Glove Selection

How to select disposable gloves

"with variability in quality and vast diversity, never before has selecting disposable gloves seemingly been so complex"

Disposable gloves in a galaxy of colours are everywhere in the workplace. Indeed if we think about it, there are countless tasks in the workplace that entail the wearing of disposable gloves.

With this rising demand for disposable gloves, comes increasing variability in quality. In addition to this vast diversity, users all appear to have different expectations. And yes, every individual is different, with different hands and therefore different needs.

Never before has selecting disposable gloves seemingly been so complex.

The good news is that by taking into account the following four criteria, those involved in selecting disposable gloves can cut through this complexity and hopefully make the correct choice.

1. **The regulations:** This is the starting point! Unfortunately users, distributors and even the manufacturers themselves may fail to interpret the legislation correctly. Taking into account the risks within the workplace (often chemical and biological), only a glove that is registered according to Personal Protective Equipment Directive (89/686/EEC) as Category III (Complex Design) is likely to be suitable.

   These gloves are designed for irreversible or mortal risk and will ideally have been tested against the latest version of the standards (EN420:2003 + A1:2009 or EN374-1/2 & 3: 2003). There are, however, many traps. To find out more, please see below under the heading 'Knowing your stuff'.

   Making the correct choice in terms of the regulations is the minimum that needs to be achieved.

2. **Protection:** We must not forget that the primary function of the glove is to protect the wearer and as such it is not a fashion ▸

accessory. Here, we must not lose sight of three basic elements:

- *Glove materials (whether they be nitrile, latex or neoprene) behave in different ways and each one of them offers advantages and disadvantages*
- *The length – the longer the glove the better it will protect the wearer. In this respect it is worth remembering the minimum liquid proof length requirement (EN374-1:2003) that specifies that a Category III PPE glove must have a length of 24cm, 25cm and 26cm for respectively sizes 8 (M), 9 (L) and 10 (X-L)*
- *The thickness – this is what provides the protective layer on the hand. Whatever the glove material used, the thicker the film the higher the level of protection afforded to the hand. A difference of just two or three hundredth of a centimetre can have a significant impact*

These three elements can affect seriously glove performances. If you're not persuaded, then see how chemical permeation can vary with gauge thickness by comparing two disposable nitrile gloves with different gauge thickness. *(Table 1)*

3. **Comfort:** Wearing gloves all day long is by no means an easy task. The notion of comfort is both very personal and highly subjective, making it difficult for glove manufacturers. Sometimes they will prioritise comfort before personal protection, as they know users will be very sensitive to this issue.

Once again, different materials offer advantages and disadvantages. Latex is undoubtedly the most comfortable material thanks to its superior elasticity, even if nitrile is making great strides in this area. Be careful, however, as in the majority of cases in order to make nitrile more comfortable, you reduce the thickness. While the result is an undeniable gain in comfort, there is also a significant loss in protection. Again, in considering the question of comfort, we should also not forget the risk of allergies and irritation as these may be more prevalent with low quality gloves. High concentrations of chemical residues by virtue of the gloves undergoing reduced washing or insufficient chlorination can contribute to increased risk of potential occupational dermatitis.

4. **Price:** While important, this remains the final part of the selection criteria. Let us not forget that a glove may be worn primarily for personal protection. It is worth pointing out that as much as 60% of the manufacturing costs of a glove are based on the raw materials – hence the very large price fluctuations in recent years, especially on latex.

Faced with this rather turbulent operating environment, manufacturers may quickly opt to reduce the length or thickness of the gloves to the extent that there could be as much as a 100% difference in the amount of raw material between two gloves. Therefore the glove will be less expensive and more comfortable, but unfortunately less effective in terms of its primary function of personal protection. So what price do you put on your personal safety?

EN374-3:2003 Chemical permeation test	ecoSHIELD Eco Nitrile PF 250 (palm thickness=0.10m	SHIELDskin ORANGE NITRILE 260 (palm thickness=0.13mm)
Hydrochloric acid 37% (CAS No: 7647-01-0)	65mins	130mins
Isopropanol 70% (CAS No: 67-63-0)	43mins	72mins
Ethanol 70% (CAS No: 64-17-5)	26mins	34mins
Ammonium hydroxide 25% (CAS No: 1336-21-6)	15mins	22mins
Acetic Acid (CAS No: 64-19-7)	4mins	6mins
Xylene 98.5% (CAS No: 1330-20-7)	2mins	4mins

Table 1 - Source: www.shieldscientific.com/index.php?language=1&menu=chemical-resistance-guide

Knowing your stuff

Even in this time of economic hardship, it's unlikely that responsible managers will want to compromise worker safety. That's why it's important to de-mystify disposable glove legislation.

The use of disposable gloves in the general working environment is widespread. Indeed, they are such a big part of our working lives that glove usage in Europe has increased, but most dramatically the US has increased from less than one billion to more than 20 billion.

We tend to use disposable gloves for either process protection from human-borne contamination or for personal protection and often for both reasons. As safety in the occupational environment becomes an increasing concern, however, do we really understand what level of protection we are getting?

Deciphering the details

For those of us who have the time to decipher the pictograms displayed on the product, we may be surprised by the different legislation being used on gloves in the general workplace. Typically, disposable gloves are classified according to Council Directive 93/42/EEC for the Medical Device Directive (MDD) and Council Directive 89/686/EEC for Personal Protective Equipment.

As the names may suggest, the primary concern for MDD is protecting the patient, while PPE focuses on protecting the glove wearer. Therefore for many applications in the general working environment where personal protection is foremost, one would suppose that gloves registered according to the PPE directive would be used. Unfortunately, this is not ▸

	1994	2003
EN374-3: Tested for protection against chemical permeation		EN374-3  AKL
Low chemical resistant or waterproof gloves		
EN388: Tested for protection against mechanical risks (abrasion, blade cut resistance, tear resistance and puncture resistance)		Unlikely to be displayed as few if any disposable gloves will achieve performance level rating of more than zero
EN374-2: Tested for protection against liquid penetration and micro-organisms		EN374-2  Level 2
Instructions for use	Usually incorporated in the pictogram as 'i'	

always the case as those engaged in sourcing the gloves may not understand the difference between PPE and MDD.

Gloves certified to the PPE directive

We have established that for many applications in the general workplace, the focus is on personal protection and therefore gloves covered by the PPE directive may be the most appropriate.

What should we be looking for, though, and how does the PPE directive help us in terms of giving us optimum protection?

In order to assist health and safety personnel engaged in audits to identify the appropriate PPE to match the hazards and risks, PPE is categorised as Simple Design (often referred to as Category 1) or Complex Design (Category 3). Intermediate design (Category 2) gloves are those gloves that do not fall into either complex design or simple design categories.

> "how does the PPE directive help us in terms of giving us optimum protection?"

Simple Design is considered to be low risk and as such Simple Design gloves are defined as those gloves that protect the wearer from cleaning materials of weak action and easily reversible effects. Gloves giving protection against diluted detergent solutions are given as an example.

Apart from bearing the CE mark, simple design gloves should mention clearly 'For minimal risks only' in at least the official language of the country of destination. Significantly, Simple Design is a self certification process that imposes no obligation on the manufacturer to conduct tests according to certain standards.

While there is an expectation that the manufacturer will compile a technical file (of which the key elements might include manufacturing procedures, ISO compliance, quality control systems, packaging specifications or complaints procedures), there is no external validation.

From this description, it would appear that Simple Design gloves may have a limited role in the workplace where protection from chemicals and micro-organisms is sought.

Complex design gloves

Complex Design covers the highest level of risk, otherwise defined as irreversible and mortal risk. Disposable gloves in this category are typically those gloves that provide protection against chemical splashes and micro-organisms. For these gloves, the following normative references may apply: EN374-1 (terminology and performance requirements), EN374-2 (resistance to penetration by chemicals and micro-organisms), EN374-3 (resistance to permeation by chemicals), EN388 (mechanical risks) and EN420 (general requirements for gloves).

Crucially, Complex Design brings the need for regular auditing by an external organisation body, called a Notified Body. The presence of the Notified Body is clearly evident, as under the CE mark will appear four digits (e.g. 0120 = SGS, 0493=Centexbel, 0321=Satra or 0123=TÜV). The Notified Body validates the quality assurance system used by the manufacturer.

In addition, disposable gloves that have been registered as Complex Design will typically display two or three pictograms, depending on whether they have been tested according to the 1994 or 2003 versions of the norms relating to the PPE directives.

Testing for compliance to Complex Design can take two forms: Article 11A 'EC quality control system for the final product' entails testing of samples by the Notified Body and checks at least every year of the manufacturing facility to ensure homogeneity with the product featured in the EC-type examination certificate.

With Article 11B 'System for ensuring EC quality of production by means of monitoring', testing may be conducted by the manufacturer, but the quality control procedures of the manufacturer are periodically audited by the Notified Body. These details are important as it may help to explain why some manufacturers continue to use the 1994 version of the standards relating to the PPE directive and others the 2003 version.

While the Article 11A route obliges the Notified Body to use the ▸

latest norms, there does not appear to be any such obligation for manufacturers selecting the internal auditing option of Article 11B.

Significance of 1994 and 2003 PPE norms

The 1994 version of the norms did not differentiate between thin gauge disposable gloves designed for incidental exposure to chemical splashes and thicker gauge gloves intended for immersion.

Indeed, for all the relevant normative references (e.g. EN388, EN374-2 and EN374-3), testing was the crucial element for achieving registration. With regard to the mechanical risks pictogram (EN388: 1994), few if any disposable gloves would have the necessary properties to achieve anything more than a performance level rating of '0' for the four specific mechanical tests (resistance to abrasion, blade cut resistance, tear resistance and puncture resistance).

Likewise for chemical permeation (EN374-3: 1994), selection of the four chemicals to be tested was left to the manufacturer, while the outcome mattered little so long as the testing had been done.

In all cases the 'i' on the pictogram referred the user to more detailed test data displayed on the glove dispenser box. Testing for protection against liquid penetration and micro-organisms (EN374-2: 1994) gave manufacturers a choice of levels of pinholes (Acceptable Quality Levels or AQL of 4, 1.5 and 0.65), without stating a minimum level.

In view of the possible confusion between the levels of protection being offered by thin gauge disposable gloves versus thick gauge gloves, the 2003 version of the standards relating to the PPE directive imposes more rigorous testing criteria:

EN388: 2003 (protection from mechanical risks) - this pictogram can only be displayed if the glove achieves a performance level rating of one in at least one of the four specific tests.

> "in view of the possible between levels of protection, the 2003 version of standards imposes more rigorous testing criteria"

EN374-3: 2003 (determination of resistance to permeation by chemicals) - this glass beaker pictogram can now only be displayed if a breakthrough time of at least 30 minutes (permeation performance level: 2) has been achieved in three of the 12 listed chemicals (see *Table 2*).

The code letters of the three tested chemicals must now feature below the pictogram. In each chemical class, it would appear that the most aggressive chemical has been selected giving the glove wearer a worse case scenario for chemicals in that particular classification.

Consequently, EN374-3: 2003 represents a significant improvement on the previous version, in terms of its value to those seeking protection from chemicals. Closer scrutiny of the 12 selected chemicals, however, would suggest that no standard thin gauge disposable glove in whatever material would achieve the required level 2 in three out of the 12 listed chemicals.

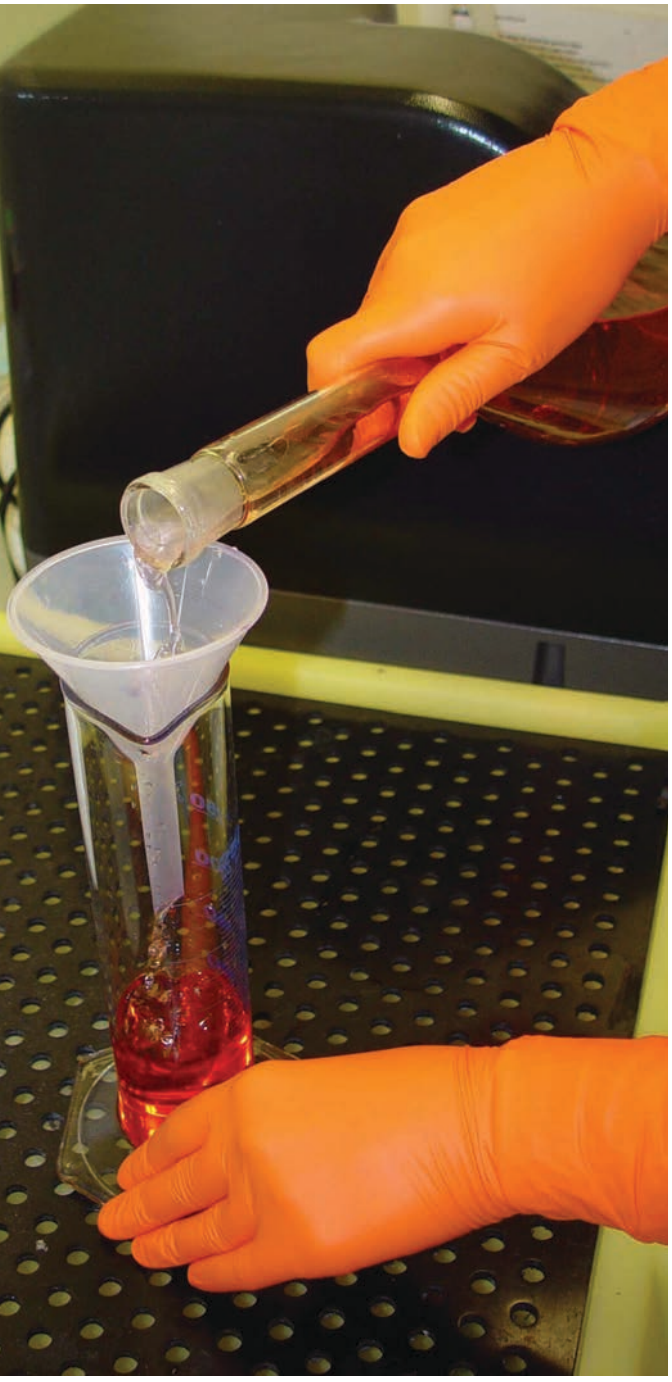
To highlight the limitations of the chemical barrier properties of standard thin gauge disposable ▸

Code letter	Chemical	CAS N°	Class
A	Methanol	67-56-1	Primary alcohol
B	Acetone	67-64-1	Ketone
C	Acetonitrile	75-05-8	Nitrile Compound
D	Dichloromethane	75-09-2	Chorinated paraffin
E	Carbon disulphide	75-15-0	Sulphur containing organic compound
F	Toluene	108 88 3	Aromatic hydrocarbon
G	Diethylamine	109 89 7	Amine
H	Tetrahydrofurane	109 99 9	Heterocyclic and ether compound
I	Ethyl acetate	141 78 6	Ester
J	n-Heptane	142 85 5	Saturated hydrocarbon
K	Sodium hydroxide 40%	1310 73 2	Inorganic base
L	Sulphuric acid 96%	7664 93 9	Inorganic mineral acid

Table 2

Performance level	Acceptable Quality Level (AQL) unit	Inspection levels
Level 3	‹0.65	G1
Level 2	‹1.5	G1
Level 1	‹4.0	S4

Table 3



"glove choice may well have become over simplified, so that you just purchase on the basis of it being latex or nitrile"

gloves and to emphasise that these gloves are designed only for incidental exposure to chemical splashes, EN374: 2003 has given us a new pictogram.

The question mark in the middle of the square-shaped glass beaker reminds those of us engaged in risk assessments that we are referring to 'low chemical resistant' or 'waterproof' gloves. Significantly, there is no obligation for the manufacturer to undertake any testing on the 12 listed chemicals and the new pictogram only tells us that the gloves have fulfilled the penetration test (EN374-2: 2003).

While it is prudent to seek advice from the manufacturer on actual breakthrough times with a particular chemical, we should not forget that this test data will often be based on deep immersion of the glove into the chemical and therefore may not offer a realistic representation of a work situation where the focus is on splash protection.

Also, it should be noted that any test data is likely to be done on an unused glove and does not reflect the actual workplace situation, where the used glove is subjected to many other stresses that are beyond the scope of a simple laboratory test.

EN374-2: 2003 (determination of resistance to penetration by chemical and/or micro-organisms through porous material). An important test for those using disposable gloves to protect themselves from micro-organisms, as it gives us an indication of the barrier properties of the glove to liquid-borne biohazards.

For most disposable gloves, the water leak test is used, where according to the inspection level based on ISO 2859 a specified number of gloves from every batch are filled with water to assess the levels of pinholes. Levels of pinholes are measured in terms of AQL or Acceptable Quality Level, with an AQL of 0.65 having a lower level of acceptable pinholes than 4.0. To display the pictogram and as part of the process for satisfying a Complex Design registration, gloves must have a minimum AQL of 1.5. EN374-2: 2003 describes the levels, which are often displayed underneath the pictogram *(Table 3)*.

Conclusions

As you will have already appreciated, choosing a glove is difficult when there is such a vast jungle of available products. Glove choice may well have become over simplified, so that you just purchase on the basis of it being latex or nitrile, powdered or powder-free and depending on price.

For practical and economic reasons, often the users select just one glove. A better strategy might be to use two or three different gloves to cover all the needs you are likely to encounter in the workplace. This approach is likely to better optimise the balance between protection and cost – or comfort and cost. ■

Bibliography

EN374-1:2003 Protective gloves against chemicals and micro-organisms – Part 1: Terminology and performance requirements

EN374-2:2003 Protective gloves against chemicals and micro-organisms – Part 2: Determination of resistance to penetration

EN374-3:2003 Protective gloves against chemicals and micro-organisms – Part 3: Determination of resistance to permeation by chemicals

EN420:2003 + A1:2009 Protective gloves – General requirements and test methods

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