General

Airflex marine clutches are readily adaptable to the wide variety of drive arrangements found in the marine industry. They have been used for main propulsion, bow thrusters, reverse-reduction gears and Z-drives.

The type VC element can be easily combined with a torsional coupling for the main propulsion drive or it can be furnished in quill shaft mountings required for reverse-reduction gear drives. The more common VC marine clutch arrangements appear on the following pages.

Type CH elements can be used as either wet clutches for mounting within reverse-reduction gears or as externally mounted dry clutches.

Type CM elements are used primarily for connecting the engine to in-line reverse reduction gears.

Selection Procedure

Clutch selection is based upon the torque requirement calculated from the maximum power to be transmitted, clutch shaft rpm and an appropriate service factor. For drives utilizing a controllable pitch propeller, the service factor is 1.5; for a fixed pitch propeller 1.7.

Maximum recommended operating air pressure for reversing clutch application is 125 psi (8,6 bar). For reversing applications employing a propeller shaft brake or disconnect applications having a controllable pitch propeller, maximum operating air pressure is 150 psi (10,3 bar).

Follow the selection procedure outlined in Section B for VC and CM elements and Section D for CH elements. Horsepower capacities for VC elements at various speeds appear on the following pages. The elements shown have sufficient thermal capacity to handle crash stops. For maneuvering (slipping the clutch to obtain propeller speeds below engine idle), contact the factory.

Clutch Power Capacities — Reversing Applications — 125 psi (8,6 bar) Fixed-Pitch Propeller

Clutch Shaft rpm	11.5VC500		14VC500		16VC500		20VC600		24VC650		28VC650		33VC650		37VC650		42VC650	
	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW
200	91	68	133	99	220	164	313	234	453	338	609	455	849	633	1060	791	1256	937
250	114	85	165	123	273	204	389	290	561	419	753	562	1046	781	1302	971	1542	1150
300	136	101	197	147	326	243	462	345	666	497	892	665	1234	920	1529	1140	1808	1349
350	158	118	228	170	377	281	533	398	766	572	1023	763	1409	1051	1737	1296	2051	1530
400	179	133	258	192	427	318	601	449	862	643	1147	856	1570	1171	1924	1436	2268	1692
450	199	149	287	214	475	354	666	497	952	710	1262	941	1716	1280	2087	1557	2454	1831
515	225	168	323	241	535	399	746	556	1059	790	1396	1042	1878	1401	2258	1684	2644	1973
550	239	178	342	255	566	422	786	586	1112	829	1461	1090	1951	1455	2328	1736	2720	2029
600	258	192	368	274	608	454	839	626	1181	881	1542	1150	2036	1519	2399	1790	2791	2082
650	275	205	392	293	648	483	888	662	1241	926	1610	1201	2098	1565	2434	1816	2817	2101
720	299	223	424	316	699	522	947	706	1311	978	1681	1254	2140	1596	2416	1802	2769	2065
750	309	230	436	326	720	537	969	723	1334	995	1701	1269	2141	1597	2382	1777	2716	2026
810	327	244	460	343	757	565	1007	751	1370	1022	1725	1287	2111	1574	2265	1689	2547	1900
850	338	252	474	353	780	582	1027	766	1385	1033	1726	1287	2065	1540	2147	1602	2385	1779
900	351	262	489	365	805	600	1046	780	1393	1039	1710	1276	1976	1474				
950	363	271	503	375	826	616	1058	789	1389	1036	1674	1249						
1000	373	278	514	384	843	629	1062	793	1371	1023	1617	1206						
1050	382	285	523	390	857	639	1059	790	1339	999								
1100	390	291	530	395	866	646	1047	781										
1225	403	301	535	399	870	649												
1300	407	303	530	395														
1400	405	302	512	382														
1500	396	295	481	359														
1600	378	282	436	325														
1700	353	263	377	281														
1800	316	236																

Clutch Power Capacities — Reversing Applications — 125 psi (8,6 bar) Fixed-Pitch Propeller

Clutch Shaft rpm	14VC1000		16VC1000		20VC1000		24VC1000		28VC1000		32VC1000	
	HP	KW	HP	KW	HP	KW	HP	KW	HP	KW	HP	KW
200	286	213	382	285	538	401	730	544	984	733	1375	1025
250	356	265	476	355	668	498	904	674	1217	907	1698	1266
300	424	317	567	423	795	593	1073	800	1441	1074	2007	1497
350	492	367	657	490	918	684	1236	922	1655	1234	2299	1715
400	559	417	744	555	1036	773	1391	1037	1857	1385	2572	1918
450	623	465	829	618	1149	857	1538	1147	2045	1525	2823	2105
515	705	526	935	698	1288	961	1714	1278	2266	1690	3111	2320
550	747	557	990	738	1359	1013	1801	1343	2373	1770	3247	2421
600	806	601	1066	795	1453	1083	1916	1429	2510	1872	3414	2546
650	863	643	1137	848	1540	1148	2017	1504	2626	1958	3548	2646
720	937	699	1230	917	1647	1229	2136	1593	2750	2051	3674	2740
750	968	722	1267	945	1688	1259	2178	1624	2789	2079	3705	2763
810	1025	764	1336	997	1759	1312	2244	1673	2838	2116	3720	2774
850	1061	791	1378	1028	1799	1341	2274	1696	2848	2124	3695	2755
900	1102	822	1426	1063	1838	1371	2296	1712	2835	2114	3620	2700
950	1141	851	1468	1094	1866	1392	2298	1713	2791	2081	3496	2607
1000	1175	876	1503	1121	1882	1404	2279	1700	2714	2024	3319	2475
1050	1205	899	1533	1143	1886	1406	2240	1670	2602	1940		
1100	1231	918	1555	1160	1876	1399	2178	1624	2455	1830		
1225	1277	953	1580	1178	1789	1334	1917	1430				
1300	1291	963	1572	1172	1691	1261						
1400	1290	962	1532	1142								
1500	1268	945	1456	1086								
1600	1221	911										
1700	1150	857										
1800	1051	784										

Clutch Power Capacities — Reversing Applications With Propeller Shaft Brake, and Disconnect Applications with Controllable Pitch Propeller — 150 psi (10,3 bar)

Clutch Shaft rpm	14VC1000		16VC1000		20VC1000		24VC1000		28VC1000		32VC1000	
	HP	KW	HP	KW	HP	KW	HP	KW	HP	KW	HP	KW
200	346	258	463	345	652	486	884	659	1192	889	1668	1244
250	430	321	576	430	810	604	1097	818	1477	1102	2064	1539
300	514	384	688	513	965	720	1305	973	1754	1308	2446	1824
350	597	445	798	595	1116	832	1506	1123	2020	1507	2812	2097
400	678	506	905	675	1263	942	1700	1268	2274	1696	3158	2355
450	758	565	1010	753	1405	1048	1885	1406	2515	1875	3482	2596
515	859	641	1142	852	1581	1179	2112	1575	2804	2091	3865	2882
550	912	680	1211	903	1671	1246	2226	1660	2947	2198	4051	3021
600	986	735	1307	974	1794	1337	2379	1774	3136	2339	4292	3201
650	1057	789	1398	1043	1909	1423	2519	1879	3304	2464	4499	3355
720	1153	860	1520	1133	2056	1533	2692	2007	3501	2611	4728	3526
750	1192	889	1569	1170	2114	1576	2757	2056	3571	2663	4802	3581
810	1268	945	1662	1239	2219	1655	2869	2140	3683	2746	4905	3658
850	1316	981	1720	1283	2281	1701	2930	2185	3735	2785	4939	3683
900	1372	1023	1788	1333	2349	1752	2991	2230	3774	2814	4937	3682
950	1425	1063	1849	1379	2406	1794	3031	2260	3782	2820	4886	3644
1000	1475	1100	1905	1421	2450	1827	3052	2276	3757	2802	4782	3566
1050	1520	1133	1955	1458	2482	1851	3051	2275	3698	2758		
1100	1561	1164	1997	1489	2500	1865	3027	2257	3603	2686		
1225	1645	1226	2073	1546	2485	1853	2863	2135				
1300	1680	1253	2095	1562	2429	1812						
1400	1710	1275	2095	1562								
1500	1717	1281	2059	1535								
1600	1701	1268										
1700	1676	1250										
1800	1609	1200										

Clutch Power Capacities – Fixed Pitch Propeller – 125 psi (8,6 bar)

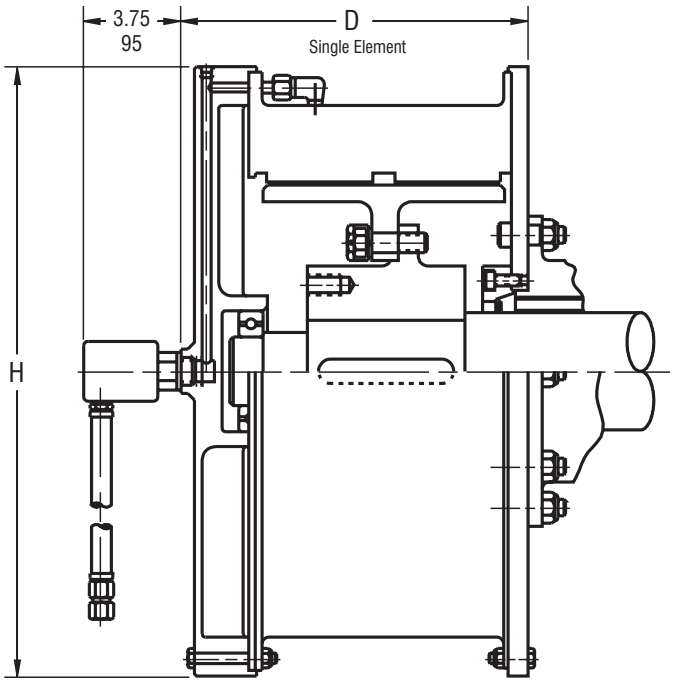
Clutch Shaft rpm	38VC1200		42VC1200		46VC1200		52VC1200		51VC1600		60VC1600		66VC1600	
	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW
80	816	608	982	733	1138	849	1454	1085	1927	1437	2610	1947	3340	2491
100	1017	759	1224	913	1418	1058	1810	1351	2399	1790	3248	2423	4151	3097
120	1217	908	1465	1093	1695	1264	2162	1613	2866	2138	3876	2892	4947	3691
180	1803	1345	2169	1618	2500	1865	3181	2373	4218	3146	5687	4243	7211	5380
200	1992	1486	2396	1788	2759	2058	3505	2615	4648	3468	6259	4669	7914	5904
250	2451	1829	2946	2198	3377	2519	4274	3188	5669	4229	7602	5671	9528	7108
300	2884	2152	3463	2583	3947	2944	4970	3708	6597	4921	8798	6563	10899	8130
350	3286	2452	3941	2940	4459	3327	5580	4163	7411	5529	9816	7323	11978	8936
400	3652	2724	4372	3261	4905	3659	6089	4543	8094	6038	10627	7928	12717	9487
450	3975	2966	4751	3544	5274	3934	6483	4836	8627	6436	11203	8357		
515	4325	3227	5154	3845	5623	4195	6799	5072	9064	6762				
550	4477	3340	5324	3972	5743	4285	6868	5123						
600	4645	3465	5506	4108	5825	4345								
650	4750	3543	5609	4184										

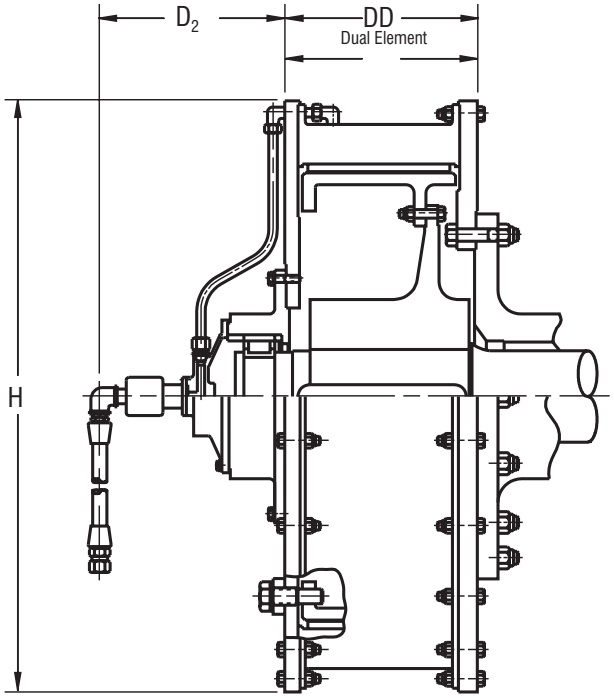
Clutch Shaft rpm	Dual 32VC1000		Dual 38VC1200		Dual 42VC1200		Dual 46VC1200		Dual 52VC1200		Dual 51VC1600		Dual 60VC1600		Dual 66VC1600	
	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW
80	997	743	1631	1217	1964	1465	2276	1698	2908	2169	3853	2875	5219	3893	6680	4983
100	1243	927	2034	1517	2449	1827	2835	2115	3621	2701	4799	3580	6495	4846	8303	6194
120	1489	1110	2433	1815	2929	2185	3389	2528	4324	3226	5732	4276	7753	5784	9895	7382
180	2212	1650	3605	2689	4337	3236	5001	3731	6362	4746	8435	6293	11374	8485	14422	10759
200	2448	1826	3985	2973	4793	3575	5518	4116	7011	5230	9297	6935	12518	9339	15828	11808
250	3023	2255	4903	3658	5892	4396	6753	5038	8548	6376	11339	8459	15205	11343	19056	14215
300	3574	2666	5769	4304	6926	5167	7893	5889	9940	7415	13193	9842	17596	13126	21797	16261
350	4095	3055	6573	4903	7881	5879	8919	6653	11160	8325	14823	11058	19632	14646	23956	17871
400	4583	3419	7303	5448	8744	6523	9810	7318	12178	9085	16189	12077	21255	15856	25434	18974
450	5031	3753	7951	5931	9502	7088	10547	7868	12966	9673	17254	12872	22405	16714		
515	5548	4139	8651	6454	10308	7690	11246	8390	13598	10144	18129	13524				
550	5791	4320	8954	6680	10649	7944	11487	8569	13735	10246						
600	6093	4546	9290	6930	11012	8215	11650	8691								
650	6337	4727	9500	7087	11218	8368										
720	6570	4901	9565	7135												
750	6628	4945														
800	6667	4973														
900	6504	4852														
950	6294	4695														

Clutch Power Capacities – Controllable Pitch Propeller – 125 psi (8,6 bar)

Clutch Shaft rpm	38VC1200		42VC1200		46VC1200		52VC1200		51VC1600		60VC1600		66VC1600	
	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW
80	924	690	1113	830	1290	962	1648	1229	2184	1629	2957	2206	3785	2824
100	1153	860	1388	1035	1607	1199	2052	1531	2719	2028	3681	2746	4705	3510
120	1379	1029	1660	1238	1920	1433	2451	1828	3248	2423	4393	3277	5607	4183
180	2043	1524	2458	1834	2834	2114	3605	2690	4780	3566	6445	4808	8173	6097
200	2258	1684	2716	2026	3127	2333	3973	2964	5268	3930	7094	5292	8969	6691
250	2778	2073	3339	2491	3827	2855	4844	3613	6425	4793	8616	6428	10798	8055
300	3269	2439	3925	2928	4473	3337	5633	4202	7476	5577	9971	7438	12352	9214
350	3724	2778	4466	3332	5054	3770	6324	4718	8399	6266	11125	8299	13575	10127
400	4139	3087	4955	3696	5559	4147	6901	5148	9174	6844	12044	8985	14412	10752
450	4505	3361	5384	4017	5977	4459	7347	5481	9778	7294	12696	9471		
515	4902	3657	5841	4357	6373	4754	7706	5748	10273	7664				
550	5074	3785	6034	4502	6509	4856	7783	5806						
600	5264	3927	6240	4655	6602	4925								
650	5383	4016	6357	4742										

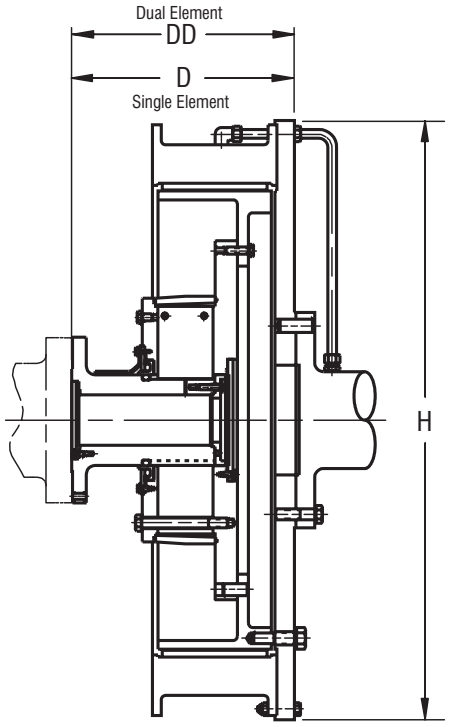
Clutch Shaft rpm	Dual 32VC1000		Dual 38VC1200		Dual 42VC1200		Dual 46VC1200		Dual 52VC1200		Dual 51VC1600		Dual 60VC1600		Dual 66VC1600	
	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW	HP	kW
80	1129	843	1849	1379	2226	1661	2579	1924	3295	2458	4367	3258	5915	4413	7570	5647
100	1409	1051	2305	1720	2775	2070	3214	2397	4103	3061	5438	4057	7362	5492	9410	7020
120	1687	1258	2758	2057	3320	2477	3841	2865	4901	3656	6496	4846	8787	6555	11214	8366
180	2507	1870	4086	3048	4916	3667	5668	4228	7211	5379	9560	7132	12891	9616	16345	12194
200	2774	2069	4516	3369	5432	4052	6253	4665	7946	5927	10536	7860	14187	10584	17938	13382
250	3426	2556	5557	4145	6678	4982	7654	5710	9687	7227	12851	9587	17232	12855	21596	16111
300	4050	3021	6538	4877	7850	5856	8946	6674	11266	8404	14953	11155	19942	14877	24704	18429
350	4641	3462	7449	5557	8932	6663	10108	7540	12648	9435	16799	12532	22250	16598	27150	20254
400	5194	3875	8277	6175	9910	7393	11118	8294	13802	10296	18347	13687	24089	17970	28825	21503
450	5702	4254	9011	6722	10769	8033	11954	8918	14695	10962	19555	14588	25392	18943		
515	6287	4690	9804	7314	11682	8715	12746	9508	15411	11497	20546	15327				
550	6563	4896	10148	7571	12069	9003	13018	9712	15567	11613						
600	6906	5152	10528	7854	12481	9311	13203	9850								
650	7182	5357	10766	8032	12714	9484										
720	7446	5555	10840	8087												
750	7512	5604														
800	7556	5636														
900	7372	5499														
950	7133	5321														

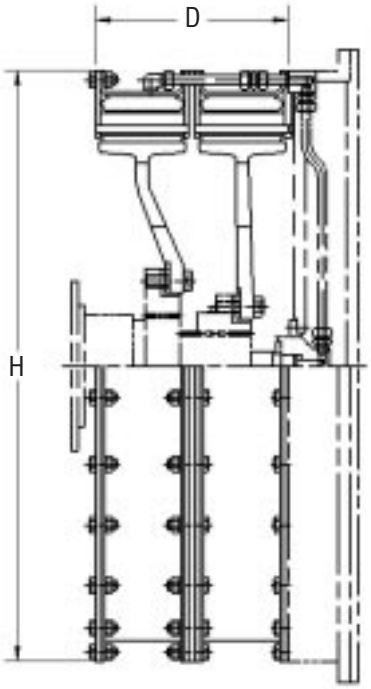




Capacities to 4900 HP (3680 kW)				
Size	Dimensions in inches		Dimensions in millimeters	
	D	H	D	H
14VC1000	14.69	24.00	373	610
16VC1000	14.44	26.00	368	660
20VC1000	14.81	30.00	376	762
24VC1000	14.81	34.50	376	876
28VC1000	14.94	38.50	379	978
32VC1000	15.88	44.25	403	1124

Capacities to 29000 HP (21600 kW)				
English	Dimensions in inches			
38VC1200	19.75	33.50	17.00	49.88
42VC1200	19.75	33.50	17.00	54.13
46VC1200	20.25	34.00	17.00	60.75
52VC1200	20.75	35.00	18.00	67.50
51VC1600	24.25	42.50	18.00	67.50
60VC1600	24.25	43.00	18.00	76.50
66VC1600	24.25	43.00	18.00	83.50
Size Single or Dual	D	DD	D_2	H
38VC1200	502	851	432	1267
42VC1200	502	851	432	1375
46VC1200	514	863	432	1543
52VC1200	527	889	457	1715
51VC1600	616	1080	457	1715
60VC1600	616	1092	457	1943
66VC1600	616	1092	457	2120
SI	Dimensions in millimeters			





Capacities to 29000 HP (21600 kW)

Size Single or Dual	Dimensions in inches			Dimensions in millimeters		
	D	DD	H	D	DD	H
38VC1200	17.00	34.50	49.88	432	876	1267
42VC1200	19.50	34.50	54.13	495	876	1375
46VC1200	20.00	37.75	60.75	508	959	1543
52VC1200	21.00	38.75	67.50	533	984	1715
51VC1600	25.50	40.75	67.50	648	1035	1715
60VC1600	27.50	45.75	76.50	699	1162	1943
66VC1600	29.75	48.00	83.50	756	1219	2121

Capacities to 2820 HP (2100 kW)

Size	Dimensions in inches		Dimensions in millimeters	
	D	H	D	H
11.5VC500	12.25	19.63	311	498
14VC500	12.25	23.50	311	597
16VC600	14.75	25.50	375	648
20VC600	14.75	29.50	375	749
24VC650	15.38	34.50	391	876
28VC650	15.38	38.00	391	965
33VC650	15.38	44.63	391	1134
37VC650	15.38	48.63	391	1235
42VC650	15.38	53.63	391	1362

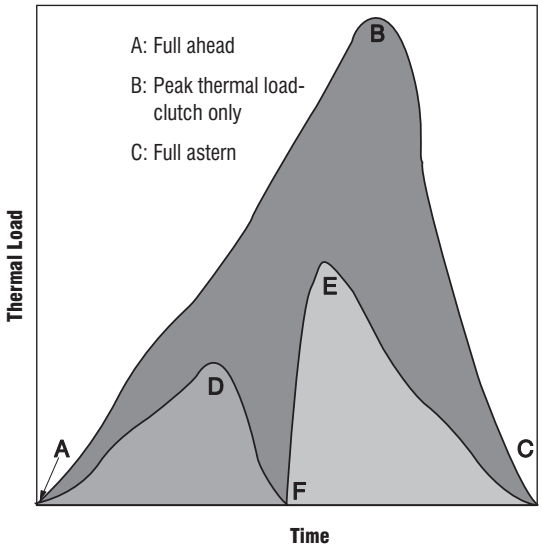
General dimension of typical VC clutches for marine application are shown in the above drawings. Construction details vary slightly in clutches of different sizes. For example, clutch design may include a one-piece or two-piece drum and hub.

Propeller Shaft Brakes

General

Propeller shaft brakes are used to improve vessel maneuverability by stopping the propeller shaft as fast as possible, to prevent engine stalling during hard reversing maneuvers and to reduce the thermal load on the reversing clutch. In addition, the brake reduces the shock loads on the major components of the propulsion system and prevents freewheeling of the propeller in heavy currents.

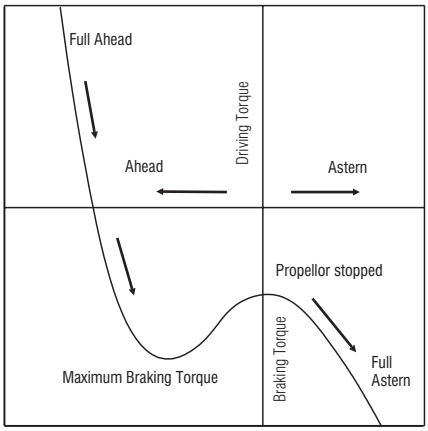
The chart below compares the thermal load imposed on a reversing clutch through a "crash astern maneuver" and a brake and reverse clutch through the same maneuver. Clutch thermal load is much less when the brake/clutch combination is used, prolonging clutch life.



Airflex element types VC, CH and calipers are recommended for use as propeller shaft brakes.

Brake Selection Procedure

A characteristic propeller shaft reversing torque curve at maximum speed ahead is shown below. This generally is the operating speed requiring the greatest stopping torque. The characteristic curve is dependent upon ship design and varies somewhat with the type of vessel.



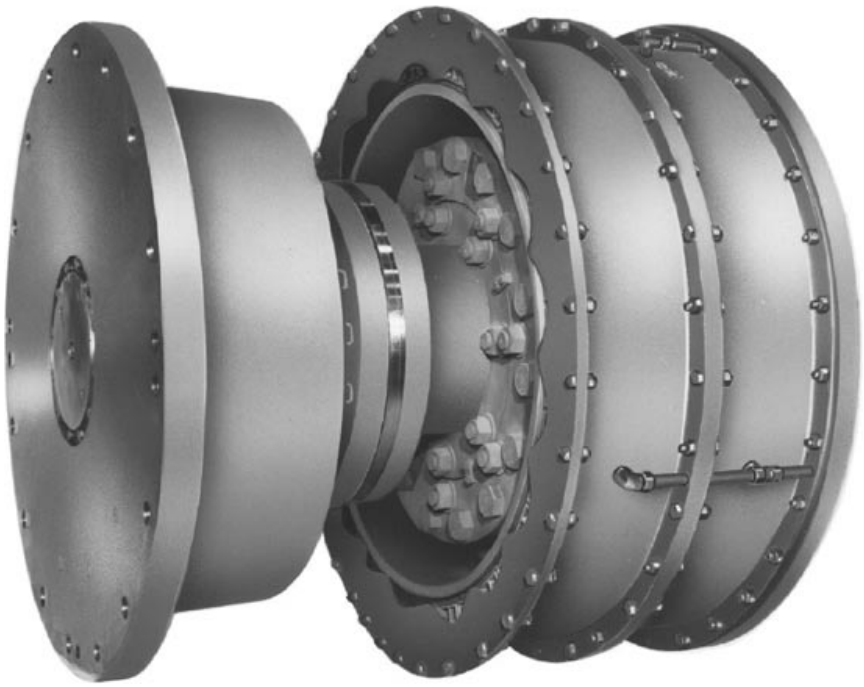
The propeller shaft brake must have sufficient torque to reduce propeller speed to the maximum brake torque point. This torque rarely exceeds 70% of full power torque except for vessels with high performance hulls and/or twin propellers. Use 100% of full power torque for these vessels. (Full power torque does not include service factor). Brake torque at various speeds for different types of vessels are given in the following table:

Brake Torque as a Percentage of Full Propulsive Power

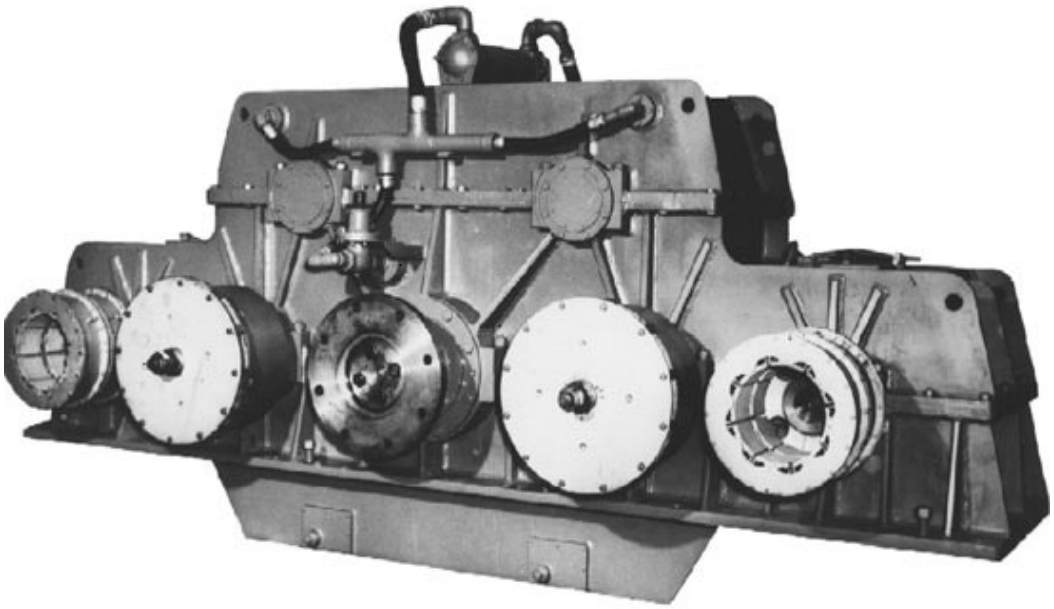
Ship Speed	Towing Barge, Tug & Fishing Boats	High Performance Hulls & Twin propellers	All other vessels
Full	100	100	100
3/4	50	100	70
1/2	25	50	35
1/4	20	45	25

After the propeller is stopped, the reversing clutch is engaged and the propeller speed increased in the astern direction to stop the vessel.

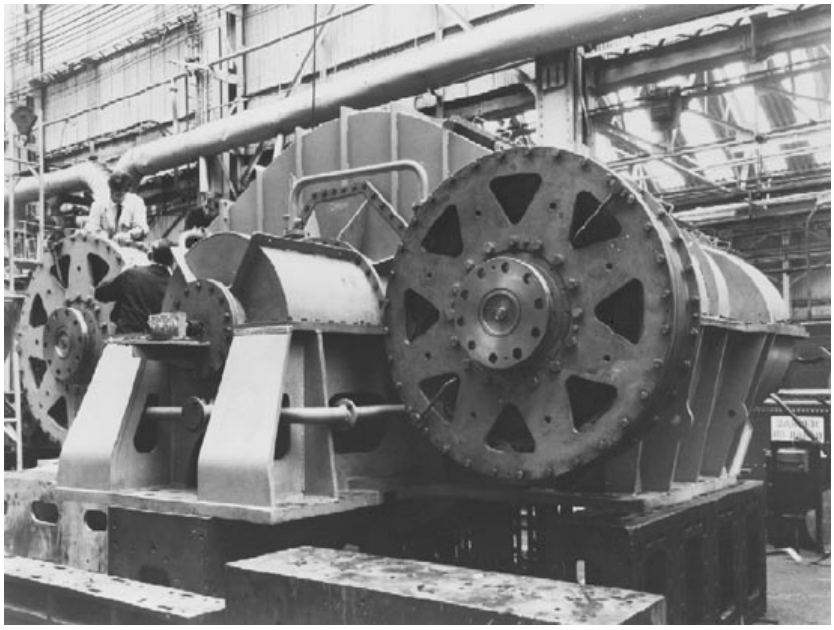
A tentative brake selection is made using the torque calculated from the percentage of full propulsive power. The selected brake's thermal capacity is then compared to the stopping thermal load. The thermal load is calculated from the component inertias to be stopped and the windmilling propeller torque resulting from water flow through the propeller.



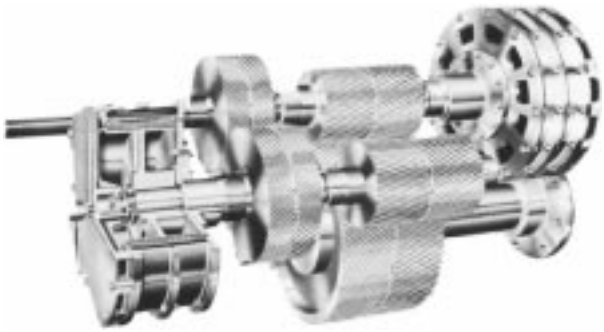
Dual 52VC1200 clutch combined with a Geislinger torsional coupling and flexible link — 16500 HP (12310 kW) @ 400 rpm.



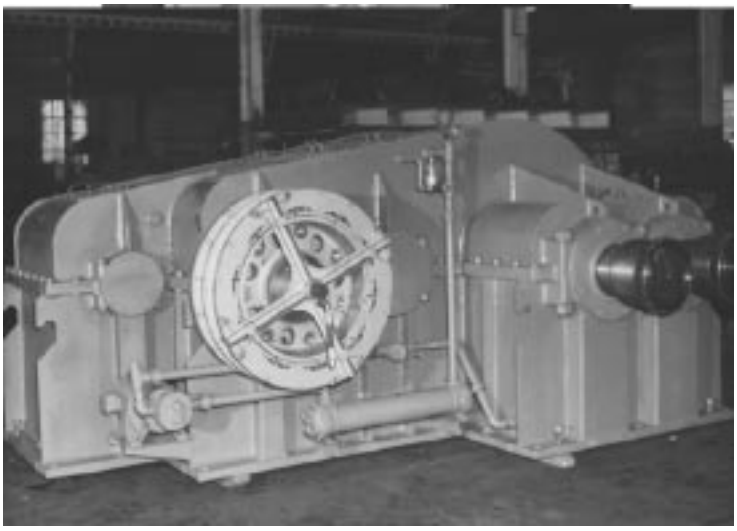
Compound reverse-reduction gear using dual 11.5VC500 cut-off clutches between engines and gear, and 16VC1000 forward and reverse clutches.



52VC1200 clutch combined with a Geislinger BC 90 torsional coupling on a main propulsion gear - 6750 HP (5035 kW) @ 400 rpm.



Typical reverse-reduction gear train with quill mounted VC clutches.



Reverse-reduction gear with quill mounted clutch.