CRTi® Internal Grip Casing Running Tool

The Volant® CRTi® casing running tool is fully mechanical and designed for casing running or drilling with top-drive equipped rigs to make up, break out, reciprocate, rotate, fill, circulate, and cement casing and liner strings, reducing non-productive time and associated costs. A simple rig-up and rig-down further increase operational efficiency.

- New standard CRTi1-10.75 tools come with Low-Release Quad-Cams, which reduce the turns required to set and release the CRTi tool and lower the release torque ratio. The Low-Release Quad-Cams are also available to upgrade legacy Quad-Cam CRTi tools.
- All configurations are mechanically activated in tension and both rotational directions by top-drive control using patented TAWG® torque activated wedge grip technology.

Starting from the insertion diameter (cage OD) of the base tool, selectable sizes of dies and integral slips (all of which can be designed for Corrosion Resistant Alloy [CRA] casing running) are used to configure the CRTi tool to support gripping casing of increasing internal diameter. Through the use of a patented extended reach die structure, the gripping diameter can be further increased to include casing sizes much greater than that of the base tool.

Base Tool Characteristics[1]

			CRTi1-10.75
Maximum Load Capacities	Hoist	short tons (tonne)	1,250 (1,133)
	Torque	ft.lb. (N.m)	125,000 (169,400)
Set-down Load Capacity[2]		short tons (tonne)	100 (90)
Typical Circulation Pressure Capacity[3]		psi (MPa)	5,000 (34.4)
Maximum Pressure End-load		short tons (tonne)	750 (680)
Base Tool Length[4]		in. (mm)	80.4 (2,045)
Base Tool Weight[5]		lb. (kg)	1,951 (885)
Base Tool Diameter[6]		in. (mm)	20.0 (510)
Die Range		in. (mm)	10.75 – 36.00 (273.05 – 914.40)
Diametrical Stroke		in. (mm)	1.00 (25.0)
Through-Hole Diameter		in. (mm)	2.25 (57.0)
Maximum Flow Rate[7]		gpm (m^3/min.)	1,450 (5.50)
Maximum Rotational Speed[8]		rpm	Unlimited
Tool Joint			8⅝ REG
Turns to Stroke Out[9]			0.62

Cage Specific Characteristics

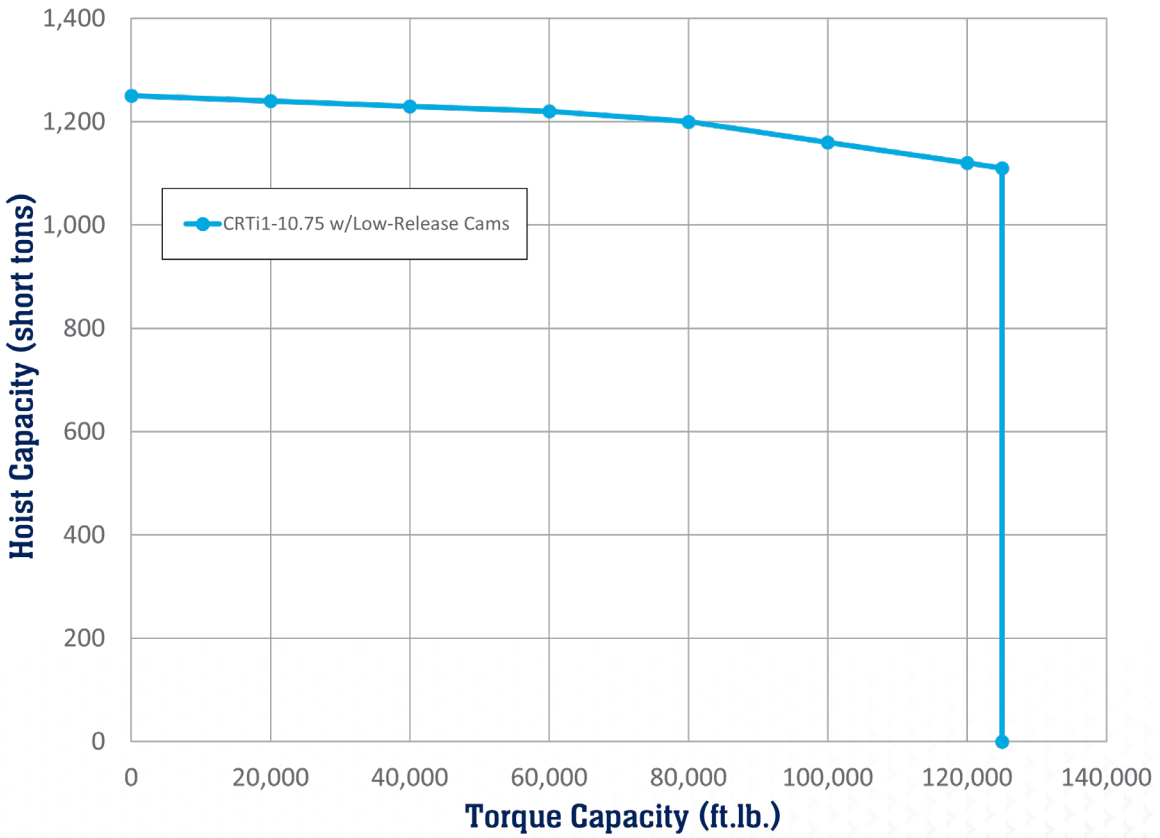
Cage P/N	Torque Capacity ft.lb. (N.m)	OD in. (mm)
104269	125,000 (169,400)	9.123 (231.75)

Casing Seal Assembly: Overall CRTi Tool Lengths

Casing Seal Description	Seal Type	Casing Size in. (mm)	Overall Tool Length in. (mm)
Swivel Casing Seal	Packer Cup	10.75 (273.05) – 13.38 (339.85)	93.4 (2,375)
	WedgeSEAL™	13.38 (339.85) – 36.00 (914.40)	89.8 (2,285)

Combined Load Operation Curve

The graph below illustrates the full hoist and torque capabilities of the CRTi1-10.75 tool. Please refer to the *Base Tool Characteristics* table on *Page 1* for the CRTi1-10.75 tool's maximum hoist and torque capacities.



Tool Selection Guide

Step 1: Base Tool Selection

The CRTi tool is available in a variety of dimensions and ratings. The ***Base Tool Characteristics*** table contains the capacities and overall dimensions of each base tool.

The operating hoist, torque, set-down load capacity, and maximum flow rate must each be lower than or equal to its respective base tool capacity.

If combined hoist and torque is required for the casing running job, the combined hoist and torque point must fall below or on the ***Combined Load Operation Curve*** on ***Page 2***.

Step 2: Cage Selection

The torque capacity of the CRTi tool may be limited by the torque capacity of the cage. Some cages are designed to run casing sizes with smaller drift diameters. Higher torque capacity is preferable for cage selection unless the drift diameter of the casing is smaller than the cage OD. See the ***Cage Specific Characteristics*** table on ***Page 2***.

Step 3: Slip Selection

Casing sizes and weights with drift diameter above 9.123 in. (231.75 mm) are available for this CRTi tool. Find the appropriate slip based on casing size and weight in the ***Dies and Integral Slips*** table on ***Page 4***. Some slips can run a range of casing weights.

Step 4: Slip/Casing Hoist Capacity

The CRTi tool's Maximum Hoist Capacity is based on API Specification 8C's requirements, but there is a separate Slip/Casing Hoist Capacity due to inefficiencies between the slips and the casing. This Slip/Casing Hoist Capacity must be determined in pre-job planning to avoid excessive casing deformation.

The lower of these two capacities shall be the limiting factor.

$F_{slip} = \eta_{slip} \times F_{casing}$

F_{slip} is the Slip/Casing Hoist Capacity due to slip/casing interaction.
η_{slip} (Slip Efficiency) is the slip-to-pipe-body load efficiency.
F_{casing} is the Plain End Pipe Body Yield found in API TR 5C3.

For example, in API TR 5C3 the Plain End Pipe Body Yield for 16.00 in. x 84.0 ppf J55 (406.40 mm x 125.01 kg/m J55) casing is 1,326,000 lb. (5,899 kN). The Slip Efficiency for die 104422, which will be used to run this casing, is 80%. (See the ***Dies and Integral Slips*** table.)

Therefore, the Slip/Casing Hoist Capacity is:

80% × 1,326,000 lb. = 1,060,800 lb. = 530.4 short tons; ***or***
80% × 5,899 kN = 4,719.2 kN = 481.4 tonne

Step 5: Slip/Casing Torque Capacity

The CRTi tool's Maximum Torque Capacity is based on API Specification 8C's requirements, but there is a separate Slip/Casing Torque Capacity due to the Torque Factor between the slips and the casing. This Slip/Casing Torque Capacity must be determined in pre-job planning to avoid excessive casing deformation.

The lower of these two capacities shall be the limiting factor. If no Torque Factor is provided for the slip, the Maximum Torque Capacity shall be the limiting factor.

$T_{slip} = K_{torque} \times W_{casing} \times \sigma Y_{casing}$

T_{slip} is the Slip/Casing Torque Capacity due to slip/casing interaction.
K_{torque} is the Torque Factor in the ***Dies and Integral Slips*** table.
W_{casing} is the casing weight.
σY_{casing} is the casing material API Grade's Yield Strength found in API TR 5C3.

In API TR 5C3, the Yield Strength for J55 casing is 55,000 psi (379.2 MPa). Therefore, the Slip/Casing Torque Capacity for running 16.00 in. x 84.0 ppf J55 (406.40 mm x 125.01 kg/m J55) casing with die 104422 is:

0.03414 ft.lb./psi/ppf × 84.0 ppf × 55,000 psi = 157,726 ft.lb.; ***or***
4.511 N.m/MPa/(kg/m) × 125.01 kg/m × 379.2 MPa = 213,838 N.m

Step 6: Hoist Capacity Pressure Reduction

The Maximum Hoist Capacity and the Slip/Casing Hoist Capacity must be further reduced due to the circulation pressure in relation to the casing and mandrel inner diameters.

This Hoist Capacity Pressure Reduction must be determined in pre-job planning and subtracted from the limiting factor hoist capacity determined in ***Step 4***.

$F_{EndPressure} = 0.79 \times P \times (ID_{casing}^2 - ID_{mandrel}^2)$

$F_{EndPressure}$ is the amount by which the limiting factor hoist capacity must reduce due to pressure end-load.
P is the circulation pressure in the casing.
ID_{casing} is the casing Inside Diameter found in API Specification 5CT.
$ID_{mandrel}$ is the mandrel Through-Hole Diameter.

For example, in API Specification 5CT, the casing Inside Diameter for 16.00 in. x 84.0 ppf (406.40 mm x 125.01 kg/m) casing is 15.010 in. (381.30 mm). Therefore, for a circulation pressure of 500 psi (3.4 MPa), the Hoist Capacity Pressure Reduction is:

0.79 x 500 psi × ((15.010 in.)² – (2.25 in.)²) = 86,994 lb. = 43.5 short tons
or
0.79 x 3.4 MPa × ((381.30 mm)² – (57.0 mm)²) = 381,790 N = 38.9 tonne

Therefore, the Maximum Hoist Capacity for the CRTi tool reduces to 1,250 – 43.5 = 1,206.5 short tons (1,094.1 tonne), and the Slip/Casing Hoist Capacity calculated in ***Step 4*** for die 104422 reduces to 530.4 – 43.5 = 486.9 short tons (442.5 tonne).

Please contact Volant for further information.

Dies and Integral Slips[10]

Slip / Die P/N	Nominal Pipe Size		Max. Pipe Weight[11] (W_{casing})		Min. Pipe Weight[12] (W_{casing})		Slip Efficiency (η_{slip})	Torque Factor (K_{torque})	
	in.	mm	ppf	kg/m	ppf	kg/m		ft.lb./psi/ppf	N.m/MPa/(kg/m)
104432	10.75	273.05	55.5	82.59	32.8	48.81	80%	0.04426	5.848
105100	10.75	273.05	79.2	117.86	**55.5**[13]	**82.59**[13]	80%	0.05046	6.667
105136	11.75	298.45	71.0	105.66	**42.0**[13]	**62.50**[13]	80%	0.03979	5.257
104434	11.75	298.45	94.0	139.89	65.0	96.73	80%	0.04495	5.939
104498	12.75	323.85	58.4	86.91	44.4	66.07	80%	0.04423	5.844
101955	13.38	339.85	72.0	107.15	48.0	71.43	80%	0.03930	5.193
104422	16.00	406.40	97.0	144.35	65.0	96.73	80%	0.03414	4.511
104542	16.00	406.40	129.5	192.72	97.0	144.35	80%	-	-
104423	16.77	425.96	83.7	124.56	**69.4**[13]	**103.28**[13]	80%	0.03565	4.710
104424	18.00	457.20	129.0	191.97	117.0	174.12	80%	-	-
104421	18.63	473.20	117.0	174.12	**87.5**[13]	**130.21**[13]	80%	0.03237	4.277
104425	18.63	473.20	139.0	206.85	106.0	157.75	80%	-	-
104426	20.00	508.00	129.3	192.42	94.0	139.89	80%	0.02991	3.952
104494	20.00	508.00	147.0	218.76	**118.0**[13]	**175.60**[13]	80%	-	-
104427	20.00	508.00	166.6	247.93	147.0	218.76	80%	-	-
104428	22.00	558.80	184.5	274.57	180.0	267.87	78%	-	-
104429	22.00	558.80	228.8	340.49	**228.8**[13]	**340.49**[13]	79%	-	-
102736	24.00	609.60	201.0	299.12	171.3	254.92	66%	-	-
104430	26.00	660.40	219.0	325.91	201.3	299.57	65%	-	-
104431	28.00	711.20	222.7	331.41	222.7	331.41	62%	-	-
105778	30.00	762.00	196.3	292.13	196.1	291.83	48%	-	-
105177	30.00	762.00	239.0	355.67	196.3	292.13	46%	-	-
105182	36.00	914.40	373.8	556.28	373.8	556.28	49%	-	-
105777	36.00	914.40	557.0	828.91	557.0	828.91	50%	-	-
105779	36.00	914.40	731.9	1089.19	731.9	1089.19	52%	-	-

1. Characteristics are based on standard CRTi tool components and are independent of specific limitations of cage and accessories.
2. Maximum allowable set-down load applied to the CRTi tool. Some set-down load may be reacted through the coupling. This rating does not consider coupling bearing load limitations.
3. Typical Circulation Pressure Capacity is generally governed by packer cup pressure capacity, and may be less than indicated if alternative seal arrangements are used.
4. Base Tool Length does not include casing seal assembly. To find overall CRTi tool lengths see ***Casing Seal Assembly: Overall CRTi Tool Lengths*** table.
5. Base Tool Weight is approximate and represents 10.75 in. base tool configuration. Contact Volant Sales at +1 780.784.7099 or Volant Customer Support at +1 780.784.7098 or +1 877.786.5268 for further information on CRTi tool weight.
6. For nominal pipe sizes 18.63 in. – 28.00 in., the Max. Tool Diameter is 30.0 in. (765 mm).
   For nominal pipe sizes 30.00 in. – 36.00 in., the Max. Tool Diameter is 38.0 in. (970 mm).
7. Maximum Flow Rate is based on minimizing erosion rates when using typical fluids. Erosion rates may vary depending upon the fluid contents. Please inspect CRTi tool bore regularly.
8. When rotating a casing/liner string during running/drilling operations, Maximum Rotational Speeds are governed by top-drive or casing connection specific limits.
9. Turns to Stroke Out is the rotational limit during CRTi tool make-up.
10. Common die sizes shown. All API casing sizes and weights with drift diameter above 9.123 in. (231.75 mm) are available.
11. Maximum pipe weight is defined by the API Specification 5CT drift diameter of the heaviest weight casing into which the CRTi tool assembled with the specified die set will fit.
12. Indicated minimum pipe weight is based on the assumption that control of average pipe inside diameter over die grip interval does not allow pipe body area reduction less than 3.5% from nominal and additionally considers tool wear allowances, die penetration, casing deformation, and diametrical stroke.
13. Hoist capacity is 1,100 short tons (997 tonne) for this minimum pipe weight. Hoist capacity of 1,250 short tons (1,133 tonne) is retained for heavier pipe weights of standard casing listed in API Specification 5CT.