

ACTION RESEARCH PROJECT REPORT

ON

**“TO STUDY THE NATIONAL AND GLOBAL PRACTICES
RELATING TO QUALITY ASPECTS OF KNOCK-DOWN
FURNITURE”**

(Unique Project Number: AR/0020)



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भारतीय मानक बूरे
BUREAU OF INDIAN STANDARDS

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DECLARATION OF ORIGINAL WORK

I, Pradeep Singh Shekhawat, Scientist-D (indicate official's Name & Designation), Employee No 065510 hereby declare that the Action Research Project titled "To study the national and global practices relating to quality aspects of knock-down furniture" is the original research work done by me. I have not copied from any other Action Research Project or any other work of similar nature and topic done by any person/institution/body either published or yet to be published. Data and information from other sources, used if any, have been with prior permission, wherever required and is duly acknowledged appropriately in the project report submitted by me.

This declaration is made on the 30th day of June 2021.

Sd/-
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1.1 General

Furniture is one of the most widely used and functionally important items for interiors in homes, offices, hospitals, educational institutions and other occupancies. Traditionally, wooden furniture was used for the purpose, whether in drawing rooms, bed rooms, for study purposes or offices. Subsequently, steel and later plastic furniture also came into use. Also, the wood in wooden or composite type of furniture has been used to a large extent substituted by various reconstituted wood panel products such as plywood, particle board and medium density fibreboard.

Of late, in place of finished wooden furniture, the furniture in knock-down condition are also being manufactured using wood or more frequently other lignocellulosic material based panel products making the tops, slabs, sides, etc of the furniture. In knock-down furniture, various parts are supplied separately which are assembled at customer's end quite conveniently. Knock-down furniture decreases the unit transport cost, and the risk of damage from hitting and dropping during transport is lesser in knock-down furniture systems, apart from these being more convenient for transportation being in more compact form. Hence, they are suitable for transportation in mass to greater distances. In India, the major part (approximately 85 percent) of furniture industry is in unorganized sector. The organized sector in the country comprises large scale industry with popular Indian brands or those from abroad having entity in India, such as Godrej & Boyce Manufacturing Co Ltd, BP Ergo, Featherlite, Haworth, Style Spa, Yantra, Renaissance, Millennium Lifestyles, Durian, Kian, Tangent, Furniture Concepts, Furniturewala, Zuari, Truzo, N R Jasani & Company, V3 Engineers, PSL Modular Furniture, etc who also engage in manufacture/sale of knock-down furniture.

1.2 Need & Objective of Study

Day by day furniture imports are increasing in India, the main reasons behind the increase in demand of furniture being boom in housing and commercial sector, increase in per capita income level and influence of global lifestyle. As per the information available on internet, in India, most of the furniture exported/imported are knock-down furniture. As per the available data of furniture export in 2018, India is at 28th

number and the countries like China, Germany, Poland, Italy and USA are the leaders in exports. To ensure proper quality control of such type of furniture in India through certification like BIS Certification Mark Scheme, Indian Standards – Specifications are required. So, for the same first we need to study the Internationally available standards/practices as well to find the standard practices followed by the furniture industry world-wide.

In view the above, the objective of this study is to study the national and global practices/standards relating to quality aspects of knock-down furniture and then after their comparison of these with the available Indian Standards. And finally, recommendation for formulation on Indian Standards on the different knock-down furniture.

1.3 Organization of the Report-

The entire report is divided into three chapters. The first chapter discusses about the developments the Furniture sector with respect to increase in customer demand and availability of the same along with quality conformance. Also discussed about the need and objective of the study on the national and global practices/standards relating to quality aspects of knock-down furniture. Finally, the organization of the report is presented.

Chapter 2 presents literature review of IS, ISO and EN Standards on different type of furniture and world-wide practices followed by the Furniture industry.

Chapter 3 presents conclusion and recommendations.

2.1 GENERAL

In India we have Indian Standards on different type of Furniture like office chairs, wooden chairs, metal chairs, folding chairs, tables, stools, steel cabinets, steel shelving racks etc. But most of the Indian Standards are having mainly raw material requirements and for final product only finished surface requirements have been given. Also, most of these Indian Standards are formulated in between period of 1975 to 1995. After that, since last two decades' lot of changes have happened in demand and supply in furniture sector.

Internationally ISO and EN standards are available for type of furniture and on the test methods for check their performance requirements. Most of the countries either directly use these ISO or EN standards or have been formulated their own country standards based on these standards.

Other than that globally the furniture industry also uses the BIFMA (Business and Institutional Furniture Manufacturers Association) guidelines/standards to check the conformance of their products. BIFMA is the not-for-profit trade association for business and institutional furniture manufacturers. BIFMA develops, maintains, and publishes safety and performance standards for furniture products.

2.2 EXISTING STANDARDIZATION ON FURNITURE

The existing literature shows that the ISO & EN standards most commonly used world-wide. And common thing in all of the product specification is that in all these standards the performance requirements of the furniture have been focused. The details related to India Standards, ISO Standards & EN Standards for furniture are as follows:

2.2.1 Indian Standards related to Furniture

In India, the Indian Standards have been formulated by the Furniture Sectional Committee, CED 35, Scope of the Sectional Committee is '*Standardization in the field of furniture including furniture used for general purposes, offices, schools, stadium, auditorium, cinema houses, restaurants, library, etc.*' The details of Indian Standards formulated by this committee are given below:

SI No.	IS Number	Title	No. of Amd.
1	IS 1829 (Part 1):2017	Library furniture and fittings — Specification: Part 1 Timber (<i>second revision</i>)	
2	IS 1829 (Part 2):2017	Library furniture and fittings: Part 2 Steel — Specification (<i>second revision</i>)	
3	IS 1883:2020	Metal shelving racks (adjustable type) — Specification (<i>fourth revision</i>)	
4	IS 2695:1993	Specification for drawing filing equipment (<i>second revision</i>)	
5	IS 3312:2021	Steel shelving cabinets (adjustable type) — Specification (<i>third revision</i>)	
6	IS 3313:1983	Specification for steel filing cabinets for general office purposes (<i>second revision</i>)	
7	IS 3314:1984	Specification for steel clothes lockers (<i>second revision</i>)	
8	IS 3497:1992	Steel wardrobes (adjustable type) — Specification (<i>second revision</i>)	
9	IS 3498:1993	Metal table (office type) — Specification (<i>third revision</i>)	
10	IS 3499 (Part 1):1985	Specification for metal chairs for office purposes: Part 1 Non-revolving and non-tilting (<i>second revision</i>)	
11	IS 3499 (Part 2):1985	Specification for metal chairs for office purposes: Part 2 Revolving and tilting (<i>second revision</i>)	
12	IS 3499 (Part 2):1985(B)		
12	IS 3663:2018	Dimensions of tables and chairs for office purposes (<i>third revision</i>)	
13	IS 3761:2020	Metal side racks (adjustable type) — Specification (<i>second revision</i>)	
14	IS 3762:1979	Specification for metal waste paper bins (<i>first revision</i>)	
15	IS 3763:1983	Specification for metal folding chairs (<i>first revision</i>)	

SI No.	IS Number	Title	No. of Amd.
16	IS 3791:1983	Specification for metal paper trays (<i>first revision</i>)	
17	IS 3845:1966	Code of practice for joints used in wooden furniture	
18	IS 4103:1977	Specification for metal nesting chairs (<i>first revision</i>)	1
19	IS 4116:1988	Specification for wooden shelving cabinets (adjustable type) (<i>second revision</i>)	2
20	IS 4126:1986	Specification for wooden wardrobes (adjustable and non- adjustable type) (<i>first revision</i>)	2
21	IS 4204:1974	Functional requirements for drafting chairs (<i>first revision</i>)	1
22	IS 4205:1989	Drafting stools — Specification (<i>second revision</i>)	
23	IS 4414:1990	Wooden table tops — Specification (<i>second revision</i>)	2
24	IS 4415:1974	Glossary of terms relating to wooden furniture and fixtures (<i>first revision</i>)	1
25	IS 4837:1990 IS 4837:1990 (B)	School furniture, classroom chairs and tables — Recommendations (<i>second revision</i>)	1
26	IS 5391:1992	Adjustable metal chairs for use of typists and operators in telephone exchanges — Specification (<i>second revision</i>)	
27	IS 5416 (Part 1):1988	Methods of test for strength and stability of chairs and stools: Part 1 Strength (<i>first revision</i>)	
28	IS 5416 (Part 2):1988	Method of test for strength and stability of chairs and stools: Part 2 Determination of stability of chairs and stools (<i>first revision</i>)	
29	IS 5807 (Part 1):1975	Methods of test for clear finishes for wooden furniture: Part 1 Resistance to dry heat (<i>first revision</i>)	
30	IS 5807 (Part 2):1975	Methods of test for clear finishes for wooden furniture: Part 2 Resistance to wet heat (<i>first revision</i>)	
31	IS 5807 (Part 3):1971	Methods of test for clear finishes for wooden furniture: Part 3 Resistance to marking by oils and fats	

SI No.	IS Number	Title	No. of Amd.
32	IS 5807 (Part 4):1975	Methods of test for clear finishes for wooden furniture: Part 4 Resistance to marking by liquids	
33	IS 5807 (Part 5):1975	Methods of test for clear finishes for wooden furniture: Part 5 Test for low-angle glare	
34	IS 5807 (Part 6):1978	Methods of test for clear finishes for wooden furniture: Part 6 Resistance to mechanical damage	
35	IS 5823:1986	Specification for dining tables (<i>first revision</i>)	2
36	IS 5923:1986	Specification for wooden clothes lockers (<i>first revision</i>)	2
37	IS 5967 (Part 1):1988	Methods of test for strength and stability of tables and trolleys: Part 1 Strength (<i>first revision</i>)	
38	IS 5967 (Part 2):1988	Methods of test for strength and stability of tables and trolleys: Part 2 Stability (<i>first revision</i>)	
39	IS 5974:1986	Specification for divans and easy chairs (<i>first revision</i>)	2
40	IS 6179:1971	Specification and safety requirements for rigid sided playpens	3
41	IS 6184:1971	Dimensions for furniture mirrors	
42	IS 6185:1971	Specification and safety requirements for high chairs	
43	IS 6188:1988	Specification for wooden bedside table (<i>first revision</i>)	2
44	IS 6189:1985	Specification for metal stationary cupboards (<i>first revision</i>)	
45	IS 6632:1988	Specification for wooden folding chairs (<i>first revision</i>)	2
46	IS 7070:1988	Wooden shelving racks, adjustable and non-adjustable type — Specification (<i>first revision</i>)	2
47	IS 7076:1983	Specification for metal book ends (<i>first revision</i>)	
48	IS 7259 (Part 1):1988	Specification for wooden beds: Part 1 For use with	2

SI No.	IS Number	Title	No. of Amd.
		mattresses (<i>first revision</i>)	
49	IS 7760:1985	Specification for steel glass-front cabinets (<i>first revision</i>)	
50	IS 7761:1983	Specification for steel book cases (<i>first revision</i>)	
51	IS 8126:1993	Specification for composite office tables (<i>first revision</i>)	
52	IS 8467:1977	Specification for steel card-index cabinets	1
53	IS 8761:1978	Specification for steel folding cots	
54	IS 9236:1993	Metal letter-rests — Specification (<i>first revision</i>)	
55	IS 9715:1981	Specification for steel visible indexing system cabinets	
56	IS 11525:1986	Specification for wooden chairs for office purposes	2
57	IS 11679:1986	Specification for wooden tables for office use	2
58	IS 12674 (Part 1):1989	Methods of test for strength and stability of settees and benches: Part 1 Strength	
59	IS 12674 (Part 2):1989	Methods of test for strength and stability of settees and Benches: Part 2 Stability	
60	IS 12680:1989	Wooden sofa-cum-bed — Specification	2
61	IS 13089:1991 / ISO 7171-1988	Furniture — Storage units — Determination of stability	
62	IS 13713:2021	Plastic chairs for general purposes — Specification (<i>first revision</i>)	
63	IS 13896:1994	Machine operators table and visual display unit (VDU) table — Specification	

2.2.2 ISO Standards related to Furniture

In the ISO, the standardization work related to Furniture has been assigned to the Technical Committee ISO/TC 136 – Furniture. The Secretariat of the Committee is with Italy (UNI), 27 countries are the Participating members and 36 countries are the Observing members.

The Scope of this committee is - *Standardization in the field of furniture including:*

- *Terms and definitions;*
- *Performance, safety and dimensional requirements;*
- *Requirements for specific components (such as hardware);*
- *Test methods.*

By furniture is meant free-standing or built-in units which are used for storing, lying, sitting, working and eating.

Excluded: Such units with corresponding functions that are dealt with by other ISO technical committees.

Till date total 25 ISO standards has been published by this committee and 10 ISO standards under development. The details of ISO Standards formulated by this committee is given below:

Sl No.	ISO Standard Number	Title
1.	ISO 3055:1985	Kitchen equipment — Coordinating sizes
2.	ISO 4211-2:2013	Furniture — Tests for surface finishes — Part 2: Assessment of resistance to wet heat
3.	ISO 4211-3:2013	Furniture — Tests for surface finishes — Part 3: Assessment of resistance to dry heat
4.	ISO 4211-4:1988	Furniture — Tests for surfaces — Part 4: Assessment of resistance to impact
5.	ISO 4211:1979	Furniture — Assessment of surface resistance to cold liquids
6.	ISO 7170:2005	Furniture — Storage units — Determination of strength and durability
7.	ISO 7171:2019	Furniture — Storage units — Test methods for the determination of stability
8.	ISO 7172:1988	Furniture — Tables — Determination of stability

Sl No.	ISO Standard Number	Title
9.	ISO 7173:1989	Furniture — Chairs and stools — Determination of strength and durability
10.	ISO 7174-1:1988	Furniture — Chairs — Determination of stability — Part 1: Upright chairs and stools
11.	ISO 7174-2:1992	Furniture — Chairs — Determination of stability — Part 2: Chairs with tilting or reclining mechanisms when fully reclined, and rocking chairs
12.	ISO 7175-1:2019	Furniture — Children's cots and folding cots for domestic use — Part 1: Safety requirements
13.	ISO 7175-2:2019	Furniture — Children's cots and folding cots for domestic use — Part 2: Test methods
14.	ISO 8191-1:1987	Furniture — Assessment of the ignitability of upholstered furniture — Part 1: Ignition source: smouldering cigarette
15.	ISO 8191-2:1988	Furniture — Assessment of ignitability of upholstered furniture — Part 2: Ignition source: match-flame equivalent
16.	ISO 9098-1:1994	Bunk beds for domestic use — Safety requirements and tests — Part 1: Safety requirements
17.	ISO 9098-2:1994	Bunk beds for domestic use — Safety requirements and tests — Part 2: Test methods
18.	ISO 9221-1:2015	Furniture — Children's high chairs — Part 1: Safety requirements
19.	ISO 9221-2:2015	Furniture — Children's high chairs — Part 2: Test methods
20.	ISO 10131-1:1997	Foldaway beds — Safety requirements and tests — Part 1: Safety requirements
21.	ISO 10131-2:1997	Foldaway beds — Safety requirements and tests — Part 2: Test methods
22.	ISO 19833:2018	Furniture — Beds — Test methods for the determination of stability, strength and durability
23.	ISO 21015:2007	Office furniture — Office work chairs — Test methods for the determination of stability, strength and durability
24.	ISO 21016:2007	Office furniture — Tables and desks — Test methods for the determination of stability, strength and durability

SI No.	ISO Standard Number	Title
25.	ISO 24496:2017	Office furniture — Office chairs — Methods for the determination of dimensions

2.2.3 EN Standards related to Furniture

In the European Committee for Standardization (CEN), the standardization work related to Furniture has been assigned to the Technical Committee CEN/TC 207 – Furniture. The Secretariat of the Committee is with Italy (UNI).

The Scope of this committee is - *Standardization in the field of all furniture (including mattresses, mechanical aspects of the electrically operated furniture; excluding transport furniture), considering, where appropriate: - terminology; - safety and health; - product environmental sustainability and sector-specific applications of circular economy principles; - test methods and requirements for end products, parts, components, surfaces, surface finishes and furniture hardware; - dimensions. Standards for raw materials are excluded.*

Till date total 82 EN standards has been published by this committee and 24 EN standards under development. The details of EN Standards formulated by this committee are given below:

SI No.	EN Standard Number	Title
1.	CEN/TR 14699:2004	Office furniture - Terminology
2.	CEN/TR 14073-1:2004	Office furniture - Storage furniture - Part 1: Dimensions
3.	CEN/TR 15349:2006	Hardware for furniture - Terms for extension elements and their components
4.	CEN/TR 1335-4:2009	Office furniture - Office work chair - Part 4: Clarifications to EN 1335-1:2000 (Dimensions)
5.	EN 1335-1:2020	Office furniture - Office work chair - Part 1: Dimensions - Determination of dimensions
6.	CEN/TR 15588:2007	Hardware for furniture - Terms for hinges and their components

Sl No.	EN Standard Number	Title
7.	EN 15706:2009	Hardware for furniture - Strength and durability of slide fittings for sliding doors and roll fronts
8.	CEN/TR 15709:2008	Hardware for furniture - Terms for slide fittings for sliding doors and roll fronts
9.	CEN/TR 16015:2010	Hardware for furniture - Terms for locking mechanisms
10.	EN 1725:1998	Domestic furniture - Beds and mattresses - Safety requirements and test methods
11.	EN 581-1:2017	Outdoor furniture - Seating and tables for camping, domestic and contract use - Part 1: General safety requirements
12.	EN 16890:2017	Children's furniture - Mattresses for cots and cribs - Safety requirements and test methods
13.	EN 1022:2018	Furniture - Seating - Determination of stability
14.	EN 12727:2016	Furniture - Ranked seating - Requirements for safety, strength and durability
15.	EN 15372:2016	Furniture - Strength, durability and safety - Requirements for non-domestic tables
16.	EN 581-2:2015	Outdoor furniture - Seating and tables for camping, domestic and contract use - Part 2: Mechanical safety requirements and test methods for seating
17.	EN 1130:2019	Children's furniture - Cribs - Safety requirements and test methods
18.	EN 1728:2012/AC:2013	Furniture - Seating - Test methods for the determination of strength and durability
19.	EN 16139:2013/AC:2013	Furniture - Strength, durability and safety - Requirements for non-domestic seating
20.	EN 16955:2017	Hardware for furniture - Tapered pressure tubes for self-supporting gas springs for the height adjustment of seating - Test methods and requirements for strength and durability
21.	EN 1116:2018	Furniture - Kitchen furniture - Coordinating sizes for kitchen furniture and kitchen appliances

Sl No.	EN Standard Number	Title
22.	EN 716-2:2017	Furniture - Children's cots and folding cots for domestic use - Part 2: Test methods
23.	EN 16122:2012/AC:2015	Domestic and non-domestic storage furniture - Test methods for the determination of strength, durability and stability
24.	EN 13721:2004	Furniture - Assessment of the surface reflectance
25.	EN 14434:2010	Writing boards for educational institutions - Ergonomic, technical and safety requirements and their test methods
26.	CEN/TS 16209:2011	Furniture - Classification for properties for furniture surfaces
27.	EN 17214:2019	Visual assessment of furniture surfaces
28.	EN 15828:2010	Hardware for furniture - Strength and durability of hinges and their components - Stays and hinges pivoting on a horizontal axis
29.	CEN/TR 17202:2018	Furniture - General safety guidelines - Entrapment of fingers
30.	CEN/TR 17292:2018	Technical report regarding precision data for standards EN 12720, EN 12721, EN 12722, EN 15185 and EN 15186
31.	EN 16121:2013+A1:2017	Non-domestic storage furniture - Requirements for safety, strength, durability and stability
32.	EN 15186:2012	Furniture - Assessment of the surface resistance to scratching
33.	EN 16122:2012	Domestic and non-domestic storage furniture - Test methods for the determination of strength, durability and stability
34.	EN 527-2:2016+A1:2019	Office furniture - Work tables - Part 2: Safety, strength and durability requirements
35.	EN 16337:2013	Hardware for furniture - Strength and loading capacity of shelf supports
36.	EN 15570:2008	Hardware for furniture - Strength and durability of hinges and their components - Hinges pivoting on a vertical axis
37.	EN 716-1:2017+AC:2019	Furniture - Children's cots and folding cots for domestic use - Part 1: Safety requirements
38.	EN 15939:2019	Hardware for furniture - Strength and loading capacity of wall attachment devices
39.	CEN/TR 17538:2020	Furniture - Common test equipment - Test foams and mattresses

Sl No.	EN Standard Number	Title
40.	EN 1021-2:2014	Furniture - Assessment of the ignitability of upholstered furniture - Part 2: Ignition source match flame equivalent
41.	EN 1023-2:2000	Office furniture - Screens - Part 2: Mechanical safety requirements
42.	EN 1129-2:1995	Furniture - Foldaway beds - Safety requirements and testing - Part 2: Test methods
43.	EN 12720:2009+A1:2013	Furniture - Assessment of surface resistance to cold liquids
44.	EN 1021-1:2014	Furniture - Assessment of the ignitability of upholstered furniture - Part 1: Ignition source smouldering cigarette
45.	EN 13759:2012	Furniture - Operating mechanisms for seating and sofa-beds - Test methods
46.	EN 581-2:2015/AC:2016	Outdoor furniture - Seating and tables for camping, domestic and contract use - Part 2: Mechanical safety requirements and test methods for seating
47.	EN 527-1:2011	Office furniture - Work tables and desks - Part 1: Dimensions
48.	EN 1728:2012	Furniture - Seating - Test methods for the determination of strength and durability
49.	EN 1729-1:2015	Furniture - Chairs and tables for educational institutions - Part 1: Functional dimensions
50.	EN 1130:2019/AC:2020	Children's furniture - Cribs - Safety requirements and test methods
51.	EN 14749:2016	Furniture - Domestic and kitchen storage units and kitchen-worktops - Safety requirements and test methods
52.	EN 1729-1:2015/AC:2016	Furniture - Chairs and tables for educational institutions - Part 1: Functional dimensions
53.	EN 15338:2007+A1:2010	Hardware for furniture - Strength and durability of extension elements and their components
54.	EN 14072:2003	Glass in furniture - Test methods
55.	EN 16014:2011	Hardware for furniture - Strength and durability of locking mechanisms

Sl No.	EN Standard Number	Title
56.	EN 1335-2:2018	Office furniture - Office work chair - Part 2: Safety requirements
57.	EN 581-3:2017	Outdoor furniture - Seating and tables for camping, domestic and contract use - Part 3: Mechanical safety requirements for tables
58.	EN 747-2:2012+A1:2015	Furniture - Bunk beds and high beds - Part 2: Test methods
59.	EN 13150:2020	Workbenches for laboratories in educational institutions - Dimensions, safety and durability requirements and test methods
60.	EN 1129-1:1995	Furniture - Foldaway beds - Safety requirements and testing - Part 1: Safety requirements
61.	EN 1334:1996	Domestic furniture - Beds and mattresses - Methods of measurement and recommended tolerances
62.	EN 1730:2012	Furniture - Tables - Test methods for the determination of stability, strength and durability
63.	EN 597-2:2015	Furniture - Assessment of the ignitability of mattresses and upholstered bed bases - Part 2: Ignition source: match flame equivalent
64.	EN 16139:2013	Furniture - Strength, durability and safety - Requirements for non-domestic seating
65.	EN 597-1:2015	Furniture - Assessment of the ignitability of mattresses and upholstered bed bases - Part 1: Ignition source smouldering cigarette
66.	EN 1957:2012	Furniture - Beds and mattresses - Test methods for the determination of functional characteristics and assessment criteria
67.	EN 1023-1:1996	Office furniture - Screens - Part 1: Dimensions
68.	EN 14073-3:2004	Office furniture - Storage furniture - Part 3: Test methods for the determination of stability and strength of the structure
69.	EN 12722:2009+A1:2013	Furniture - Assessment of surface resistance to dry heat

Sl No.	EN Standard Number	Title
70.	EN 14074:2004	Office furniture - Tables and desks and storage furniture - Test methods for the determination of strength and durability of moving parts
71.	EN 12521:2015	Furniture - Strength, durability and safety - Requirements for domestic tables
72.	EN 13722:2004	Furniture - Assessment of the surface gloss
73.	EN 12721:2009+A1:2013	Furniture - Assessment of surface resistance to wet heat
74.	EN 1729-2:2012+A1:2015	Furniture - Chairs and tables for educational institutions - Part 2: Safety requirements and test methods
75.	EN 12227:2010	Playpens for domestic use - Safety requirements and test methods
76.	EN 747-1:2012+A1:2015	Furniture - Bunk beds and high beds - Part 1: Safety, strength and durability requirements
77.	EN 12520:2015	Furniture - Strength, durability and safety - Requirements for domestic seating
78.	EN 14073-2:2004	Office furniture - Storage furniture - Part 2: Safety requirements
79.	EN 15185:2011	Furniture - Assessment of the surface resistance to abrasion
80.	EN 15187:2006	Furniture - Assessment of the effect of light exposure
81.	EN 1023-3:2000	Office furniture - Screens - Part 3: Test methods
82.	EN 14703:2007	Furniture - Links for non-domestic seating linked together in a row - Strength requirements and test methods

2.3 STANDARDS RELATED TO KNOCK-DOWN FURNITURE

2.3.1 Indian Standards Covering Knock-Down Furniture

From the above-mentioned list of Indian Standards (2.2.1), The Standards mostly covers Conventional Furniture, Metal Furniture, Plastic Furniture etc. And only few Indian Standards covering to knock-down furniture. The summary of these Indian Standards are as follows:

1) IS 3499 (Part 1):1985 - Specification for metal chairs for office purposes: Part 1 Non-revolving and non-tilting.

Summary –

This standard cover requirements of materials, construction and finish of non-revolving and non-tilting metal chairs for office purposes. Different construction materials are allowed with conformance to their respective Indian Standards like aluminium sheet & tube, mild steel sheet & tube, electrodes, screws etc. The fabrication & assembly recommendations have also been given to guide the manufacturer.

The chairs are further classified as per chairs with and without arm rest. However, the type of tests and the requirements for both type of chairs are remains same. Other than raw material conformance, the testing of final product is only related to the surface performance requirements i.e. Scratch hardness test, Pressure test, Flexibility and Adhesion test, Stripping test and Test for protection against corrosion under conditions of condensations.

No performance requirements have been given related to strength, stability and durability of the Chairs.

2) IS 3499 (Part 2):1985 - Specification for metal chairs for office purposes: Part 2 Revolving and tilting.

Summary –

This standard cover requirements of materials, construction and finish of revolving and tilting metal chairs for office purposes. Different construction materials are allowed with conformance to their respective Indian Standards like aluminium sheet & tube, mild steel sheet & tube, electrodes, screws etc. The fabrication & assembly recommendations have also been given to guide the manufacturer.

Other than raw material conformance the testing of final product is only related to the surface performance requirements i.e. Scratch hardness test, Pressure test, Flexibility and Adhesion test, Stripping test and Test for protection against corrosion under conditions of condensations.

No performance requirements have been given related to strength, stability and durability of the Chairs.

2.3.2 ISO Standards Related to Knock-Down Furniture

The above-mentioned ISO standards (2.2.3) covers mostly all type of furniture. However, as the scope of this study is limited to study of national and global practices for knock-down

furniture. The following standards has been studied and summary details of each standards is also mentioned below:

1) ISO 21015:2007 - Office furniture — Office work chairs — Test methods for the determination of stability, strength and durability

Summary –

This Standard specifies test methods for determining the stability, strength and durability of office work chairs. Guidance is given on the choice of forces, cycles, etc., for these tests. The detail of test methods are as follows:

(i) Stability Tests;

- a) Front edge overturning
- b) Forwards overturning
- c) Forwards overturning for chairs with foot rest
- d) Sideways overturning for chairs without arm rests
- e) Sideways overturning for chairs with arm rests
- f) Rearwards overturning for chairs without back-rest inclination
- g) Rearwards overturning for chairs with back-rest inclination

(ii) Strength Tests (Static-load tests):

- (a) Seat front-edge static-load test
- (b) Combined seat and back static-load test
- (c) Arm-rest downward static-load test — Central
- (d) Arm-rest downward static-load test — Front
- (e) Arm-rest sideways static-load test
- (f) Foot-rest static-load test

(iii) Durability Tests:

- (a) Seat and back durability
- (b) Arm-rest durability
- (c) Swivel test
- (d) Foot-rest durability
- (e) Castor and chair-base durability

The above-mentioned tests are designed to be applied to an article of furniture that is fully assembled and ready for use. The dimensions in the tests are applicable to office work chairs intended for adult persons. The tests consist of the application, to various parts of the item, of forces simulating normal functional use, as well as misuse that can reasonably be expected to occur.

Along with these test methods, the test conditions, test set-up and test sequencing have been also given in this standard.

The forces and cycles given in this standard are based upon use for 40 hours per week, by persons weighing up to 110 kg. For chairs used by heavier people and/or for more hours per week, the following principles apply;

- a) Heavier people: Multiply the forces by the actual weight divided by 110, e.g. a chair for a 165 kg person, multiply the forces by 1.5.
- b) More hours per week: Multiply the number of cycles by the actual hours divided by 40, e.g. a chair for 120 h use per week, multiply the cycles by 3.
- c) For continuous use throughout the week, multiply the cycles by 4.2.

Assessment of ageing and degradation is not included in this standard. The tests are also not intended to assess the durability of upholstery, i.e. filling materials and covers.

2) ISO 7172:1988 - Furniture — Tables — Determination of stability determination of stability, strength and durability

Summary –

This Standard describes methods for determining the stability of all kinds of tables, except tables permanently attached to the structure of the building. Guidance is given on the choice of forces, cycles, etc., for these tests. The detail of test methods are as follows:

- (i) Stability with vertical forces
- (ii) Stability with vertical and horizontal forces

The above-mentioned tests are designed to be applied to an article of furniture that is fully assembled and ready for use. Along with these test methods, the test conditions, test set-up and test sequencing have been also given in this standard.

3) ISO 21016:2007 - Office furniture — Tables and desks — Test methods for the determination of stability, strength and durability

Summary –

This Standard specifies test methods for the determination of the stability, the strength and the durability of all types of office tables designed for use in the seated and/or standing position, e.g. work tables, height-adjustable tables, meeting tables and desks. It applies to tables that are fully assembled and ready for use. Guidance is given on the choice of forces, cycles, etc., for these tests. The detail of test methods are as follows:

- (i) Stability Tests;
 - a) Stability under vertical load
 - b) Stability with extension elements open
- (ii) Strength Tests:
 - a) Strength under vertical static force
 - b) Strength under horizontal static force
 - c) Drop test
- (iii) Durability Tests:
 - a) Durability under vertical force
 - b) Durability of the height adjustment mechanism
 - c) Durability and stiffness under horizontal force
 - d) Durability of tables with castors
- (iv) Deflection of table tops

This Standard does not contain test methods for storage elements, which can be found in ISO 7170. The tests consist of the application, to various parts of the unit, of loads, forces and velocities simulating normal functional use, as well as misuse, that can reasonably be expected to occur.

With the exception of the deflection of table tops, the tests are designed to evaluate properties without regard to materials, design/construction or manufacturing processes.

Assessment of ageing and degradation is not included in this standard.

4) ISO 7173:1989 - Furniture — Chairs and stools — Determination of strength and durability

Summary –

This Standard describes test methods for determining the strength and durability of all types of chairs, easy chairs and stools. Guidance is given on the choice of forces, cycles, etc., for these tests. The detail of test methods are as follows:

- (i) Strength Tests;
 - a) Seat static load test
 - b) Back static load test
 - c) Arm and wing sideways static load test
 - d) Arm downwards static load test
 - e) Leg forward static load test
 - f) Leg sideways static load test
 - g) Diagonal base load test
 - h) Seat impact test
 - i) Back impact test
 - j) Arm impact test
 - k) Drop test
- (ii) Durability Tests:
 - a) Seat fatigue test
 - b) Back fatigue test

5) ISO 7174-1:1988 - Furniture — Chairs — Determination of stability — Part 1: Upright chairs and stools

Summary –

This Standard describes methods for determining the stability of all types of upright chairs, stools and pouffes. It does not apply to settees and other multiple seating, nor to reclining chairs when they are reclined, chairs with tilting mechanisms when they are tilted, nor to swivelling or rocking chairs.

Guidance is given on the choice of forces, etc., for these tests. The detail of test methods are as follows:

- (i) Forwards overbalancing and sideways overbalancing for chairs without arms
- (ii) Rearwards overbalancing

(iii) Sideways overbalancing for chairs with arms

6) ISO 7174-2:1992 - Furniture — Chairs — Determination of stability — Part 2: Chairs with tilting or reclining mechanisms when fully reclined, and rocking chairs

Summary –

This Standard describes methods for determining the rearward stability of chairs with tilting, reclining and adjustable back angle mechanisms when they are fully tilted or reclined, and of rocking chairs.

7) ISO 19833:2018 - Furniture — Beds — Test methods for the determination of stability, strength and durability

Summary –

This Standard specifies test methods for determining the stability, strength and durability of all types of fully assembled beds including bed frames and bed bases.

Also applies to adult beds for domestic and non-domestic use. It does not apply to waterbeds, airbeds, foldaway beds, bunk beds and beds for people with special needs, nor to beds for healthcare and medical purposes.

Guidance is given on the choice of forces, cycles, etc., for these tests. The detail of test methods are as follows:

- (i) Stability Test
- (ii) Vertical static load tests
 - a) Vertical static load on bed base
 - b) Vertical static load on side rail
- (iii) Horizontal static load tests
 - a) Horizontal static load on headboard of beds $\leq 1\ 200$ mm in width
 - b) Horizontal static load on headboard of beds $> 1\ 200$ mm in width
 - c) Horizontal static load test for beds without headboards
- (iv) Durability tests
 - a) Vertical durability test of bed base
 - b) Horizontal durability test of bed frame

- (v) Vertical impact test
- (vi) Durability of mechanisms for lifting bed bases

These test methods for the assessment of ageing, degradation, fire resistance and electrical functions are not included in this document. The tests are not intended to assess the durability of upholstery, e.g. filling materials and covers.

8) ISO 7170:2005 - Furniture — Storage units — Determination of strength and durability

Summary –

This Standard specifies test methods for determining the strength and durability of storage units that are fully assembled and ready for use, including their movable and non-movable parts.

The tests consist of the application, to various parts of the unit, of loads, forces and velocities simulating normal functional use, as well as misuse, that might reasonably be expected to occur.

Guidance is given on the choice of forces, cycles, etc., for these tests. The detail of test methods are as follows:

- (i) Test procedures for non-movable parts:
 - a) Shelf retention test
 - b) Deflection of shelves
 - c) Strength of shelf supports
- (ii) Tops and bottoms
 - a) Sustained load test for tops and bottoms
 - b) Static load test for tops and bottoms
- (iii) Strength of clothes rails and their supports
 - a) Strength of clothes-rail supports
 - b) Dislodgement of clothes rails
- (iv) Strength of the Structure
 - a) Test for structure and underframe
 - b) Drop test
 - c) Tests for units with castors or wheels

- (v) Test procedures for movable parts
 - a) Strength of pivoted doors
 - b) Slam-shut test of pivoted doors
 - c) Durability of pivoted doors
- (vi) Sliding doors and horizontal roll-fronts
 - a) Slam shut/open test of sliding doors and horizontal roll-fronts
 - b) Durability of sliding doors and horizontal roll-fronts
- (vii) Flaps
 - a) Strength of bottom-hinged flaps
 - b) Durability of flaps
 - c) Drop test for top-hinged flaps
- (viii) Vertical roll-fronts
 - a) Slam shut/open of vertical roll-fronts
 - b) Durability of vertical roll-fronts
- (ix) Extension elements
 - a) Strength of extension elements
 - b) Durability of extension elements
 - c) Slam shut/open test of extension elements
 - d) Displacement of extension element bottoms
 - e) Interlock test
- (x) Locking and latching mechanism tests
 - a) Strength test for locking and latching mechanisms for extension elements
 - b) Locking and latching mechanisms for doors, flaps and roll-fronts
 - c) Durability test of locking and latching mechanisms

The strength and durability tests do not assess the structure of the building, e.g. the strength of wall hanging cabinets includes only the cabinet and the parts used for the attachment. The wall and the attachment into the wall are not included.

Assessment of ageing and degradation is not included in this Standard.

9) ISO 7171:2019 - Furniture — Storage units — Test methods for the determination of stability

Summary –

This Standard specifies test methods for determining the stability of free-standing storage units that are fully assembled and ready for use.

The tests consist of the application, to various parts of the unit, of loads, forces and velocities simulating normal functional use, as well as misuse, that might reasonably be expected to occur.

Guidance is given on the choice of forces, cycles, etc., for these tests. The detail of test methods are as follows:

- (i) Stability Tests:
 - a) Doors, extension elements and flaps closed, all storage units unloaded
 - b) Opening doors, extension elements and flaps, all storage units unloaded

2.3.3 EN Standards Related to Knock-Down Furniture

The above-mentioned EN standards (2.2.3) covers mostly all type of furniture, However, as the scope of this study is limited to study of national and global practices for knock-down furniture. The following standards has been studied and summary details of each standards is also mentioned below:

1) BS EN 1730:2012 - Furniture — Tables — Test methods for the determination of stability, strength and durability

Summary –

This European Standard specifies test methods for the determination of stability, strength and durability of the structure of all types of tables and desks without regard to use, materials, design/construction or manufacturing process.

In this standard, along with the test methods, details like test setup/ apparatuses, tolerances in the forces, velocities, masses, dimensions have been also recommended. The detail of test methods are as follows:

- (i) Strength and Durability
 - a) Horizontal static load test
 - b) Vertical static load tests

- c) Vertical static load on ancillary surface
 - d) Horizontal durability and stiffness test
 - e) Vertical durability test
 - f) Vertical impact test
 - g) Deflection of table tops
 - h) Durability of tables with castors
 - i) Drop test
 - j) Durability of Height adjustment mechanisms
- (ii) Stability
- a) Stability under vertical load
 - b) Stability for tables with extension elements
 - c) Stability of tables designed to support a parasol

Test methods for the assessment of ageing, degradation, and electrical functions are not included.

This European Standard does not apply to the strength and durability of any storage features that are covered by other European Standards.

2) BS EN 1725:1998- Domestic furniture - Beds and mattresses - Safety requirements and test methods

Summary –

This European Standard specifies mechanical safety requirements and testing for all types of fully erected domestic adult beds including all component elements such as bed frame, bed base, mattress and mattress pads (when they form a unit with the mattress). It does not apply to foldaway beds, bunk beds, children's cots and adjustable beds for disabled persons where separate standards exist, as well as waterbeds and air beds.

The detail of test methods are as follows:

- (i) Strength and Durability tests under vertical loads.
- (ii) Vertical Impact Test
- (iii) Durability of Bed Edge
- (iv) Vertical Static Load Test
- (v) Vertical Static Load Test of the Edge of the Bed.

Assessment for ageing and degradation are not included.

3) BS EN 14073-3: 2004 - Office furniture - Storage furniture - Part 3: Test methods for the determination of stability and strength of the structure

Summary –

This standard specifies the test methods for determination of stability and strength of the structure of free-standing screen wall hanging office storage furniture as well as stability of free-standing units.

The detail of test methods are as follows:

- (i) Strength of unit
- (ii) Pull out of shelves
- (iii) Strength of shelf supports
- (iv) Strength of top surface
- (v) Stability of unloaded unit
- (vi) Stability of loaded unit
- (vii) Dislodgment of wall hanging cabinets and shelves
- (viii) Strength of wall attachment devices

2) BS EN 14074: 2004 - Office furniture – Tables, Desks and Storage furniture - Part 4: Test methods for the determination of stability and strength of moving parts

Summary –

This standard specifies the test methods for determination of stability and strength of moving parts of tables, desks and storage furniture.

The detail of test methods are as follows:

- (i) Strength of extension elements
- (ii) Durability test of extension elements
- (iii) Slam open of extension elements
- (iv) Interlock test
- (v) Vertical load on hinged or pivoted doors
- (vi) Horizontal static force on open door
- (vii) Durability test on hinged or pivoted doors

- (viii) Durability test of sliding doors and horizontal roll fronts
- (ix) Slam shut/open of sliding doors and horizontal roll fronts
- (x) Durability of vertical roll front
- (xi) Strength of flaps
- (xii) Durability of flaps
- (xiii) Rolling test for mobile filing pedestals

Assessment of ageing is not included in this standard.

4) BS EN 527-2:2016 - Office furniture - Work tables - Part 2: Safety, strength and durability requirements

Summary –

This European Standard specifies safety, strength and durability requirements for work tables and desks for office tasks to be undertaken in a seated, a sit-stand or standing position.

The detail of test methods are as follows:

- (i) Shear and squeeze points
- (ii) Durability of height adjustment mechanisms
- (iii) Horizontal static load test
- (iv) Additional horizontal static load test for adjustable tables with a height more than 950 mm
- (v) Vertical static load tests
- (vi) Additional vertical static load test for adjustable tables with a height more than 950 mm
- (vii) Horizontal durability test
- (viii) Stiffness of the structure
- (ix) Vertical durability test
- (x) Durability of tables with castors
- (xi) Vertical impact test
- (xii) Drop test
- (xiii) Stability under vertical load
- (xiv) Stability for work tables extension elements

5) BS EN 1022:2018 - Furniture - Seating - Determination of stability

Summary –

This Standard specifies test methods and requirements for the determination of the stability of all types of seating for adults weighing up to 110 kg, without regard to use, materials, design/construction or manufacturing process.

The test methods described can be used for seating for children and heavier adults by modifying test loads and loading points.

This document does not apply to children's highchairs, table mounted chairs and bath seats which are covered by other European Standards.

The detail of test methods are as follows:

- (i) Forwards overturning
- (ii) Forwards overturning for seating with foot rest
- (iii) Corner stability test
- (iv) Sideways overturning, all seating without arm rests
- (v) Sideways overturning, all other seating
- (vi) Rearwards overturning, all seating with back rests
- (vii) Additional test procedures for seating with reclining back rests.

6) BS EN 1728:2012- Furniture — Seating — Test methods for the determination of strength and durability

Summary –

This European Standard specifies test methods for the determination of strength and durability of the structure of all types of seating without regard to use, materials, design/construction or manufacturing process.

This European Standard does not apply to children's highchairs, table mounted chairs and bath seats which are covered by other European Standards.

Test methods for the assessment of ageing, degradation, ergonomics and electrical functions are not included.

The test methods are not intended to assess the durability of upholstery materials, such as

upholstery filling materials and upholstery covers.

This European Standard does not include any requirements. Requirements for different end uses can be found in other Standards.

The detail of test methods are as follows:

- (i) Seat static load and back static load test
- (ii) Seat Front Edge Static Load
- (iii) Vertical load on back rests
- (iv) Horizontal forward static load test on back rests
- (v) Foot rest static load test
- (vi) Leg rest static load test
- (vii) Arm rest sideways static load test
- (viii) Arm rest downwards static load test
- (ix) Headrest static load test
- (x) Vertical upwards static load on arm rests
- (xi) Vertical static load on auxiliary writing surfaces
- (xii) Leg forward static load test
- (xiii) Leg sideways static load test
- (xiv) Combined seat and back durability test
- (xv) Seat front edge durability test
- (xvi) Durability test on seating with a multi-position back rest
- (xvii) Arm rest durability test
- (xviii) Foot rest durability test
- (xix) Auxiliary writing surfaces durability test
- (xx) Tipping seat operation
- (xxi) Seat impact test
- (xxii) Back impact test
- (xxiii) Arm rest impact test
- (xxiv) Drop tests
- (xxv) Castor and chair base durability
- (xxvi) Rolling resistance of the unloaded chair

7) BS EN 1335-2:2018- Office furniture - Office work chair Part 2: Safety requirements

Summary –

This document specifies safety, strength and durability requirements for office work chairs. It does not apply to other seating in the office area for which other European Standards exist. The requirements are based upon use for 8 h a day by persons weighing up to 110 kg.

The detail of test methods are as follows:

- (i) Corner stability
- (ii) Forward overturning
- (iii) Forward overturning for chairs with footrests
- (iv) Sideways overturning for chairs without arm rests
- (v) Sideways overturning for chairs with arm rests
- (vi) Rearwards overturning for chairs without back rest inclination and for chairs with adjustable backrest inclination that can be locked
- (vii) Rearwards overturning for chairs with back rest inclination
- (viii) Combined seat and back static load test
- (ix) Seat front edge static load test
- (x) Foot rest static load test
- (xi) Seat and back durability
- (xii) Armrest downward static load test – central
- (xiii) Armrest downward static load test – central

Requirements

The strength and durability requirements are fulfilled when, after testing in accordance with the specification:

- a) there are no fractures of any member, joint or component;
- b) there is no loosening of joints intended to be rigid; and
- c) the chair fulfils its functions after removal of the test loads.

3.1 CONCLUSIONS

After review of different Indian Standards, ISO Standards & EN Standards in the literature review section, the following points have been concluded:

- (i) The requirements have been given with respect to conformance to the raw materials used in the construction. Recommendations related to fabrication and assembly also have been given in these Indian Standards.
- (ii) The final product conformance is only related to their surface performance requirements.
- (iii) The available Indian Standards related to different type of furniture are formulated considering their construction practices.
- (iv) However, as this study is related to knock-down furniture, only two Indian Standards are relating knock-down furniture and others are applicable to different type of conventional furniture.
- (v) Internationally, both ISO & EN have already formulated different standards covering wide range of domestic, offices, institutional furniture.
- (vi) After the study of ISO & EN standards for Office work chairs, General purpose chairs, Table & Desks, Beds, Storages units and their test methods. It is observed that all these standards specify the performance of furniture in terms on Strength, Stability & Durability irrespective of their construction or materials used. Where-ever applicable, these requirements also have been given for the attachments.
- (vii) As per discussion with different furniture industries in India, who are in the manufacturing of knock-down furniture. It is observed that, for the quality compliance these industries follow BIFMA guidelines/standards. And most of the BIFMA guidelines/ standards are made in-line with these ISO & EN standards. The main difference in between these standards & guidelines are the loading criteria. The loading criteria, number of cycles and durations of loading varies as per the use of the furniture.

3.2 FURTHER SCOPE OF THE STUDY

- (i) Other than office work chairs, general purpose chairs, table & desks, beds, storages units, ISO & EN standards are also available for furniture related to children, library furniture, public seating, sofa, health care furniture. So, to cover all type of furniture, further study of other ISO & EN standards required.
- (ii) Also, as many industries follow the BIFMA guidelines/ standards, study of the guidelines/ standards also to understand the quality aspects followed by the furniture industry world-wide.

3.3 RECOMMENDATION:

In view of the above study and conclusions mentioned above, it is recommended to draft separate Indian Standards on different knock-down furniture i.e. Office work chairs, General purpose chairs, Table & Desks, Beds, Storages units and on the applicable test methods by taking assistance from ISO & EN standards. However, the values related forces, masses, number of cycles, loading duration etc can be decided indigenously.