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The Distribution Condition and Clothing Construction Factors of the Working Clothes[+]

- Reference to the Changwon National Industrial Complex -

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Abstract

To investigate the actual distribution condition and clothing construction factors of the working clothes supplied to the Changwon national industrial complex, 5 major companies in machinery, automotive, industrial engineering, shipbuilding and rolling stock in the industrial complex located in Gyeongsangnam-Do were selected.

The questionnaire designed for the research consisted of working clothes distribution policies in manufacturing industry and the actual conditions of the design facts, repair and maintenance of the working clothes, etc. The analysis of the clothing construction factors of the working clothes provided by 5 respondent companies were conducted in parallel. The results derived from the study were as follows:

The basic types of working clothes were the blouson jacket and straight pants; safety equipments for manufacture were safety helmets, gloves, snickers, goggles, masks, ear caps, wristlets, leggings, apron, etc. The size-charts adopted by the participant companies were the small-medium-large and cm/inch measurement size systems. To solve wearer's dissatisfaction with the garment fit, certain clothing construction factors were used, e.g. strap bands and the elastic band on a waist band. The types of fabrics used for the working clothes were mainly polyester/cotton and polyester/rayon blended ones. Moreover, to provide with more air permeability to wearers, the warp knit material was used to construct the lining and the armpit or back bodice slits. Lock, two-thread chain, safety, overedge stitches were applied with flat, lap felled, French, superimposed, lapped, bound and edge finishing seams to construct the working clothes selected.

Key Words : working clothes, safety equipment, distribution condition of the working clothes, clothing construction factors, stitch and seam types, working clothes materials.

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I. Introduction

As a key member of the world, Korea aims to fully arrive in the 21st century with the goal of becoming one of the world's leading countries in pursuit of unlimited global business opportunities. In view of that, Korea has the task to increase the nation's competitiveness in the world through the specialization of local industries by encouraging the regional attributes of distinctiveness. Gyeongsangnam-do is one of the exceptional provinces in the nation which has played a key role of Korea's automotive, machinery, aerospace, and shipbuilding industries equipped with well-developed industry based infrastructure. As of December 2006, the total number of companies in Gyeongsangnam-Do province was 11,393, which included 1,635 metalworking firms and 2,513 machinery companies. Most of all, the numbers of employees in the machinery industry were up to 130,000. Considering this, it would not be too exaggerating to say that Gyeongsangnam-Do has a crucial status in machinery, electronics, cars, shipbuilding industries which occupied almost 20% of the whole nation's industry scale[1].

In the Changwon national industrial complex located in Gyeongsangnam-Do, 71,649 people were employed (male - 62,304 and female - 9,345 reported as of Aug. 2003) and in addition, for the employees are the inhabitants who live in adjacent regions to their works, the condition of employees' health may be directly related not only to the industrial productivity but also to the quality of life. Kim et al.[2] highlighted the importance of the systematic group health service because the workers' health status is directly related to the social and industrial productivity. Park[3] also defined that the working environments consisted of 5 major environmental conditions, i.e. physical, chemical, biological, mechanical and operational conditions. One of these, the operational condition included the workers' knowledge and attitude toward their tasks, working clothes, working hours, and etc. However, as each industry's work features vary in chemical and physical aspects, it might not be possible to provide with the literally perfect work environments to the employees. Therefore, the working clothes and the auxiliary safety accessories that industrial workers wear in many hours a day can be the solution to improve the industrial work conditions. In this sense, the examination of the design features, clothing construction details, supply and wearing conditions of the industrial working clothes would help to have an understanding of the actual working clothes manufacturing condition for the relevant industries and thus to set up the practical guidelines to develop the improved working clothes.

To construct the working clothes, Korean Industrial Standards (refer to KS K 7803) prescribes the regulations for working clothes. It imposes certain factors for the working clothes: such as properties of fabrics, lining and interlining, sewing yarns and various trimmings like buttons, hooks and eyes, fastenings in material terms; stitches, seams, seam allowances, ironing in terms of the clothing construction. However, the regulations of the clothing construction factors are not specified enough to construct the various working clothes.

The relevant researches on the working clothes and the auxiliary safety accessories, e.g. safety helmet, protection goggles, gas masks, protection wears, etc. have tried to improve industrial working environment[4] by improving the wearing environments of the workers. The working clothes researches can be divided into

two which are firstly, on the actual condition of and the preference to the work clothes and secondly on the development of specified industrial working clothes. The researches on the general conditions of or the preference to the various working clothes in textiles[5], automotive[6], mechanical[7] industries, burning waste working environment[8] and for the railroad maintenance[9] and the building construction workers[10] have been carried out. The studies on the development of the working clothes for various industries have been also conducted and the examples are the clean room garment for the semiconductor industry[11][12], mine detective gear[13], coveralls[14], etc. However, it is hard to find out the research presenting the specified clothing construction factors in detail. Furthermore, regarding the overseas protective equipments, the relevant regulations set by the OSHA(Occupational Safety & Health Administration)[15], ANSI(American National Standards Institute)[16] and NIOSH(the National Institute for Occupational Safety and Health)[17] can be referred to.

Since the clothing construction factors of the working clothes have been rarely discovered, this study aimed to investigate the actual distribution condition of the working clothes supplied to the Changwon national industrial complex; and to analyze their clothing construction factors in terms of clothing design details, sizing systems, materials and equipments utilized. The results derived from the study would improve the working clothes development procedures and also help both the relevant enterprises and government imply the working clothes manufacturing guidelines to fulfill the industrial workers' demand for the working clothes which means better working environments.

II. Research Methodology

1. Objectives

The study was designed:

(1) to investigate the actual distribution condition of working clothes supplied to 5 subject companies in the Changwon national industrial complex; and

(2) to analyze the clothing construction factors of the working clothes collected from 5 subject companies.

2. Subjects and the Investigation Period

5 major companies were selected for the research according to the company sizes in the Changwon national industrial complex located in Gyeongsangnam-Do. As they were the leading companies in the relevant industries, it was assumed that the distribution condition of working clothes of the participant companies was better than the others. Subject companies were in the industries of machinery, automotive, industrial engineering, shipbuilding and rolling stock respectively (refer to <Table 1>) and the investigation was performed from Aug. to Sep. 2007. 5 respondents were in charge of the working clothes supply and maintenance, who have been employed in the same industry for 10 to 18 years. As described in <Table 1> the respondents were all managerial staff, i.e. 3 posted to the general affairs department and each to manufacture and safety departments.

3. Actual Distribution Condition of the Working Clothes

To find out the actual distribution condition of the working clothes, a questionnaire was designed by referring to the relevant researches[18][19] and

<Table 1> General Characteristics of Subject Companies

Company	Type of Industry	Period of Employment of Respondent (years)	Department Placed
A	Machinery	18	Manufacture
B	Automotive	15	General Affairs
C	Industrial Engineering	11	General Affairs
D	Shipbuilding	10	General Affairs
E	Rolling Stock	17	Safety

the preliminary survey on the types and details of the working clothes and safety equipments of a machinery company carried out during July, 2007. The questionnaire consisted of the actual distribution condition inquiries of the subject companies working clothes: (1) general facts of the subject companies working clothes under the investigation: policies of working clothes diversification by working environment characteristics and seasons, the types of working clothes and safety equipments, working clothes distribution frequency; (2) design facts: colors and enterprise image represented in the working clothes; and (3) inquiries related to sizing system adopted and the repair and maintenance of the working clothes.

4. Investigation of the Clothing Construction Factors of the Working Clothes

The analysis of the clothing construction factors of the working clothes collected from 5 subject companies has been conducted in terms of: (1) working clothes garment details, which were divided into the parts of the collar, front bodice panel, sleeves, side panel, back bodice panel, linings for an upper garment and the parts of waist, front and back panels, pockets and hem for a lower garment; and (2) the clothing construction factors e.g. fabrics, linings, trimmings, stitches, seams and equipments utilized according to the garment details identified.

III. Results and Discussions

1. The Actual Distribution Condition of the Working Clothes

1) General Distribution Facts of the Working Clothes

<Table 2> shows that the working clothes selected for the research have not been differentiated by the types of work procedures, while the working environmental characteristics related to the work posts are various (e.g. the departments of management, quality assurance, cutting, grinding, assembly, welding, transportation, etc). It is because that employees' wearing the exactly same types of working clothes within a company can enhance the feeling of conformity with other colleague workers. There was a response from company E to have different types of the working clothes only for the special cases of employees' visiting the public offices, sales occasions and so on.

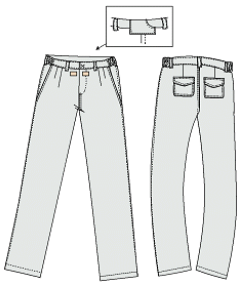
However, the working clothes are diversified for seasons. 2 respondents answered to have 3 types of working clothes seasonally diversified such as 'Spring-Fall', 'Summer' and 'Winter' type garments while the rests of the respondents had 2 seasonally diversified working clothes, i.e. 'Spring-Summer-Fall' and 'Winter' types.

All the respondents (A to E, 100%) answered

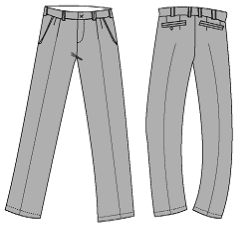
<Table 2> General Distribution Facts of the Working Clothes

Distribution Policy	Company - Frequency(%)	Total Frequency(%)
Diversification of Working Clothes According to Working Environments	Partially Diversified: E - 1(20.0)	5(100.0)
	Not Diversified: A, B, C, D - 4(80.0)	
Diversification of Working Clothes According to Seasons	3 Seasonally Diversified (Spring- Fall, Summer & Winter): A, B - 2(40.0)	5(100.0)
	2 Seasonally Diversified (Spring-Summer-Fall & Winter): C, D, E - 2(40.0)	
Purchase of Working Clothes	Distributed Free on Any Occasion: A, B, C, D, E - 5(100.0)	5(100.0)
Purchase of Safety Equipments	Distributed Free on Any Occasion: A, D, E - 3(60.0)	5(100.0)
	Distributed Free and Personal Purchase Available When Damage Occurred by Own Inattention: B, C - 2(40.0)	
Distribution Frequency of the Basic Working Clothes	1/yr: A, B, C, E - 4(80.0)	5(100.0)
	2/yr: D - 1(20.0)	
Distribution Frequency of the Working Clothes : summer T-shirt & Winter Garment	1/yr: A, B, C, D, E - 5(100.0)	5(100.0)

Blouson Jacket:
Adopted by A, B, C, D, E Companies



Straight Pants Casual:
Adopted by A, B, C, D, E Companies



Straight Pants Formal:
Adopted by E Company

<Fig. 1> Basic Styles of Working Clothes Upper and Lower Garments
- Blouson Jacket and Straight Pants 2 Types(Casual and Tailored)

to a question on the distribution frequency of 'Summer T-shirts' and 'Winter' garments as once a year. As to the 'Spring-Summer-Fall' type working clothes, company D supplied twice a year while the other A, B, C, E companies distributed this type of working clothes once a year.

Following <Figure 1>, <Table 3> and <Table 4> show the types of working clothes and safety equipments in detail. The basic garment styles

are the blouson type jacket and the straight pants for the upper and lower working clothes separately as illustrated in <Figure 1>, which were adopted by all the respondent companies. In particular, the pants are differentiated into 2 types: casual and tailored ones in the occasions of working outside and of formal meeting. Nevertheless the casual type straight pants were taken for most of working time.

The safety equipments distributed by the respondent companies were as like the safety vest, wristlets, leggings, apron, waist belt buckle cover, non-woven disposable overalls, clean room garment, safety helmet, protection goggles, gas masks, ear caps, safety gloves, safety snickers and etc. Among the respondent companies in various industries, company B in automotive got various types of the safety equipments required for the complicated procedures.

<Table 3> Types of Working Clothes and Garment Items of the Subject Companies

Type of Working Clothes / Garments Item	S-F Upper Garment	S-F Lower Garment	Summer Upper Garment	Summer Lower Garment	Winter Upper Garment	Winter Lower Garment	Thermal Upper Garment	Thermal Lower Garment
T-shirt			ABCE (with collar) D (with collar & round neck - 2 types)					
Blouson Jacket	ABCDE		B		ABCDE			
Parka							ACE	
Pants		ABCDE		ABE		ACDE		ABCE
Skirt								
Overall								

※ Company B did not distribute 'Winter' type lower garment in particular, whereas distributed thermal padding pants to workers in the case of working outside.

<Table 4> Types of the Safety Equipments of the Subject Companies

Type of Equipment	Companies	Total No. of Response
Safety Vest	B, E	2
Wristlets	B	1
Leggings	B	1
Apron	A, B, C, D, E	5
Waist Belt Buckle Cover	B	1
Non-woven Disposable Overalls	A B, C, D, E - Occasionally Distributed	5
Clean Room Garment	C	1
Safety Helmet	A, B, C, D, E	5
Gas Mask	A, B, C, D, E	5
Eye Protection Goggles	A, B, C, D, E	5
Ear Caps	A, B, C, D, E	5
Safety Gloves	A, B, C, D, E	5
Safety Snickers	A, B(In & Out Door Type Distribution), C, D, E	5

2) Design Facts of the Working Clothes

The investigation presented the design facts of the working clothes selected in terms of colors and color co-ordination implied by working clothes garment types (refer to <Table 5>). Furthermore, the implication of the enterprise image shown in the working clothes were analyzed by exploring the enterprise image colors and symbols applied to the selected working clothes garment details.

As seen in <Table 5>, the responding companies did not adopt various colors for their working clothes. Through all the types of working garments of the participate companies, the color groups implied are limited within 2 to 3 color co-ordinations, i.e. purple, beige and gray colors. Some showed the basic and point colors matches as well, e.g. 'beige(basic) and blue purple(point)' and 'gray(basic) and navy blue(point)' color matches presented from the working garments of respondent B and 'beige-khaki' coordination for the ones of respondent D.

The working clothes can help employees have conformity at work and make themselves to be proud of their work companies by notifying the enterprise images in their working clothes. The details of the working clothes have been explored and the parts of the working clothes representing the enterprise image and symbol colors were: the main and sub colors of the garment fabrics; company title written on the zipper fastener and buttons/studs; and the company

<Table 5> Colors Implied to the Working Clothes

Working Clothes Type / Color	S-F Upper Garment	S-F Lower Garment	Summer Upper Garment	Summer Lower Garment	Winter Upper Garment	Winter Lower Garment	Thermal Upper Garment	Thermal Lower Garment	Summer T-shirt Short Sleeve
Yellow (Orange Incl.)									
Red (Pink Incl.)									
Blue (Sky Blue, Indigo Incl.)							E	E	A(Sky Bl) B(Gra+Nvy) D
Green (Yellow Gr. Incl.)									
Purple	B(Bg+Pl)		B(Bg+Pl)		B(Bg+Pl)				
Bwon									
Beige (Light Khaki Incl.)	B(Bg+Pl) C D(Bg+Kh)	B C D(Bg+Kh)	B(Bg+Pl)	B	B(Bg+Pl) C D(Bg+Kh)	C D(Bg+Kh)	C(Bg+Kh)	B C(Bg+Kh)	C E(Kh)
Gray	A E	A E	E	A E	A E	A E	A	A	B(Gra+Nvy)
White									
Black									
Total No. of Color Used	3	2	3	2	3	2	3	3	3

logos embroidered on the chest. Implementing the enterprise image colors into the working clothes is more frequently shown in zipper fasteners (5 responses, 100%), buttons or studs (5 responses, 100%) than as in the garment fabric (1 response, 20%) or lining. In addition, implication of the enterprise image symbols in garments is relatively rare, except using the zipper tab pull cases of respondents B and D's working garments (refer to <Table 6>). All the respondents had their enterprise logo embroidery on the chest part of the working jackets. To see these only limited occasions of implementing the business image on the working clothes, it must mean abundant opportunities to make use of the enterprise image and symbol representing garment details to improve the productivity and employee's satisfaction with their work.

3) Size System and Maintenance of the Working Clothes

The results derived from the inquiries into the sizing system of the subject companies were in variety like that A, C, E companies adopted the small-medium-large size system for the upper working garments and C company for lower working garments. Whereas B and D companies adopted the cm/inch measurement size code system for the upper working garments and the companies of A, B, D and E for lower working garments. This kinds of size chart suit the mass production system, which can easily cause the wearer's dissatisfaction with the garment fit. However, certain clothing construction factors, e.g. strap bands to control the measurements and the elastic band on the waist can solve the fit problems as discussed later (refer to <Table 14> and <Table 15>).

<Table 6> Working Clothes Details Implying the Enterprise Image Color and Symbol

Garment Construction Factors	Enterprise Image Color	Total No. of Response	Enterprise Symbol	Total No. of Response
Garment Fabrics	B	1	-	-
Garment Linings	-	-	-	-
Zipper Fastener	A, B, C, D, E	5	B, D	2
Buttons/Studs	A, B, C, D, E	5	-	-
Reflective Material Tape With Hologram	-	-	-	-
Enterprise Logo Embroidery	A, B, C, D, E	5	A, B, C, D, E	5
Others	-	-	-	-

<Table 7> Size Systems Adopted to the Working Clothes

Size System \ Type of Working Clothes	Upper Garment	Lower Garment
S-M-L Size System	A, C, E	C
cm/inch Measurement Size System	B, D	A, B, D, E

To distribute the working clothes to their employees, to set an order for number and size proportions of working clothes is fairly important, which links to the employees'garment satisfaction. For this, the respondent companies have established the data base of their employees measurements (some in detail and some roughly). <Table 8> and <Table 9> show the size proportions for upper and lower working garments. Company A and B established the garment measurement data base for employees (especially shoe measurement D/B established for B company). For upper garment, A company has the size proportion: under Small(S)-14%, Medium (M)-41%, Large(L)-27% and over XLarge(XL) -18%; C company size proportion: S-7%, M-15%, L-46%, XL-32%; E company: S-5%, M-20%, L-60%, XL-15%; B company: 5% for under 95, 100-45%, 105-40%, 10% for over 110; D company: 95-5%, 100-40%, 105-45%, 110-10%. Lower garment size code systems are divided into two, i.e. S-M-L and inch measurement systems. Lower garment size proportions of C company are: under Small(S) - 7%, Medium(M) - 15%, Large(L) - 46% and over XLarge(XL) - 32%; for A company: under 30-10%, 32-33%, 34-45%, over 36-12%; B company: under 30-5%, 32-30%, 34-50%, over 36-15%; D company:

<Table 8> Size Proportions of the Working Clothes Upper Garment (%)

Size Code / Subject Company	~ S	M	L	XL ~	~ 95	100	105	110 ~	Total
A	14	41	27	18					100
B					5	45	40	10	100
C	7	15	46	32					100
D					5	40	45	10	100
E	5	20	60	15					100

※ Company A established the employees' garment size D/B and Company B established the employees' garment & shoe size D/B.

<Table 9> Size Proportions of the Working Clothes Lower Garment (%)

Size Code / Subject Company	~ S	M	L	XL ~	~ 30	32	34	36 ~	Total
A					10	33	45	12	100
B					5	30	50	15	100
C	7	15	46	32					100
D					5	40	45	10	100
E					30	50	15	5	100

※ Company A established the employees' garment size D/B and Company B established the employees' garment and shoe size D/B.

under 30-5%, 32-40%, 34-45%, over 36-10%; and under 30-30%, 32-50%, 34-15%, over 36-5% for E company.

It is a very common mistake to give unnecessary measurement allowances for apparel patternmaking to reduce the size problem, for this soon causes the fit problem and thus the repair of the garments as well. Next, <Table 10> indicates that the garment parts requiring frequent size repair are pants length and waist girth (both for the lower garment). Washing working clothes can be basically done by the companies, however the repair and washing of the working clothes was usually performed by individual wearers.

2. Clothing Construction Factors of the Working Clothes

1) Stitch and Seam Types of the Working Clothes

5 Respondent companies working clothes jackets and pants were collected and analyzed to have an in depth understanding of the working clothes clothing construction factors.

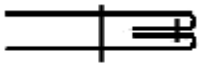
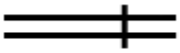
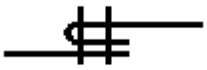
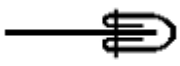
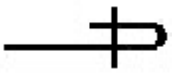
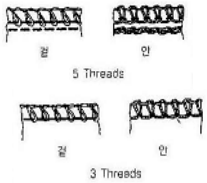
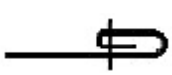
The Korean Industrial Standards, International Standardization Organization, Federal Standards (US) define the types of stitches and seams for clothing construction, i.e. standards of stitches and seams, KS K 0029, KS K 0030, ISO 4915, FS (US). The major stitch classes found out through the analysis of the working clothes of 5 respondent companies were three such as 300, 400 and 500. The stitch types of them were 301: lockstitch, 401: two-thread chain stitch, 504: overedge stitch and 516: safety stitch (refer to <Table 11>).

Seam types applied to the working clothes construction were 14 that are pointed out in <Table 11>. They are Flat Seam (FIS); Lap Felled Seam(LFS); French Seam(FS): French Seam-1(FS-1), French Seam-2(FS-2); Superimposed Seam(SS): Superimposed Seam-1, Superimposed Seam-3 (SS-1 and SS-3); Lapped Seam: Lapped Seam a(LSa), Lapped Seam b(LSb), Lapped Seam q(LSq), Lapped Seam bm(LSbm); Bound Seam-2(BS-2); Edge Finishing Seam: Edge Finishing a(EFa), Edge Finishing b(EFb) in detail.

<Table 10> Repair and Maintenance of the Working Clothes

Descript.	Repair and Maintenance Details	Frequency (%)
Repair Part	Upper Garment Length: N/A	0 (0.0)
	Upper Garment Girth: N/A	0 (0.0)
	Sleeve Length: N/A	0 (0.0)
	Lower Garment Length: A, B, C, D, E	5 (100.0)
	Lower Garment Waist Girth: C, D	2 (40.0)
Repair Method	Repair By Company: N/A	0 (0.0)
	Repair By Person: A, B, C, D, E	5 (100.0)
	Repair By Both Company and Person: N/A	0 (0.0)
Washing Method	Washing By Company: N/A	0 (0.0)
	Washing By Person: C	1 (20.0)
	Washing By Both Company and Person: A, B, D, E	4 (80.0)

<Table 11> Stitch and Seam Types Applied to the Working Clothes

No.	Seam Name	Seam Diagram	Stitch Type	Stitch Name	Stitch Diagram
1	Flat Seam (FIS)		301	Lock Stitch	
2	Lap Felled Seam (LFS)		301	Lock Stitch	
3	Lap Felled Seam (LFS)		401	Two-thread Chain Stitch	
4	French Seam-1 (FS-1)		301	Lock Stitch	
5	French Seam-2 (FS-2)				
6	Superimposed Seam-1 (SS-1)				
7	Superimposed Seam-3 (SS-3)				
8	Lapped Seam a (LSa)				
9	Lapped Seam b (LSb)				
10	Lapped Seam q (LSq)				
11	Lapped Seam bm (LSbm)				
12	Bound Seam-2 (BS-2)				
13	Edge Finishing a (EFa)		504/ 516	Overedge Stitch/ Safety Stitch	
	Edge Finishing b (EFb)				

2) Garment Details of the Working Clothes

Most of all, the clothing construction factors of the working clothes jacket were analyzed in terms of the garment details. The type of the working clothes jacket was the blouson mentioned afore, which has been divided into 5 parts, i.e. collar, front panel, sleeves, back panel and various types of pockets. In particular, many pockets were constructed to provide with functional performance to keep tools and personal things into the working garments. Pants were the basic lower garment type of the working clothes divided into 4 major parts, i.e. waist band, front and back panels and pockets.

The results throughout the jacket analysis were for the collar: shirt collar with band stand separated, one-piece shirt collar. As to the front fly opening, zipper fly was put up with placket 3-velcro fastened, 2 button fastened and 2 press stud fastened (visible/invisible both); jacket front panel: whole bodice pattern or yoke & lower section divided patterns(refer to <Table 12>).

Pockets constructed within the jacket were in various types. The main pockets on the abdominal region: single or double welt bound pockets inserted, inserted pockets, styled patch pockets were presented. Secondly, types of pockets on chest like a double welt bound pocket, an inserted pocket zip fastened (left side), a patch pocket with flap button-buttonhole fastened (both side), a single welt bound pocket inserted with flap stud fastened (both side) and a patch pocket with flap velcro fastened (both side) were shown. As the respondents answered that employees wanted more convenience to keep things during work

<Table 12> Clothing Construction Factors of Working Clothes Jacket - Collar & Front Panel

Garment Parts	Type of Garment Detail	Stitch Type Used	No. of Stitch /inch	Seam Type Used
Collar	Shirt Collar	1/2-Row Top Stitch (Lock Stitch)	9~10	FS-1/FS-2
	Collar Stand	1-Row Top Stitch (Lock Stitch)	9~10	LSb
	One Piece Shirt Collar	1-Row Top Stitch (Lock Stitch)	8~10	FS-1
Front Fly Opening	Zipper Fly	2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	8~10	FS-1/FS-2
	3 Velcro Fastening	1-Row Top Stitch (Lock Stitch)	10	SS-1
	2 Button Fastening	Button Sewing Stitch	-	-
	2 Press Stud Fastening (Visible/Invisible)	Stud Pressing	-	-
Front Panel	Whole Bodice	Lock Stitch	9~10	SS-3
		1/2-Row Top Stitch (Lock Stitch)	9~10	LFS/SS-3
	Yoke & Lower Section Divided	1/2-Row Top Stitch (Lock Stitch/Two-thread Chain Stitch)	10	LFS/LSbm/LSq

with a tight look at the same time, the inner pockets were preferred to. There were also lots of types about inner pockets constructed for the jacket such as a single welt bound pocket inserted with the button and rouleau fastened, a double welt bound pocket inserted zipper fastened and a mobile phone keeping pocket with a strap velcro fastened. Besides, a pen-keeping pocket was one of key garment details as well: 2 or 3 pen-keeping patch on side seam and 2 pen-keeping patch inside pocket types were shown. There were 2 types of armhole constructions, i.e. the standard armhole and the air vent slit armpit constructed using 100% polyester net lining as can be seen in the sports wear. Three types of working clothes sleeves were found out: a traditional one piece sleeve, a 2-piece sleeve for color coordination and a 3-piece sleeve to construct the air vent armpit (refer to <Table 13>).

The jacket back panel was completed with whole bodice panel with 2 pleats on a waist line which can give more stretch to movement; yoke, reflective tape and lower section divided back panel with 2 pleats on a waist line; yoke, reflective tape and lower section divided back panel with 2 slits down to give more air permeability function and with 2 pleats on a waist line. The velcro/button-buttonhole/press stud fastened straps on the side seams of the waist band can shorten or lengthen the waist measurement. Working clothes jackets had different linings parts constructed with the full woven pattern or half net pattern as well as without linings (details represented in <Table 14>).

The garment details of the working clothes pants were divided into 4 major parts, i.e. waist band, front and back panels and pockets. The results were as follows: 5 respondent companies working pants were all constructed with the straight waist band and one of 5 subject companies had the elastic band on the side panels of the waist band. Number of loop belt carriers was 7 to 8. The front fly of working clothes pants was the type of zipper fly with hook and eye or button fastened. Front pockets of the pants were inserted pockets or patch pockets with flaps button-buttonhole fastened (both side). The pants had 2-pleated front panels and 2-darts on the hip section. The pants had hip pockets: single welt bound inserted pockets, double welt bound inserted pockets button-buttonhole fastened, patch pockets with flaps button-buttonhole fastened (both side placed). 2.5/3.0/4.0cm seam allowances were given to the pants hem line (the seam allowance required at minimum for the working clothes pants' hem lines was 2.5cm).

3) Materials and Equipments Used for the Working Clothes

The development of the working clothes requires many factors, such as the functional performance impacting on the working environment features, the wearer's aesthetic preferences and the image adopted by the enterprise. To fulfill all the requirements, the clothing manufacturing technologies like functional fabrics, linings, interlinings (fusible), sewing machines and relevant equipments are necessary. <Table 16> and <Table 17> specify these manufacturing factors in detail.

The fabrics used to construct the working clothes were mainly polyester/cotton (65%/35%) and polyester/rayon (65%/35%) blended fabrics and to provide with more air permeability to wearers, warp knitted linings (polyester 100%) were used (refer to <Table 16>). The required

<Table 13> Clothing Construction Factors of Working Clothes Jacket - Pockets & Sleeves

Garment Parts	Type of Garment Detail	Stitch Type Used	No. of Stitch /inch	Seam Type Used
Waist Pocket	Single/Double Welt Bound Pocket Inserted	1/2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	8~10	SS-1/SS-3/ FS-2/LS
	Inserted Pocket	2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	9	LSq
	Styled Patch Pocket	2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	9	LSq
Chest Pocket	Without Pocket In Chest Area	-	-	-
	Double Welt Bound Pocket Inserted Zip Fastened(Left)	Lock Stitch	9	SS-1
	Patch Pocket	Lock Stitch	9	LSb
	With Flap Button-Buttonhole Fastened (Both Side)	Lock Stitch Zig-zag Stitch	9	LSb
	Single Welt Bound Pocket Inserted	2-Row Top Stitch (Lock Stitch)	9	SS-1
	With Flap Stud Fastened (Both Side)	Lock Stitch	10	FS-1
	Patch Pocket	Lock Stitch	8	LSb
	With Flap Velcro Fastened (Both Side)	Lock Stitch	8	FS-1
Inner Pocket	Without Inner Pocket	-	-	-
	Single Welt Bound Pocket Inserted With Button & Rouleau Fastened	Lock Stitch	10	SS-1
	Double Welt Bound Pocket Inserted Zipper Fastened	Lock Stitch	9	SS-1
	Cell-Phone Pocket With Strap Velcro Fastened	Lock Stitch	10	LSb
Pen Pocket	2/3-Pen Patch On Side Seam	1-Row Top Stitch (Lock Stitch) Zig-zag Stitch	9	LSb
	2-Pen Patch Inside	1-Row Top Stitch (Lock Stitch) Zig-zag Stitch	9	LSb
Armhole	Standard Armhole	1/2-Row Top Stitch (Lock Stitch)	8~10	LFS/LSbm
	Net Material Using Armpit Construction	Lock Stitch	10	EFb
Sleeve	1 Piece Sleeve	1/2-Row Top Stitch (Lock Stitch)	9~10	LFS/LSbm
	2 Piece Sleeve	1/2-Row Top Stitch (Lock Stitch)	9~10	LFS/LSbm
	3 Piece Sleeve	2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	10	LFS
Cuff	Folded On Wrist Line With Velcro/Button-Buttonhole/Stud Fastened	Lock Stitch 1/2-Row Top Stitch (Lock Stitch)	9~10	FS-1/BS-2

trimmings for the working clothes were the fusible interlinings, zip fasteners, buttons, press studs, hooks and eyes, velcro, tapes, embroidered appliques and etc.

<Table 14> Clothing Construction Factors of Working Clothes Jacket - Back Panel, Major Seam Lines and Linings

Garment Parts	Type of Garment Detail	Stitch Type Used	No. of Stitch /inch	Seam Type Used
Back Panel	Whole Bodice with 2 Pleats on Waist Line	Lock Stitch	9~10	SS-3
		1/2-Row Top Stitch (Lock Stitch)	9~10	LFS/SS-3
	Yoke, Reflective Tape(2cm Width) & Lower Section Divided with 2 Pleats on Waist L.	2-Row Top Stitch (Lock Stitch/Two-thread Chain Stitch)	10	LFS/LSq
	Yoke, Reflective Tape(2cm Width) & Lower Section Divided with 2 Slits Down and 2 Pleats on Waist L.	Lock Stitch 2-Row Top Stitch (Lock Stitch)	11	LFS/SS-3
Waist Band	Folded on Waist Line with Velcro/Button-Buttonhole/Stud Fastened Straps	Lock Stitch 2-Row Top Stitch (Lock Stitch)	8~9	BS-2
Shoulder Seam	On Shoulder Line	Lock Stitch 1/2-Row Top Stitch (Lock Stitch)	8~10	LSq
		2-Row Top Stitch (Lock Stitch/Two-thread Chain Stitch)	8~10	LFS/LSbm
Side Seam	On Side Seam Line	Lock Stitch 2-Row Top Stitch (Lock Stitch/Two-thread Chain Stitch)	9~10	SS-3/LFS/ LSq
Linings	N/A	-	-	-
	Full Woven Lining	Lock Stitch	9~10	FIS
	Half Net Lining	Lock Stitch	10	BS-2

<Table 15> Clothing Construction Factors of Working Clothes Pants

Garment Parts	Type of Garment Detail	Stitch Type Used	No. of Stitch /inch	Seam Type Used
Waist Band	Straight Waist Band with the Elastic Band	Lock Stitch 1/2-Row Top Stitch (Lock Stitch)	8~10	BS-2
Loop Belt Carriers	No. of Loops : 7~8	Lock Stitch Zig-zag Stitch	9~11	LSb
Front Fly	Zipper Fly with Hook&Eye/Button/Hook&Eye with Button Fastened	Lock Stitch Button Sewing Stitch	8~11 -	LS -
Front Pocket	Inserted Pocket	2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	9~11	FS-1/FS-2 /LSb
	Patch Pocket with Flap Button-Buttonhole Fastened (Both Side)	Lock Stitch 1-Row Top Stitch (Lock Stitch) Zig-zag Stitch	10	LSb

<Table 15> Continue

Garment Parts	Type of Garment Detail	Stitch Type Used	No. of Stitch /inch	Seam Type Used
Front Panel	2-Pleated	Lock Stitch 2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	8~9	LFS/SS-3/FIS
Side Seam	On Side Seam Line	Lock Stitch 2-Row Top Stitch (Lock Stitch/Two-thread Chain Stitch) Zig-zag Stitch	8~11	LSbm/LFS
Hip Section	1-Dart	Lock Stitch 2-Row Top Stitch (Lock Stitch/Two-thread Chain Stitch) Zig-zag Stitch	9~11	LSbm/LFS /LSq
	2-Dart	Lock Stitch	9~11	FIS
Hip Pocket	Single Welt Bound Inserted Pocket	Lock Stitch & Zig-zag Stitch	10~11	LS
	Double Welt Bound Inserted Pocket with Button-Buttonhole Fastened	Lock Stitch & Zig-zag Stitch	10~11	LS
	Patch Pocket	Lock Stitch/ 2-Row Top Stitch (Lock Stitch) Zig-zag Stitch	9	LSb
	With Flap Button-Buttonhole Fastened (Both Side)	Lock Stitch Zig-zag Stitch	9	LSq/LSb
Hem Line	2.5/3.0/4.0cm Seam Allowances	Lock Stitch/ Lock Stitch & Overedge Stitch	10~12	EFa/EFb
The Others	Waist Belt Buckle Cover Velcro Fastened	Lock Stitch	10	FS-1

<Table 16> Fabrics Used for the Working Clothes

Working Clothes Type / Fabric Type	SF Jacket	SF Pants	Summer Jacket	Summer Pants	Winter Jacket	Winter Pants	Winter Parka	Padding Pants	Summer T-shirt
Polyester/Cotton (65%/35%)	ABDE	ABDE		AE	ABDE	ADE	A(Denim) CE	ABE	A
Polyester/Rayon (65%/35%)	C	C	B	B	C	C		C	
Polyester100% (Performance Material: Coolon™)									BCDE

※ Company B did not distribute 'Winter' type lower garment in particular, whereas distributed thermal padding pants to its employees in the occasion of the outside work.

<Table 17> Main Fabrics and Trimmings Used for the Working Clothes

Material Type	Material Details	Stitch Type	Equipments Type Utilized
Main Fabrics	Polyester/Cotton(65%/35%) or Polyester/Rayon(65%/35%) Z-direction 2x1 Twill or Z-direction 3x1 Twill	Lock Stitch 301 /Safety Stitch 516	Lock Stitch / Safety Stitch Sewing M/C
Linings	Polyester 100%, Z-direction 1x1 Twill; and Various Warp Knitted Linings (Polyester 100%) Rachel Net Linings (Polyester 100%)	Lock Stitch 301	Lock Stitch Sewing M/C
Interlinings	Non-woven Fusible Interlinings (Polyester 100%)	Lock Stitch 301	Lock Stitch Sewing M/C
Zip Fastener	Fly Front Concealed Zipper Insertion Trouser Fly Zipper Insertion Slot Zipper Insertion	Overedge Stitch 504 Safety Stitch 516	Overedge Stitch / Safety Stitch Sewing M/C
Buttons	4-hole Plastic Buttons	Button Sewing Stitch	Button Sewing & Buttonhole M/C
Press Studs	Metal/Plastic Press Studs	-	Stud Pressing M/C
Hooks & Eyes	Metal Hooks & Eyes	Button Sewing Stitch	Button Sewing M/C
Velcro	Nylon & Plastic	Lock Stitch 301	Lock Stitch Sewing M/C
Tapes	Elastic Tape (for the waist band) Reflective Material Tape (1.5~2cm width tapes)	Lock Stitch 301 Zig-zag Stitch	Lock Stitch Sewing M/C Embroidery M/C
Embroidery	Embroidery on Reflective Material Tape (Cut as designed)	Lock Stitch 301 Zig-zag Stitch	Lock Stitch Sewing M/C Embroidery M/C

IV. Conclusion

With the aims to investigate the actual distribution condition of working clothes and to analyze the clothing construction factors of the working clothes supplied to 5 major heavy equipment product manufacturing companies in the Changwon national industrial complex, a questionnaire survey was conducted for the research and the clothing construction factors of the working clothes collected from the participant companies have been analyzed in parallel.

The results derived from the study on the actual distribution condition of the working clothes were as follows:

At the beginning of the research, it has been hypothesized that the garment types of the working clothes would have been differentiated from industry to industry or work process to process. However, throughout the survey on the participant companies, it was revealed that the same garment styles of the working clothes using the same types of materials were worn by the employees within a company and in various industries. Although the participant companies

manufactured the same type of products, yet this result was a notable exception. If wearing the same work clothes can achieve the uniformity at work, then using the safety kit well-developed can improve the functional performance at differentiated work places. The basic garment types of working clothes investigated were the blouson jacket and the straight pants and the differentiated safety equipments were required by differed work fields. Most of the work processes demanded the safety helmet, gloves and snickers; protection goggles, gas masks, ear caps, wristlets, leggings, aprons were required for cutting, welding, grinding, inspection and quality assurance processes; and the disposable overall type of working clothes was distributed for the painting procedure (especially, various types of covers were used in automobiles).

The analysis of the working clothes design facts showed the limited cases of implementing the enterprise image and symbol on the working clothes (e.g. the main and sub colors of the garment fabrics; company title written on the zipper fastener, buttons, or studs; and the company logo embroidered on the chest). Therefore, more opportunities to apply the enterprise image and symbol to garment details can be explored and these would improve the industrial productivity and employees' feeling a connection to their work. Enterprise image colors and symbols can be directly implied to the textile designs of garment fabrics and linings, reflective material tape hologram apart from the zipper fastener, buttons or studs already used.

The size systems adopted by the participant companies were the 'small-medium-large' and 'cm/inch measurement' size code systems that suit the mass production but not the individual expectation level of fit. To solve wearer's dissatisfaction with the garment fit, certain clothing construction factors were used, e.g. strap bands and the elastic band on the waist to control the girths.

Regarding the garment details of the working clothes, the blouson jackets collected from the subject companies have been analyzed into 5 parts, i.e. collar, front panel, sleeves, back panel and various types of pockets. In particular, the back bodice panel of the working jacket included 15~20cm down slits constructed using the net material to provide with the appropriate air permeability within the clothing inner climate during the operation. Moreover, to strengthen the air permeability function of the working jacket the underarm part i.e. the under sleeve and side bodice panel of the working jacket were constructed by using the net material. Many types of pockets were constructed to provide with functional performance to keep tools and personal things into the working garments. According to respondents, workers were told to prefer to the inner pockets for keeping mobile phone constructed inside the working jackets. Pants were the basic garment type of the working clothes lower garment divided into 4 major parts, i.e. waist band, front and back panels and pockets. There were also lots of specs about inner pockets for the jacket.

The working clothes fabrics were mainly polyester/cotton (65%/35%) and polyester/ rayon (65%/35%) blended fabrics and to provide with more air permeability to wearers, warp knitted linings (polyester 100%) were used. The required trimmings to construct working clothes were fusible interlinings, zip fastener, buttons, press studs, hooks and eyes, velcro, tapes, embroidery, etc. The major stitch types found out through the analysis of the working clothes of 5 respondent companies were lockstitch

(301), two-thread chain stitch (401), overedge stitch (504) and safety stitch (516). Seam types applied to the working clothes construction were summarized into 7 categories i.e. flat, lap felled, French, superimposed, lapped, bound, edge finishing seams.

The development of the working clothes requires in-depth understanding of many clothing construction factors and in this sense the research would provide with practical guidelines to evaluate the working clothes construction procedures to fulfill the industrial workers' demand for the improved work environment. The results derived from the study and further studies extended to other various industries can contribute to establish clothing construction data base to develop appropriate working clothes considering the working environments.

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