long-armed male (probably the industrial engineer who set up the machine) sitting farther away from the point of operation and closer to the e-stop. He has both the e-stop and the point of operation both within reach.



Women and Personal Protective Equipment Survey
STATE OF CALIFORNIA, DEPT. OF INDUSTRIAL RELATIONS, DEPT. OF HEALTH SERVICES

Women – Does your protective equipment fit you?

Welcome to the women and personal protective equipment (PPE) survey. Cal/OSHA and the Occupational Health Branch of the California Department of Health Services have designed this confidential survey to find out whether women are having problems getting safe and effective PPE on the job. Please take a few minutes and complete this form. You can also make copies of the survey for others to complete by July 30, 2004.

IF YOU PREFER TO FILL OUT THIS SURVEY ON THE INTERNET,
GO TO: <http://fs6.formsite.com/BuildSafe/WomenPPE/>

If you are a firefighter, please fill out the **FIREFIGHTERS' SURVEY** instead of this survey.
The firefighters' survey is online at: <http://fs6.formsite.com/BuildSafe/Firefighter/>

1. What industry do you usually work in? (choose one)
- | | |
|--|---|
| <input type="checkbox"/> Government | <input type="checkbox"/> Transportation, Shipping |
| <input type="checkbox"/> Construction | <input type="checkbox"/> Utilities, Communications, |
| <input type="checkbox"/> Manufacturing | <input type="checkbox"/> Wholesale or Retail Trade |
| <input type="checkbox"/> Services (e.g. auto repair) | |
| <input type="checkbox"/> Other _____ | |

2. What is your usual occupation? (choose one)
- | | |
|--|--|
| <input type="checkbox"/> Asbestos worker / Insulator | <input type="checkbox"/> Ironworker |
| <input type="checkbox"/> Boilermaker | <input type="checkbox"/> Laborer |
| <input type="checkbox"/> Bricklayer / Tilelayer | <input type="checkbox"/> Mechanic / Machinist |
| <input type="checkbox"/> Carpenter / Piledriver / etc. | <input type="checkbox"/> Operating engineer |
| <input type="checkbox"/> Cement mason / Plasterer | <input type="checkbox"/> Plumber / Steamfitter |
| <input type="checkbox"/> Electrician | <input type="checkbox"/> Painter |
| <input type="checkbox"/> Elevator constructor / Mechanic | <input type="checkbox"/> Roofer |
| <input type="checkbox"/> Floor Coverer | <input type="checkbox"/> Sheetmetal worker |
| <input type="checkbox"/> Hazardous waste worker | <input type="checkbox"/> Stationary engineer |
| <input type="checkbox"/> Other _____ | |

3. How long have you worked in this occupation? ___ years and ___ months

4. Are you mainly: (choose one)
- | | |
|---|---|
| <input type="checkbox"/> Employee (union) | <input type="checkbox"/> Foreman / Supervisor |
| <input type="checkbox"/> Employee (non-union) | <input type="checkbox"/> Manager / Superintendent |
| <input type="checkbox"/> Self-Employed | <input type="checkbox"/> Owner |

5. How many people work for your current or most recent employer / company?
- | | |
|---|--|
| <input type="checkbox"/> 1 – 10 people | <input type="checkbox"/> 51 – 100 people |
| <input type="checkbox"/> 11 – 50 people | <input type="checkbox"/> Over 100 people |

6. Are you an apprentice now? Yes No

Office use only

ID: _____

california
OSHA



Cal/OSHA 2006 survey of tradeswomen, female firefighters

- Most respondents had at least one piece of equipment that was a problem, and almost all respondents had at least one type of equipment that was satisfactory
- For tradeswomen:
 - “almost unusable” most often for specialty gloves
 - poor fit most common for specialty gloves, chemical and general protective clothing, and fall protection
 - highest “well” fit is only 40% of hearing protection

There have been recommendations ...

Jeanne Stellman's
recommendations
(1984)

- manufacturers incorporate the available anthropometric data on female dimensions into the sizing and design of their safety products and produce more equipment based on these measurements;
- women workers make their specific needs and preferences known to manufacturers to ensure that final products are as comfortable and safe as possible;
- better methods of communicating information to women workers and their employers about the availability of PPE for women be developed
- information concerning new products on the market designed for women and how and where to obtain them needs to be more widely disseminated among buyers and users of PPE; and
- standard-setting and certification should incorporate female anthropometry wherever possible.

...and recommendations:

Women in the
Construction
Workplace: Providing
equitable safety and
health protection
(U.S., 1999)

Personal protective equipment and clothing

- Revise OSHA standard on personal protective equipment for construction so it's the same as the General Industry Standard one for PPE (it specifies the employer select PPE that properly fits each affected employee, added partly to address problem that PPE and PPC often did not fit women).
- OSHA: produce and promote a resource guide about where to get adequate fitting PPE and PPC for construction workers.
- Manufacturers of PPC and PPE should be encouraged to expand the range of sizes offered.
- Employers should provide the best fitting PPE and PPC currently available.

*And yet: Who knows women's
PPE/PPC is out there?*

What seemed to be a real barrier is that a lot of workers, and foremen, didn't know that PPE designed for women even exists. They get catalogs from their distributors, and the stuff just isn't in there, even if the companies carry it. I started looking at catalogs and websites for the big national distributors to see if they carried PPE for women, and how it was marketed.

Former NIOSH researcher

Most US distributors offer women's and unisex products BUT rarely feature them prominently, display them on a model or label them for women

Distributor	Product type(s)	Women's or unisex products offered?	Featured prominently?	Product(s) labeled as women's or unisex?	How are products modeled?
A	Hardhats, accessories, face shields, welding helmets, welder's caps	Unclear	No	No	No female models. Men only on home page of website, no models in catalog
B	Eye protection, goggles, hard hats and accessories, welding helmets. welding goggles.	No	NA	No	Two of the eye protection products modeled by white males, white males featured in graphic on eye protection page. White woman model for hearing protection (not labeled as a women's product). Two other models featured for general safety products both white males. White men only modeling all brands of harnesses/fall protection harnesses, lanyards, and accessories.
C	Self-contained respirators, air-purifying respirators, hardhats, protective glasses, goggles, fall protection, welding helmets	Unclear	No	No	Models on home page are diverse, including women and people of color. Only with a female model is one type of air-purifying (respirator).

DeLaney, S. (2012, March). *Web-based marketing of alternative-sized PPE for a diverse workforce*. Poster presented at the NIOSH-PPT program stakeholder meeting. Pittsburgh, PA.

Distributor	Product type(s)	Women's or unisex products offered?	Featured prominently?	Product(s) labeled as women's or unisex?	How are products modeled?
D	Hard hats, eye protection, face shields, respiratory protection, fire and rescue helmets	Yes	No	No	Woman featured on website in a ha2mat suit, all other models are male. Air purifying and supplied air respirators included pictures of both men and women. A woman is also depicted at the top of the website wearing a hazmat hood and using a stethoscope. All categories of fire and rescue included male models and men's products only
E	Fall protection	Yes	No	No	No women featured oo home page, or anywhere oo product pages of website
F	Welding helmets, goggles, glasses, hard hats, safety vests, hearing protection, gloves. respirators	Unclear	No	No	All models were male, no women featured on the site.
G	Respirators, head protection, hearing protection, hand protection and gloves, protective footwear, eye and face protection, fall protection	Yes	Yes	Yes, some	Models include women and people of color on home page and throughout
H	Eye protection, hearing protection, respirators, hand and arm protection, fall protection	Yes	No	Yes, eyewear only	No women on home page, but women featured elsewhere on the website. Women and people of color featured in catalog and in fit diagrams. 2010 catalog features three varieties of eye protection specifically labeled for women.

DeLaney, S. (2012, March). *Web-based marketing of alternative-sized PPE for a diverse workforce*. Poster presented at the NIOSH-PPT program stakeholder meeting. Pittsburgh, PA.

Fall protection - as an example

We at Miller Safety have addressed the questions of functional design of the fall arrest harness and .. are quite confident that our standard sub-pelvic type full body harness is suitable for female use...It would appear that fall arresting for women is not a major problem, yet, as is evident from the replies to our enquiries, we have been unable to uncover any factual confirmation or rejection of this thesis.

*From: Fall protection for women,
presented by Jack Dingle, VP Miller Safety, Canada, COPE 1984*

I am afraid that we have no information on your subject. I have checked this answer with Mr. Gunnar Lundborg, who is the head of our General Section 1 which inter alia is responsible for rule-making concerning protective equipment. (Gunilla Warnbeck, National Board of Occupational Safety and Health - Sweden)

There seems to be no research which has looked into possible problems of harnesses for women. (Helmut F. Microys, Yolles & Microys Ltd.)

14 years Later ...

Fortunately, there is one harness available for women. Introduced by Miller Fall Protection (Sperian) in 1998, the Ms. Miller is the ONLY full-body harness on the market specifically designed to fit women. It was designed by two female engineers and is quite different than standard men's fall protection harnesses. The Ms. Miller is modeled after a rock climber's harness.

<http://safetygearforwomen.co/2009/07/18/ms-miller-womens-fall-protection-harness-e570-additional-information-faq/>



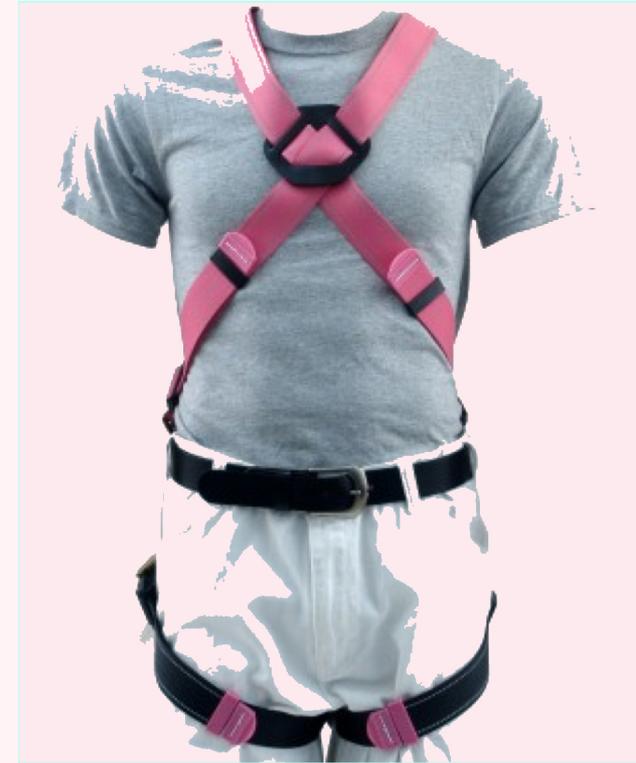
Or would you wear this?



The leading cause of worksite fatalities in the construction trades is falling from a dangerous height. But standard fall harnesses aren't manufactured to fit women.

"They cut them right in the breasts," said Debra Chaplan, director of special programs for the State Building and Construction Trades Council. "Some jobsites have started using ones that form a triangle around the chest, but that just opens women up to even more sexual harassment."

<http://womensenews.org/story/entrepreneurship/110619/female-tradesworkers-run-special-safety-risks?page=0,1>
(2014)



It's a contradictory picture;
Women just aren't mentioned in
PPE/PPC materials, or PPE/PPC
issues aren't

● OVERVIEW AND PHILOSOPHY OF PERSONAL PROTECTION

Robert F. Herrick

The entire topic of personal protection must be considered in the context of control methods for preventing occupational injuries and diseases. This article presents a detailed technical discussion of the types of personal protection which are available, the hazards for which their use may be indicated and the criteria for selecting appropriate protective equipment. Where they are applicable, the approvals, certifications and standards which exist for

while the equipment is in use. This preliminary evaluation of the hazards is an essential diagnostic step which must be accomplished before moving on to selecting the appropriate protection.

Selection

The selection step is dictated in part by the information obtained in hazard evaluation, matched with the performance data for the protective measure being considered for use and the level of exposure which will remain after the personal protective measure is in place. In addition to these performance-based factors, there are guidelines and standards of practice in selecting equipment, particularly for respiratory protection. The selection criteria for respiratory protection have been formalized in publications such

ILO Encyclopedia on Occupational Health and Safety, 4th Edition (edited by Jeanne Stellman)

OSHA
www.osha.gov

Selecting PPE

All PPE clothing and equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion. Employers should take the fit and comfort of PPE into consideration when selecting appropriate items for their workplace. PPE that fits well and is comfortable to wear will encourage employee use of PPE. Most protective devices are available in multiple sizes and care should be taken to select the proper size for each employee. If several different types of PPE are worn together,

OSHA (2003) *Personal protective equipment*



NEW (Non-traditional Employment for Women, NYC)

A current study: Little has changed

- Female construction workers in NY area are rarely provided PPE designed for women, some buy their own PPE
- Many companies purchase equipment in a one-size fits all manner
- Lack of PPE designed for women can present potential employment issues (i.e., looking for the correct fitting PPE may delay hiring, complaining to companies about PPE that doesn't fit properly may lead to unnecessary conflict with management)
- Lack of PPE designed for women occasionally affects OHS and/or productivity of female construction workers (e.g., dexterity issues using gloves that don't fit, fall arrest harness that doesn't fit correctly, large safety vests that can get snagged on objects)
- Almost all the women in the three focus groups were unaware that there equipment or tools designed for women

What the Latest studies tell us (on the negative side)

- this is still a really serious problem for female workers, one that seems to gain and lose momentum
- it's still true: people are not in the same percentile group for each body part measurement, nor are our body dimensions always “normally distributed”
- anthropometric measurements need updating, with help from 3-D scanning
- anthropometric data needs to cover different postures, what people are wearing (e.g., turnout gear for firefighters' engine cabs, people using harnesses in cold weather), and other aspects of real life on the job
- women still are left out of too many studies and activities about protective equipment, ergonomic tools and equipment

Yet there are some success
stories and reasons to
hope



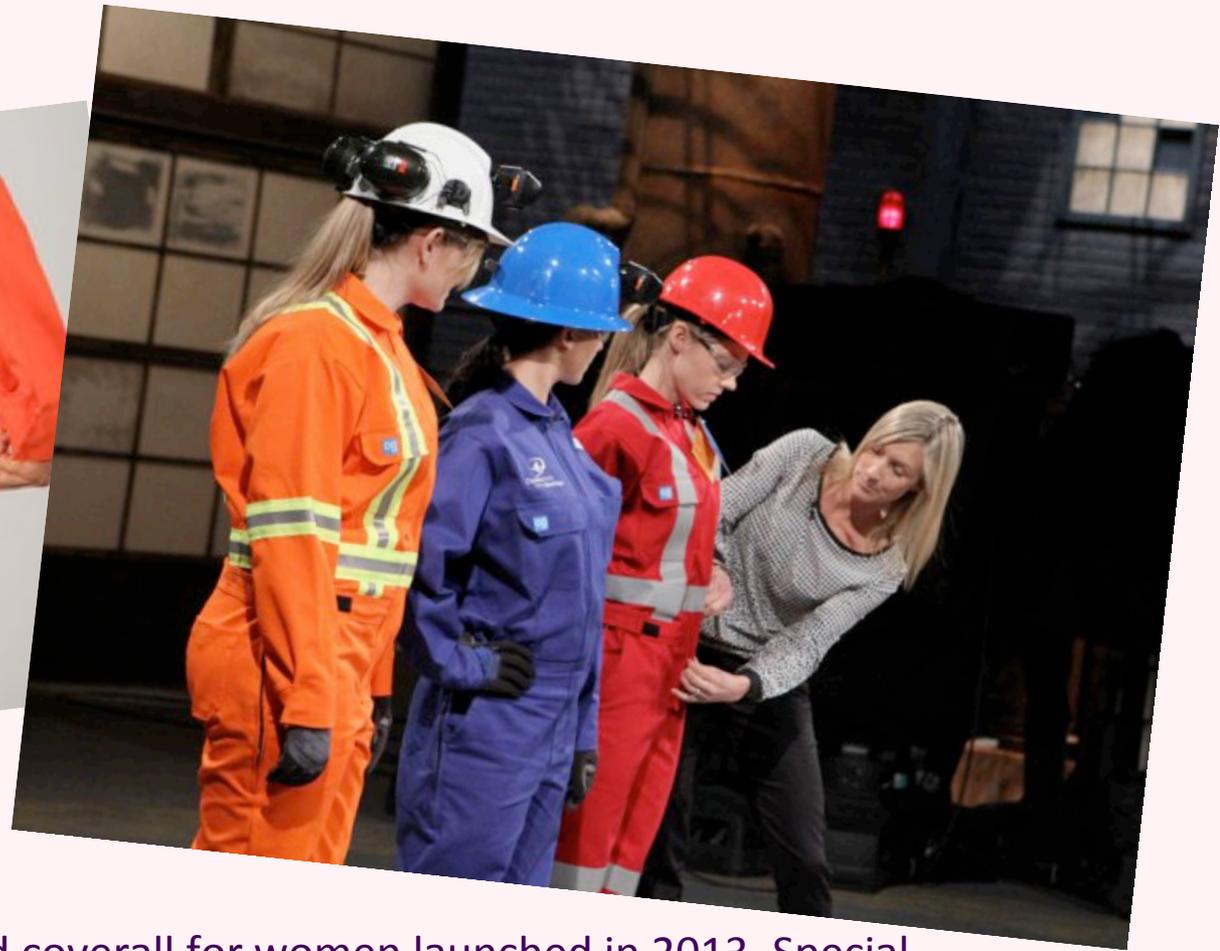
Clothing
designed
by and for
women



covergalls™

INCORPORATED

working never **WORKED** | so well



First Canadian-made and designed coverall for women launched in 2013. Special features include a drop back, secured pockets and snaps at the wrists for a better fit. Now has a quilted version, for those COLD Canadian climes. The Sudbury company won an investment on the “Dragon’s Den” in 2014 (photo on right).

Recent spurt in magazine coverage

Standards Insider

PPE for Women Finding the Appropriate Fit

PS: Provide a brief description of your professional background and of your position as director of member and technical services for International Safety Equipment Association (ISEA).

Cristine: By way of education, I have a degree in political science but have been employed by standards-developing organizations in their technical departments my entire career. I have been with ISEA for more than 17 years. In my current position, I am responsible for the development, process management, marketing and advocating the acceptance of ISEA-sponsored ANSI standards.

PS: How does standard PPE differ between men and women when it comes to size and fit? How are anthropometry and ergonomics used in the design of PPE for women?

Cristine: Numerous anthropomorphic studies have identified the differences in body part measurements between men and women. It is known that female hands tend to be smaller, with shorter, narrower fingers than males. The same is true for foot measurements. Manufacturers have used this information to design items that can provide better fit in various ways. They may reapportion the

Inadequately fitting PPE can expose workers to greater risk. Stuffing cotton balls in the tips of gloves that have fingers too long or wide for the wearer can reduce dexterity and tactility. This can increase the potential for hand injuries. Female workers who are given protective footwear sized for men may experience more trips or slips while walking or climbing ladders, or they may experience blisters on their feet, creating discomfort.

Protective apparel that is too loose can get caught in machinery. Eyewear that does not fit may continually slip off the face. The employee may become annoyed at the constant adjusting of the spectacles and may opt to not wear any eye protection, which increases the potential for eye injuries.

PS: Why don't more PPE manufacturers produce products that are correctly sized and proportioned for women?

Cristine: Demand is a factor. Given the extremely diverse workforces, manufacturers are challenged with designing equipment that is best suited for all employees, regardless of gender, ethnicity or other defining characteristics. Multiple decisions go into product development, research

and how well your protective gear was designed, then you would have no qualms about making sure that your PPE was the best possible.

Most firefighters cannot choose the exact gear they wear; that's a decision made by department officials. In some cases, a fire department will go through a relatively detailed process of hazard and risk assessment, field trials, and product examination.

At the other extreme, some departments may simply buy what is least expensive based on a limited budget and a general assumption that all gear meeting NFPA 1971 should be adequate for minimal protection.

One important choice

Even if the turnout gear has been selected for you, you do have one important choice — how your gear fits. There is a definite relationship between PPE fit and protection.



Protective UPDATE

ISHN

YOUR SOURCE FOR SAFETY, HEALTH & ENVIRONMENT

PPE for Women We've Come A Long Way, 'Rosie,' But We Still Have A Ways to Go

By Joseph L. Walker
International Safety Equipment Association

In the World-War-II-era "We Can Do It" factory worker commonly — albeit misnomer — "Rosie the Riveter" is not wearing a single piece of protective equipment (PPE) nor a stitch of it. More than half a century after that iconic U.S. Occupational Safety and Health Administration advisory committee heard complaints about ill-fitting PPE and garments that were being provided to women in non-traditional jobs. Their 1999 report* determined that poor-fitting protective equipment and clothing frequently did not function in the manner for which it was designed; accordingly, protection that the gear was supposed to deliver was compromised — leading to serious health and safety risks for women in those trades.

Fast-forward another 11 years and the situation with regard to PPE and protective clothing for women has improved dramatically. Hundreds of products designed with women in mind now are available from manufacturers and distributors. "Industries have often adjusted to meeting the needs of women," said Terri Sandu, founder of the Cleveland-based Hard-Hatted Women, who added that whole businesses have devel-

[Home](#)

One size doesn't fit all

By [Jim Hutter](#)

September 3, 2014

Numbers don't lie — more and more women are employed exclusively by men.

Over the past 20 years, the face of America has changed. The number of women employed in the U.S. construction industry is up to 10 percent of all U.S. construction workers are women employed in various sectors of the construction industry.

As the number of women in construction continues to grow, both male and female construction workers face unique work-related injury, illness and death.

Occupational hazards specific to female construction workers, the safety of even the most well-organized, well-protected for an increasingly diverse construction workforce to ensure you properly address critical safety issues.

1. Purchase the right protective equipment for women.



NIOSH Publications on Anthropometry

[Head-and-face shape variations of U.S. civilian workers](#)
Applied Ergonomics: February 2013 / [Epub ahead of print]

[Anthropometric procedures for protective equipment sizing and design](#)
Human Factors: February 2013 / 55(1):6-35

[U.S. truck driver anthropometric study and multivariate anthropometric models for cab designs](#)
Human Factors: October 2012 / 54(5):849-871

[Digital 3-D headforms representative of Chinese workers](#)
The Annals of Occupational Hygiene: January 2012 / 56(1):113-122

[Digital 3-D headforms with facial features representative of the c](#)
Ergonomics: May 2010 / 53(5):661-671

[Facial anthropometric differences among gender, ethnicity, and a](#)
The Annals of Occupational Hygiene: March 2010 / 54(4):391-40

[Shape analysis of 3D head scan data for U.S. respirator users](#)
EURASIP Journal on Advances in Signal Processing: January 2010

[Development of sizing structure for fall arrest harness design](#)
Ergonomics: September 2009 / 52(9):1128-1143

[Harness sizing and strap length configurations](#)
Human Factors: August 2009 / 51(4):497-518

[Anthropometric changes among U.S. truck drivers](#)
Proceedings of the 17th World Congress on Ergonomics (IEA2009)
Madison, WI: International Ergonomics Association: August 2009

[Hand dimensions of Hispanic and other ethnic group meat proces](#)
Proceedings of the 17th World Congress on Ergonomics (IEA2009)
Madison, WI: International Ergonomics Association: August 2009

[Safety eyewear: How much coverage does it provide?](#)
Professional Safety: July 2009 / 54(7):22-27

[Evaluation of fall arrest harness sizing schemes](#)
Human Factors: June 2007 / 49(3):447-464



U.S. NIOSH
is paying
some
attention

SPECIAL SECTION: 2012 Human Factors Prize Winner

Anthropometric Procedures for Protective Equipment Sizing and Design

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Objectives: This article presented four anthropometric theories (univariate, bivariate/probability distribution, multivariate, and shape-based methods) for protective equipment design decisions.

Background: While the significance of anthropometric information for product design is well recognized, designers continue to face challenges in selecting efficient anthropometric data processing methods and translating the acquired information into effective product designs.

Methods: For this study, 100 farm tractor operators, 3,718 respirator users, 951 firefighters, and 816 civilian workers participated in four studies on the design of tractor roll-over protective structures (ROPS), respirator test panels, fire truck cabs, and fall-arrest harnesses, respectively. Their anthropometry and participant-equipment interfaces were evaluated.

Results: Study 1 showed a need to extend the 90-cm vertical clearance for tractor ROPS in the current industrial standards to 98.3 to 101.3 cm. Study 2 indicated that current respirator test panel would have excluded 10% of the male firefighter population; a systematic adjustment to the boundaries of test panel cells was suggested. Study 3 provided 24 principal component analysis-based firefighter body models to facilitate fire truck cab design. Study 4 developed an improved gender-based fall-arrest harness sizing scheme to supplant the current unisex system.

INTRODUCTION

Protective equipment (PE) provides the last line of defense to workers who perform their professional duties in areas where hazards cannot be completely eliminated or control technologies cannot be cost-effectively implemented. PEs include but are not limited to respirators, tractor roll-over protective structure (ROPS) frames, vehicle cab workspace protective volumes, fall-arrest harnesses, heat-resistant bunker gear, chemical-resistant clothing, gloves, and hard hats. Key users of such PEs are firefighters, health care professionals, coal miners, agricultural workers, professional drivers, construction workers, and industrial laborers. One of the greatest challenges in designing effective PE is quantification of PE fit to specific worker populations. Poor fit of respirator units can result in serious health effects in firefighting, coal mining, hazardous waste cleanup, and other workplace conditions due to

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New Respirator Fit Test Panels Representing the Current U.S. Civilian Work Force

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*In the upcoming year, the OSHA and NAWIC Alliance Implementation Team is planning a number of activities to provide information, guidance, and access to training resources that will help them protect employees' health and safety, particularly in reducing and preventing exposure to ergonomic hazards, sanitation hazards, and **issues related to personal protective equipment selection** in the construction industry for workers with unique needs.*

Annual Alliance Report
Occupational Safety and Health Administration and
the National Association of Women in Construction

August 22, 2014

For construction, there is great hope in Boston



- check out the project that's tackling the system, not going contractor by contractor:
<http://www.policygroupontradeswomen.org/>
- wide cross-section of unions, employers, researchers involved in area construction
- approach to increase women's participation in construction careers includes: recruitment, retention, and compliance and enforcement
- aiming for 25% women in industry by 2020
- showing that the accommodations women want and need are the things that people want and need (e.g., day care, toilets, harnesses that fit)

What the latest studies tell us (on the positive side)

- women have common cause with men who do not fit the “young white American (armed forces) male” label – i.e., ergonomics (the real kind) can “save” us
- 3-D scanners can provide information perhaps better/more easily than traditional physical measurements of body dimensions
- gloves best designed by using length and circumference measurements
- there’s practical, recent fall protection design data for US male and female workers and about firefighters, that should be used and can inspire other activities

Recommendations (which haven't changed much since 1988)

- take workers' needs seriously for PPE/PPC fit and comfort – involve them in choosing equipment (not treated like children for whom things are provided)
- information must be gathered, consolidated, translated and used
- designs must change – anthropometry is a key part of this availability must improve – and knowledge of what's available with it – while manufacturers' catalogues should draw attention to equipment/clothing that fits women and others outside the "average" mold
- technology-forcing specification standards and laws that take ergonomic approaches to all OHS design issues
- pilot programmes, and publicity for them, to spread the word
- we need to keep monitoring this, so the interest and activity is more consistent
- higher priority for unions, workers' OHS and women's reps

Think hazards.

Think big.

Think solutions.

Think tools.

Think collective action.

With thanks to Ken Geiser, University of Massachusetts Lowell, Toxics Use Reduction Institute, Lowell Center for Sustainable Production, and great thinker.