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E-HANDBOOK

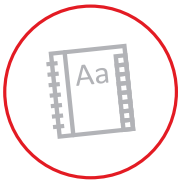
KNOBS
HANDLES
HAND WHEELS

KNOBS, HANDLES & HAND WHEELS

Contents

KNOBS, HANDLES & HAND WHEELS

The purpose of this Resource Guide is to aid customers in the selection of industrial products in the Knobs, Handles, Hand Wheels category of Reid Supply product offerings for your desired application, new or existing.



Terminology

Terms defining products are typically determined by the vendor. Much of this may not be standard. For instance: a knob in Europe may be referred to as a hand wheel. A lobe-type knob is also referred to as a star or scalloped knob.

As Reid Supply purchases its products from several vendors, it is sometimes difficult to sort and categorize these differences. If you find yourself confused by terminology in the catalog or this document, try shopping online using the website listed below or contact us at sales@reidsupply.com.

Design Considerations

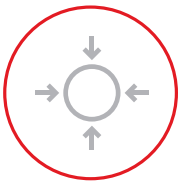
Information included in this Resource Guide extends beyond the catalog to provide specifications, data and other information to assist engineering, maintenance and others in selecting the best part for design and application. Although considerations for every and all applications is beyond the scope of this manual, purchases may be based on one or more of the following:

Physical Attributes

Physical attributes are primary considerations in the design of mechanical systems. This also extends to selecting Knobs, Handles & Hand Wheels for manipulating and controlling desired movement. Physical attributes of Knobs, Handles & Hand Wheels may include, but are not limited to, applied forces, space allotted and assembly.

It is important to choose the knob, handle or hand wheel for the application to:

- Prevent bodily injury.
- Avoid damage to control mechanisms.
- Ensure the control will not fail during use.



Applied Forces

Magnitude and direction of required forces upon mechanical controls is not as important as you might think. For example, little effort is required to maneuver a scoop on a front-end loader, hook on a 40-ton crane or even steer a cruise ship. In these cases, mechanical, hydraulic, electrical and pneumatic systems do all the heavy work commanded by as little as a finger's worth of force.

But grab a hold of the hand wheel of a 48-inch manual valve with a gear box and requiring 215 turns to close. Hopefully, that hand wheel is equipped with a revolving handle, is fully lubricated and free of obstructions and corrosion.

That said, if the application calls for a significant amount of human strength, refer to the section on Human Factors for additional guidance.

Table 1 includes a fairly comprehensive list of applied force directions and typical knobs, handles and hand wheels used to control them.

Ball Knob

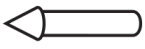
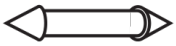
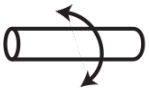
Push-Pull Knob

Pull Handle

Crank Handle

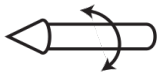
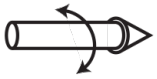
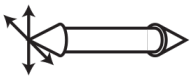
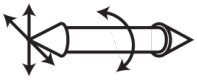
T-Handle

TABLE 1: APPLIED FORCES

Applied Forces	Applicable Manual Control Types[1]	
 Pull	• Ball knob • Bridge handle • Drawer Pull • Push-pull knob	• For light duty applications. • If pulling a knob with two fingers, ensure back side is comfortable and non-slip.
Lift	• Bridge handle • Lifting handle • Luggage handle • Toolbox handle	• Knobs are not typically designed for lifting. A handle may be a better solution above 1 lb of force. • Control size matters.
 Push	• Ball knob • Push-pull knob	• If pushing with a finger or thumb, a knob with a concave surface can prevent slippage. • One-handed push knobs should comfortably fit the palm of the hand.
 Push-Pull	• Ball knob • Push-pull knob • Bridge handle	• Ensure control fits comfortably for the amount of force • necessary.
 Up-Down	• Ball knob • Bridge handle • Handle • Push-pull knob	
 Left-Right	• Ball knob • Bridge handle • Handle	
 Up-Down Left-Right	• Ball knob • Handle	
 Circular	• Ball knob • Handle	
 Clamp	• Clamping lever • Hand wheel with thru-hole • Lobe knob with thru-hole • Prong knob with thru-hole	• Generally, Knobs, Handles & Hand wheels with thru-hole are used for clamping.
 Rotate	• Ball knob with knurl • Bar knob • Control lever • Crank handle • Fluted handle • Hand wheel • Instrument knob • Knurled knob • Lobe (Star) knob • Prong knob • T-handle • Thumb knob	• In confined spaces, consider a lever, a ratcheting feature or one with adjustable position. • For speed, use large knob or hand wheel with revolving handle. • A square blind or thru-hole allows the handle to be removed and stored after rotation. • To prevent control from rotating off, use a lock nut or thru-hole knob. • Unfinished cast iron or aluminum levers and handles can be custom machined to customer specifications. • If torque is desired beyond that of a thumb screw, refer to the section on Human Factors.

Lobe/Prong Knob

Ball Knob/Gear Lever

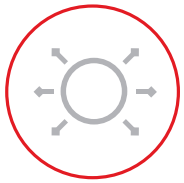
Applied Forces	Applicable Manual Control Types[1]	
 Rotate-Pull	• Adjustable handle • Fluted handle	
 Rotate-Push	• Knurled ball knob • Knurled push-pull knob • Fluted handle • Prong knob	
 Push-Pull Up-Down Left-Right	• Ball knob • Handle • Prong knob	
 Push-Pull Up-Down Left-Right Rotate	• Ball knob with knurl • Prong knob	

1) The Knobs, Handles & Hand Wheels listed are typical. Design requirements may deviate from those suggested in the table.

In most industrial applications, knobs, handles, hand wheels and levers have one thing in common: human contact. This means the force applied is varied, but limited to Human Factors. Refer to the Human Factors section below for further details.

Hardness

If hardness is an issue with plastic or metal products, this information and much more can easily be obtained from the Internet.



Space Allotted

Available over the Internet, Mil-Std-1472F includes the results of government studies on design considerations for a wide variety of work conditions. Reference Figures 26, 33, 39, 42 and 45; Tables VII, XIV and XX. Other reports are available, but most use this document as a reference.

In some situations, these guidelines may not be easy to follow, including crawl spaces, cab dimensions, pits, etc. In these situations, the knob, handle or hand wheel selected can help. With an understanding of Human Factors, the design engineer can select Knobs, Handles & Hand Wheels easily manipulated by the operator with minimum body movement. For instance, add a revolving handle to a hand wheel, use a fluted handle instead of a knob for rotation or a lever with a ratcheting feature. All these can change the direction of required force relative to allowed body movement.

Refer to the section on Human Factors for more information.

Assembly

The magnitude and direction of required forces on the knob, handle or hand wheel determines the type of mechanical assembly required. For instance, if a pull knob is required, you should consider one with a threaded metal insert as opposed to molded thread or insert with a setscrew. If rotation is also required, add a lock nut or reconsider an insert with a setscrew.

A molded thread may be more than sufficient on a lever to move a front loader up and down. But, a lock nut would definitely be recommended on a rotating mechanical control with a threaded metal insert which rotates in both directions. Also, a large hand wheel may function more positively with a dowel pin holding it in place.

Environment

For most applications, environment is not a factor. However, environments with high or low humidity, high or low temperature, sanitation or poor air quality require consideration.

Temperature

Cold is usually not a problem for most Knobs, Handles & Hand Wheels, except where ice build-up may prevent operation.

Heat is another story. According to Table 11, the melting point for many plastics is relatively low. Deflection temperature is even more important. This is the temperature at which the plastic control begins to lose shape and functionality.

Dry

Not so much a problem with metals, but like the steering wheel in antique vehicles, plastic will begin to shrink and crack with long-term exposure to sunlight and dry conditions.

Wet

Depending on the source of wetness and solutions being exposed to the knob, handle or hand wheel, wetness may be an issue. Wet environments can either dissolve the plastic or corrode metal inserts. Simply cleaning plastic surfaces with chemically hostile solutions can destroy the surface of the plastic or polymer knob. Depending on the material and chemical applied, the surface can lose its shape and remain sticky for the functional life of the control. It is best to replace the knob, handle or hand wheel after exposure.

Refer to Table 12 to select the best material for the chemical environment relative to the application.

Air Quality

Compounds, particles and other pollutants in the air can be harmful to materials used in the manufacture of Knobs, Handles & Hand Wheels and their function. Abrasive dust in the air at a quarry, for example, can affect the operation of Knobs, Handles & Hand Wheels with mechanical moving parts. Industrial machines use coolants and other chemicals that collect in the air and on everything close. These environments can erode materials not designed to function under such conditions.

Contaminant-free environments for clean rooms, laboratories and electronic assembly facilities have high-quality filtering systems for ventilation, but it doesn't hurt to include knob, handle or hand wheel styles that resist and minimize the creation of dust buildup. For example: knurled knobs can create dust when hands, gloves or other material slide over them.

Sanitation

Food processing and medical applications demand sanitary environments with regular cleaning. These environments may also include heating or drying ovens and/or airborne chemicals.

Human Factors

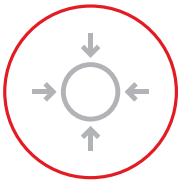
Mil-Std-1472F [5] includes several references to human factors relative to applications designed for human operation. Following several years of studies, this report includes design criteria for the Department of Defense. This single document is a primary resource for engineers and organizations such as the Human Factors and Ergonomics Society (HFES). Only some HFES design criteria relative to Knobs, Handles & Hand Wheels is mentioned in this resource guide. Much more is available at hfes.org and elsewhere on the internet. Note that Human Factors concepts and practices are still applicable to automated systems for human operation, accessibility, maintenance and repair.

Angle of Approach

Many factors determine the best angle of approach for Knobs, Handles & Hand Wheels. Whether the operator, maintenance person or other individual is sitting, standing, prone or in a confined space; some thought should be given to determine the best approach to access and manipulate the knob, handle or hand weel. For instance, reaching over the head can be straining for long periods of time. Elbow room may be limited in a confined space.

Different control types require different muscle groups and different body movement. A fluted handle requires twisting of the wrist and arm while a lever (one-handed motion) or hand wheel (two-handed motion) requires more elbow room.

Figures 39 and 45 of Mil-Std-1472F include data on minimum space requirements relative to human factors.



Applied Forces

Muscle strength depends on many factors including individual fitness, muscle cross-section area, muscle size and shape, bone strength, etc. Maximum strength is limited by the cross-sectional area and condition of the bone relative to the muscle group required. Mil-Std-1472F [5] Figures 5 - 23, 25, 40 and 41; plus Tables VII, IX, XI, XVII, XVIII, XIX include guidelines for various positions and lists human strength data for both men and women. Table 1 lists available Knobs, Handles & Hand Wheels applicable to 14 directions of applied forces.

In designing machine controls, cabinets and other systems with Knobs, Handles & Hand Wheels, do not base considerations on maximum strength, but minimum strength of the human body.

This is especially true when either men or women must interact with your design. Mechanical principles should be employed that allow operators to easily manage controls with minimum force or effort.

In some cases, the knob, handle or hand wheel can act as a mechanical fuse to protect mechanical components from manipulation. Replacing an external knob, lever, etc. is usually much simpler and cost-effective than replacing relative mechanical components.

Usability

As mentioned in Angle of Approach, the body moves differently and occupies relative space while manipulating Knobs, Handles & Hand Wheels. Other factors should also be considered in the design and selection of Knobs, Handles & Hand Wheels and mechanisms, including the following:

Grip

Figure 42 of Mil-Std-1472F [5] lists recommended dimensions for a variety of handles based on bare, gloved or mittened hands. If positive grip is an issue, consider the following Knobs, Handles & Hand Wheels:

- Knurled knob
- Prong knob
- Handle
- Hand Wheel
- Lever

Soft grips can be added to handles to improve and make the grip more secure. Refer to Handle Attributes.

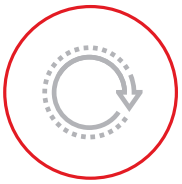
Speed

In some cases, speed matters such as emergency shut-offs or closures. Improve speed by:

- Adding a revolving lever to a hand wheel.
- Using prong knobs that are rotated quickly with one finger if the applied torque is low enough.
- Using a ratchet handle vs. one that lifts off for repositioning.

Position

Much Human Factors literature is devoted to locating controls and the operator for best performance.



Feedback

In an open-loop system, control operation does not directly include feedback. Pulling back on a lever to lift a plow is open-loop by design because there is typically no display or mechanical indicator to judge position. In this case, feedback is provided by visually monitoring the plow blade itself or listening for the sound of the clunk as it hits the pavement.

However, feedback is a vital part of a closed-loop design where some measure of the object being controlled is provided to the operator. This could be in a wide variety of forms.

Any of five human senses (touch, sight, sound, taste, smell) can be used as feedback to a control. A knob comes to a halt when fully turned in one direction or another. It may also have a pointer that indicates a meaningful value. A bar may also rise up and down or move horizontally on the display. The sound of a motor may speed up and slow down or move a table to the desired position.

But what if the knob, lever or hand wheel becomes more resistant in one direction and less resistant in the other? This would be an application of haptics. Haptics is applied when the operator may be overwhelmed with visual feedback. The solution is to use one of the other four senses, typically touch.

If the object being controlled is not visible and feedback is necessary to properly and accurately position the object, consider adding a sensor or other means of providing this information to the operator. Hand wheels are also available with built-in dials for position.

Safety

Safety is an issue for any application. In the case of Knobs, Handles & Hand Wheels:

- Body parts can get pinched or wedged between surfaces during operation.
- The control itself may be safe, but what is being controlled may not. In this case, proper labels should be posted next to the control.
- Emergency controls should be properly colored, labeled or otherwise identified.

Resources for safety information and compliance for both US and European directives include:

ANSI - The American National Standards Institute establishes and provides standards for industry in the US. Many of these are safety related, especially where labels and signs are concerned relative to Knobs, Handles & Hand Wheels and machinery.

CE Mark - A Community Europe directive required for products to be sold in Europe. This directive requires OEM's to conduct, document and provide (as needed) Risk Analysis data for their product.

ISO - Like ANSI, the International Organization for Standardization provides recommended standards for the international community.

OSHA - The Occupational Safety & Health Administration is a branch of the U.S. Department of Labor. Much information relative to safe machine design can be obtained from this organization.

RoHS - Primarily European, this Restriction of Hazardous Substances directive is also a concern in the US.

Selecting the Correct Component

Knowing and understanding all the above information then leads to choice of:

- Material
- Size
- Style
- Color
- Cost

Material

Selecting the appropriate material is important. Should the material chosen have an adverse reaction to chemicals or temperature or both, it will not perform well. Weight may be an issue, which would favor plastics. Stress can also be an issue if the material selected will not hold up to the applied forces and bends or brakes.

Some basic material properties are included in this document. If a material is not listed or more details are required, other resources are available, including the internet. Or contact Reid Supply Customer Service at the toll-free number listed below for assistance.

Plastic

Several types of plastics are used in the manufacture of Knobs, Handles & Hand Wheels. Three tables are provided at the end of this document listing plastics properties.

Table 10 includes thermal properties of plastics used to manufacture Knobs, Handles & Hand Wheels.

Table 11 lists deflection temperatures for some plastics. This is the temperature at which plastics become pliable and can lose shape. This is especially important when using inserts, as the bond between plastic and metal can break down and slip. Refer to the reference indicated for testing details.

Table 12 lists thermal and chemical properties of plastics. This information is handy when plastics are exposed to lubricants, coolants and other chemicals. All-metal Knobs, Handles & Hand Wheels may be the better choice for a reliable system, depending on the application.

Unlike metals, plastics are available in a wide variety of colors and textures. Labeling is also easily applied to plastics:

- Pad printing - Digital art in one or two colors.
- Hot stamping - Pressed-in look, available in several colors and metallic pigments.
- Inlays - Enabling full-color designs.
- Embedded characters - Permanently marks product.

Metal

Most Knobs, Handles & Hand Wheels are available in either plastic, metal or a combination of both. As with plastics, properties of metals should be considered.

Size

Size can be a constraint for four reasons: available space, weight, strength and grip. Figure 39 and 42 of Mil-Std-1472F includes data on minimum space requirements and control sizes relative to human factors. Control sizes are listed for bare-handed, gloved and mittened applications. Refer to the section on Human Factors for more details.

Style

After practical considerations and depending on the number of choices left, a major consideration for selecting a style of knob, handle or hand wheel is aesthetic and cost. However, this document focuses on the practical considerations.

Table 1 groups knob, handle and hand wheel styles by applicable direction of applied forces, while tables 2 through 9 looks at some of the pros and cons of selecting Knobs, Handles & Hand Wheels.

Sanitation

In food production, medical and other industries where sanitation is an issue, the knob, handle or hand wheel selected must be easy to clean. Features such as knurling, open back or exposed screw holes can collect and retain unwanted contaminates. Antimicrobial knobs, handles and hand wheels have a special coating which helps prevent collecting and spreading bacteria, mold and mildew.

For more assistance, contact Reid Supply Customer Service at the toll-free number listed below.

Color

Although a wide range of colors are available, due to the nature of plastics, it is difficult to ensure color consistency. For instance, glass fiber, used to increase strength and other properties in plastics, is clear and tends to reflect white light. This can lighten the selected color.

Cost

The goal of Reid Supply and this guide is to ensure the customer gets the best part for the intended application. Quality does not equate to purchasing the highest-cost item in its class. It equates to purchasing the best item that meets all requirements for the applied application at the best price. If a lesser product is used, future replacements, repairs or modifications may result in even higher costs.

Knobs

A wide range of industrial knobs are available to consider. They come in all shapes, sizes and styles.

But, which one best suits your purpose?

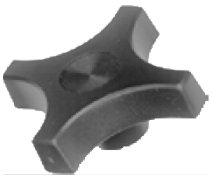
Table 1 - Direction of applied forces is important.

Table 2 - Knob styles and their pros and cons.

Table 3 - Attributes to industrial knobs and their pros and cons.

In most cases, both male and female versions are available. Non-threaded female knobs can be machined to add pin or screw for assembly.

TABLE 2: KNOB STYLES

Style	Pros	Cons
 Ball	• Omnidirectional - can be easily moved in multiple directions. • Easy to clean. • Can add knurling to improve grip. • Comfortable to hold.	• Can be slippery to handle if wet with water, grease or other liquids and powders. • May be difficult to rotate with gloves or when wet.
 Bar	• Great for heavy clamping. • Custom hole types. • Compact. • Removable bar.	• May need to machine hole. • Bar may be lost or misplaced. Consider localized hanger or storage.
 Instrument	• Easily rotated with thumb and finger. • Pointer to scale for feedback.	
 Lobe (Fluted, Star or Scalloped)	Somewhere between push/pull and prong knobs, lobe knobs come in a wide variety of sizes, styles, shapes and materials. They can have from 3 to 8 lobes.	
	• Easy to grab using bare hands or gloves. • Works well for clamping. • Allows for control in multiple directions (see Table 1). • Alleviates the need for tools. • Can add knurling to improve grip.	• Limited torque capability. Depending on torque requirements, use a prong knob, lever or hand wheel.
 Prong	Typically having protrusions from the center hub, these types of knobs can be used in a variety of applications without tools.	
	• Stronger rotation torque than comparable lobe or knurled knob. • Allows for control in multiple directions (see Table 1). • Can be spun with one finger for light torque applications. • Can apply strong clamping force with no tools.	• With increased surface space, can be harder to clean. • Must release knob to continue turning by hand. If this is a problem consider a crank or hand wheel.
 Push/Pull	A diverse style of knob applicable to a wide variety of applications.	
	• Easy to control. • Easily cleaned if solid. • Metal inserts add strength and longevity. • Can add knurling to improve grip.	• Open backed knobs can collectcontaminates. • Can be slippery in some environments. • Look at adding knurl, lobe or prong type knobs.
 T-handle	• Strong control in rotary and in/out directions. • Simple design. • Works well in limited spaces reachable by only one arm. • Can apply strong clamping force with no tools.	• In some situations, can be rotated to an awkward angle for grasping. Consider a prong knob.

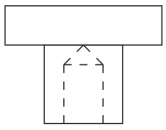
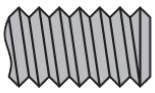
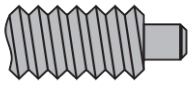
Style	Pros	Cons
 Tapered	• Excellent for up/down or left/right motion. • Can be fluted for rotary motion. • Great for grasping and rotating from 90° angle.	• Can be slippery in some environments. Look at fluted, lobe, prong type knobs or T-handle.
 Thumb	• Easy to grasp with thumb and finger. • Can be machined to add pin or screw for non-thread applications.	• For low torque applications only.
 Wing Style	• Controllable with thumb and finger only. • Can apply strong clamping force with no tools.	

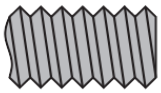
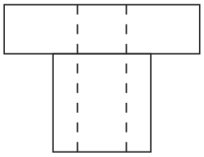
Knob Attributes

Table 3 lists some attributes to knobs which alter or enhance their function. Pros and cons are also listed for each.

If you do not find a desired attribute of adaptation, try using our online catalog or contact Reid Supply at the toll-free number listed below.

TABLE 3: KNOB ATTRIBUTES

Attribute	Pros	Cons
 Blind hole	• Easily attachable to the end of any shaft. • Can be threaded or non-threaded with pin or screw.	
 Caps	• Eliminates confusion among multiple controls. • Can be color coded. • Provides ID for control. • Covers and protects fastener.	
 Bevel Point	• Threads start easily.	
 Dog Point	• Great as locking pin without damaging threads.	

Attribute	Pros	Cons
 Flat Point		• Can be harder to align and start thread than bevel point.
 Knurling	• Improves grip.	• Harder to clean, can collect and retain contaminants.
 Metal Insert	• Stronger clamping. • Withstands more torque. • Bonds easily to plastic when molded. • Can be used in blind or thru-hole knobs.	• May be corrosive. • Adds more weight.
 "Soft Touch"	• Rugged construction with a soft feel. • Improved sure grip.	
 Thru-hole	• Great for clamping along a threaded shaft. • Can be used as locking nut with no tools.	

Handles

As with knobs, a wide variety of industrial handles are available for most any application.

It should be noted that a handle is intended for one-handed operation, however some are large and strong enough for two hands for some applications.

If torque is an issue, consider a lever.

Table 4 - Handle styles and their pros and cons.

Table 5 - Attributes to industrial handles and their pros and cons.

There may be some confusion between knobs and handles because some knobs are long enough to be handles; tapered and fluted knobs for example. If these products are suitable and meet all design requirements, there should be no problem in using them.

TABLE 4: HANDLE STYLES

Style	Pros	Cons
 Adjustable	• Multiple positions. • Saves space. • Easy to grasp with bare hands or gloves. • Can be male or female (with metal insert). • Works in both directions. • Can be moved to one side after operation.	• Operation can be slower than crank or ratchet handle.
 Chest (Bail or Barrel)	• Folds away easily when not in use. • Allows for easy handling of chests, drawers or other pulling and lifting requirements.	
 Crank	• For high torque applications. Well suited for clamping. • Fast operation. • Typically one handed operation. • Can be removable.	• Lighter plastic cranks not as strong as metal for same or longer lengths.
 Flush or Recessed Mount	• Does not protrude from surface. • Offers protection to fingers during use.	• Generally requires extra preparation for installation.
 Grab	• Similar to pull handle, but stronger. • Mounted horizontally and can take a lot of downward force. • Comfortable to grab and hold.	• Will have some protrusion from mounted surface, but this allows for quicker grabbing.
 Grips (vinyl or soft foam)	• Easily converts rod, pipe or other round stock into a lever or handle. • Improves grip.	
 Guard	• Protects fingers during use.	

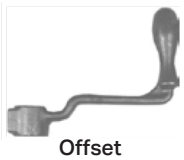
Style	Pros	Cons
 Machine	• High torque. • Comfortable grip with bare hands or gloves. • Threaded or press fit. • Can be applied to hand wheels. • Revolving options available.	
 Pull (Bridge, Cabinet, Drawer or Lift)	• Easy to grab. • Very large selection to choose from. • Easy to install. • Available in plastic or metal.	• Can break or loosen if too much force is applied in wrong direction.
 Ratchet	• High torque. • Works well in confined or limited space. • Can move to one side after use.	

Handle Attributes

Like knobs, handles have male (stud or threaded shaft) and female (tapped, blind or through hole and square hole) genders. Many knob attributes also apply to handles.

If you do not find a desired attribute of adaptation, try using our online catalog or contact Reid Supply at the toll-free number listed below.

TABLE 5: HANDLE ATTRIBUTES & MOUNT TYPES

Attribute	Pros	Cons
 Concealed mounting hole	• Could be designed for installation on front side only. • Hides fasteners.	
 Fold-away	• Folds down after use. • Works well with hand wheel. • Plastic or metal available.	• May not be as strong as non-folding.
 Offset	• Allows handle to rise above obstacles.	• Taller than flat or straight handle.
 Unfinished	• Can be machined to suite application. • Holes can be drilled, tapped or broached.	• Casting only, no machined surfaces. • Needs some machining.

Hand Wheels

Heavy-duty industrial hand wheels are well-suited for rotary control, especially where the strength of two hands are required.

Some basic considerations include size, torque and accessibility.

Table 6 - Hand wheel styles and their pros and cons.

Table 7 - Attributes to industrial hand wheels and their pros and cons.

Being primarily round objects, styles are somewhat limited.

TABLE 6: HAND WHEEL STYLES

Style	Pros	Cons
 Position Indicating	• Displays accurate positioning of shaft in number of turns. • Allows repeatability. • Water proofing and other features available.	• Shaft or stem must be in horizontal position.
 Solid	• Works either as a knob, wheel or crank. • More torque than a knob but less than a crank.	
 Spoked	• Lighter than comparable solid. • Available in larger diameter than solid. • Very high torque in large sizes.	

Hand Wheel Attributes

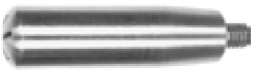
This section lists some basic attributes relative to heavy-duty industrial hand wheels.

If you do not find a desired attribute of adaptation, try using our online catalog or contact Reid Supply at the toll-free number listed below.

TABLE 7: HAND WHEEL ATTRIBUTES

Attribute	Pros	Cons
 Balanced	• Allows for smooth operation in both horizontal or vertical directions. • Improves precision adjustment. • Remains stationary with vibration.	
 Finger grips	• Reduces slippage with bare hands or gloves.	

KNOBS, HANDLES & HAND WHEELS

Attribute	Pros	Cons
 Fixed handle	• Speeds up operation by allowing spinning of the wheel. • Able to apply more torque, as with a crank.	
 Folding handle	• Folds out of way. • Speeds up operation.	• May not be as strong as fixed handle.
 Unfinished	• Can be machined to suite application. • Holes can be drilled, tapped or broached. • Revolving or fixed handle can be added.	• Cast only, no machined surfaces. • Needs some machining.
 Position Indicators	• Gives positive feedback to control element position. • Inch or metric versions available, depending on shaft size. • Reduces setup time. • Gives more accurate and repeatable control.	• If not direct driven, to get inch or metric units from display, some gearing may be required.
 Revolving handle	• Allows for stronger grip and increasedtorque. • Improves grip by eliminating slipping in hands or gloves to turn hand wheel or lever. • Speeds up operation.	

Levers

Like handles, heavy-duty industrial levers are primarily used for one-handed control.

Table 8 - Groups of levers along with pros and cons of each.

Table 9 - Includes some basic lever attributes.

TABLE 8: LEVER STYLES

Style	Pros	Cons
 Ball knob	• Easy to control. • Allows for control in multiple directions.	
 Clamping	• Easy to control. • Stronger clamping capability than adjustable handles.	• Use Ratchet type where 360° of rotation is not allowed.
 Ratchet	• Same as clamping lever, but able tofunction in limited space. • Can be rotated out of way after use.	

Lever Attributes

Table 9 includes some special options for heavy-duty industrial levers and the pros and cons of each.

If you do not find a desired attribute of adaptation, try using our online catalog or contact Reid Supply at the toll-free number listed below.

TABLE 9: LEVER ATTRIBUTES

Attribute	Pros	Cons
 Malleable	• Can be machined to suite application. • Holes can be drilled, tapped orbroached.	• Cast only, no machined surfaces. • Needs additional machining
 Shaft	• Allows custom assembly. • Can take advantage of a wide selection of knobs. • Knob is easily replaced.	• Must use threaded components.

Re-Machining Tips

It is impossible to inventory and stock the limitless combinations of mechanical assemblies possible for knobs, handles and hand wheel products. Re-machining Knobs, Handles & Hand Wheels may be necessary to connect the control to the shaft or other mechanical connection. In many cases, Knobs, Handles & Hand Wheels are incomplete assembly components. A blind-hole knob may be purchased with only a hole. It is up to the designer to determine the best means of attachment, i.e., a pin, setscrew or keyway. A hand wheel or lever may include a pilot hole as a guide to the center. These parts will require some re-machining.

This section lists some tips to prevent damage or distortion of products during this process.

Thermoplastics

Excessive temperature and pressure are the primary causes of failure when machining plastics. When machining the metal insert, excessive heat can weaken or destroy the bond between the metal insert and plastic, causing the bond to slip.

To avoid damage:

- Machine at low cutting speeds and feeds.
- HSS tools can have a short life when machining large quantities or long machining time. Use hard metal tools when machining large quantities or for long periods of time. Keep the cutter sharp and use compatible coolant to avoid heat.
- If the final hole is much larger than the pilot hole, use several passes with increasing diameters.
- Threaded holes in plastic tend to be narrower than normal. This can result in a light braking force on the screw.
- When converting from a blind hole to a thru-hole, be careful not to chip out when exiting.
- For knobs and small diameter hand wheels, mount the part on the spindle by gripping the hub.

Metals

Standard machining practices apply to machining metal. However, special shapes and plastic molded products may need special consideration.

General Tips

These are some general tips for machining Knobs, Handles & Hand Wheels:

- Use ordinary emulsified water to disperse heat and keep part and tool cool.
- If the equipment will allow, mount hand wheels by the crown for machining. This allows for better centering of the hole and surface machining relative to the cast or molded part.

If the proper equipment for the above machining is not at your disposal or there are concerns about damaging components during machining, contact Customer Service using the toll free number below or Email at sales@reidsupply.com with “Customer Service” in subject line.

Custom Products

Can’t find what you need? Contact our Customer Service department using the toll-free number listed at the bottom of the page or email: sales@reidsupply.com with “Customer Service” in the subject line.

Summary

The primary goal of this document is to help select the best part for your application needs. If you need more information, would like to add information or comment on the contents; contact the Customer Service department using the toll-free number listed at the bottom of the page. Or e-mail us at sales@reidsupply.com (enter “Knobs, Handles & Hand Wheels Resource Guide” in the subject line).

TABLE 10: THERMAL PROPERTIES OF PLASTICS [2]

Material			Tempurature exposure °C/°F			
Class	Common Name	Chemical ID	Brief (60/120 sec.)	Continuous (+8 hrs)		Continuous under HDT/A (+8 hrs)"
				MAX	MIN	
Thermoplastic	Plastics which can be melted, reshaped and cooled.					
	Acrylic					
	Acrylonitrile Butadiene Styrene	ABS	100 / 212	85 / 185	-40 / -40	100 / 212
	Polycarbonate	PC	140 / 284	120 / 248	-40 / -40	120 / 248
	Polystyrene	PS	90 / 194	75 / 167	-10 / 14	75 / 167
	Polyethylene	PE-HD PE-LD	85 / 185	75 / 167	-50 / -58	40 / 104
	Reinforced copolymer polyproplene	PP	-	-	-50 / -58	90 / 194
Thermoset	Plastics hardened during cooling. Generally stronger than thermoplastics, works better around high temperatures.					
	Bakelite					
	Polymide (Nylon)	PA6	120 / 248	80 / 176	-10 / 14	80 / 176
	Reinforced polyamide	PA6+GF	160 / 320	110 / 230	-10 / 14	100 / 212
	Thermohardened		200 / 392	200 / 392	-40 / -40	-
	Vulcanized rubber	NBR	130 / 266	100 / 212	-30 / -22	-

TABLE 11: DEFLECTION TEMPERATURES FOR POLYMERS [3]

Polymer Type	Deflection Temperatures at .46 MPa (°C/°F)	Deflection Temperatures at 1.8 MPa (°C/°F)	Melting Point (°C/°F)
ABS	98 / 208.4	88 / 158.4	105 / 221
ABS + 30% Glass Fiber	150 / 302	145 / 293	-
Acetal Copolymer	160 / 320	110 / 230	200 / 392
Acetal Copolymer + 30% Glass Fiber	200 / 392	190 / 374	200 / 392
Acrylic	95 / 203	85 / 185	130 / 266
Nylon 6	160 / 320	60 / 140	220 / 428
Nylon 6 + 30% Glass Fiber	220 / 428	200 / 392	220 / 428
Polycarbonate	140 / 252	130 / 266	-
Polyethylene, HDPE	85 / 185	60 / 140	130 / 266
Polyethylene Terephthalate (PET)	70 / 158	65 / 149	250 / 480
PET + 30% Glass Fiber	250 / 480	230 / 446	250 / 480
Polypropylene	100 / 212	70 / 158	160 / 320
Polypropylene + 30% Glass Fiber	170 / 338	160 / 320	160 / 320
Polystyrene	95 / 203	85 / 185	-

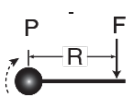
TABLE 12: CHEMICAL PROPERTIES OF PLASTICS [2]

		ABS	PA 6 Polyamide	PC Polycarbonate	PE-HD Polyethylene high density	PE-LD Polyethylene low density	PP Polypropylene	PS Polystyrene
	Water	A	A	A	A	A	A	A
ACIDS	Weak acids	A	E	A	A	A	A	A
ACIDS	Strong acids	B	E	D	A	A	B	B
ACIDS	Hydrofluoric acid	A	E	B	A	A	B	B
ALKALIS	Weak alkalis	A	B	E	A	A	A	B
ALKALIS	Strong alkalis	A	A	E	A	A	A	A
ALKALIS	Inorganic salts	A	A	B	A	A	A	A
ALKALIS	Halogens	E	E	A	E	E	D	E
ALKALIS	Oxidant compounds	D	E	C	E	E	E	C
SOLVENTS	Hydrocarbons Paraffins	C	B	B		D	B	D
SOLVENTS	Halogens-Alkanes	E	B	E	D	E	D	E
SOLVENTS	Alcohols	B	B	B	A	A	A	A
SOLVENTS	Ethers	E	A	E	C	D	C	D
SOLVENTS	Esters	E	A	C	A	B	B	E
SOLVENTS	Ketones	E	A	C	A	B	B	E
SOLVENTS	Aldehydes	D	B	E		B	A	D
SOLVENTS	Amines	A	A	E		A	A	A
SOLVENTS	Organic acids	A	B	C	A	A	B	B
SOLVENTS	Aromatic compounds	E	B	E	B	B	D	D
	Fuels	A	A	B	B	B	B	D
	Mineral Oils	A	A	A	B	B	A	C
	Greases, oils	A	A	A	A	B	A	A

A = STABLE
B = From STABILITY to LIMITED STABILITY
C = LIMITED STABILITY
D = From LIMITED STABILITY to UNSTABLE
E = UNSTABLE

Glossary

Below is a list of terms used in this document.

Term	Definition
ABS	Acrylonitrile Butadiene Styrene - a common thermoplastic used to make light, rigid, molded products such as piping, golf club heads and LEGO blocks.
Acrylic	Refers to chemical compounds made from Acrylic acid.
Antimicrobial	A substance that kills or inhibits the growth of microbes such as bacteria.
Haptics	From the Greek word (Haphe), means pertaining to the sense of touch (or possibly from the Greek word haptesthai meaning “contact” or “touch”). Usually refers to the study of human reactions associated with touch.
HDT	Heat Deflection Temperature - temperature at which plastics begin to deform under load.
Nylon	Name given to a group of synthetic polymers first developed by DuPont.
Phenolic	Made of Phenol (or carbolic acid), a colorless crystalline solid and aromatic compound. Combined with resin to make pool balls, knobs.
Polymer	Refers to the covalent bonding of molecules with large molecular mass composed of repeating structural units, or monomers, connected together. Commonly known polymers include plastic, DNA and proteins.
Polymerization	The process of bonding single units together through a variety of reaction mechanisms to form longer chains named polymers.
Polypropylene (PP)	Thermoplastic polymer (C3H6) used in a wide variety of applications from plastic bags to food containers. It is rugged and unusually resistant to many chemical solvents, bases and scids.
Resin	Organic hydrocarbon secretion from many plants. Pine pitch is a form of resin. Used in varnishes, adhesives and in the making of Phenolic Resin Polymers or plastic.
Thermoplastic	A plastic that melts to a liquid when heated and freezes to a brittle, very glassy state when cooled sufficiently. Are impact resistant and resilient.
Thermoset	Usually liquid or malleable prior to curing, this type of plastic is designed to be molded into its final form, or used as adhesives. Curing is accomplished with heat (generally above 200°C) or chemically; as with epoxies. It’s glossy smooth surface is resistant to water, oils, grease and common chemicals.
Torque 	Measured in NM (Newton-meters) or ft-lbs (foot-pounds), Torque is the resulting radial force (F) applied over a radial distance (R) at, and normal to, the pivot point (P). The equation: T = FR For example: if a force (F) of 10 lbs is applied 2 feet (R) from the center of the pivot point (P), the resulting torque would be 20 ft-lbs; or: 2 ft x 10 lbs = 20 ft-lbs.
Vinyl	Any organic compound that contains a vinyl group (or ethenyl).

References

The following is a list of reverenced used in to create this document. They are referred to by number, i.e. [5], in the text where applicable.

1. Dimco Gray Corporation- www.DimcoGray.com
2. JenCan Ltd.- www.jencan.com
3. www.matweb.com
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5. Human Engineering - mil-std-1472f Department of Defense Design Criteria Standard, August 1999.
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7. Dennis R Andrews PhD, PSP, CECD: “Concepts in Human Factors Engineering (3): The Energy Force of Our Frame,” Expert Article Library (http://expertpages.com/news/concepts_in_human_actors_engineering_3.htm) 2006.

Notes