CLAIMS

We claim:

1. A flame resistant fabric having a warp direction and a fill direction, the fabric comprising:

(a) a plurality of body yarns each formed of a body yarn fiber blend and provided in both the warp direction and the fill direction of the fabric, wherein the body yarn fiber blend comprises modacrylic fibers, cellulosic fibers, and aramid fibers; and

(b) a plurality of stretch yarns extending between at least some of the body yarns in at least one of the warp direction or the fill direction of the fabric, wherein each stretch yarn comprises an elastic core surround by a sheath, wherein the sheath comprises a sheath fiber blend comprising modacrylic fibers, cellulosic fibers, and aramid fibers, wherein:

i. the fabric has a char length of 6 inches or less and an afterflame of 2 seconds or less when tested pursuant to ASTM D6413 (2015);

ii. the fabric has an arc rating of at least 8 cal/cm^2 when tested pursuant to ASTM F1959 (2014); and

~~iii. the fabric exhibits thermal shrinkage of no more than 10% in both the warp and fill directions when tested pursuant to ASTM F 2894 (2021); and~~

~~iv.~~iii. the fabric comprises a percent stretch and a percent recovery in the at least one of the warp direction or the fill direction in which the plurality of stretch yarns extend, wherein the percent stretch is at least 10% and the percent recovery is at least 90% after 100 industrial launderings, whereby in each industrial laundering the fabric is subjected to a standard 140° Fahrenheit industrial wash for 30 minutes and the fabric is dried for 30 minutes in an industrial dryer with a stack temperature not exceeding 155° Fahrenheit.

2. The flame resistant fabric of claim 1, wherein the cellulosic fibers in the body yarn blend are non-FR cellulosic fibers, and wherein the body yarn fiber blend comprises ~~40-~~

~~55~~ 30-60 wt. % modacrylic fibers, ~~30-45~~ 20-60 wt. % non-FR cellulosic fibers, and ~~10-20~~ 5-30 wt. % aramid fibers.

3. The flame resistant fabric of claim 1, wherein the cellulosic fibers in the sheath fiber blend are non-FR cellulosic fibers, and wherein the sheath fiber blend comprises ~~40-55~~ 30-60 wt. % modacrylic fibers, ~~30-45~~ 20-60 wt. % non-FR cellulosic fibers, and ~~10-20~~ 5-30 wt. % aramid fibers.

4. The flame resistant fabric of claim 1, wherein the body yarn fiber blend and the sheath fiber blend are substantially identical.

5. The flame resistant fabric of claim 4, wherein the body yarn fiber blend and the sheath fiber blend each comprises 30-60 ~~40-55~~ wt. % modacrylic fibers, 20-60 ~~30-45~~ wt. % non-FR cellulosic fibers, and 5-30 ~~10-20~~ wt. % aramid fibers.

6. The flame resistant fabric of claim 1, wherein the body yarn fiber blend comprises only modacrylic fibers, cellulosic fibers, and aramid fibers.

7. The flame resistant fabric of claim 1, wherein the elastic core comprises polyolefin.

8. The flame resistant fabric of claim 1, wherein the plurality of stretch yarns are provided in only one of the warp direction and the fill direction.

9. The flame resistant fabric of claim 8, wherein the plurality of stretch yarns are provided in only the fill direction.

10. The flame resistant fabric of claim 1, wherein the plurality of stretch yarns are provided in the at least one of the warp direction or the fill direction of the fabric in a stretch yarn to body yarn ratio from about 1:2 to about 1:10.

11. The flame resistant fabric of claim 10, wherein the plurality of stretch yarns are provided in the at least one of the warp direction or the fill direction of the fabric in a stretch yarn to body yarn ratio from about 1:2 to about 1:5.

12. The flame resistant fabric of claim 11, wherein the plurality of stretch yarns are provided in the at least one of the warp direction or the fill direction of the fabric in a stretch yarn to body yarn ratio of 1:2.

13. The flame resistant fabric of claim 1, wherein the fabric comprises a weight between 7-9 ounces per square yard, inclusive.

14. The flame resistant fabric of claim 1, wherein the body yarns are spun yarns.

15. The flame resistant fabric of claim 1, wherein the aramid fibers are producer-colored fibers and contain a dark pigment.

16. The flame resistant fabric of claim 1, wherein at least some of the body yarns are plied.

17. The flame resistant fabric of claim 1, wherein the percent recovery is at least 95%.

18. The flame resistant fabric of claim 1, wherein the percent stretch and the percent recovery after 100 industrial launderings is no more than 5% less than the percent stretch and the percent recovery prior to a first of the 100 industrial launderings.

19. A flame resistant fabric having a warp direction and a fill direction, the fabric comprising:

(a) a plurality of body yarns each formed of a body yarn fiber blend and provided in both the warp direction and the fill direction of the fabric, wherein the body yarn fiber blend comprises modacrylic fibers, cellulosic fibers, and aramid fibers;

(b) a plurality of stretch yarns extending between at least some of the body yarns in at least one of the warp direction or the fill direction of the fabric, wherein each stretch yarn comprises an elastic core surround by a sheath, wherein the sheath comprises a sheath fiber blend comprising modacrylic fibers, cellulosic fibers, and aramid fibers, wherein:

i. the body yarn fiber blend and the sheath fiber blend each comprises 30-60 ~~40-55~~ wt. % modacrylic fibers, 20-60 ~~30-45~~ wt. % non-FR cellulosic fibers, and 5-30 ~~10-20~~ wt. % aramid fibers;

ii. the body yarn fiber blend and the sheath fiber blend are substantially identical;

iii. the plurality of stretch yarns are provided in the at least one of the warp direction or the fill direction of the fabric in a stretch yarn to body yarn ratio from about 1:2 to about 1:~~4~~10;

iv. the fabric has a char length of 6 inches or less and an afterflame of 2 seconds or less when tested pursuant to ASTM D6413 (2015);

v. the fabric has an arc rating of at least 8 cal/cm^2 when tested pursuant to ASTM F1959 (2014);

~~vi. the fabric exhibits thermal shrinkage of no more than 10% in both the warp and fill directions when tested pursuant to ASTM F 2894 (2021);~~

~~vii.~~vi. the fabric comprises a weight between 7 to 10 ounces per square yard, inclusive; and

~~viii.~~vii. the fabric comprises a percent stretch and a percent recovery in the at least one of the warp direction or the fill direction in which the plurality of stretch yarns extend, wherein the percent stretch is at least 10% and the percent recovery is at least 95% after 100 industrial launderings, whereby in each industrial laundering the fabric is subjected to a standard 140° Fahrenheit industrial wash for 30 minutes and the fabric is dried for 30 minutes in an industrial dryer with a stack temperature not exceeding 155° Fahrenheit.

20. The flame resistant fabric of claim 19, wherein the plurality of stretch yarns are provided in only the fill direction.

21. The flame resistant fabric of claim 2, wherein the body yarn fiber blend further comprises 5-25 wt. % nylon fibers.

22. The flame resistant fabric of claim 1, wherein the body yarn fiber blend consists of modacrylic fibers, cellulosic fibers, aramid fibers, nylon fibers, and anti-stat fibers.

23. The flame resistant fabric of claim 3, wherein the sheath fiber blend further comprises 5-25 wt. % nylon fibers.

24. The flame resistant fabric of claim 1, wherein the sheath fiber blend consists of modacrylic fibers, cellulosic fibers, aramid fibers, nylon fibers, and anti-stat fibers

~~21.~~25. The flame resistant fabric of claim 1, wherein the fabric exhibits thermal shrinkage of no more than 10% in both the warp and fill directions when tested pursuant to ASTM F 2894 (2021).