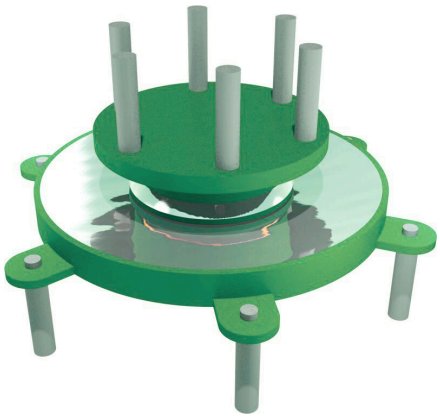
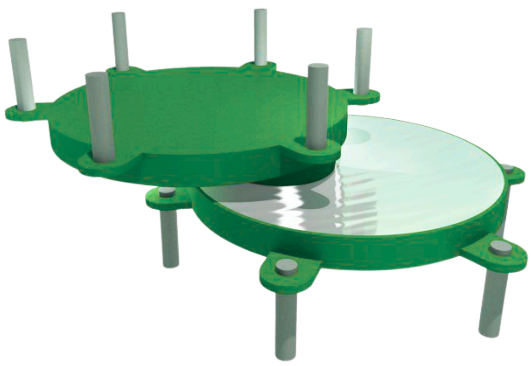
CARPENTER & PATERSON (ASIA) LTD

WITCH PIPE SUSPENSION EQUIPMENT

FRICTION PENDULUM



Single Pendulum
TSP



Double Pendulum
TDP

FRICTION PENDULUM

FRICTION PENDULUM SEISMIC ISOLATION TECHNOLOGY

Friction Pendulum Isolators are engineered to protect structures from the damaging effects of seismic activity by allowing controlled sliding motion between curved surfaces. During an earthquake, these devices reduce the transmission of seismic forces into the structure, helping to maintain stability, minimise structural stress, and support rapid post-event functionality

Friction Pendulum isolators operate based on the principle of a pendulum effect created by a curved sliding surface. When horizontal movement occurs, the mass of the structure is supported on a slider that moves along a defined radius of curvature. This mechanism provides both energy dissipation through friction and a natural restoring force that returns the structure to its original position once seismic motion subsides.

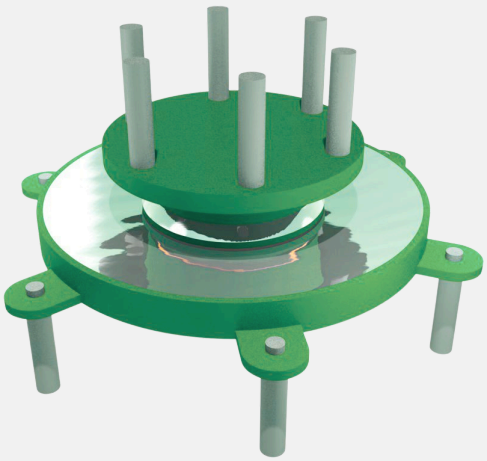
Key Benefits

- Reduces seismic forces transmitted into the structure
- Provides controlled horizontal displacement during earthquakes
- Dissipates energy through friction, improving structural resilience
- Automatically re-centres the structure after seismic movement
- Suitable for new construction and seismic retrofit projects

CPA provides two types of curved-surface isolators to meet different structural requirements:

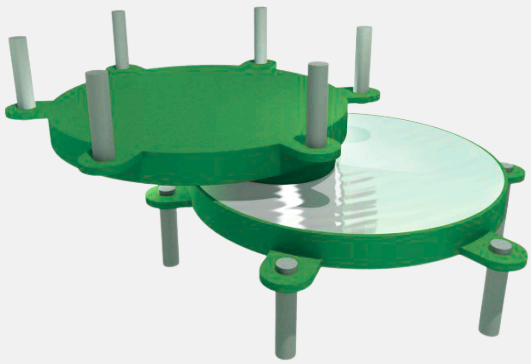
TSP (Single Curvature Friction Pendulum)

Designed for controlled displacement and rotational articulation, suitable for general structural applications.



TDP (Double Curvature Friction Pendulum)

Provides higher horizontal displacement capacity and improved energy dissipation for heavy or critical infrastructure.



Both systems are manufactured to high engineering standards using stainless-steel sliding surfaces and advanced friction materials to ensure long-term performance and reliability in demanding environments.

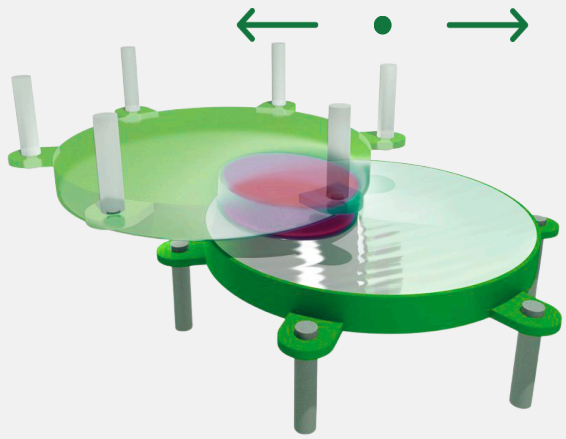
SYSTEM BEHAVIOUR

Friction Pendulum isolators function through controlled sliding along a curved surface.

During seismic movement

- The slider travels along the curvature
- The supported mass rises slightly, creating a restoring force
- Energy is dissipated through friction, producing stable hysteretic behaviour
- Vertical load is supported at all times, even under large displacements

The radius of curvature (R) determines the effective period of vibration and restoring stiffness, while the friction coefficient (μ) governs energy dissipation. The displacement capacity (D) defines the maximum allowable horizontal travel during an earthquake.



During seismic movement, the slider travels along the curved surface, allowing horizontal displacement while generating a restoring force and dissipating energy through friction.

MATERIALS

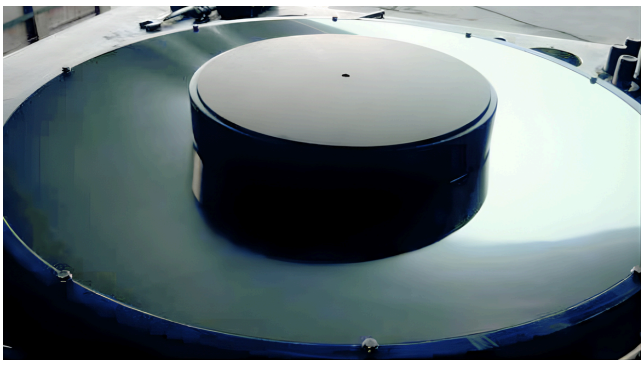
Structural Steel Components

Manufactured from S355 structural steel or equivalent, providing predictable strength characteristics and compliance with EN 10025.

Sliding Surfaces

Concave surfaces are fitted with 316L stainless steel plates, processed to achieve:

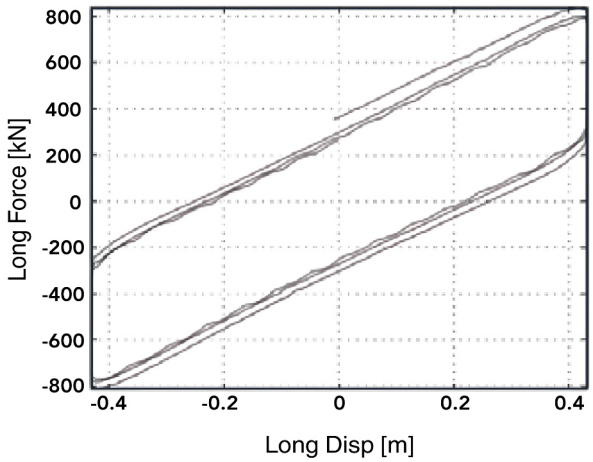
- low surface roughness (< 1 μm)
- high corrosion resistance
- uniform sliding behaviour



Friction Material

The friction interface consists of a filled PTFE-based composite engineered to:

- minimise stick–slip behaviour
- provide stable static and dynamic friction coefficients
- maintain performance under temperature and loading variations
- satisfy requirements of EN 1337 and EN 15129



Typical force–displacement hysteresis of a curved-surface slider using PTFE-based friction material.

This material is used on both TSP and TDP devices, with TDP additionally using Technoslide® T11a for enhanced performance.

FRICTION PENDULUM

MODELLING

The design of Friction Pendulum devices follows the basic principles of simple pendulum motion. Equivalent values for the effective period of vibration, effective stiffness, and damping are obtained from the radius of curvature and the friction characteristics of the sliding interface.

For a device supporting a vertical load N on a curved surface with radius Rec, the effective period of vibration (Tp) and the associated effective stiffness (Kp) can be estimated using:

$$T_p = 2\pi\sqrt{\frac{R_{ec}}{g}} \qquad K_p = \frac{N}{R_{ec}}$$

The effective damping and hysteretic behaviour are governed by the friction coefficient (μ) and the displacement demand, represented using a bilinear force–displacement model.

Modelling standards from Eurocode 8 and other international seismic codes are applied to ensure accurate performance predictions.

Iterative checks are carried out until the difference between assumed and calculated peak displacement values remains within acceptable limits.

STANDARDS AND CERTIFICATIONS

The Friction Pendulum devices are manufactured in accordance with the requirements of EN 15129 for seismic isolation systems.

Depending on project location, compliance with Eurocode 8, ASCE, AASHTO, and relevant local seismic codes can also be applied during design.

The sliding interface materials meet the performance criteria defined in EN 1337 and associated international standards.

DESIGN CAPABILITY

Curved-surface sliders are designed to accommodate a wide range of vertical loads and horizontal displacement demands.
Performance evaluation considers:

- combined axial load
- project-specific seismic hazard parameters
- displacement spectra
- friction characteristics
- required displacement capacity

Design verification includes nonlinear analyses to ensure isolation requirements are satisfied.

Typical capacity ranges:

Parameter	TSP	TDP
Axial Load (kN)	100–140000	100–140000
Maximum Horizontal Displacement (mm)	±800	±1300

APPLICATIONS

Friction Pendulum isolators are used in:

- Industrial facilities (tanks, factories, heavy mechanical plants)
- Hospitals and healthcare facilities
- Data centres (low or high mass)
- Critical infrastructures (bridges, viaducts, airports, etc.)
- Office buildings up to mid-rise
- Large-span structures (stadiums, terminals, exhibition halls)
- Commercial facilities

SINGLE CURVATURE FRICTION PENDULUM - TSP

DESCRIPTION

TSP is a single-curvature friction pendulum isolator designed to reduce seismic forces by permitting controlled horizontal sliding on a concave stainless-steel surface. The device uses a curved sliding interface that generates a restoring force, returning the structure to its original position after an earthquake.

The TSP assembly consists of a sliding shoe positioned between upper and lower plates with different radii of curvature.

- **The lower curved surface**
  governs horizontal displacement and defines the isolation period.
- **The upper interface**
  fixed to the backing plate and allows rotation (articulation) without horizontal movement.

During seismic motion, simultaneous sliding and rotation ensure that the upper and lower plates remain parallel, maintaining alignment of the supported structure throughout the displacement cycle.

Cross-section views of the TSP isolator showing the curved sliding surface, PTFE composite interface, and articulation mechanism.

TECHNICAL SPECIFICATIONS

Standard performance parameters for the TSP single-curvature friction pendulum isolator.

Parameter	Value/ Unit
Nominal Dynamic Friction Coefficient	2% – 10%
Axial Load Capacity (P)	100 – 140,000 kN
Horizontal Displacement Capacity (±D)	±10 mm – ±1,300 mm
Equivalent Radius of Curvature	Project-specific

Exploded view illustrating the sliding shoe, PTFE layers, curved surface, and backing plates of the TSP isolator.

DOUBLE CURVATURE FRICTION PENDULUM - TDP

DESCRIPTION

TDP is a double-curvature friction pendulum isolator designed to dissipate seismic forces while allowing large horizontal displacements. Unlike the TSP, which contains a single sliding surface, the TDP uses two curved sliding interfaces with the same radius of curvature, allowing higher displacement capacity within a more compact form.

The sliding element of the TDP moves simultaneously on both upper and lower concave surfaces. Each surface accommodates half of the total design displacement, while the paired motion maintains parallelism between the supported structure and the foundation throughout the earthquake cycle.

Both friction surfaces are engineered for stable sliding performance:

- **Stainless steel**
  on the backing plate side
- **Technoslide® filled PTFE composite**
  on the sliding element side

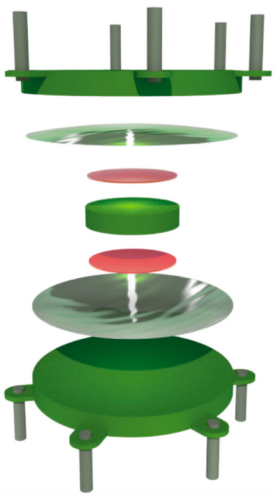
This material pairing ensures consistent friction behaviour, reliable hysteretic energy dissipation, and long-term durability under repeated loading.

Cross-section view of the TDP isolator showing the double-curvature sliding interfaces and simultaneous bi-directional movement.

TECHNICAL SPECIFICATIONS

Standard performance parameters for the TDP double-curvature friction pendulum isolator.

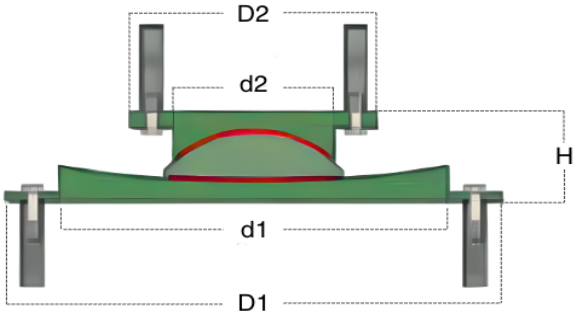
Parameter	Value/ Unit
Nominal Dynamic Friction Coefficient	2% - 10%
Axial Load Capacity (P)	100 – 140,000 kN
Horizontal Displacement Capacity (±D)	±10 mm – ±1,300 mm
Equivalent Radius of Curvature	Project-specific



Exploded view illustrating the sliding element, Technoslide® composite layers, dual curved surfaces, and backing plates of the TDP isolator.

PRODUCT TABLE

SINGLE PENDULUM - TSP



Displacement: ± 100mm | Friction: 5% | Damping: 36.30%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/100/5	1000	88	395	149	495	269	98	47
TSP 2000/100/5	2000	176	451	202	551	322	108	72
TSP 3000/100/5	3000	264	494	243	644	363	125	104
TSP 4000/100/5	4000	351	530	277	680	397	136	133
TSP 5000/100/5	5000	439	562	307	712	427	147	165
TSP 6000/100/5	6000	527	591	335	831	455	160	201
TSP 7000/100/5	7000	615	617	360	857	480	178	249
TSP 8000/100/5	8000	702	642	383	882	503	191	291
TSP 9000/100/5	9000	790	665	405	905	525	212	350
TSP 10000/100/5	10000	878	687	426	927	546	234	415

Displacement: ± 100mm | Friction: 7% | Damping: 41.40%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/100/7	1000	108	420	172	520	292	90	48
TSP 2000/100/7	2000	216	486	235	586	355	105	79
TSP 3000/100/7	3000	324	537	284	687	404	127	124
TSP 4000/100/7	4000	431	580	324	730	444	143	168
TSP 5000/100/7	5000	539	617	360	767	480	166	227
TSP 6000/100/7	6000	647	651	392	891	512	185	284
TSP 7000/100/7	7000	755	683	422	923	542	213	364
TSP 8000/100/7	8000	862	712	450	952	570	238	438
TSP 9000/100/7	9000	970	739	476	979	596	277	542
TSP 10000/100/7	10000	1078	765	500	1005	620	361	698

Displacement: ± 100mm | Friction: 10% | Damping: 46.20%

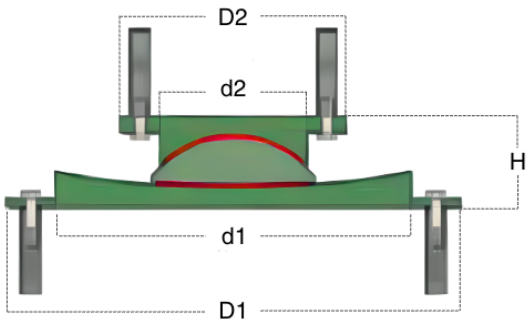
Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/100/10	1000	138	467	217	567	337	88	57
TSP 2000/100/10	2000	276	552	298	652	418	114	113
TSP 3000/100/10	3000	414	617	360	767	480	142	184
TSP 4000/100/10	4000	551	673	413	823	533	182	289
TSP 5000/100/10	5000	689	721	458	871	578	229	418
TSP 6000/100/10	6000	827	765	500	1005	620	337	628
TSP 7000/100/10	7000	958	806	539	1046	659	238	630
TSP 8000/100/10	8000	1095	843	574	1083	694	276	797
TSP 9000/100/10	9000	1231	879	609	1119	729	326	1005
TSP 10000/100/10	10000	1368	912	640	1152	760	431	1314

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 2650 mm (T = 3.27 sec.) for loads up to 6000 kN and R = 2720 mm (T = 3.31 sec.) for higher loads. Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

PRODUCT TABLE

SINGLE PENDULUM - TSP



Displacement: ± 200mm | Friction: 5% | Damping: 25.40%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/200/5	1000	126	595	149	695	269	98	92
TSP 2000/200/5	2000	251	651	202	751	322	108	126
TSP 3000/200/5	3000	377	694	243	844	363	125	170
TSP 4000/200/5	4000	502	730	277	880	397	136	207
TSP 5000/200/5	5000	628	762	307	912	427	147	247
TSP 6000/200/5	6000	753	791	335	1031	455	160	290
TSP 7000/200/5	7000	879	817	360	1057	480	178	349
TSP 8000/200/5	8000	1004	842	383	1082	503	191	398
TSP 9000/200/5	9000	1130	865	405	1105	525	215	468
TSP 10000/200/5	10000	1255	887	426	1127	546	234	545

Displacement: ± 200mm | Friction: 7% | Damping: 30.60%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/200/7	1000	146	620	172	720	292	90	91
TSP 2000/200/7	2000	291	868	235	786	355	105	134
TSP 3000/200/7	3000	437	737	284	887	404	127	193
TSP 4000/200/7	4000	582	780	324	930	444	143	247
TSP 5000/200/7	5000	728	817	360	967	480	166	320
TSP 6000/200/7	6000	873	851	392	1091	512	185	387
TSP 7000/200/7	7000	1019	883	422	1123	542	213	480
TSP 8000/200/7	8000	1164	912	450	1152	570	238	565
TSP 9000/200/7	9000	1310	939	476	1179	596	277	683
TSP 10000/200/7	10000	1455	965	500	1205	620	361	853

Displacement: ± 200mm | Friction: 10% | Damping: 36.30%

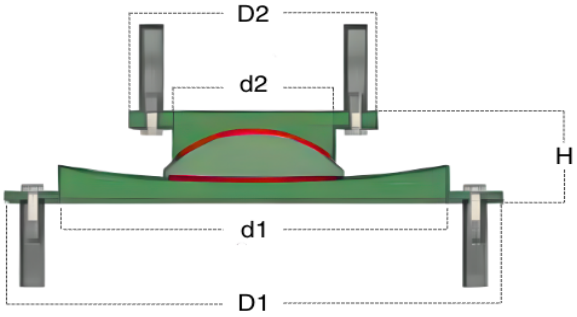
Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/200/10	1000	176	667	217	767	337	88	103
TSP 2000/200/10	2000	351	752	298	852	418	114	175
TSP 3000/200/10	3000	527	817	360	967	480	142	261
TSP 4000/200/10	4000	702	873	413	1023	533	182	386
TSP 5000/200/10	5000	878	921	458	1071	578	229	535
TSP 6000/200/10	6000	1053	965	500	1205	620	337	765
TSP 7000/200/10	7000	1215	1006	539	1246	659	238	788
TSP 8000/200/10	8000	1389	1043	574	1283	694	276	976
TSP 9000/200/10	9000	1562	1079	609	1319	729	326	1207
TSP 10000/200/10	10000	1736	1112	640	1352	760	431	1538

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 2650 mm (T = 3.27 sec.) for loads up to 6000 kN and R = 2720 mm (T = 3.31 sec.) for higher loads. Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

PRODUCT TABLE

SINGLE PENDULUM - TSP



Displacement: ± 300mm | Friction: 5% | Damping: 19.50%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/300/5	1000	164	795	149	895	269	98	178
TSP 2000/300/5	2000	327	851	202	951	322	108	228
TSP 3000/300/5	3000	490	894	243	1044	363	125	290
TSP 4000/300/5	4000	653	930	277	1080	397	136	340
TSP 5000/300/5	5000	817	962	307	1112	427	147	392
TSP 6000/300/5	6000	980	991	335	1231	455	160	447
TSP 7000/300/5	7000	1143	1017	360	1257	480	178	522
TSP 8000/300/5	8000	1306	1042	383	1282	503	191	582
TSP 9000/300/5	9000	1469	1065	405	1305	525	212	668
TSP 10000/300/5	10000	1633	1087	426	1327	546	234	761

Displacement: ± 300mm | Friction: 7% | Damping: 24.30%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/300/7	1000	184	820	172	920	292	90	177
TSP 2000/300/7	2000	367	886	235	986	355	105	240
TSP 3000/300/7	3000	550	937	284	1087	404	127	320
TSP 4000/300/7	4000	733	980	324	1130	444	143	390
TSP 5000/300/7	5000	917	1017	360	1167	480	166	483
TSP 6000/300/7	6000	1100	1051	392	1291	512	185	565
TSP 7000/300/7	7000	1283	1083	422	1323	542	213	679
TSP 8000/300/7	8000	1466	1112	450	1352	570	238	779
TSP 9000/300/7	9000	1649	1139	476	1379	596	277	916
TSP 10000/300/7	10000	1833	1165	500	1405	620	361	1107

Displacement: ± 300mm | Friction: 10% | Damping: 29.90%

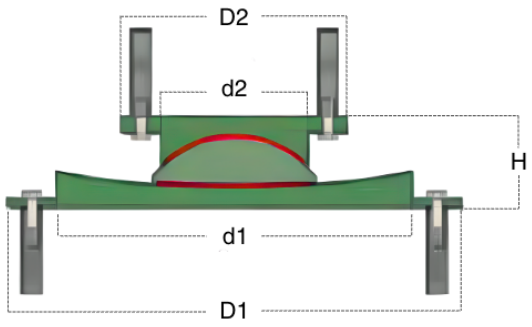
Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/300/10	1000	214	867	217	967	337	88	194
TSP 2000/300/10	2000	427	952	298	1052	418	114	294
TSP 3000/300/10	3000	640	1017	360	1167	480	142	406
TSP 4000/300/10	4000	853	1073	413	1223	533	182	560
TSP 5000/300/10	5000	1067	1121	458	1271	578	229	737
TSP 6000/300/10	6000	1280	1165	500	1405	620	337	997
TSP 7000/300/10	7000	1473	1206	539	1446	659	238	1050
TSP 8000/300/10	8000	1683	1243	574	1483	694	276	1267
TSP 9000/300/10	9000	1893	1279	609	1519	729	326	1528
TSP 10000/300/10	10000	2103	1312	640	1552	760	431	1890

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 2650 mm (T = 3.27 sec.) for loads up to 6000 kN and R = 2720 mm (T = 3.31 sec.) for higher loads. Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

PRODUCT TABLE

SINGLE PENDULUM - TSP



Displacement: ± 400mm | Friction: 5% | Damping: 15.80%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/400/5	1000	201	995	149	1095	269	98	332
TSP 2000/400/5	2000	402	1051	202	1151	322	108	407
TSP 3000/400/5	3000	603	1094	243	1244	363	125	494
TSP 4000/400/5	4000	804	1130	277	1280	397	136	563
TSP 5000/400/5	5000	1005	1162	307	1312	427	147	633
TSP 6000/400/5	6000	1206	1191	335	1431	455	160	705
TSP 7000/400/5	7000	1407	1217	360	1457	480	178	802
TSP 8000/400/5	8000	1608	1242	383	1482	503	191	879
TSP 9000/400/5	9000	1809	1265	405	1505	525	212	986
TSP 10000/400/5	10000	2010	1287	426	1527	546	234	1100

Displacement: ± 400mm | Friction: 7% | Damping: 20.20%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/400/7	1000	221	1020	172	1120	292	90	332
TSP 2000/400/7	2000	442	1086	235	1186	355	105	425
TSP 3000/400/7	3000	663	1137	284	1287	404	127	536
TSP 4000/400/7	4000	884	1180	324	1330	444	143	630
TSP 5000/400/7	5000	1105	1217	360	1367	480	166	751
TSP 6000/400/7	6000	1326	1251	392	1491	512	185	855
TSP 7000/400/7	7000	1547	1283	422	1523	542	213	997
TSP 8000/400/7	8000	1768	1312	450	1552	570	238	1118
TSP 9000/400/7	9000	1989	1339	476	1579	596	277	1282
TSP 10000/400/7	10000	2210	1365	500	1605	620	361	1500

Displacement: ± 400mm | Friction: 10% | Damping: 25.40%

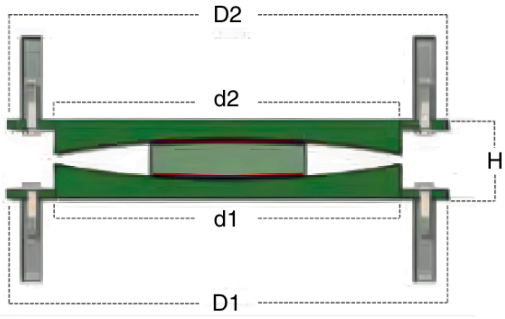
Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TSP 1000/400/10	1000	251	1067	217	1167	337	88	360
TSP 2000/400/10	2000	502	1152	298	1252	418	114	502
TSP 3000/400/10	3000	753	1217	360	1367	480	142	651
TSP 4000/400/10	4000	1004	1273	413	1423	533	182	847
TSP 5000/400/10	5000	1255	1321	458	1471	578	229	1064
TSP 6000/400/10	6000	1506	1365	500	1605	620	337	1363
TSP 7000/400/10	7000	1730	1406	539	1646	659	238	1457
TSP 8000/400/10	8000	1977	1443	574	1683	694	276	1714
TSP 9000/400/10	9000	2224	1479	609	1719	729	326	2015
TSP 10000/400/10	10000	2471	1512	640	1752	760	431	2417

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 2650 mm (T = 3.27 sec.) for loads up to 6000 kN and R = 2720 mm (T = 3.31 sec.) for higher loads. Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

PRODUCT TABLE

DOUBLE PENDULUM - TDP



Displacement: ± 100mm | Friction: 5% | Damping: 45.18%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/100/5	1000	71	295	295	395	395	56	17
TDP 2000/100/5	2000	141	351	351	451	451	63	30
TDP 3000/100/5	3000	212	394	394	544	544	70	46
TDP 4000/100/5	4000	282	430	430	580	580	76	64
TDP 5000/100/5	5000	353	462	462	612	612	83	84
TDP 6000/100/5	6000	423	491	491	731	731	89	107
TDP 7000/100/5	7000	493	517	517	757	757	95	131
TDP 8000/100/5	8000	564	542	542	782	782	102	158
TDP 9000/100/5	9000	634	565	565	805	805	108	186
TDP 10000/100/5	10000	705	587	587	827	827	114	217

Displacement: ± 100mm | Friction: 7% | Damping: 49.30%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/100/7	1000	91	320	320	420	420	57	21
TDP 2000/100/7	2000	181	386	386	486	486	65	40
TDP 3000/100/7	3000	272	437	437	587	587	73	62
TDP 4000/100/7	4000	362	480	480	630	630	80	88
TDP 5000/100/7	5000	453	517	517	667	667	87	117
TDP 6000/100/7	6000	543	551	551	791	791	95	150
TDP 7000/100/7	7000	633	583	583	823	823	102	187
TDP 8000/100/7	8000	724	612	612	852	852	109	226
TDP 9000/100/7	9000	814	639	639	879	879	116	269
TDP 10000/100/7	10000	905	665	665	905	905	123	315

Displacement: ± 100mm | Friction: 10% | Damping: 52.90%

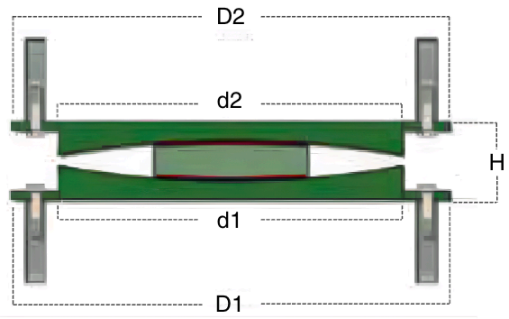
Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/100/10	1000	121	367	367	467	467	60	31
TDP 2000/100/10	2000	241	452	452	552	552	70	63
TDP 3000/100/10	3000	362	517	517	667	667	79	103
TDP 4000/100/10	4000	482	573	573	723	723	89	152
TDP 5000/100/10	5000	603	621	621	771	771	98	207
TDP 6000/100/10	6000	723	665	665	905	905	107	269
TDP 7000/100/10	7000	843	706	706	946	946	116	340
TDP 8000/100/10	8000	964	743	743	983	983	125	416
TDP 9000/100/10	9000	1084	779	779	1019	1019	134	501
TDP 10000/100/10	10000	1205	812	812	1052	1052	143	592

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 4900 mm (T = 4.44 sec.). Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

PRODUCT TABLE

DOUBLE PENDULUM - TDP



Displacement: ± 200mm | Friction: 5% | Damping: 35.00%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/200/5	1000	91	395	395	495	495	62	31
TDP 2000/200/5	2000	182	451	451	551	551	70	53
TDP 3000/200/5	3000	273	494	494	644	644	77	76
TDP 4000/200/5	4000	364	530	530	680	680	85	103
TDP 5000/200/5	5000	455	562	562	712	712	92	132
TDP 6000/200/5	6000	545	591	591	831	831	99	163
TDP 7000/200/5	7000	636	617	617	857	857	106	197
TDP 8000/200/5	8000	727	642	642	882	882	112	233
TDP 9000/200/5	9000	818	665	665	905	905	119	272
TDP 10000/200/5	10000	909	687	687	927	927	126	313

Displacement: ± 200mm | Friction: 7% | Damping: 40.20%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/200/7	1000	111	420	420	520	520	63	38
TDP 2000/200/7	2000	222	486	486	586	586	73	66
TDP 3000/200/7	3000	333	537	537	687	687	81	99
TDP 4000/200/7	4000	444	580	580	730	730	90	137
TDP 5000/200/7	5000	555	617	617	767	767	98	177
TDP 6000/200/7	6000	665	651	651	891	891	106	222
TDP 7000/200/7	7000	776	683	683	923	923	113	271
TDP 8000/200/7	8000	887	712	712	952	952	121	324
TDP 9000/200/7	9000	998	739	739	979	979	129	380
TDP 10000/200/7	10000	1109	765	765	1004	1004	136	440

Displacement: ± 200mm | Friction: 10% | Damping: 45.20%

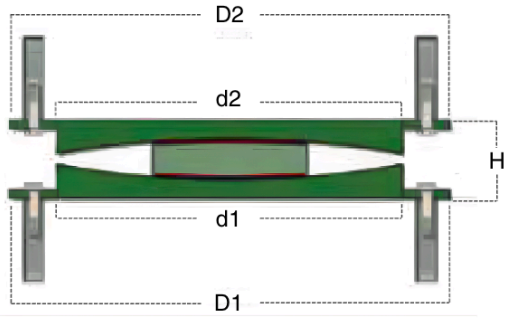
Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/200/10	1000	141	467	467	567	567	67	53
TDP 2000/200/10	2000	282	552	552	652	652	79	101
TDP 3000/200/10	3000	423	617	617	767	767	90	157
TDP 4000/200/10	4000	564	673	673	823	823	100	223
TDP 5000/200/10	5000	705	721	721	871	871	110	296
TDP 6000/200/10	6000	845	765	765	1005	1005	120	379
TDP 7000/200/10	7000	986	806	806	1046	1046	130	471
TDP 8000/200/10	8000	1127	843	843	1083	1083	140	569
TDP 9000/200/10	9000	1268	879	879	1119	1119	150	678
TDP 10000/200/10	10000	1409	912	912	1152	1152	160	794

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 4900 mm (T = 4.44 sec.). Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

PRODUCT TABLE

DOUBLE PENDULUM - TDP



Displacement: ± 300mm | Friction: 5% | Damping: 28.60%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/300/5	1000	112	495	495	595	595	69	55
TDP 2000/300/5	2000	223	551	551	651	651	79	87
TDP 3000/300/5	3000	334	594	594	744	744	87	1221
TDP 4000/300/5	4000	445	630	630	780	780	95	158
TDP 5000/300/5	5000	557	662	662	812	812	103	198
TDP 6000/300/5	6000	668	691	691	931	931	110	240
TDP 7000/300/5	7000	779	717	717	957	957	118	286
TDP 8000/300/5	8000	890	742	742	982	982	125	334
TDP 9000/300/5	9000	1002	765	765	1005	1005	132	385
TDP 10000/300/5	10000	1113	787	787	1027	1027	140	439

Displacement: ± 300mm | Friction: 7% | Damping: 33.90%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/300/7	1000	132	520	520	620	620	72	65
TDP 2000/300/7	2000	263	586	586	868	868	82	107
TDP 3000/300/7	3000	394	637	637	787	787	92	153
TDP 4000/300/7	4000	525	680	680	830	830	101	204
TDP 5000/300/7	5000	657	717	717	867	867	110	259
TDP 6000/300/7	6000	788	751	751	991	991	118	318
TDP 7000/300/7	7000	919	783	783	1023	1023	127	384
TDP 8000/300/7	8000	1050	812	812	1052	1052	135	452
TDP 9000/300/7	9000	1182	839	839	1079	1079	144	525
TDP 10000/300/7	10000	1313	865	865	1105	1105	152	602

Displacement: ± 300mm | Friction: 10% | Damping: 39.50%

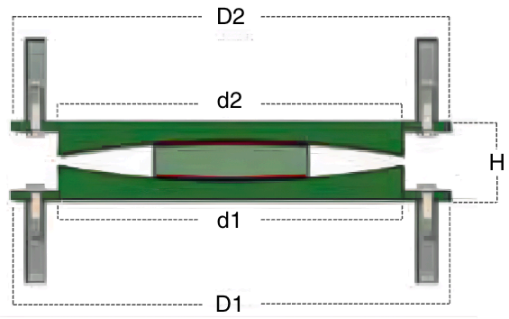
Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/300/10	1000	162	567	567	667	667	76	87
TDP 2000/300/10	2000	323	652	652	752	752	90	155
TDP 3000/300/10	3000	484	717	717	867	867	102	233
TDP 4000/300/10	4000	645	773	773	923	923	114	322
TDP 5000/300/10	5000	807	821	821	971	971	125	418
TDP 6000/300/10	6000	968	865	865	1105	1105	136	525
TDP 7000/300/10	7000	1129	906	906	1146	1146	147	642
TDP 8000/300/10	8000	1290	943	943	1183	1183	157	765
TDP 9000/300/10	9000	1452	979	979	1219	1219	168	901
TDP 10000/300/10	10000	1613	1012	1012	1252	1252	178	1042

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 4900 mm (T = 4.44 sec.). Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

PRODUCT TABLE

DOUBLE PENDULUM - TDP



Displacement: ± 400mm | Friction: 5% | Damping: 24.20%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/400/5	1000	132	595	595	695	695	79	92
TDP 2000/400/5	2000	264	651	651	751	751	90	138
TDP 3000/400/5	3000	395	694	694	844	844	99	185
TDP 4000/400/5	4000	527	730	730	880	880	108	236
TDP 5000/400/5	5000	659	762	762	912	912	116	289
TDP 6000/400/5	6000	790	791	791	1031	1031	124	346
TDP 7000/400/5	7000	922	817	817	1057	1057	132	405
TDP 8000/400/5	8000	1054	842	842	1082	1082	140	468
TDP 9000/400/5	9000	1185	865	865	1105	1105	148	533
TDP 10000/400/5	10000	1317	887	887	1127	1127	155	601

Displacement: ± 400mm | Friction: 7% | Damping: 29.80%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/400/7	1000	152	620	620	720	720	82	106
TDP 2000/400/7	2000	304	686	686	786	786	94	166
TDP 3000/400/7	3000	455	737	737	887	887	105	230
TDP 4000/400/7	4000	607	780	780	930	930	115	298
TDP 5000/400/7	5000	759	817	817	967	967	124	370
TDP 6000/400/7	6000	910	851	851	1091	1091	133	447
TDP 7000/400/7	7000	1062	883	883	1123	1123	143	532
TDP 8000/400/7	8000	1214	912	912	1152	1152	252	620
TDP 9000/400/7	9000	1365	939	939	1179	1179	160	710
TDP 10000/400/7	10000	1517	965	965	1205	1205	169	807

Displacement: ± 400mm | Friction: 10% | Damping: 35.00%

Product Name	Nsd (kN)	V (kN)	d1 (mm)	d2 (mm)	D1 (mm)	D2 (mm)	H (mm)	W (kg)
TDP 1000/400/10	1000	182	667	667	767	767	87	138
TDP 2000/400/10	2000	364	752	752	852	852	103	232
TDP 3000/400/10	3000	545	817	817	967	967	116	335
TDP 4000/400/10	4000	727	873	873	1023	1023	129	451
TDP 5000/400/10	5000	909	921	921	1071	1071	141	575
TDP 6000/400/10	6000	1090	965	965	1205	1205	153	710
TDP 7000/400/10	7000	1272	1006	1006	1246	1246	165	858
TDP 8000/400/10	8000	1454	1043	1043	1283	1283	176	1010
TDP 9000/400/10	9000	1635	1079	1079	1319	1319	187	1177
TDP 10000/400/10	10000	1817	1112	1112	1352	1352	198	1349

The values given in the tables can be considered preliminary: they are calculated considering an equivalent radius of curvature R = 4900 mm (T = 4.44 sec.). Specific isolators will be designed when all the seismic parameters of the project will be available.

Nsd = ULS Maximum Load, V = Maximum Shear force, d1 = Internal diameter of the lower plate, d2 = Internal diameter of the upper plate, D1 = External diameter of the lower plate, D2 = External diameter of the upper plate, H = Height of the device, W = Weight of the device

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