Right Mounting for Safe Grinding

Though all grinding wheels are relatively fragile, they are safe operating tools if handled and used properly. However, if abused they can pose serious safety hazards.

The most common type of abuse is in the form of wrong mounting and studies have established that 3/4 of the total number of accidents of the shopfloor are the result of incorrect mounting . In many countries abroad regulations have been brought out to make training in the correct mounting of abrasive wheels mandatory.

Grinding wheels will withstand substantial compressive stresses, but under tensile or bending stresses they give way easily. Besides, all major stresses that develop in a grinding wheel under operating conditions are maximum near the bore. Keeping these two factors in view, mounting flanges are designed in such a way that wheels are subjected only to compressive stresses and such stresses act on the wheel away from the bore. Most of the wheels are held between symmetrical flanges. These flanges are relieved near the bore and the bearing area is sufficiently away from the hole. The bearing area depends upon the size of the wheel and forces acting on the wheel. The flanges should be made from good quality mild steel or similar material and poses sufficient rigidity and resist deflection when they are tightened up to the wheel.

The tables 1, 2, & 3 (at the end of this section) show the important dimensions of the various types of flanges commonly used for mounting grinding wheels. (For additional information please refer to Indian Safety Code No.IS:1991-1993).

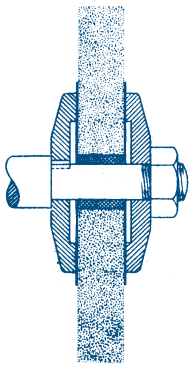


Fig. 1 A straight-sided wheel with a small hole correctly mounted.

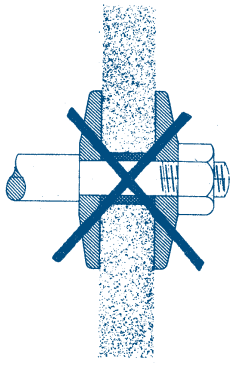


Fig. 2 An incorrectly mounted wheel flanges not recessed and washers not fitted.

TYPES OF MOUNTING

The manner of mounting a wheel depends upon the size and shape of the wheel and the grinding operation.

1. STRAIGHT WHEELS WITH SMALL BORES

These wheels are generally used on Bench and Pedestal grinders (Fig.1). The wheel is held between 2 flanges of equal diameter. The driving flange is keyed to the spindle to avoid slippage between the flange and the spindle. Both flanges are symmetrical in all other respects. The recesses shift the mounting stresses away from the hole. Fig. 2 shows a wheel which is incorrectly mounted. The flanges are not recessed and there is no blotter between the wheel face and the flanges to provide a cushioning effect when the nut is tightened, with the result that the stresses concentrate at the bore region. This type of mounting can easily cause wheel breakage.

However, when the wheel diameter is very small as in the case of the internal grinding wheel such relieving is not necessary (Fig.3).

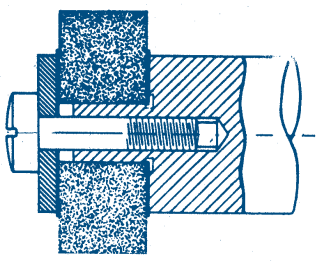


Fig. 3

Method of mounting a small wheel used for internal grinding.

2. STRAIGHT WHEELS WITH LARGE HOLES

Straight wheels with large holes are commonly used for high speed snagging. Instead of mounting the wheels directly on the spindle, adaptor flanges are used (fig.4).

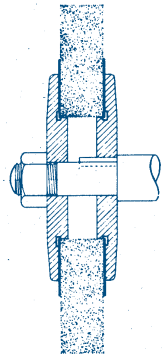


Fig. 4

A flange assembly for a wheel with a large hole. The corners of the wheel seatings must be undercut as shown.

These flanges are similar to the ones shown in fig.1 in all other respects. The undercut at the corner facilitates proper seating.

Large precision grinding wheels are mounted by means of sleeve flanges (fig. 5 & 6). The wheel holder or collet is machined to form one of the flanges for gripping the wheel. The collet fits the tapered end of the spindle and is held in place by means of a lock nut. It is usual to keep wheels of different specifications mounted on the sleeve and kept ready so that the complete mounting can be replaced to save time.

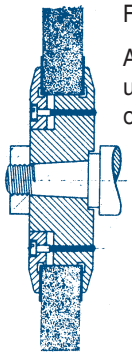


Fig. 5

A sleeve flange used with a wheel of large bore.

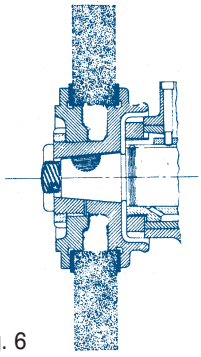


Fig. 6

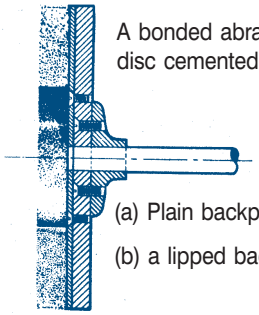
A method of mounting a precision wheel for external cylindrical grinding.

3. CYLINDER WHEELS AND NUT INSERTED DISCS.

a. Cylinder wheels

Cylinder wheels are mounted to a back plate or wheel head by means of mechanical clamps or by using cements. When mechanical clamps are used they should conform to the OD of the wheel and provide good gripping (fig. 7, 8, & 9).

Fig. 7.

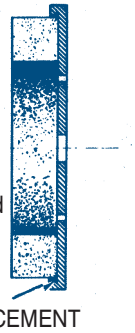


A bonded abrasive disc cemented to

(a) Plain backplate end

(b) a lipped backplate

Fig. 8.



CEMENT

Fig. 9

A cylinder wheel mounted in a protection chuck. The chuck should be kept adjusted for minimum exposure of the wheel.

b. Nut Inserted Discs

These wheels are commonly used for disc grinding operations and are mounted by means of steel nuts embedded on the side. The hole on the face plate and the nuts on the wheel should be accurately matched. The penetration of the screw should be less than the depth of the nut, otherwise the screw will pull the nut off the wheel. The face plate should be of adequate thickness and flat and provide even support over a large area of contact. Before mounting the face plate should be thoroughly cleaned. The screws should be tightened uniformly in a diametrical sequence (fig.10).

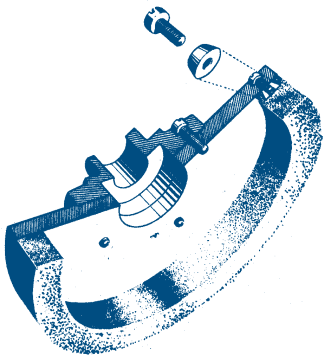


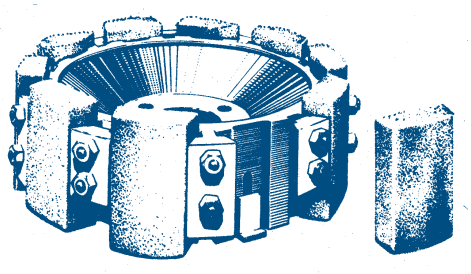
Fig. 10

Inserted nut mounting for a cylinder wheel. The screws must not come into contact with the abrasive material.

4. GRINDING SEGMENTS

Fig.11 shows typical arrangements for mounting segments. The segments are held in position by dovetailed wedged fitted on the periphery of the chuck. It is advisable to use blotters between the segments and the wedges. These wedges should be regularly checked to see that worn out wedges are not used for clamping. Such wedges will develop uneven mounting stresses and cause breakage. The overhang of the segment should not exceed its thickness.

Fig.11. A typical mounting for abrasive segments.



5. CUP WHEELS

a. On fixed machine situations, cup wheels are commonly used on tool and cutter grinding machines, for sharpening cutting tools (fig.12). Flanges used for mounting cup wheels are similar to the sleeve type flanges described earlier.

Fig. 12. A cup wheel mounting for fixed machine.

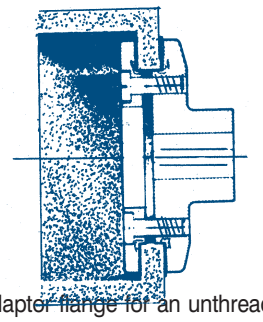
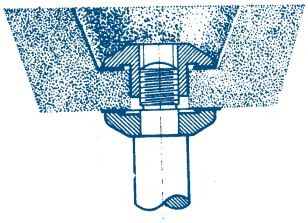


Fig.13. An adaptor flange for an unthreaded hole cup wheel. To provide proper support, the adaptor flange and back flange should be equal in outside diameter and diameter of recess.



b. On portable machine situations, cup wheels with plain or threaded holes are used. Plain wheels are mounted by means of adaptor flanges as shown in fig.13. Wheels with threaded holes are screwed on to the end of the machine spindle against the flange. The flange should be flat and not recessed (fig.14). Recessed flanges (fig.15) would tend to strain the threaded bushings. Blotters are not necessary.

Fig 14. A correctly mounted threaded-hole wheel.

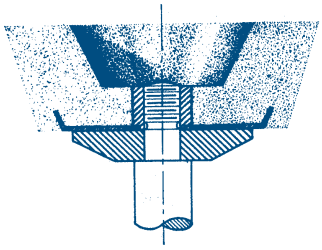
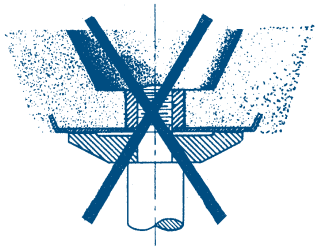


Fig.15. An incorrectly mounted threaded-hole wheel. The recessed flanges do not provide proper support.



6. NUT INSERTED CONES

These are used on portable grinders in place of mounted points. Before mounting, the hole should be checked that it is free from foreign matter. Threaded spindles should be shorter than the depth of the nut but long enough for sufficient thread engagement. Flanges should not be flat and not recessed, otherwise the nut will be pulled out while tightening (fig.16 & 17).

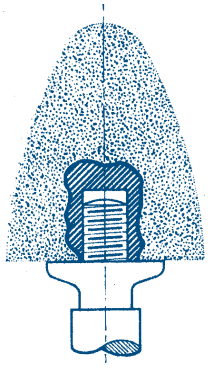
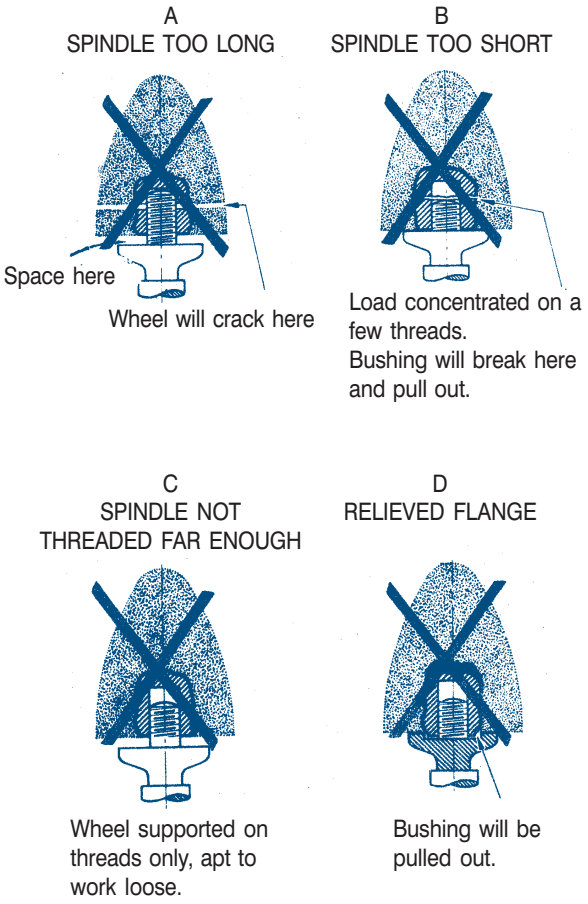


Fig. 16

A correctly mounted cone wheel.

Fig. 17. Common faults in the mounting of cone wheels



7. DEPRESSED CENTRE DISCS

Depressed centre discs are used on Portable Angle Grinders for fettling operations. The wheels are usually used at an angle and therefore they are subjected to a certain amount of bending stresses. To Provide flexibility they are reinforced with glassfibre discs. However, unless properly supported at the sides by flanges there is danger of it breaking when subjected to bending stresses.

Flanges used for mounting depressed centre discs larger than 115mm dia (180mm and 230mm dia) are different from the common type. They are unequal in diameter and asymmetrical in shape. The larger flange which provides support at the back of the disc has critical dimensions. The depth of the recess is the most important dimension and the gaps between the discs and the flanges at the periphery and centre should not be more than the stipulated maximum (fig. 18 & 19).

Fig. 18.

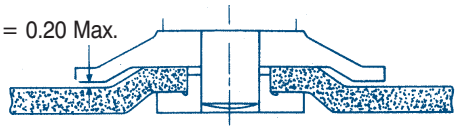
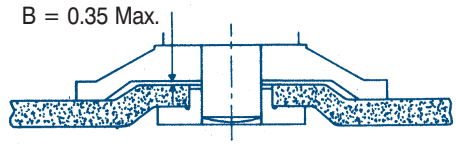
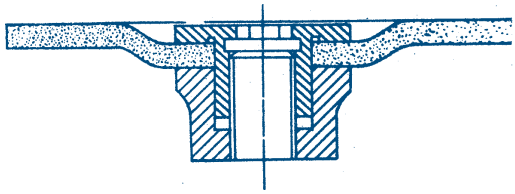


Fig. 19.



Depressed centre discs smaller than 115mm O.D. shall be mounted either with adapters as described above in fig. 18 & 19 or between equal size flanges. (fig.20) proved the matched flanges are atleast one-third the wheel diameter.

Fig. 20. Type 27 wheel 4½" diameter and smaller



Correct properly mounted 4½" diameter Type 27 wheel.
Mounting condition shown must have flanges atleast one third wheel diameter.

If the wheels are mounted in any other way (fig.21 & 22) then there is a danger of cracks developing (fig.23) and ultimately the disc breaking.

Fig. 21

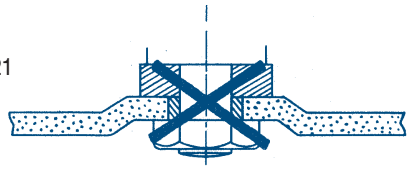


Fig. 22

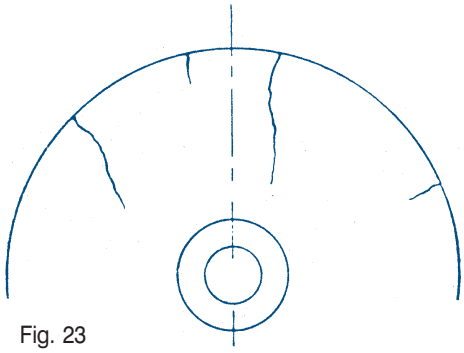


Fig. 23

SUMMARY OF MOUNTING PRECAUTIONS

1. Wheel mounting should be carried out only by competent and appointed persons.
2. A wheel should be mounted only on the machine for which it is intended. Before mounting, all wheels should be closely inspected to ensure that they have not been damaged in storage or transit.
3. The speed marked on the machine should not exceed the speed marked on the wheel blotter or tag.
4. The bush, if any, should not project beyond the sides of the wheel.
5. The wheel should fit freely but not loosely on the spindle.
6. Flanges should not be less than one-third the diameter of the wheel, and their bearing surfaces should be true and be free from burrs.
7. With the exception of the single flange used with the threaded-hole wheels, all flanges, should be properly recessed or undercut.
8. Flanges should be of equal diameter and have equal bearing surfaces.
9. Paper blotters slightly larger than the flanges, should be used with all bonded abrasive wheels, except tapered wheels, threaded-hole wheels, discs, cylinder wheels and on the hub section of depressed-centre wheels. Wrinkles in blotters should be avoided.
10. Wheels, blotters and flanges should be free from foreign matter.
11. Clamping nuts should be tightened only enough to hold the wheels firmly. When the flanges are clamped by a series of screws they should be tightened uniformly in pattern formation (diametrical sequence).
12. Screws for inserted-nut mounting of discs, cylinder and cones should be long enough to engage a sufficient length of thread, but not so long that they contact the abrasive.
13. When mounting mounted wheels and points the overhang (appropriate to the speed, diameter of the mandrel and size of wheel) should not be exceeded and there should be sufficient length of mandrel in the collet or chuck.

Guards should be properly secured and adjusted and work-rests set as close as possible to the wheel. New wheels should be allowed to run free for a short period before they are used.

Caution : Do not stand in front of the wheel during a test-run.

WHEEL HANDLING, STORAGE AND INSPECTION

HANDLING

Grinding wheels are very fragile. Care must be exercised in handling and storage of wheels to prevent damage. Handle wheels carefully and avoid dropping or bumping. Do not roll wheels (hoop fashion). Where this is unavoidable because of the large size of the wheel, use a soft resilient floor covering. Use suitable conveyors and support during transportation of big wheels which cannot be carried by hand.

STORAGE

Wheel storage should be arranged to allow wheel selection and removal without disturbing or damaging other wheels. Wheel storage rooms should not be subjected to extreme temperatures and should always be kept dry. Racks should be located as near as practical to the grinding location to facilitate easy handling, but should never be located where there is danger of damage from crane handling or vibration. Racks, bins and drawers should be constructed to accommodate each of the various types of wheels stored in an orderly and safe manner.

Generally the following guidelines should be observed.

1. Thin organic bonded wheels (cutting-off) should be laid flat on a perfectly flat horizontal surface away from excessive heat to prevent warpage.
2. Straight or tapered wheels with appreciable thickness are best supported on edge in racks. Such racks should preferably be

made to provide a two-point cradle support to prevent rolling and with partitions at regular intervals to allow wheel selection without handling or tipping the other wheels.

3. Cylinder wheels (type 2) and large straight cup wheels should be stocked on flat sides with corrugated paper or other cushioning material between them or vertically, similar to straight wheels.

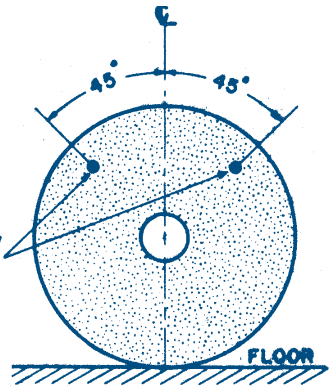
4. Small cups and other shapes may be stored in Boxes, Bins or Drawers.

INSPECTION

After unpacking, closely inspect all the wheels to make sure that they are not damaged during handling, shipping or other causes. Wheels should be tapped gently with a light non-metallic implement like a wooden mallet. The best spot to "TAP" a wheel for ring test is about 45° either side of vertical centre line about 1 to 2 inches from periphery (see Sketch)

A sound and undamaged wheel will give clear metallic tone. If cracked, there will be a dead sound and not a clear 'Ring'. Repeat ring test just before mounting either a new or used wheel on the machine.

Light wheels suspended from hole by small pin on finger.

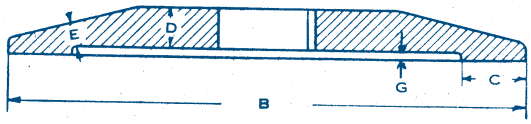


Heavy Wheels supported on clean hardfloor.

During 'Ring Testing' of small or not too heavy wheels, suspend them from the hole on a pin or finger. Heavier wheels may be allowed to rest in a vertical position on a clean hard floor.

TABLE 1

IMPORANT DIMENSIONS OF FLANGES FOR STRAIGHT WHEELS WITH SMALL HOLES

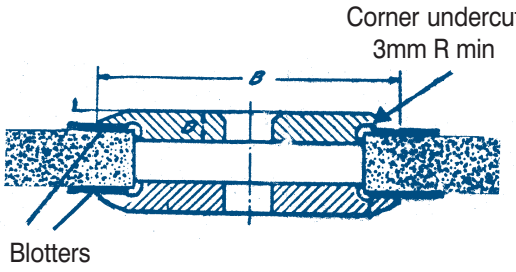


	B	C		D	E
Wheel Diameter	Minimum Outside Diameter of Flange	Radial Width of Bearing Surface		Minimum Thickness of Flange at Bore	Minimum Thickness of Flange at Recess
		Minimum	Maximum		
25	10	2	3	2	2
50	20	3	5	3	2
75	25	3	6	5	2
100	32	5	10	5	3
125	38	5	10	6	3
150	50	6	13	10	5
175	63	6	13	10	5
200	75	6	13	10	5
250	88	8	16	10	6
300	100	8	16	13	8
350	114	10	20	13	8
375	125	13	25	13	8
400	140	13	25	13	8
450	150	13	25	16	10
500	175	16	32	16	10
550	190	32	21	16	11
600	200	20	32	16	11
650	215	20	32	16	13
700	225	20	32	16	13
750	250	22	38	20	13
825	275	25	50	22	20
900	300	25	50	22	20
1050	350	25	50	22	20
1125	375	32	50	29	25
1200	400	32	50	29	25
1350	450	32	50	32	29
1500	500	32	50	32	29
1575	525	32	50	32	29
1800	600	32	50	38	32

All figures in mm

TABLE 2

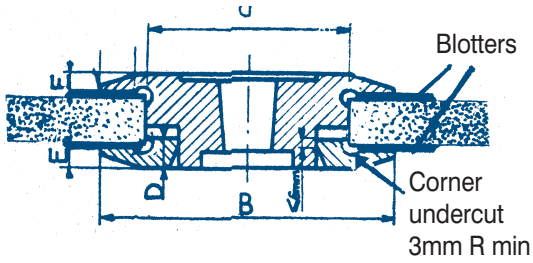
IMPORANT DIMENSIONS OF FLANGES FOR STRAIGHT WHEELS WITH LARGE HOLES



		B	D	E
Wheel Diameter	**Diameter of Bore**	**Minimum Outside Diameter of Flange**	**Minimum Thickness of Flange at Bore**	**Minimum Thickness of Flange at Recess**
300 to 350	100	150	16	10
	125	175	16	10
	150	200	16	10
Larger than 350, upto 450	100	150	16	10
	125	175	16	10
	150	200	16	10
	175	225	16	10
	200	250	16	10
Larger than 450, upto 600	150	200	20	13
	175	225	20	13
	200	250	20	13
	250	300	20	13
	250	350	20	13
Larger than 600, upto 900	300	375	20	13
	400	500	29	22
	500	600	32	25
Larger than 900, upto 1200	300	400	25	20
	400	500	29	22
	500	600	32	25

TABLE 3

MINIMUM DIMENSIONS OF STRAIGHT COLLET FLANGES USED AS WHEEL SLEEVES FOR PRECISION GRINDING ONLY



		B	D	E
Wheel Diameter	**Diameter of Bore**	**Minimum Outside Diameter of Flange**	**Minimum Thickness of Flange at Bore**	**Minimum Thickness of Flange at Recess**
300 to 350	125	175	13	11
Larger than 350, upto 500	125	175	13	11
	150	200	16	11
	200	250	16	11
	250	290	16	11
	300	340	16	11
Larger than 500, upto 750	200	250	20	13
	250	290	20	13
	300	340	20	13
	400	440	20	13
Larger than 750, upto 1250	300	340	20	13
	400	440	20	13
	450	490	20	13
	500	540	20	13
Larger than 1250, upto 1700	400	500	25	20
	500	600	25	20
	600	725	29	22

All figure in mm

TORQUE FOR TIGHTENING THE FLANGES

Grinding wheel must be clamped with adequate torque so that it is neither loose, which will result in wheel slippage, nor excessively high to cause wheel cracking.

The torque required for tightening of flanges depends on the flange design, bearing area, diameter of wheel number holts and pitch of bolt.

Machine manufacturers have their own flange design and they differ from each other. **It is recommended to use torque specified by the machine manufacturer in their manual.**

The following table gives the torque to be used for standard flanges. This is taken from Frech Safety Code INRS - 12 - F - 1996. This can be referred only if machine manufacturer's recommendation is not available.

TABLE 4

Wheelr Diameter	Thread Pitch 2mm M - kg	3mm M - kg	4mm M - kg	5mm M - kg
100	0.4	0.4	0.6	0.8
200	1.2	1.6	2.0	2.8
300	-	3.6	4.8	6.0
400	-	6.4	8.0	10.0
500	-	10.0	14.8	16.0
600	-	14.4	19.2	24.0
800	-	25.6	34.0	44.0

Note : Fore resinoid wheels multiply the torque by a factor of 2.

TABLE 4

Torque for vitrified and magnesite wheels with adaptor type/collet flanges.

Wheelr Diameter	No. of bolts	Type of bolts	Torque M - Kg.
250	6	M8	0.30
300	6	M8	0.42
350	6	M10	0.60
400	6	M10	0.72
500	8	M10	0.96
600	8	M12	1.50
750	8	M16	3.00
900	8	M16	4.20
1060	8	M16	6.00
1250	8	M16	7.80

Note : 1) Surface grinding, divide the torque by 2.

2) For heavy duty / fettling with resinoid wheels multiply the torque by 4.

It is advisable to use torque-wrench while mounting a wheel. This will prevent over/under tightening of flanges.