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.

- The heavyweight CRTi2-4.5HW configuration increases the tool's hoist capacity and allows running 4.50 in. 15.1 ppf pipe sizes.
- The Slim Cage option enables all CRTi2-4.5 base tools to run 4.50 in. 13.5 ppf pipe sizes, while reducing the torque capacity to 10,000 ft.lb.
- 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 integral slips (all of which can be designed for Corrosion Resistant Alloy [CRA] casing running) configure the tool to support gripping casing of increasing internal diameter. Through the use of a patented extended reach slip structure, the gripping diameter can be further increased to include casing sizes much greater than that of the base tool.

Base Tool Characteristics[1]

			CRTi2-4.5	CRTi2-4.5HW
Maximum Load Capacities	Hoist	short tons (tonnes)	120 (108)	140 (127)
	Torque	ft.lb. (N.m)	13,000 (17,600)	13,000 (17,600)
Set-down Load Capacity[2]		short tons (tonnes)	70 (63)	70 (63)
Typical Circulation Pressure Capacity[3]		psi (MPa)	5,000 (34.4)	5,000 (34.4)
Maximum Pressure End-load		short tons (tonnes)	50 (45)	50 (45)
Base Tool Length[4]		in. (mm)	41.1 (1,045)	40.6 (1,035)
Base Tool Weight[5]		lb. (kg)	337 (153)	334 (152)
Base Tool Diameter		in. (mm)	10.9 (280)	10.9 (280)
Integral Slip Range		in. (mm)	4.50 – 5.50 (114.30 – 139.70)	4.50 (114.30)
Diametrical Stroke		in. (mm)	0.47 (11.5)	0.31 (7.5)
Through-Hole Diameter		in. (mm)	1.00 (25.0)	1.00 (25.0)
Maximum Flow Rate[6]		gpm (m^3/min.)	290 (1.10)	290 (1.10)
Maximum Rotational Speed[7]		rpm	Unlimited	Unlimited
Tool Joint			NC50	NC50
Turns to Stroke Out[8]			1.78	1.13

Cage Specific Characteristics

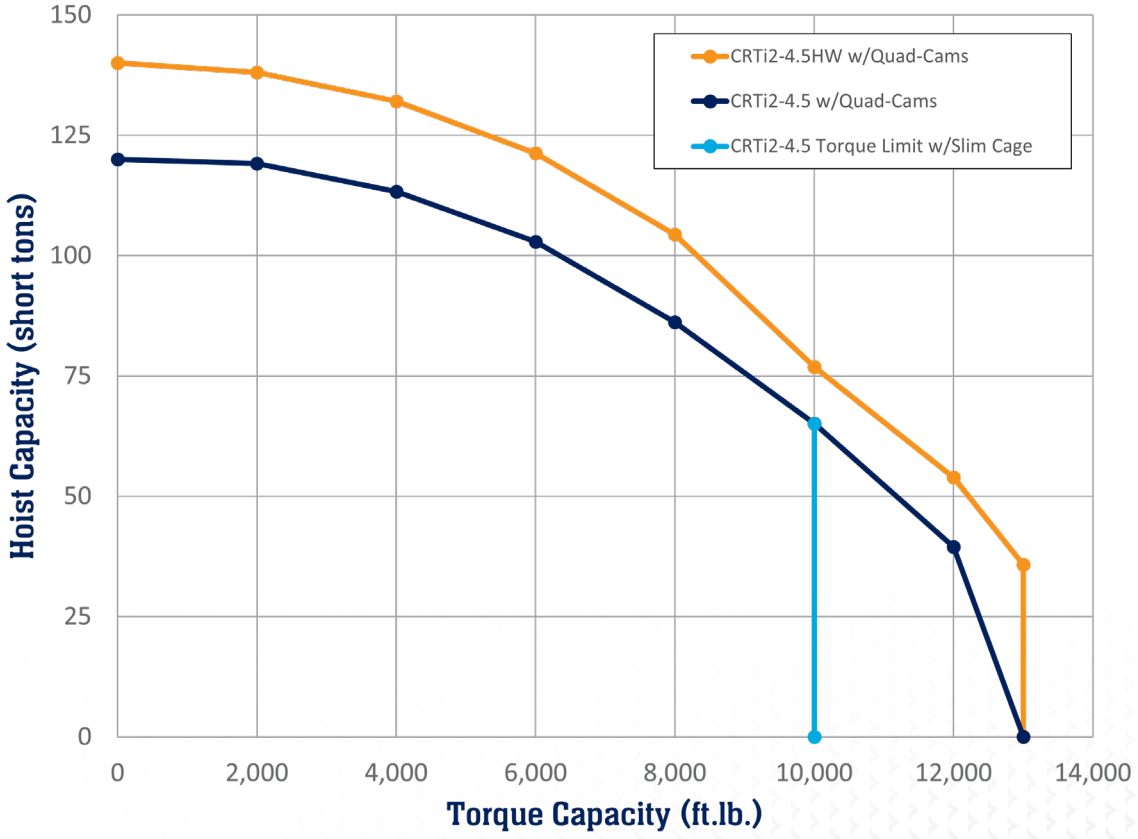
CRTi2-4.5 Cage P/N	Torque Capacity ft.lb. (N.m)	OD in. (mm)	CRTi2-4.5HW Cage P/N	Torque Capacity ft.lb. (N.m)	OD in. (mm)
81325 (Slim Cage)	10,000 (13,500)	3.790 (96.30)	107999	13,000 (17,600)	3.696 (93.90)
80939	13,000 (17,600)	3.870 (98.30)			

Casing Seal Assembly: Overall CRTi Tool Lengths

Seal Type	Casing Size in. (mm)	CRTi2-4.5 Overall Tool Length in. (mm)	CRTi2-4.5HW Overall Tool Length in. (mm)
Swivel (Packer Cup)	4.50 (114.30) – 5.50 (139.70)	49.2 (1,250)	48.7 (1,240)

Combined Load Operation Curve

The graph below illustrates the full hoist and torque capabilities of each CRTi2-4.5 tool configuration. Please refer to the *Base Tool Characteristics* table on *Page 1* for each CRTi2-4.5 tool configuration'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 on ***Page 1*** contains the capacities of each base tool.

The operating hoist, torque, set-down load, and 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 cage torque capacity may limit the CRTi tool torque capacity. 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 3.696 in. (93.90 mm) are available for this CRTi tool. Find the appropriate slip based on casing size and weight in the integral slips tables 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 4.50 in. x 11.6 ppf L80 (114.30 mm x 17.26 kg/m L80) casing is 267,000 lb. (1,188 kN). The Slip Efficiency for slip 80957, which will be used to run this casing, is 80%. (See the integral slips tables on ***Page 4***.)

Therefore, the Slip/Casing Hoist Capacity is:

80% × 267,000 lb. = 213,600 lb. = 106.8 short tons; ***or***
80% × 1,188 kN = 950.4 kN = 96.9 tonnes

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 integral slips tables on ***Page 4***.
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 L80 casing is 80,000 psi (551.5 MPa). Therefore, the Slip/Casing Torque Capacity for running 4.50 in. x 11.6 ppf L80 (114.30 mm x 17.26 kg/m L80) casing with slip 80957 is:

0.01336 ft.lb./psi/ppf × 11.6 ppf × 80,000 psi = 12,398 ft.lb.; ***or***
1.765 N.m/MPa/(kg/m) × 17.26 kg/m × 551.5 MPa = 16,800 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 4.50 in. x 11.6 ppf (114.30 mm x 17.26 kg/m) casing is 4.000 in. (101.60 mm). Therefore, for a circulation pressure of 500 psi (3.4 MPa), the Hoist Capacity Pressure Reduction is:

0.79 x 500 psi × ((4.000 in.)² – (1.00 in.)²) = 5,925 lb. = 3.0 short tons
or
0.79 x 3.4 MPa × ((101.60 mm)² – (25.0 mm)²) = 26,048 N = 2.7 tonnes

Therefore, the Maximum Hoist Capacity for the CRTi tool reduces to 120 – 3.0 = 117 short tons (105.3 tonnes), and the Slip/Casing Hoist Capacity calculated in ***Step 4*** for slip 80957 reduces to 106.8 – 3.0 = 103.8 short tons (94.2 tonnes).

Please contact Volant for further information.

Integral Slips: CRTi2-4.5

Slip P/N	Nominal Pipe Size		Max. Pipe Weight[09] (W_{casing})		Min. Pipe Weight[10] (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)
80957[11]	4.50	114.30	13.5	20.09	9.5	14.14	80%	0.01336	1.765
80957	4.50	114.30	11.6	17.26	9.5	14.14	80%	0.01336	1.765
82000	5.00	127.00	18.0	26.79	15.0	22.32	80%	0.01248	1.649
82734	5.00	127.00	21.4	31.85	18.0	26.79	80%	0.01315	1.737
80980	5.50	139.70	17.0	25.30	14.0	20.83	70%	0.00990	1.308
81182	5.50	139.70	23.0	34.23	20.0	29.76	78%	0.01125	1.486
82823	5.50	139.70	26.8	39.88	26.0	38.69	80%	-	-

Integral Slips: CRTi2-4.5HW

Slip P/N	Nominal Pipe Size		Max. Pipe Weight[9] (W_{casing})		Min. Pipe Weight[10] (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)
108002	4.50	114.30	13.5	20.09	13.5	20.09	80%	0.01313	1.734
108001	4.50	114.30	15.1	22.47	15.1	22.47	80%	0.01388	1.834

1. Characteristics are based on standard CRTi tool components and are independent of specific limitations of cage and accessories such as integral slips.
2. Maximum allowable set-down load applied to the tool. Some set-down load may be reacted through the coupling. This rating does not consider the coupling bearing load limitations.
3. Packer cup pressure capacity can limit circulation pressure capacity; tool circulation pressure capacity may vary with alternative seal arrangements.
4. Base Tool Lengths do not include casing seal assembly. To find overall tool length see ***Casing Seal Assembly: Overall CRTi Tool Lengths*** table.
5. Total weight varies with the casing seal assembly and integral slips configured. Contact Volant Customer Support for detailed tool weight information.
6. Maximum Flow Rate is based on minimizing erosion rates when using typical fluids. Erosion rates may vary depending upon the fluid contents. Please inspect tool bore regularly.
7. When rotating a casing/liner string during running/drilling operations, top-drive or casing connection specific limits govern Maximum Rotational Speeds.
8. Turns to Stroke Out is the rotational limit during tool make-up.
9. Maximum pipe weight is the API Specification 5CT drift diameter of the heaviest weight casing into which the tool assembled with the specified slip set will fit.
10. Minimum pipe weight assumes that control of average pipe inside diameter over integral slip grip interval does not allow pipe body area reduction less than 3.5% from nominal and considers tool wear allowances, slip penetration, casing deformation, and diametrical stroke.
11. In order to run integral slips P/N 80957 at 13.5 ppf, the CRTi2-4.5 tool must be configured with Slim Cage P/N 81325. All uses of Slim Cage P/N 81325, which can also be used with all other CRTi2-4.5 integral slips (but not the CRTi2-4.5HW ones), reduce the tool torque capacity to 10,000 ft.lb. (13,500 N.m).

Please contact Volant Customer Support at +1 780.784.7098 or +1 877.786.5268 for all technical enquiries about this CRTi tool.

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