

# ***Headquarters U.S. Air Force***

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***RFI #8***

***USAF Physical Fitness***



**U.S. AIR FORCE**

**Neal Baumgartner, Ph.D.  
Chief, AF Exercise Science Unit  
Exercise Physiology Consultant HQ AF  
AFPC/DSYX, JBSA Randolph, TX**

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# Tiered Approach - PF Tests and Standards

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## Health-based fitness for total force (Tier 1)

- ✓ Evidence-based, criterion standards
- ✓ Health / general fitness standard across aerobic, BC components
  - ✓ BC in Fitness Assessment; abdominal circumference measurement
- ✓ Occupationally (Military Occupational Specialty) independent
- ✓ Gender dependent



▪ *Tier 1 scores do not necessarily reflect military task achievement*

## ▪ Performance-based fitness by career field (Tier 2)

- Evidence-based, criterion standards
- Performance standard across all fitness components
- Occupationally-specific and operationally-relevant (OSOR)
- Gender, age, rank, ethnicity independent
- Next generation effort for AF Fitness - Tier 1 for all + Tier 2 for some





# Components of Physical Fitness

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## ■ Health components of physical fitness (PF)

- 1 Cardiorespiratory Endurance (Aerobic)
- 2 Body Composition (BC)
- 3 Muscular Strength
- 4 Muscular Endurance
- 5 Flexibility / Mobility - Stability

(MF)

## ■ Skill components

- 1 Agility
- 2 Balance
- 3 Coordination
- 4 Power
- 5 Reaction time
- 6 Speed

*Tier 1*  
**Total Force  
PF Tests and  
Standards**

Magnitude →

*Tier 2*  
**Occupationally-  
Specific  
PF Tests and  
Standards**

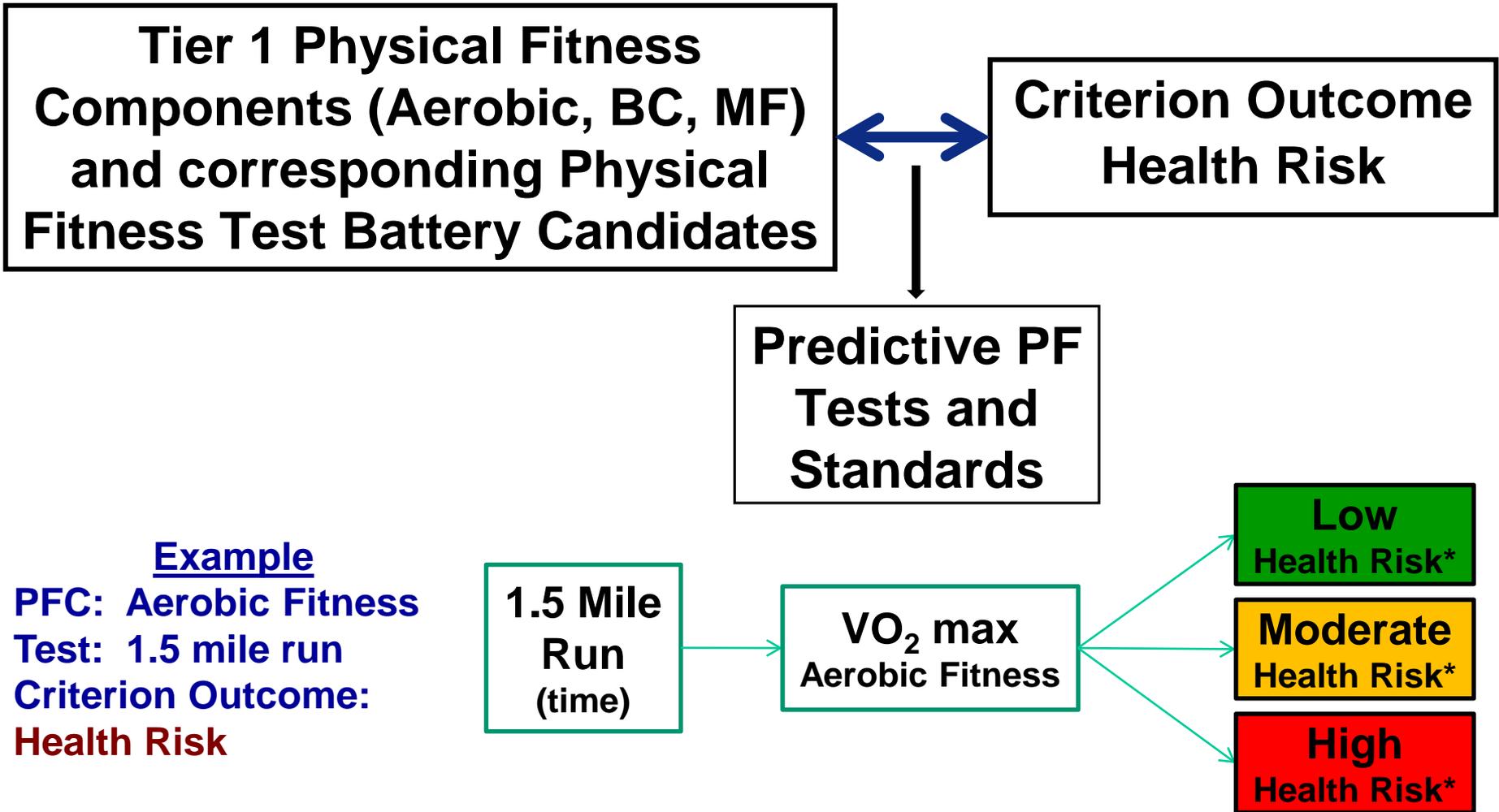


**Comprehensive Physical Fitness = Health + Skill**



# Tier 1 - Criterion Linkage

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\*All cause mortality, cardiovascular diseases, diabetes, some cancers



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# Aerobic Component

## Male and Female, < 30 yrs of age

### Cardiorespiratory Endurance - *Male*

Run Time (mins:secs)	VO <sub>2</sub> (ml/kg/min)	Health Risk	Health Risk Category	Points
≤ 9:12	≥ 56	0.2	Low-Risk	60.0
9:13 - 9:34	54-55	0.3	Low-Risk	59.7
9:35 - 9:45	53	0.3	Low-Risk	59.3
9:46 - 9:58	52	0.4	Low-Risk	58.9
9:59 - 10:10	51	0.4	Low-Risk	58.5
10:11 - 10:23	50	0.5	Low-Risk	57.9
10:24 - 10:37	49	0.6	Low-Risk	57.3
10:38 - 10:51	48	0.7	Low-Risk	56.6
10:52 - 11:06	47	0.8	Low-Risk	55.7
11:07 - 11:22	46	0.9	Low-Risk	54.8
11:23 - 11:38	45	1.0	Low-Risk	53.7
11:39 - 11:56	44	1.2	Low-Risk	52.4
11:57 - 12:14	43	1.3	Low-Risk	50.9
12:15 - 12:33	42	1.5	Low-Risk	49.2
12:34 - 12:53	41	1.8	Moderate Risk	47.2
12:54 - 13:14	40	2.0	Moderate Risk	44.9
13:15 - 13:36	39	2.4	Moderate Risk	42.3
13:37 - 14:00	38	2.7	High Risk	39.3
14:01 - 14:25	37	3.1	High Risk	35.8
14:26 - 14:52	36	3.6	High Risk	31.7
14:53 - 15:20	35	4.2	High Risk	27.1
15:21 - 15:50	34	4.8	High Risk	21.7
15:51 - 16:22	33	5.6	High Risk	15.5
16:23 - 16:57	32	6.5	High Risk	8.3
≥ 16:58	≤ 31	7.4	High Risk	0.0

### Cardiorespiratory Endurance - *Female*

Run Time (mins:secs)	VO <sub>2</sub> (ml/kg/min)	Health Risk	Health Risk Category	Points
≤ 10:23	≥ 50	0.1	Low-Risk	60.0
10:24 - 10:51	48-49	0.1	Low-Risk	59.9
10:52 - 11:06	47	0.2	Low-Risk	59.5
11:07 - 11:22	46	0.2	Low-Risk	59.2
11:23 - 11:38	45	0.2	Low-Risk	58.9
11:39 - 11:56	44	0.3	Low-Risk	58.6
11:57 - 12:14	43	0.3	Low-Risk	58.1
12:15 - 12:33	42	0.4	Low-Risk	57.6
12:34 - 12:53	41	0.5	Low-Risk	57.0
12:54 - 13:14	40	0.6	Low-Risk	56.2
13:15 - 13:36	39	0.7	Low-Risk	55.3
13:37 - 14:00	38	0.8	Low-Risk	54.2
14:01 - 14:25	37	1.0	Low-Risk	52.8
14:26 - 14:52	36	1.2	Low-Risk	51.2
14:53 - 15:20	35	1.4	Moderate Risk	49.3
15:21 - 15:50	34	1.7	Moderate Risk	46.9
15:51 - 16:22	33	2.1	Moderate Risk	44.1
16:23 - 16:57	32	2.5	High Risk	40.8
16:58 - 17:34	31	3.0	High Risk	36.7
17:35 - 18:14	30	3.7	High Risk	31.8
18:15 - 18:56	29	4.4	High Risk	25.9
18:57 - 19:43	28	5.3	High Risk	18.8
19:44 - 20:33	27	6.4	High Risk	10.3
≥ 20:34	≤ 26	7.7	High Risk	0.0



# Body Composition Component

## Male and Female

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### Body Composition - *Male*

AC (inches)	Health Risk	Health Risk Category	Points
≤ 32.5	1.0	Low-Risk	20.0
33.0	1.1	Low-Risk	20.0
33.5	1.2	Low-Risk	20.0
34.0	1.3	Low-Risk	20.0
34.5	1.4	Low-Risk	20.0
35.0	1.5	Low-Risk	20.0
35.5	1.7	Moderate Risk	17.6
36.0	1.8	Moderate Risk	17.0
36.5	2.0	Moderate Risk	16.4
37.0	2.1	Moderate Risk	15.8
37.5	2.3	Moderate Risk	15.1
38.0	2.5	Moderate Risk	14.4
38.5	2.8	Moderate Risk	13.5
39.0	3.0	Moderate Risk	12.6
39.5	3.3	High Risk	11.7
40.0	3.6	High Risk	10.6
40.5	3.9	High Risk	9.4
41.0	4.2	High Risk	8.2
41.5	4.6	High Risk	6.8
42.0	5.0	High Risk	5.3
42.5	5.5	High Risk	3.7
43.0	6.0	High Risk	1.9
≥ 43.5	6.5	High Risk	0.0

### Body Composition - *Female*

AC (inches)	Health Risk	Health Risk Category	Points
≤ 29.0	1.0	Low Risk	20.0
29.5	1.1	Low Risk	20.0
30.0	1.2	Low Risk	20.0
30.5	1.3	Low Risk	20.0
31.0	1.4	Low Risk	20.0
31.5	1.5	Low Risk	20.0
32.0	1.7	Moderate Risk	17.6
32.5	1.8	Moderate Risk	17.1
33.0	2.0	Moderate Risk	16.5
33.5	2.2	Moderate Risk	15.9
34.0	2.4	Moderate Risk	15.2
34.5	2.6	Moderate Risk	14.5
35.0	2.9	Moderate Risk	13.7
35.5	3.1	Moderate Risk	12.8
36.0	3.4	High Risk	11.8
36.5	3.7	High Risk	10.7
37.0	4.1	High Risk	9.6
37.5	4.4	High Risk	8.3
38.0	4.8	High Risk	6.9
38.5	5.3	High Risk	5.4
39.0	5.8	High Risk	3.8
39.5	6.3	High Risk	2.0
≥ 40.0	6.9	High Risk	0.0



# ***Aerobic Standards Rationale***

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- **Researched the aerobic fitness - health risk relationship**
  - **VO<sub>2</sub> max - criterion measure of aerobic fitness**
- **Used published data from the Cooper Institute's landmark Aerobics Center Longitudinal Study as criteria**
  - **Long term (1970 - present) study connects actual PF aerobic test data (vice physical activity surveys) to health outcomes**
  - **Recognized by American College of Sports Medicine - gold standard**
  - **Cooper Institute and AF-specific publications specified aerobic fitness - health risk thresholds**
- **Further supported by collective body of literature**
- **Bottom line: Run time → VO<sub>2</sub> max → Health Risk**
  - **All cause mortality, cardiovascular diseases, diabetes, some cancers**
  - **↑ VO<sub>2</sub> max = ↓ absenteeism, ↓ health care costs, ↑ cognitive function**

Blair SN, *et al.* Physical fitness and all-cause mortality. *JAMA*. 1989; 262:2395-2401

Blair SN, *et al.* Changes in physical fitness and all-cause mortality. *JAMA*. 1995; 273:1093-1098.

Wilkinson, *et al.* Physical fitness & health: a comparative review of the USAF fitness program. USAF School of Aerospace Medicine  
Technical Paper 2000-0001

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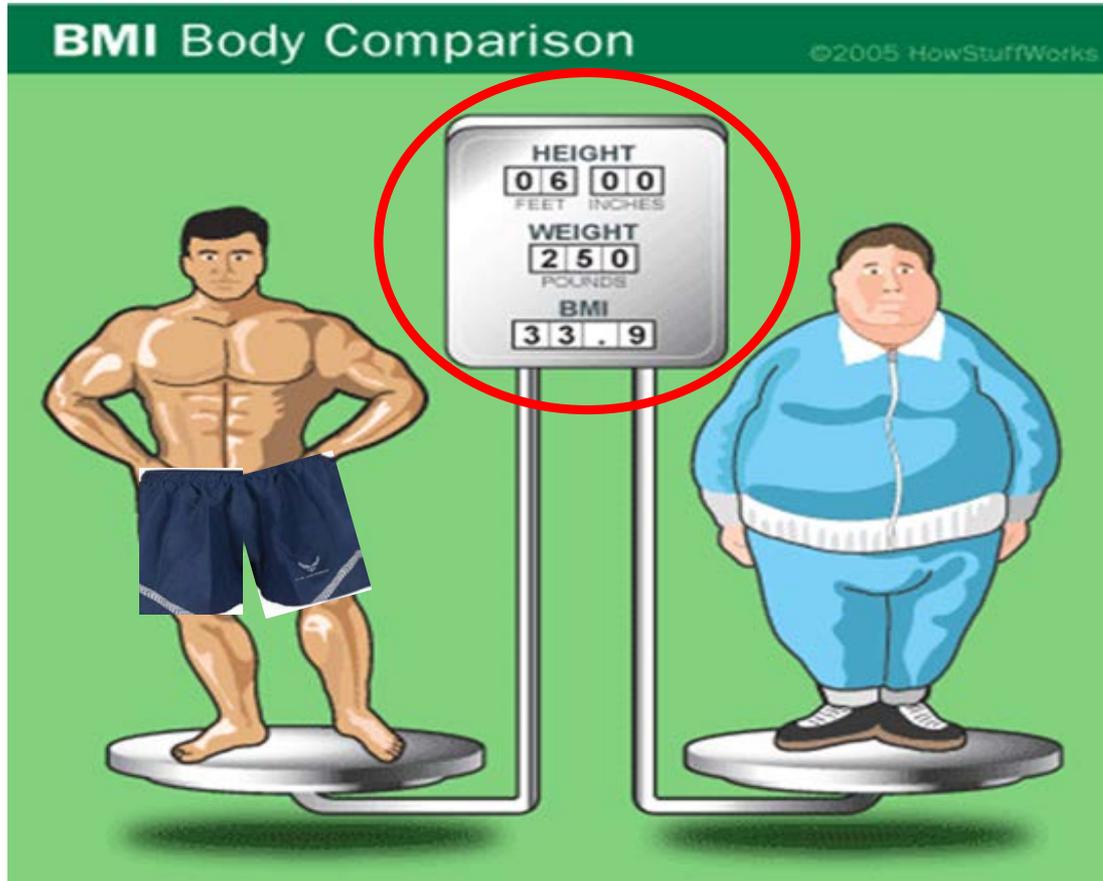


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# Misclassification with Body Mass Index

BMI commonly used as a body weight screen, but BMI does not account for fat content or fat distribution

AC = 35"



AC = 49"

**Abdominal Fat Matters!**

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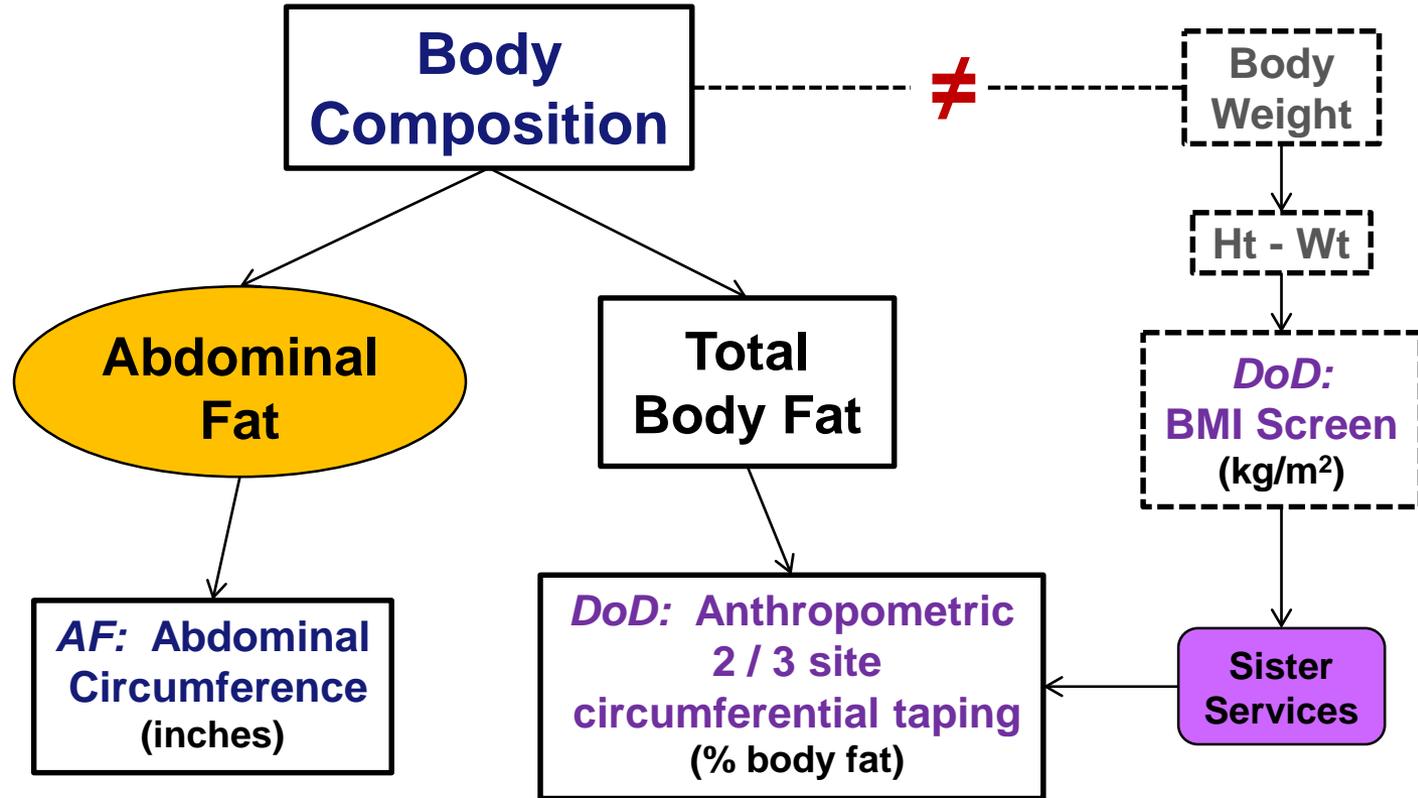
# BC: Body Fat Measurement

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**Physical Fitness Component:**

**Fat Distribution / Body Region:**

**Measurement:**



**Body Weight (BMI) ≠ Body Fat (2/3 tape) ≠ Abdominal Fat (AC)**

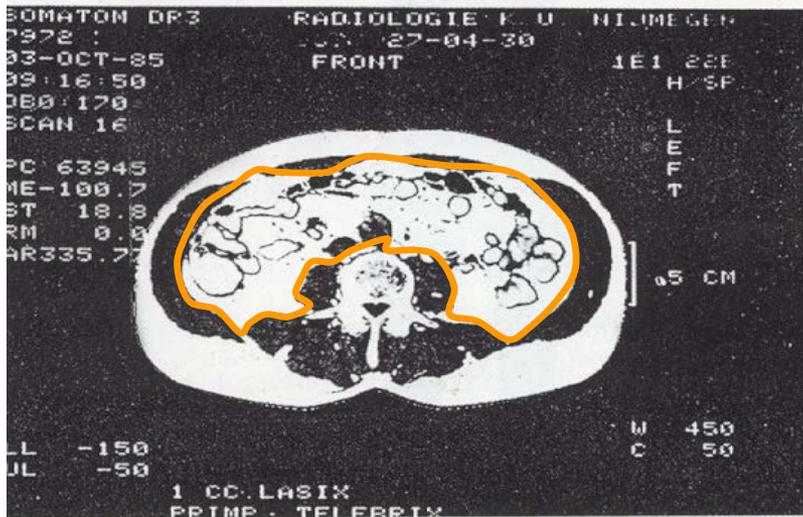


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# Central Adiposity - Dangerous Abdominal Fat



- Computer axial tomography (CAT) scans to the left (taken at the same horizontal level as AC measurement) show two individuals with different amounts of high risk intra-abdominal fat; **amber** colored lines drawn around the intra-abdominal fat. Much less of this fat in the upper scan versus the lower scan.



- Can use CAT scans and magnetic resonance imaging (MRI) to assess intra-abdominal adipose tissue area, but impractical and cost prohibitive for broad application. Hence, AC is best, simple measure of high risk intra-abdominal fat (visceral adipose tissue - “gut” fat)



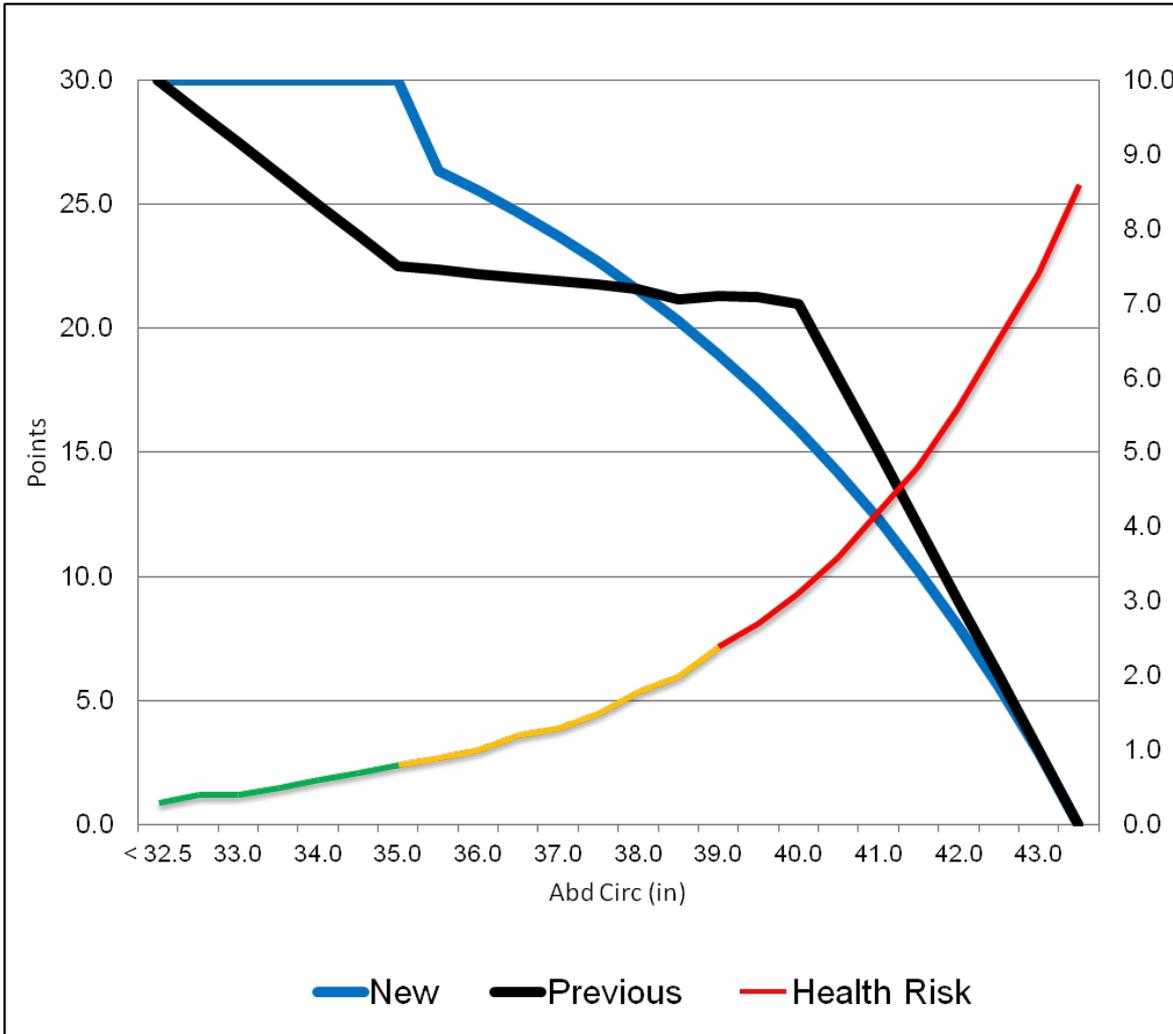
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# ***Adverse Health Outcomes with Abdominal Obesity***

<b>Condition</b>	<b>Linkage with Abdominal Obesity</b>
<b>Type II Diabetes</b>	<b>Strong association in both genders and in diverse populations</b>
<b>Impaired Glucose Tolerance</b>	<b>Strong association</b>
<b>Hypertension</b>	<b>Strong association</b>
<b>Hyperlipidemia</b>	<b>Strong association</b>
<b>Myocardial Infarction</b>	<b>Strong association</b>
<b>Stroke</b>	<b>Probable association</b>
<b>Obstructive Sleep Apnea</b>	<b>Strong association</b>
<b>Prostate Cancer or Hyperplasia</b>	<b>Significant association</b>
<b>Breast Cancer</b>	<b>Probable association</b>
<b>Colon Cancer</b>	<b>Probable association</b>
<b>Depression</b>	<b>Probable association</b>

# Body Composition Scoring System

Males - age independent



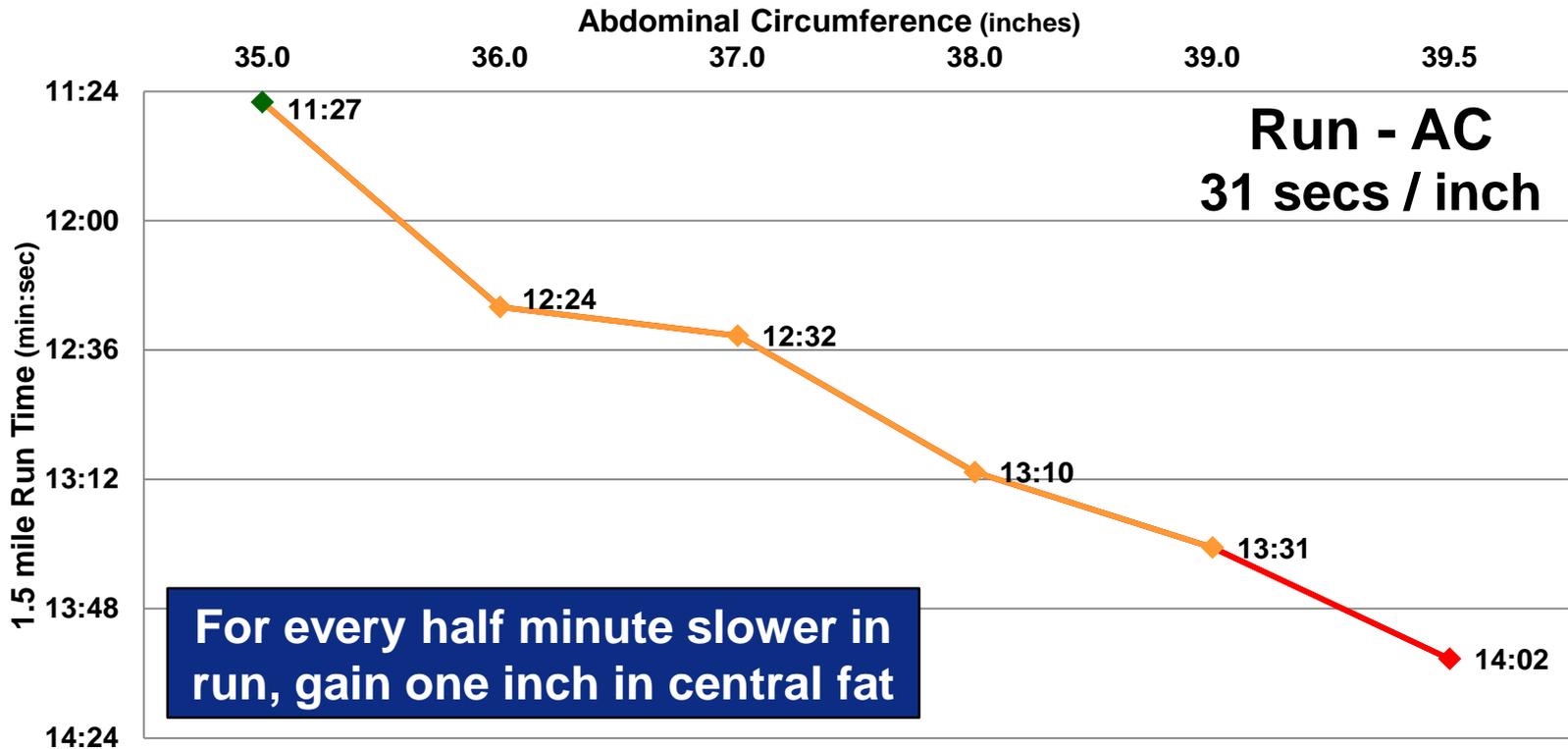
Body Comp	Previous Pts	New Pts (30%)	New Pts (20%)
< 32.5	30.00	30.0	20.0
≤ 32.5	28.75	30.0	20.0
33.0	27.50	30.0	20.0
33.5	26.25	30.0	20.0
34.0	25.00	30.0	20.0
34.5	23.75	30.0	20.0
35.0	22.50	30.0	20.0
35.5	22.35	26.4	17.6
36.0	22.20	25.6	17.0
36.5	22.05	24.7	16.4
37.0	21.90	23.7	15.8
37.5	21.75	22.7	15.1
38.0	21.60	21.5	14.4
38.5	21.15	20.3	13.5
39.0	21.30	19.0	12.6
39.5	21.25	17.5	11.7
40.0	21.00	15.9	10.6
40.5	18.00	14.2	9.4
41.0	15.00	12.3	8.2
41.5	12.00	10.2	6.8
42.0	9.00	8.0	5.3
42.5	6.00	5.5	3.7
43.0	3.0	2.9	1.9
≥ 43.5	0.0	0.0	0.0



# Health-Fitness Hierarchy

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## Aerobic > Body Comp > Muscle Fitness



**Fit & Lean > Fit & Fat > Unfit & Thin > Unfit & Fat**

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# ***Tier 2 - Physical Fitness Tests and Standards Process***

Constable S.H. and Palmer B., editors. The Process of Physical Fitness Standards Development. Human Systems Information Analysis Center State of the Art Report. Wright-Patterson Air Force Base, OH., 2000



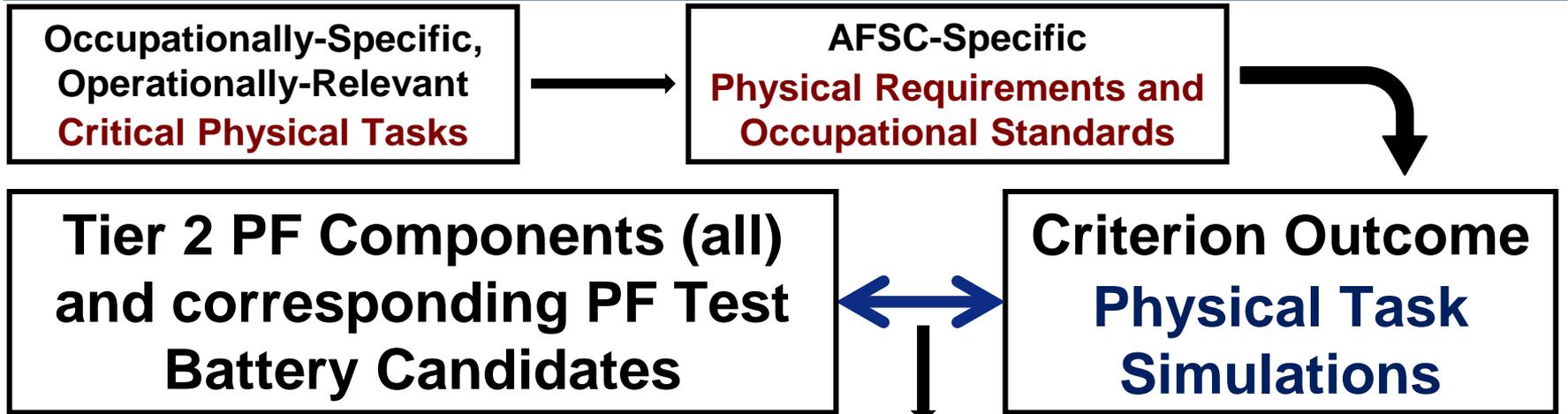
- 
- 1. Identify Physical Job Demands**
  - 2. Develop Physical Fitness (PF) Tests and Physical Task Simulations**
  - 3. Validate and Set Physical Test Standards**
  - 4. Implement, Train, Verify, Refine Prototype PF Tests and Standards**
  - 5. Deliver and Document Tier 2 Products during Adaptation Period**

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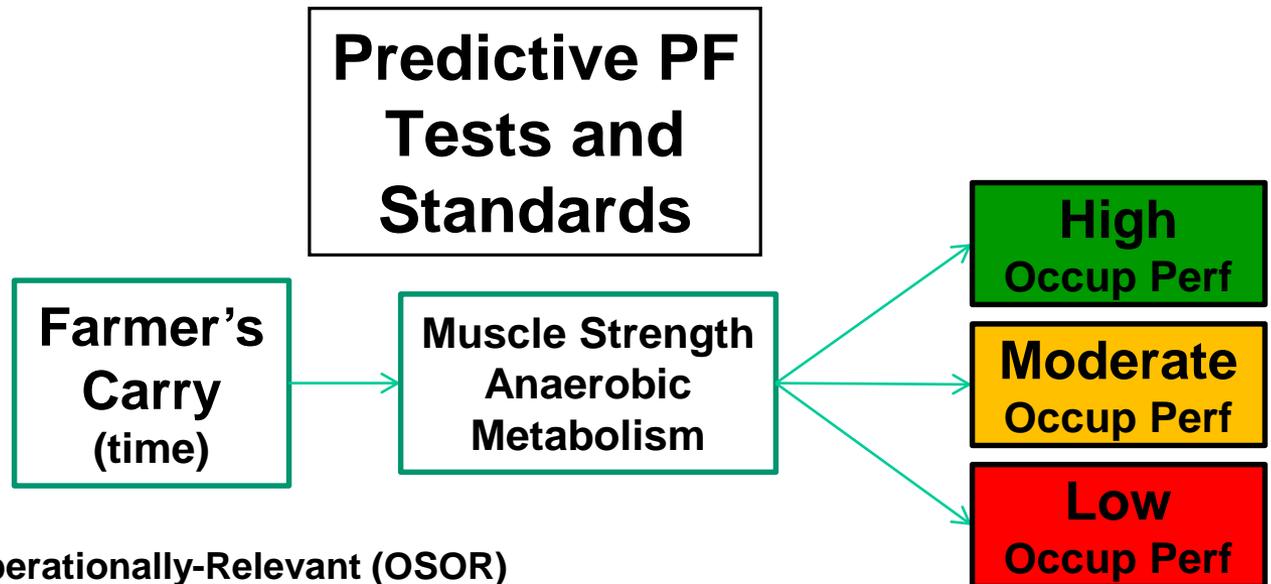
# Tier 2 - Criterion Linkage

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## Example

**PFC:** Muscle Strength, Anaerobic Metabolism  
**Test:** Farmer's Carry  
**Criterion Outcome:** OSOR Performance\*



\*Occupationally-Specific, Operationally-Relevant (OSOR)



# Tier 2 - Physical Fitness Test Battery, ALO-TACP

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Physical Fitness Component (PFC)	Recruit		Assess		Training		Operations
<b>Power</b>	Standing Long Jump		Med Ball Toss, back/side		Med Ball Toss, back/side		Med Ball Toss, back/side
<b>Agility</b>	Two Cone Drill		Two Cone Drill		Two Cone Drill		Two Cone Drill
<b>Strength</b>	Grip Strength		Grip Strength		Grip Strength		Grip Strength
<b>Endurance</b>	Lunges-wtd, 50 lbs		Lunges-wtd, 50 lbs		Lunges-wtd, 50 lbs		Lunges-wtd, 50 lbs
	Pull-Up (4)		Pull-Up (4 / 7)		Pull-Up (9 / 11)		Pull-Up (11)
	Extended Cross Knee Crunch		Extended Cross Knee Crunch		Extended Cross Knee Crunch		Extended Cross Knee Crunch
<b>Anaerobic</b>	Shuttle Run, 300 yd		Farmer's Carry, 100 yd		Farmer's Carry, 100 yd		Farmer's Carry, 100 yd
<b>Aerobic</b>	Run, 1.5 mile		Run, 1.5 mile		Run, 1.5 mile (Tier 1)		Run, 1.5 Mile (Tier 1)
<b>SAT at MEPs</b>	R1 Initial	R2 Pre-ship	A1 BMT WOT 0	A2 BMT - TT	T1 Intermediate	T2 Graduation	Operation Periodic with Random

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# Operator Tests and Standards

## **ALO-TACP Final**

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	Op1	Op2	Op3	Op4	Op5	Op6	Op7	Op8	Op9	Op10
<b>TACP Points</b>	<b>Grip Strength</b>	<b>Med Ball Toss</b>	<b>Two Cone Drill</b>	<b>Trap Bar DL</b>	<b>Pull up</b>	<b>Lunges Wtd</b>	<b>Ext Cross Knee Crunch</b>	<b>Farmer's Carry 4 x 25 yd</b>	<b>Row 1000m</b>	<b>Run 1.5 mi</b>
	PSI	ft	secs	lbs	reps	reps	reps	secs	min:secs	min:secs
10	198	50.5	8.6	469	32	199	107	21.2	3:15	7:51
9	166	47.5	8.9	435	28	161	94	22.5	3:22	8:03
8	153	44.5	9.3	399	24	148	79	23.5	3:30	8:50
7	144	42.0	9.5	376	22	123	69	24.8	3:36	9:21
6	137	40.5	9.8	356	20	104	62	25.9	3:40	9:47
5	130	39.0	10.0	338	18	88	57	26.8	3:44	10:10
4	124	37.5	10.2	320	16	73	52	27.8	3:48	10:33
3	117	35.5	10.4	300	13	58	46	28.8	3:52	10:59
2	108	33.5	10.7	276	11	43	39	30.1	3:57	11:31
1	95	30.0	11.1	240	7	24	31	32.0	4:05	12:17
<b>TACP- Component Minimums indicated in blue</b>						<b>Composite score requirement ≥ 46 of 100</b>				

# Tier 2 and Tier 1 x AFSC

Career Field Group	Physical Demand	Current Status	Total Force	% AF
ALO-TACP	Heavy	Tier 2/Step 5	2,318	0.5%
STO-CCT/CRO-PJ/SOWT	Heavy	Tier 2/Step 3	2,163	0.4%
EOD	Heavy	Tier 2/Step 4	1,700	0.3%
Fire Protection	Heavy - Mod	Tier 2/Step 1	6,629 (+4,771 civ)	1.3%
Security Forces	Moderate	Tier 2/Step 1	38,000	7.7%
Fighter Pilot	Moderate	Tier 2?	2,800	0.6%
SERE	Moderate	Tier 2?	1,450	0.3%
Loadmaster	Moderate	Tier 2?	12,000	2.4%
Aircraft Maintenance	Moderate	Tier 2?	92,000	18.5%
Civil Engineers	Moderate	Tier 2?	46,400	9.3%
Operations	Light	Tier 1 / Tier 1D?	100,600	20.3%
Medical	Light	Tier 1 / Tier 1D?	46,000	9.3%
Cyber / Communication	Light	Tier 1 / Tier 1D?	38,600	7.8%
Logistics	Light	Tier 1 / Tier 1D?	64,500	13.0%
Force Support	Light	Tier 1 / Tier 1D?	30,000	6.0%
Professional / Acquisition	Light	Tier 1 / Tier 1D?	8,400	1.7%

Total Force = 321673 AD, 69200 Res, 105700 ANG = 496573 // Current Tier 2 R&D = 10.2% of force



# Potential Changes - ESU

## Major Efforts

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*AF Exercise Science Unit highlights (unofficial, AF/A1 owns policy)*

- $VO_2$  max / AC/Stature Ratio = Fitness Fatness Index, addresses:
- Stature Concerns
- Fit-Fat relationship: aerobic fitness - central adiposity linkage
- Two most important PF components for health / general fitness;  $VO_2$  is “king” for health and performance
- Example:
  - SSgt Doe: stature 70 inches, AC 35 inches, 1.5 mile run 10:23 mins:secs
  - Numerator ( $VO_2$ ): run 10:23 mins:secs = 50 ml  $O_2$ /kg/min
  - Denominator (WHtR): 35 inches / 70 inches = 0.5 ratio
  - Fitness Fatness Index (FFI) = 50 / 0.5 = 100
  - Broad FFI scale  $\approx$  30 low fit to 185 high fit
- ESU R&D to determine FFI scale of Green (low risk), Amber (moderate risk), and Red (high risk)



# Potential Changes - ESU

## Major Efforts

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- **Test Frequency:** ↑ incentives / ↑ accountability / ↓ resources
  - ↑ Fit level = ↓ freq; controlled random / all gain-no lose ↓ test stress
  - EMC: **GAR** color risk; status: Score, Pass-Fail, Exempt, Non-current
- **Alternate Aerobic Tests:** multistage “beep” / row ergometer
- **Muscle Fitness Tests:** higher priority movement patterns
- **PF and Cognitive Function** - cannot afford to ignore linkage
- **PF Data:** 1 intra-component, 2 inter-component, 3 longitudinal
- **Tier 1D:** deployment standard - low physical demand AFSCs
- **Tier 2 R&D:** ALO-TACP, EOD, SF, FES // others considering
- **Force Generation - Force Sustainment Human Weapon System Lifecycle:** combat disparate message; consistent training (EPM)
- **PF Training > PF Test**
- ***PF and Promotions - reference AFI handout***
  - **Enlisted Airmen (2004-2014,  $n > 1$  million):** fitter Airmen promote faster



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# BACK-UPS

## BACK-UPS

### *RFI #8 questions*

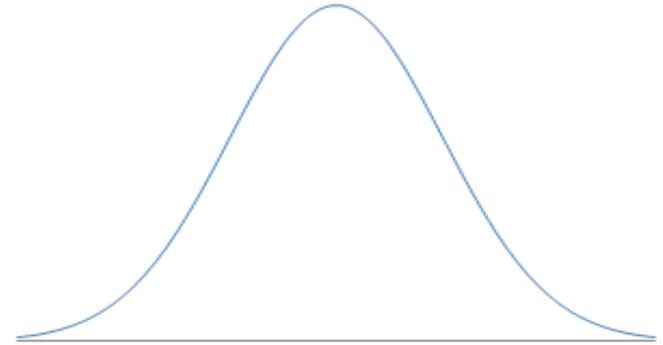
- a. What are the physical fitness test requirements for your Service?*
- b. How are the physical fitness tests graded?*
- c. What physiological science went into determining the requirements and scoring of physical fitness tests?*
- d. When was the last time the physical fitness test was changed? What prompted the change?*
- e. Are there any changes coming to the physical fitness test in the near future?*
- f. How are the physical fitness tests related to promotions?*



# “Overcoming Inertia”

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- **Traditional-Historical approach to PF Tests and Standards**
- **At best use normative data for standards**
  - **Quite subjective: “very poor” to “superior”**
  - **Scoring or P/F cut-points oft set arbitrarily**
  - **Limited: rating against peers only**
  - **Not based on recognized science, health, or performance criteria**
- **Conventional PF tests and techniques often contribute to:**
  - **Chronic injury when coupled with high demand work environments**
  - **Cumulative anatomical imbalances - detrimental career effects**
- **In contrast, USAF moved beyond traditional/historical model to criterion, science-based standards; a “Tiered” approach**



**Linkage: Fitness Parameter - Health or Performance Outcome**

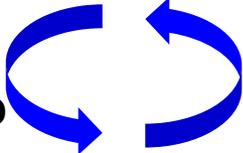
Mercer, G and M Strock. Introduction of Functional Physical Training into Special Operations Units. *J of Spec Ops Med.* 2005; 5(1) 54-59.

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# Component Hierarchy & Linkage

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- Need correct perspective and focus on hierarchy and linkage
- Component *hierarchy*
  - Aerobic fitness primary component for Tier 1 and Tier 2:
    - Health - compelling research data show aerobic fitness:
      - Provides risk protection not by reducing body mass *per se*, but by reducing VAT, SAT, and total abdominal fat - “Aerobic Protection”
      - Mitigates elevated health risk associated with increases in VAT
    - Performance - occupations, operations, deployment
  - Abdominal fat next most important for health
  - Muscle fitness (especially core) next most important for performance
- Component *linkage*
  - Aerobic fitness and BC are inextricably linked; feedback loop 
  - Faster run - lower AC, and converse - AF data show for every 31 seconds slower in run time AC (across 35 inch to 39 inch range) increases one inch and sit-ups and push-ups decrease > 2 repetitions each

**Fit and Lean > Fit and Fat > Unfit and Thin > Unfit and Fat**



# Aerobic Protection

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- **Cardiorespiratory endurance most important for health-fitness; compelling research data show aerobic fitness:**
  - Provides risk protection independent of body mass and total adiposity
  - Provides protection not by reducing body mass per se, but by reducing VAT, SAT, and total adipose tissue (AT)
  - Mitigates elevated health risk associated with increases in total AT
- **For long term health benefits we should focus on improving fitness by increasing physical activity rather than relying solely on diet for fat (weight) control**
- **“Aerobic Protection” / “Green - Green” - Tier 1 modification**
  - *Potential* mod: earn max BC component points (20) only if aerobic component is low risk (green); requires data analyses
    - May carry *some* extra central adipose tissue if fast run time
  - **Required run time most likely faster than just lowest green**

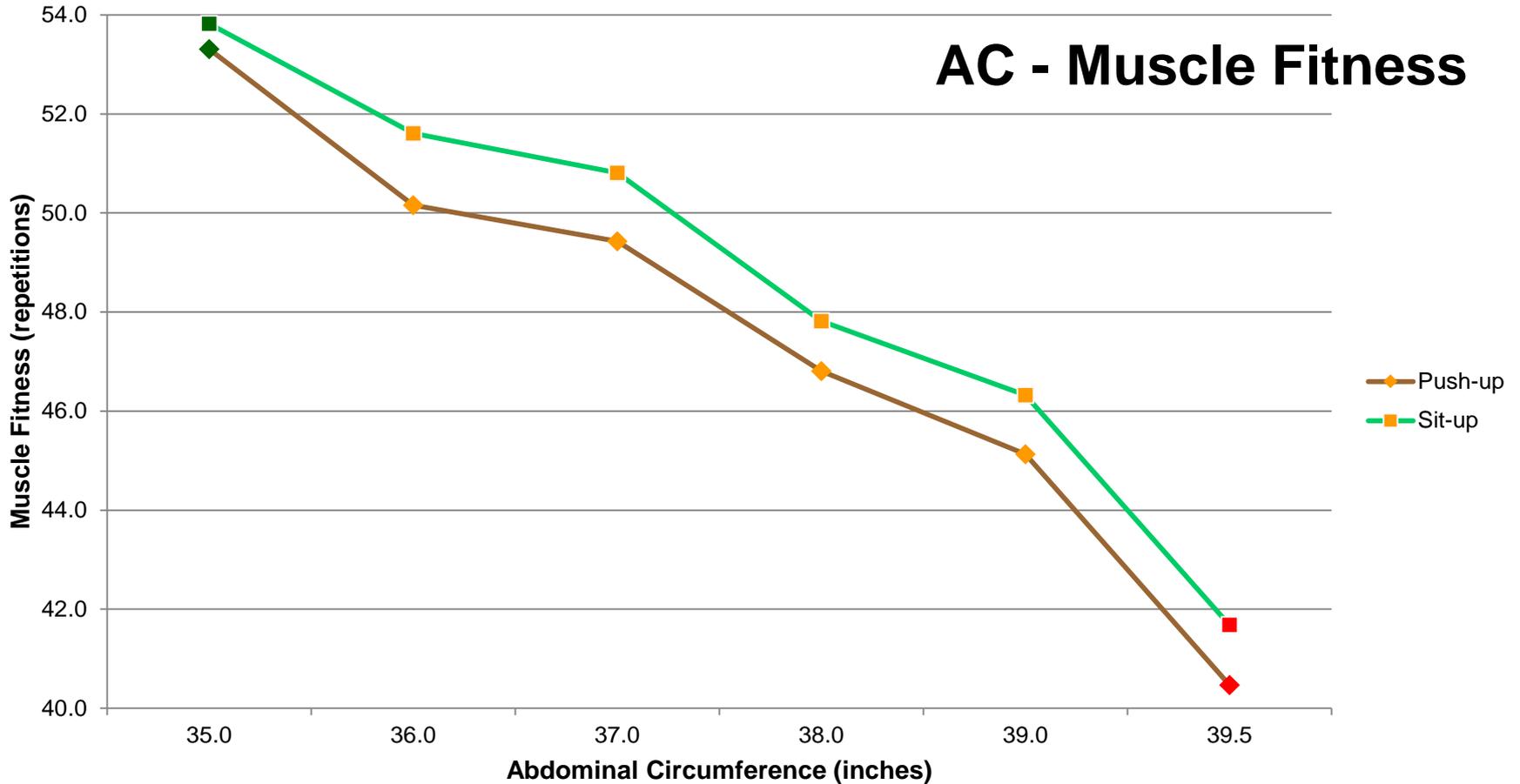
**Fit & Lean > Fit & Fat > Unfit & Thin > Unfit & Fat**

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# Higher AC - Lower MF

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With every inch gained, repetitions significantly decrease

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# *BC Health Hierarchy*

**TSgt Smith**

**TSgt Jones**

**1 Ht and Wt**

**68 in 178 lbs**

**70 in 187 lbs**

**2 BMI**

**27.1 kg/m<sup>2</sup>**

**26.8 kg/m<sup>2</sup>**

**3 Percent Body Fat**

**22 %**

**24 %**

2<sup>nd</sup> example: what if.....

**4 Abdominal Circumference**

**35 in**

**35 in**

**5 Aerobic Protection**

**12:56**

**11:30**

**Lower Health Risk**

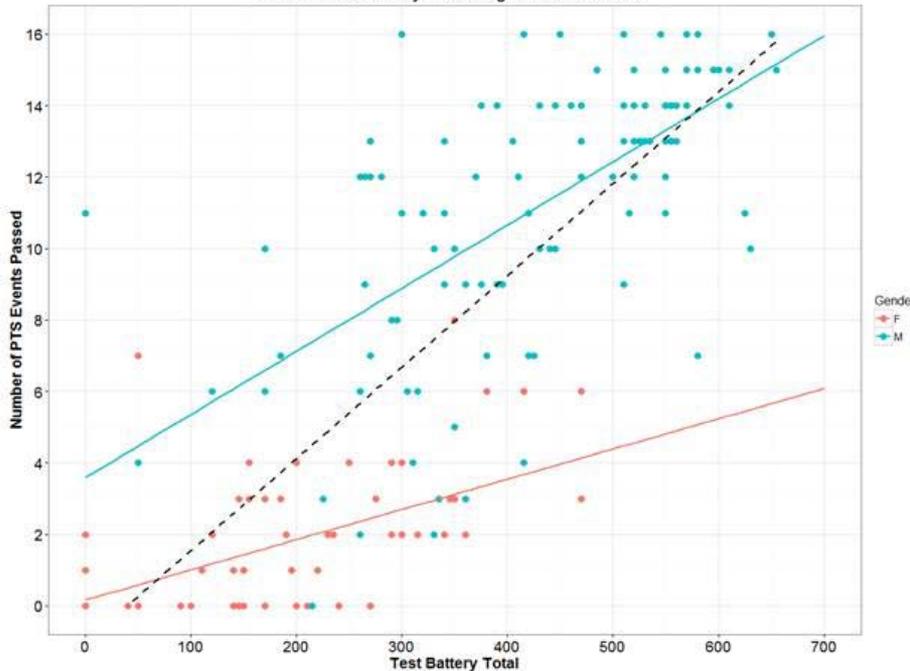


# Step 3 - Results Gender Neutrality

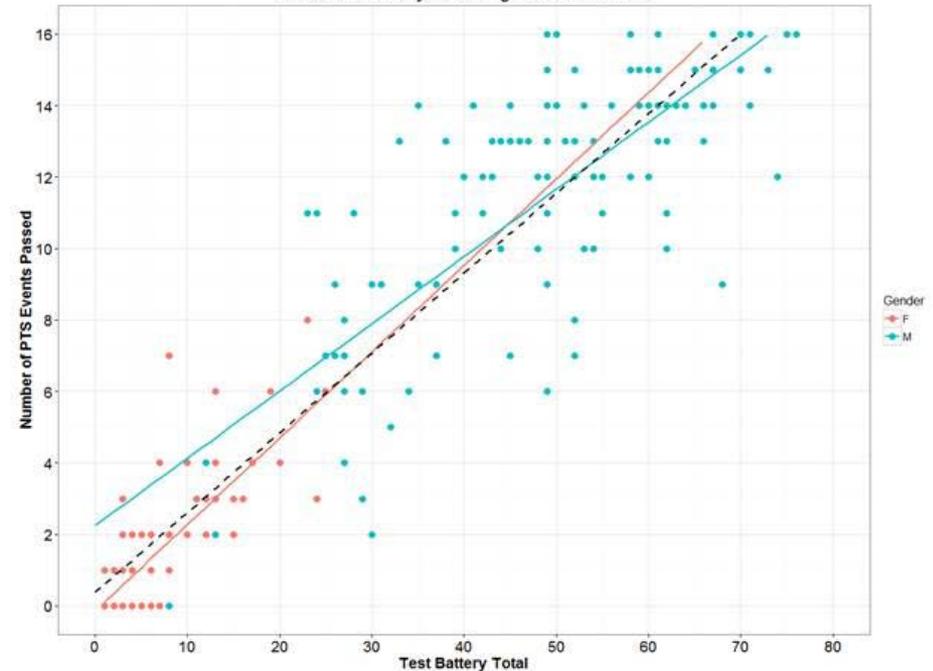
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- Gender Neutrality - incumbent test had extensive statistically significant dependence on gender (6.6 PTS difference) which resulted in under predicting male performance by 17% and over predicting female performance by 24%. Prototype PFT predicted operational performance equally well across genders

Current Test Battery Predicting Task Simulations



BA 10-Test Battery Predicting Task Simulations

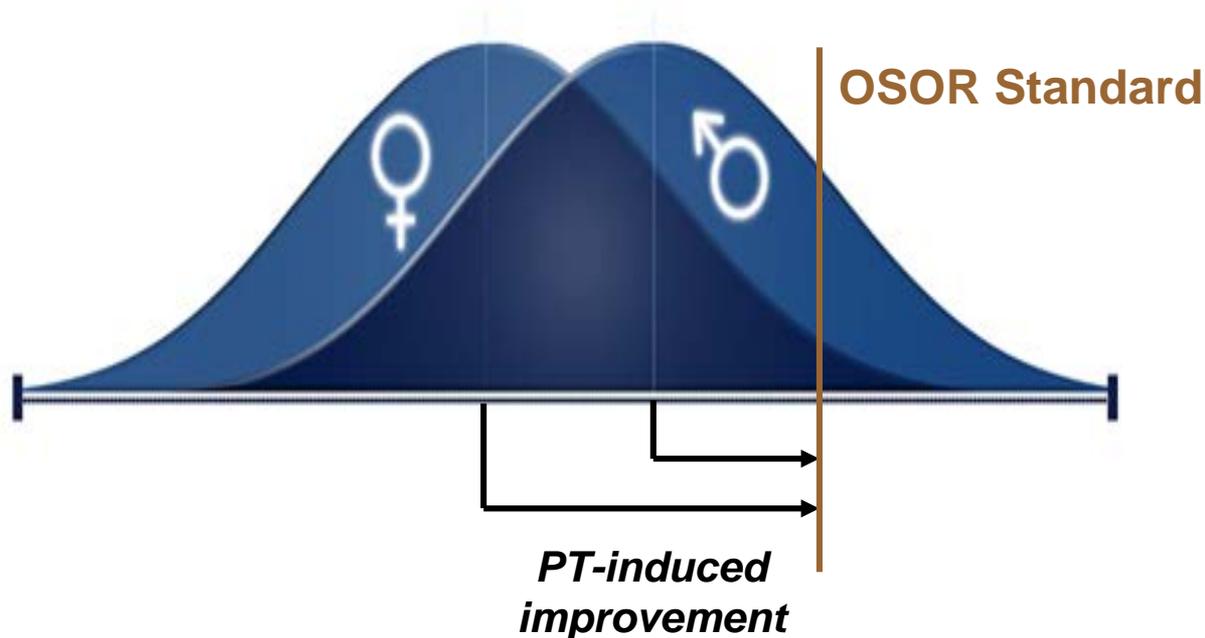


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# Sex Specific Differences PT Methods / Techniques



- Females may require a more focused, consistent, periodized training program than males to reach the same occupationally specific and operationally relevant (OSOR) physical standard, for CRE, BC, MF
  - Example, females generally need to achieve greater improvements in CRE, MF to reach the same absolute load carriage capability



# Timeline: AF FA

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